ACCESSING TRANSP OUTPUT:

A USER'S GUIDE

Accessing TRANSP Output: A User's Guide

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Princeton Plasma Physics Laboratory

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SECTION 0.

INTRODUCTION

0. Introduction

TRANSP is a time dependent tokamak transport analysis code developed at the Princeton Plasma Physics Laboratory. The code provides a means to invert data from tokamak experiments, to provide a picture of the processes which account for the confinement and heating in tokamak plasmas. The code supports a wide range of plasma geometries and incorporates in its libraries a wealth of physics modeling for neutral beam and RF auxiliary heating, neutral transport, diagnostic simulations, sawtooth and pellet events, etc.

TRANSP is used in various computing environments for tokamak data analysis at laboratories around the world. At Princeton the data files containing the results of such TRANSP analyses are stored on magnetic and laser disk on a VMS VAX cluster. The purpose of this User's Guide is to describe how to access these analysis results in graphical form on a VAX system. The reader is not expected to have specialized VAX knowledge, although familiarity with fundamentals (e.g. how to log in) will be assumed.

Each TRANSP run produces binary data files which may be accessed interactively by running a plotting program called RPLOT on the VAX. As of February, 1990, typical TRANSP results data files contained over 150 scalar functions of time and 300 profile functions of time and one additional (usually geometrical) coordinate. These functions represent parameters, measured or calculated, which together describe the evolution of an experimental tokamak plasma. Sample scalar functions are: Total Plasma Current (measured), and Beam Power Lost to Charge-Exchange (calculated). Sample profile functions are: Electron Density vs. radius and time (measured; "radius" indicates a measure of distance from the plasma center), Ion Temperature vs. radius and time (calculated but fit to measurements at the plasma center), Thermal Plasma Energy Confinement time vs. radius and time (calculated), and Beam Ion Density (calculated) vs. poloidal angle and time at various radii. A complete table of contents of the graphics files for a particular TRANSP run will be presented below in Section Z.

This User's Guide contains three sections. Section 1 describes the procedures for determining what TRANSP runs have been made, and for determining some of the important assumptions going into a particular TRANSP run, and how to request that the graphics output files for that run be recovered to disk so that they may be viewed interactively using RPLOT.

Section 2 describes how to use the RPLOT code to peruse the graphics output of a particular TRANSP run. Sample terminal sessions on the VAX and sample output are included.

Section 3 explains two subroutines, TRSCALAR & TRPROFIL, that can be used to read TRANSP data into a user's FORTRAN program on the VAX. Calling arguments are given.

Also included are three appendices. Appendix X. contains notes on the sample terminal sessions presented in Sections 1 and 2. Appendix Y. contains a list of references useful for understanding the TRANSP calculations. Appendix Z. contains the table of contents of all functions and abbreviations as well as multigraph packages for a typical run.

To use the procedures described below, one must first log onto one of the computers in the VAX cluster (e.g. RAX, HAX, EPX, USC...). Then, one should carefully follow the instructions shown in response to the command:

$ HELP TRANSP

These instructions will clarify two issues. First, it is necessary for a VAX systems administrator to grant an account the "right" to access TRANSP results data. This right is not automatically granted to all user accounts. Second, an explanation is given of simple modifications needed in a login procedure (LOGIN.COM) to define VAX DCL symbols and logical names required to run the RPLOT program. If because of lack of familiarity with the VAX system one is unable to modify one's own LOGIN.COM file correctly, one should seek the assistance of a more experienced user.

"HELP TRANSP" is demonstrated below:

```
RAX$
RAX$
RAX$ HELP  TRANSP
TRANSP


  TRANSP is a PPL time dependent transport analysis code.

  TRANSP reads diagnostic data from tokamak experiments (in UFILES format),
  and, after extensive computational modeling, creates analyzed results
  data files containing hundreds of scalar and profile functions of time
  describing the model plasma.

  TRANSP input diagnostic data UFILES must be carefully prepared.  UFILES are
  also useful in their own right.  For more information, see:
    HELP TRANSL (how to create UFILES from TFTR raw and waveform data)
    HELP UFILES
    hardcopy documentation--
      UFILES manual (D. McCune)
      Seminar on how to prepare input for TRANSP (D. McCune)
      Accessing TFTR Data on the VAX Cluster (TFTR overview, J.A. Murphy)



Press RETURN to continue ...
   TRANSP output may now be accessed directly from user accounts with a
plotting
  program.  More information in the subkeys.   ...D McCune 4-Jun-1987

  %DMC - last review/update of help module:  27-Nov-1989


  Additional information available:

  Basic_Info More_Info  JUNK_area

@USR TRANSP Subtopic?
```

By entering one of the subtopics, "Basic_Info", "More_Info" or "JUNK_area", the user can transverse the HELP tree to get further information. A carriage return in response to a prompt, takes the users back one level, in the HELP information tree.

In the remainder of the manual it will be assumed that the user has successfully followed the instructions under "HELP TRANSP". If so, the DCL symbols RPLOT and GETRUN will have been defined. RPLOT is the TRANSP output data plotting program. GETRUN is the TRANSP archive listing and retrieval program. Both programs will be described in detail. The user should also have a definition for the logical name RUNDATA. This logical name defines the list of disks where TRANSP run results data may be found. The user may test the definition of a DCL symbol e.g. with the command

"$ SHOW SYMBOL RPLOT";

a logical name definition may be tested with the command

"$ SHOW LOGICAL RUNDATA".

TRANSP output resides in subdirectories identified by logical disk and directory "RUNDATA:[TRANSP.dddd.yy]", where dddd is the experimental device such as "TFTR" or "PBX" and yy is the last two digits of the calender year of the shot such as "89" for 1989. To run RPLOT, one can first move to the subdirectory area for the tokamak that produced the data for the TRANSP run one wants to look at, or enter the information after queries from RPLOT. To move to the correct subdirectory on the VAX for TFTR for 1989, for example, one can enter the DCL command,

"$ SET DEFAULT RUNDATA:[TRANSP.TFTR.89]".

To determine what runs are available, one runs GETRUN as described below in Section 1.

A note of caution: procedures described herein may from time to time undergo revision. Occasional updates to this guide will be distributed if necessary.

SECTION 1.

LOCATING TRANSP RUNS

GETRUN

1. Locating TRANSP Runs

The output of a TRANSP run is initially stored on VAX disks logically named "RUNDATA", in the sub-directory corresponding to the year of the shot and the tokamak device that produced the data that the TRANSP run analyzed. For example, TFTR TRANSP run output for shots done in 1989 resides in RUNDATA:[TRANSP.TFTR.89]. However, due to limitations of disk space, runs that are not of special importance are usually transferred to magnetic tape and/or laser disk and removed from the main disk after a short period of time.

Each TRANSP run is identified by a **run id string** that is unique for the year of the shot and the tokamak device from which the data originated. Traditionally, these run id strings are four digit numbers known as **TRANSP run numbers**. In the future, a longer run id string imbedding a shot-try specification will be used to identify TRANSP runs, but this capability had not yet been implemented when this manual was printed. At the time of printing, all TRANSP runs were still identified by four digit run numbers. A sample run number for TFTR for 1989 is 2100. Contiguous sets of run numbers for the same tokamak-year generally identify related TRANSP runs (e.g. several TRANSP runs that analyzed the same input data). Typically, run numbers are "allocated" in blocks of 20, so that runs 2100 through 2119 would be reserved for 20 analyses of the same set of shot data. If more than 20 analyses are needed, a second block of 20 run numbers would be allocated. For a given shot, all existing TRANSP runs may be listed with the GETRUN program. For each run nnnn there exists a file, nnnnTR.INF, that contains some verbal information describing the run. This file is never deleted from the disk that has logical name TRINF, although other files associated with the run will be deleted when the run is transferred to magnetic tape or laser disk. The nnnnTR.INF file resides in the tokamak.year sub-area of the device producing the input data. Thus, to look at the nnnnTR.INF file for TFTR run 2100 for year 1989 one types

"$ SET DEFAULT TRINF:[TFTR.89]"

and then

"$ PRINT 2100TR.INF"

to send the file to a VAX printer (such as the one in the PPLCC output room), or

"$ TYPE 2100TR.INF"

to list the file on one's terminal. An example is given below. In Section 2 a means of entering new remarks about a run in its "TR.INF" file will be described.

Every time a TRANSP run is transferred to magnetic tape or laser disk, an entry is made in a TRANSP library database file to record the presence of the run there. Thus it is possible to locate any TRANSP run, whether it is on magnetic tape, main disk, laser disk or all three. To facilitate this, there is a program called GETRUN. This program functions as a librarian for TRANSP runs, allowing the listing of what TRANSP runs have been made, where the TRANSP run's output data is located, and also allowing the user to request that a TRANSP run, which is on magnetic tape but not on main disk, be recovered to main disk. Laser disk file recovery is done automatically from RPLOT, although there is a short time delay waiting for the files to be copied to the main disks. A sample terminal session with the GETRUN program is shown at the end of this section. The sample session shows (1) the generation of a list of all TFTR TRANSP runs that have been made for 1989 for run numbers between 1000 and 1100 and where they are located, and (2) the generation of a request to recover a TFTR TRANSP run to main disk. As will be seen, the use of GETRUN is, by and large, self-explanatory. To run GETRUN interactively and direct its listing output to one's terminal, enter "$ GETRUN" on the VAX. It will take a few moments for GETRUN to respond because directory listings of TRANSP runs must be read in and the lists of runs on magnetic tape and laser disk must be accessed and sorted by the routine. To speed GETRUN startup, disk directory listings of TRANSP runs are updated only once per day by a nightly batch job.

As will be seen by examining the sample terminal session at the end of this section, it is possible to restrict GETRUN's listing output to a particular tokamak and a range of dates, shot numbers and/or run numbers. Thus if one wants to determine if a particular experiment (shot) has been

analyzed by TRANSP, one may do this with GETRUN. A note of warning, however: often the input data for TRANSP is produced by averaging and/or concatenating the data from a series of similar shots, and from this series a single "nominal" shot number is chosen to identify the averaged/concatenated input data; it is this shot number (only) that shows up in the GETRUN output lists. Thus one should have GETRUN list a range of shot numbers wide enough to cover the entire range of shots of interest. Also, because of the labor involved, relatively few tokamak shots -- e.g. those actually requiring time dependent analysis, non-circular flux surface geometry, or some other feature unique to TRANSP -- are actually analyzed using the TRANSP code. On TFTR, the SNAP code analysis, which is faster and easier to use, is applied to a much wider range of shots.

GETRUN listings contain three status columns (T, L & D) indicating whether various runs are on magnetic tape, laser disk or magnetic disk (or on all three media). If the run is on magnetic disk or laser disk, RPLOT may be run to graph the output (Section 2 below). If not, i.e. the run is on magnetic tape, the files for the run must be copied to magnetic disk first. This may be done through GETRUN, as will be seen in the sample terminal session below. If one generates a request to recover a run, it will be submitted in batch when GETRUN is exited. Up to two hours delay is to be expected, as the operators in the PPLCC must locate and mount the magnetic tape on which the requested run resides. The PPLCC computer room extension is x3444. One may request as many runs as needed to be restored in a single GETRUN session. After each GETRUN session a batch job, "GETJOBdate", is submitted containing any requests for the recovery of runs. To see if this job is still executing simply type "$ BATCH" to the monitor (after exiting GETRUN); if "GETJOBdate" is still executing it will be listed in the "R_NORM" queue on the computer on which one is running. When it stops executing, all files for the runs will have been requested, i.e. queued for retrieval.

The following non-fatal error messages may be encountered running GETRUN:

"? NONE FOUND": There are no TRANSP runs for the device, date, range of shot numbers and range of run numbers that were specified.

"? RUN <device> <year> <number> HAS NOT BEEN SAVED ON MAGNETIC TAPE": The run requested is not in the magnetic tape library. Generate a list of runs to check using option 1.

"? TRANSP run <device>.<year> <number> IS ON MAGNETIC DISK": The run the user requested is already on disk; it need not be recovered, and its plotting output may be viewed forthwith.

There is an option in the GETRUN program to request that runs on disk be saved to magnetic tape. This option (which is protected by a password) need not be exercised by users, as the tape and laser disk archival of TRANSP runs is performed automatically by nightly TRANSP systems maintenance batch jobs.

Before one requests the recovery of a TRANSP run, the user will probably want to check the nnnnTR.INF file for run nnnn. This file is stored in TRINF:[dddd.yy]nnnnTR.INF where dddd is the device such as TFTR and yy is the last two digits of the year of the shot such as 89. This file will contain any information regarding possible defects in the run or its input data, as well as the shot date of the shot producing the data for the run, the charge-exchange ion temperature measurement for the run, and other notes. The procedure for printing or typing the file is given at the beginning of this section above. An example of accessing an INF file for TRANSP run 2100 for TFTR for 1989 follows:

CONVENTION: If a comma, ",", is entered in response to a prompt in RPLOT, the old value will be accepted as the default value.

NOTE: Examples is this guide are in a different font and smaller than the normal print. User input from the terminal to the computer is in full size bold print.

Example 1.a

```
RAX$
RAX$
RAX$ SET  DEFAULT   TRINF:[TFTR.89]
```

```
RAX$
RAX$ TYPE   2100TR.INF
<*=*><*=*>  REMARKS FILE "2100TR.INF" CREATED 17-JAN-90
D=17-JAN-90  BY:  TRANSP                          RUN 2100
 >>> EXPERT MODULE = 2100EX.FOR
Cris Barnes' short beam pulse experiment -- first try at
analysis.  There were unknown amounts of Helium in the
plasma so the D depletion factor is not well known.
<*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*>
D=18-JAN-90  BY:  TRANSP SYSTEM:  PLABEL=>TRFIL3 RUN 2100
     SHOT NO.:          42457
     START TIME:   2.500E+00       STOP TIME:    4.000E+00
VARIABLE GEOMETRY RUN: MINOR AND MAJOR RADIUS
AND TOROIDAL B FIELD MAY BE FUNCTIONS OF TIME
RUN USES SHAFRANOV SHIFTED CIRCLES EQUILIBRIUM
MAGNETICS CALCULATION:
     MAGDIF:      <TRUE>           SPITZER:     <FALSE>
 MAGDIF INITIALIZED WITH PARABOLIC V(R)
BALANCE CALCULATIONS:
     PTCL BAL:    <TRUE>           ION E. BAL:  <TRUE>
     ELEC E. BAL: <TRUE>           ANG.MO.BAL:  <FALSE>
DENSITY EVOLUTION MODEL:  CONSTANT V
NEUTRAL PENETRATION/SOURCE MODEL:  FRANTIC
     N0 EXTERNAL:  5.000E+11
     TAUP(G1):     2.000E-01       TAUP(G2):     2.000E-01
COLD GAS PUFF TEMPERATURES (EV):
     T0-GAS 1:     3.000E+00       T0-GAS 2:     3.000E+00
RECYCLING GAS TEMPERATURES (EV):
     T0-GAS 1:     1.500E+01       T0-GAS 2:     1.500E+01
     REFLECTIONS: <FALSE>          S0recombine: <FALSE>
PLASMA HEATING:       OHMIC:      <TRUE>
     BEAM*:       <TRUE>                ICRF:   <FALSE>
     LWR.HYBRID:  <FALSE>
*BEAM MONTE CARLO ORBITS IN SHAFRANOV GEOMETRY
<*=*><*=*>
* PLABEL=>TRFIL3  AUTOMATIC REMARKS -- PAGE 2 --
ION CONDUCTION MODEL:
     CHANG-HINTON
 ION CONDUCTIVITY MULTIPLIER *PROFILE* FORMED
 TO SET ION CONDUCTIVITY = XKFAC * ELECTRON CONDUCTIVITY
```

```
         XKFAC:    1.000E+00
ION CONVECTION MODEL:  QLOSSI=
     div(nkTv)i *  1.500E+00
ELECTRON CONVECTION MODEL:  QLOSSE=
<*=*><*=*>
* PLABEL=>TRFIL3  AUTOMATIC REMARKS -- PAGE 3 --
** FLOATING VOLTAGE MODE; RESISTIVITY ZEFF IS
      ZEFF(P.C.)*  1.000E+00
PLASMA COMPOSITION (ZEFF):
     =Z(MAGDIF)?  <FALSE>          =MEASURED?   <TRUE>
     Z-EXPONENT:   0.000E+00
     GAS NO. 1 Z=  1.000E+00                A=  1.000E+00
     GAS NO. 2 Z=  1.000E+00                A=  2.000E+00
     IMPURITY Z=   6.000E+00                A=  1.200E+01
     BEAM      Z=  1.000E+00                A=  2.000E+00
<*=*><*=*>
PHYSICS DATA-BASE (CF TRDAT):
  >1ST TRY INPUT UFILES DIRECTORY:
     CBARNES
T42457.CUR:  PLASMA CURRENT
T42457.RPL:  PLASMA POSITION
T42457.VSF:  SURFACE VOLTAGE
 *** COMPARE TO TRANSP PREDICTED SURFACE VOLTAGE ***
S42457.FMA:  NE PROFILE DATA
 *** ECE FREQUENCY TO POSITION MAP IN TRANSP
P42457.NBI:  NEUTRAL BEAM DATA
T42457.APL:  MINOR RADIUS
S42457.VBT:  VISIBLE BREMSTRAHLUNG
T42457.LAM:  LI/2+BETA(THETA) DATA
T42457.NE2:  PLASMA NEUTRON DATA
T42457.BPD:  DIAMAGNETIC BETA LOOP
T42457.DMF:  DIAMAGNETIC FLUX
T42457.RBZ:  R*VACUUM TOROIDAL FIELD
<*=*><*=*>
PHYSICS DATA TRANSMISSION INFORMATION:

DATA TYPE             LOCUS TYPE             # PTS
--------------------  --------------------   -----
ELECTRON TEMPERATURE  MIDPLANE  OUTSIDE        60
ELECTRON DENSITY      MIDPLANE  2-SIDED        60
```

```
NUMBER OF TIME PTS IN UNIFIED PHYSICS DATA FILE:
     F(X,T) DATA:         301        F(T) DATA:          301
<*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*>
RAX$
RAX$
```

The following is a sample terminal session using GETRUN. The following things are done: (1) a list of all TFTR TRANSP runs for 1989 with run numbers between 1000 and 1100 is produced (note that all these runs are on laser disk), (2) a list of all TFTR TRANSP runs for 1986 from TFTR shots 22870 through 22885 with TRANSP run numbers of between 4000 and 4010 is produced (note that none of these runs is on laser or magnetic disk), and (3) a batch request is generated to recover a TRANSP run from 1986 for TFTR with run number 4001 from magnetic tape to disk.

Example 1.b

```
HAX$
HAX$
HAX$ GETRUN
** CAUTION ** due to a systems problem, archive tape retrieves
do not work from node RAX, until further notice -DMC 14 Dec 89


  GETRUN ========================================
         ===  8 character run ID  ====  3/90  ===

 Type one of the following numbers :

1         -  Display run information
2         -  GET a run from archive tape or laser disk to magnetic disk.
3         -  SAVE a run from magnetic disk to archive tape. (privileged option)
             (run later copied to laser disk automatically)
4 or Q    -  Submit GET/SAVE archive tape requests, program exit.
5         -  Do not submit archive tape requests, program exit.

         --  Laser disk requests are processed immediately.
         --  Archive tape requests are submitted to a batch queue
```

```
            to be handled through operator intervention.

Option # :  1
[OLD VALUE:  ""]
  Display latest remarks ? (y/n) :  N
[OLD VALUE:  "N"]
  Select by date ? (y/n) :  N


TOKAMAK SELECT:
ENTER "*" TO LIST ALL RUNS FROM ALL DEVICES
ENTER "DEV" TO LIST ALL RUNS FROM SPECIFIED DEVICE
ENTER "DEV.YY" TO LIST RUNS FROM SPECIFIED DEVICE AND SHOT YEAR
EXAMPLES:  "PDX" FOR ALL PDX RUNS;
           "PLT.78" FOR PLT RUNS ON SHOTS FROM 1978

[OLD VALUE:  ""]
 DISPIX >> ENTER TOKAMAK SELECT:  TFTR.89

FOR INFO ON A *SINGLE* SHOT JUST ENTER SHOT NUMBER:
 DISPIX >> RESTRICT LISTING TO RANGE OF SHOT #S ? (Y/N)  N

In request by run ID enter either
    - old four digit run number (nnnn)
    - new eight character run ID (ssssxtt)

Intervals of run ID's are displayed with old run numbers appearing before new
run ID forms.


FOR INFO ON A *SINGLE* RUN JUST ENTER RUN ID:
[OLD VALUE:  ""]
 DISPIX >> RESTRICT LISTING TO RANGE OF RUN #S ? (Y/N)  Y
[OLD VALUE:  "    0000"]
 DISPIX: ENTER MINIMUM RUN ID (4 digits or 8 characters):  1000
[OLD VALUE:  "99999Z99"]
 DISPIX: ENTER MAXIMUM RUN ID (4 digits or 8 characters):  1100
```

==

DEV.YR	RUN ID	SHOT#	RUN DATE	T	L	PLATTER NAME	D	A
TFTR.89	1000	40050	08-OCT-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1020	41325	24-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1021	41325	25-DEC-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1040	41326	24-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1041	41326	31-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1042	41326	26-DEC-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1060	41327	24-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1061	41327	26-DEC-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1080	41683	31-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1081	41683	30-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1083	41683	04-NOV-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1084	41683	03-NOV-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1085	41683	10-DEC-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1099	41683	27-NOV-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1100	41719	02-NOV-1989	Y	Y	P10A$TFTR890	Y	G

T=on tape [Y/N/O] L=on laser disk [Y/N/O]
D=on magnetic disk [Y/N/O] A=access code [W=world, G=group]
(value O = in progress; magnetic disk restore may be done.)

[USER ACKNOWLEDGE - HIT ANY KEY]

[OLD VALUE: "N"]
Make another display ? (Y/N) : **Y**
[OLD VALUE: "Y"]
Display latest remarks ? (y/n) : **N**
[OLD VALUE: "N"]
Select by date ? (y/n) : **N**

TOKAMAK SELECT:
ENTER "*" TO LIST ALL RUNS FROM ALL DEVICES
ENTER "DEV" TO LIST ALL RUNS FROM SPECIFIED DEVICE
ENTER "DEV.YY" TO LIST RUNS FROM SPECIFIED DEVICE AND SHOT YEAR
EXAMPLES: "PDX" FOR ALL PDX RUNS;
"PLT.78" FOR PLT RUNS ON SHOTS FROM 1978

```
[OLD VALUE:  "TFTR.89"]
 DISPIX >> ENTER TOKAMAK SELECT:  TFTR.86

FOR INFO ON A *SINGLE* SHOT JUST ENTER SHOT NUMBER:
 DISPIX >> RESTRICT LISTING TO RANGE OF SHOT #S ? (Y/N)  Y
 DISPIX >> ENTER MINIMUM SHOT NUMBER TO LIST (5 DIGITS):  22870
 DISPIX >> ENTER MAXIMUM SHOT NUMBER TO LIST (5 DIGITS):  22885

In request by run ID enter either
    - old four digit run number (nnnn)
    - new eight character run ID (ssssssxtt)

Intervals of run ID's are displayed with old run numbers appearing before new
run ID forms.


FOR INFO ON A *SINGLE* RUN JUST ENTER RUN ID:
[OLD VALUE:  "    9927"]
 DISPIX >> RESTRICT LISTING TO RANGE OF RUN #S ? (Y/N)  Y
[OLD VALUE:  "    0000"]
 DISPIX: ENTER MINIMUM RUN ID (4 digits or 8 characters):  4000
[OLD VALUE:  "99999Z99"]
 DISPIX: ENTER MAXIMUM RUN ID (4 digits or 8 characters):  4010
```

DEV.YR	RUN ID	SHOT#	RUN DATE	T	L	PLATTER NAME	D	A
TFTR.86	4000	22871	17-NOV-1988	Y	N		N	G
TFTR.86	4001	22871	27-NOV-1988	Y	N		N	G
TFTR.86	4002	22871	08-DEC-1988	Y	N		N	G

```
   T=on tape [Y/N/O]                  L=on laser disk [Y/N/O]
   D=on magnetic disk [Y/N/O]         A=access code [W=world, G=group]
        (value O = in progress; magnetic disk restore may be done.)

[OLD VALUE:  "N"]
Make another display ?  (Y/N) :  ,
```

```
% OLD VALUE RETAINED
** CAUTION ** due to a systems problem, archive tape retrieves
do not work from node RAX, until further notice -DMC 14 Dec 89


  GETRUN ========================================
         ===  8 character run ID  ====  3/90  ===

 Type one of the following numbers :

1         -  Display run information
2         -  GET a run from archive tape or laser disk to magnetic disk.
3         -  SAVE a run from magnetic disk to archive tape. (privileged option)
             (run later copied to laser disk automatically)
4 or Q    -  Submit GET/SAVE archive tape requests, program exit.
5         -  Do not submit archive tape requests, program exit.

          --  Laser disk requests are processed immediately.
          --  Archive tape requests are submitted to a batch queue
              to be handled through operator intervention.

Option # :  2
[OLD VALUE:  ""]
    device.year (DDD.YY or DDDD.YY,  Q=no more) : TFTR.86
[OLD VALUE:  ""]
 Run ID: nnnn or sssssCtt (0=new DEV.YR,  Q=no more) : 4001

 Run is only on archiver tape.
 archive retrieve request will be processed.

% RUN TFTR.86 ID      4001; SHOT 22871 QUEUED FOR RETRIEVAL ON NORMAL PROGRAM
EXIT
[OLD VALUE:  "    4001"]
 Run ID: nnnn or sssssCtt (0=new DEV.YR,  Q=no more) : Q
** CAUTION ** due to a systems problem, archive tape retrieves
do not work from node RAX, until further notice -DMC 14 Dec 89


  GETRUN ========================================
         ===  8 character run ID  ====  3/90  ===
```

```
 Type one of the following numbers :

1         -  Display run information
2         -  GET a run from archive tape or laser disk to magnetic disk.
3         -  SAVE a run from magnetic disk to archive tape. (privileged option)
             (run later copied to laser disk automatically)
4 or Q    -  Submit GET/SAVE archive tape requests, program exit.
5         -  Do not submit archive tape requests, program exit.

          --  Laser disk requests are processed immediately.
          --  Archive tape requests are submitted to a batch queue
              to be handled through operator intervention.

Option # :  Q
Job GETJOB05APR90143131 (queue H_NORM, entry 264) started on H_NORM
FORTRAN STOP
HAX$
HAX$
HAX$   BATCH
Batch queue CAD$BATCH, on USC::

Batch queue CITIC1_NORM, stopped, on CITIC1::

  Jobname         Username     Entry          Status
  -------         --------     -----          ------
  SHOW-STATS      CARROLL        707          Pending
  SHOW-STATS      CARROLL        153          Pending
.
.
.
.
Batch queue H_NORM, on HAX::

  Jobname         Username     Entry          Status
  -------         --------     -----          ------
  2521TR          TRANSP         474          Executing
   GETJOB05APR90143131
                   TERPSTRA      264           Executing
  TRMONITOR       TRANSP         241          Holding until  5-APR-1990 15:21
  CM_SPLPRESS001  SERVICES       251          Holding until  5-APR-1990 15:26
```

```
  TRMONITOR       DMCCUNE        252          Holding until  5-APR-1990 16:27
  TR_NIGHTLY      TRANSP         943          Holding until  5-APR-1990 23:59
  QUE_PERDAY      MURPHY         956          Holding until  6-APR-1990 01:00

Batch queue H_SYSTEM, on HAX::

  Jobname         Username     Entry          Status
  -------         --------     -----          ------
  SHOW-STATS      CARROLL        850          Executing
  BATCH_WATCH     SYSOPR         159          Holding until  5-APR-1990 14:37
  ACCOUNT         SYSOPR         804          Holding until  5-APR-1990 23:30
.
.
.
Batch queue VS06_NORM, on VS06::

  Jobname         Username     Entry          Status
  -------         --------     -----          ------
  SHOW-STATS      CARROLL        861          Executing
HAX$
HAX$
```

SECTION 2.

ACCESSING TRANSP GRAPHICS OUTPUT RPLOT

2. Accessing TRANSP Graphics Output

If the output files of a TRANSP run are on magnetic or laser disk, the run may be examined using an interactive VAX program called RPLOT. To access this program, one can first move to the subdirectory for the year and the tokamak which produced the data TRANSP was used to analyze, e.g. type

"$SET DEFAULT RUNDATA:[TRANSP.TFTR.89]"

then type

"$ RPLOT".

This command executes RPLOT with the user's terminal as the output device. Alternatively, one can select the disk and directory in RPLOT itself by specifying them in response to queries. One must have a terminal capable of supporting Tektronix 4010 plot commands. For best results, one should have defined the logical name TERMINAL_TYPE to correctly identify the type of terminal being used. For details see $ HELP SGLIB. RPLOT uses PPPL's SGLIB subroutine library to generate its plot displays. As one runs RPLOT with the terminal as an output device, on completion of each graph the bell on the terminal will be rung. The graph will remain on the screen until one hits any key on the terminal's keyboard. This allows one to study the graph or copy it to a file (depending on how SGLIB is being used). Type

"$ HELP SGLIB"

on the VAX for further information on graphics capabilities.

To use RPLOT to draw graphs from a particular run, four data files are required. If the TRANSP run number is 1234, these files are:

1234TF.PLN,
1234MF.PLN,
and 1234NF.PLN

as well as the previously mentioned

1234TR.INF.

These first three files reside in the tokamak/year subdirectory (e.g. [TRANSP.TFTR.89] if the data for run 1234 were produced by TFTR during

1989) on the RUNDATA disk. To verify that the required files to draw graphs of run 1234 are present, move to the appropriate subdirectory,

"$ SET DEFAULT RUNDATA:[TRANSP.TFTR.89]",

and then enter the command

"$ DIRECTORY 1234*.*".

The above names 1234TF.PLN, etc. should be in the list of file names produced in response to this command. If not, then run 1234 will have been skimmed from disk and removed to magnetic tape and/or laser disk; see Section 1 above. Runs made since September, 1989, should be on laser disk and are accessible directly with RPLOT even if not currently on magnetic disk.

The remainder of this User's Guide will be devoted to instructions on how to use RPLOT to produce various graphs of a previously made TRANSP run. Subsection 2.1 describes elementary RPLOT capabilities; Subsection 2.2 describes some of RPLOT's more advanced capabilities. Sample terminal sessions and RPLOT output will be presented to illustrate.

SECTION 2.1

RPLOT: ELEMENTARY CAPABILITIES

(A) GENERATING A TABLE OF CONTENTS OF A RUN'S GRAPHICS OUTPUT FILES.

(B) PLOTTING SCALAR FUNCTIONS VS. TIME.

(C) PLOTTING FUNCTIONS OF TIME AND AN ADDITIONAL COORDINATE.

(D) DRAWING MULTIGRAPHS OF FUNCTIONS OF TIME AND AN ADDITIONAL COORDINATE.

(E) CHANGING FUNCTION NAMES, ABBREVIATIONS, AND THE CONTENTS OF MULTIGRAPH PACKAGES.

(F) MAKING REMARKS ABOUT A RUN IN ITS nnnn TR.INF FILE.

(G) CONTROLLING THE SCALE OF 2-D GRAPHS.

(H) RADIAL INTEGRATION AND AVERAGING OF PROFILE FUNCTIONS DEFINED VS. TRANSP RADIAL VECTOR.

(J) SMOOTHING AND TIME-AVERAGING OPTIONS.

(K) USING THE CALCULATOR AND READING FUNCTIONS FROM MORE THAN ONE RUN.

(L) CREATING AND READING USER DEFINED UFILE OUTPUT.

(M) CHANGING X AXES.

(N) MISCELLANEOUS 1: SPECIAL INPUT CHARACTERS.

(O) MISCELLANEOUS 2: MAKING AN INDEX; EXITING RPLOT AND FETCHING A NEW RUN.

2.1 RPLOT: Elementary Capabilities

2.1(A) Generating a table of contents of a run's graphics output files.

To use RPLOT effectively one will need to know how to identify the functions that are wanted for plotting. One way to do this is to generate a table of contents and multigraph package table for the run of interest. The table of contents lists all of the functions in the graphics files output by the TRANSP run. The multigraph package table shows how some of these functions have been grouped together for simultaneous display. A typical example of a multigraph would be "ION POWER BALANCE", which includes all the terms of a power balance equation contributing to the determination of the ion temperature. On the following pages a sample terminal session is shown in which RPLOT is used to generate a table of contents and multigraph package list for TFTR run 2100 from 1989. Appendix Z contains a copy of the table of contents and multigraph package list for run 2100.

Each function and multigraph has a 32 character explanatory label and a 15 character optional units label. However, when RPLOT requests that a single function or multigraph be identified, an abbreviation of up to nine characters must be used. The abbreviation is included in the table of contents. For example, to identify the function "ELECTRON DENSITY", one should use the abbreviation "NE". This will be shown in several examples below.

Example 2.1 (A)

```
RAX$
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS
```

ACCESSING TRANSP OUTPUT:

A USER'S GUIDE

Accessing TRANSP Output: A User's Guide

Rewritten March, 1990

Princeton Plasma Physics Laboratory

Table of Contents

****

****

SECTION 0.

INTRODUCTION

0. Introduction

TRANSP is a time dependent tokamak transport analysis code developed at the Princeton Plasma Physics Laboratory. The code provides a means to invert data from tokamak experiments, to provide a picture of the processes which account for the confinement and heating in tokamak plasmas. The code supports a wide range of plasma geometries and incorporates in its libraries a wealth of physics modeling for neutral beam and RF auxiliary heating, neutral transport, diagnostic simulations, sawtooth and pellet events, etc.

TRANSP is used in various computing environments for tokamak data analysis at laboratories around the world. At Princeton the data files containing the results of such TRANSP analyses are stored on magnetic and laser disk on a VMS VAX cluster. The purpose of this User's Guide is to describe how to access these analysis results in graphical form on a VAX system. The reader is not expected to have specialized VAX knowledge, although familiarity with fundamentals (e.g. how to log in) will be assumed.

Each TRANSP run produces binary data files which may be accessed interactively by running a plotting program called RPLOT on the VAX. As of February, 1990, typical TRANSP results data files contained over 150 scalar functions of time and 300 profile functions of time and one additional (usually geometrical) coordinate. These functions represent parameters, measured or calculated, which together describe the evolution of an experimental tokamak plasma. Sample scalar functions are: Total Plasma Current (measured), and Beam Power Lost to Charge-Exchange (calculated). Sample profile functions are: Electron Density vs. radius and time (measured; "radius" indicates a measure of distance from the plasma center), Ion Temperature vs. radius and time (calculated but fit to measurements at the plasma center), Thermal Plasma Energy Confinement time vs. radius and time (calculated), and Beam Ion Density (calculated) vs. poloidal angle and time at various radii. A complete table of contents of the graphics files for a particular TRANSP run will be presented below in Section Z.

This User's Guide contains three sections. Section 1 describes the procedures for determining what TRANSP runs have been made, and for determining some of the important assumptions going into a particular TRANSP run, and how to request that the graphics output files for that run be recovered to disk so that they may be viewed interactively using RPLOT.

Section 2 describes how to use the RPLOT code to peruse the graphics output of a particular TRANSP run. Sample terminal sessions on the VAX and sample output are included.

Section 3 explains two subroutines, TRSCALAR & TRPROFIL, that can be used to read TRANSP data into a user's FORTRAN program on the VAX. Calling arguments are given.

Also included are three appendices. Appendix X. contains notes on the sample terminal sessions presented in Sections 1 and 2. Appendix Y. contains a list of references useful for understanding the TRANSP calculations. Appendix Z. contains the table of contents of all functions and abbreviations as well as multigraph packages for a typical run.

To use the procedures described below, one must first log onto one of the computers in the VAX cluster (e.g. RAX, HAX, EPX, USC...). Then, one should carefully follow the instructions shown in response to the command:

$ HELP TRANSP

These instructions will clarify two issues. First, it is necessary for a VAX systems administrator to grant an account the "right" to access TRANSP results data. This right is not automatically granted to all user accounts. Second, an explanation is given of simple modifications needed in a login procedure (LOGIN.COM) to define VAX DCL symbols and logical names required to run the RPLOT program. If because of lack of familiarity with the VAX system one is unable to modify one's own LOGIN.COM file correctly, one should seek the assistance of a more experienced user.

"HELP TRANSP" is demonstrated below:

```
RAX$
RAX$
RAX$ HELP  TRANSP
TRANSP


  TRANSP is a PPL time dependent transport analysis code.

  TRANSP reads diagnostic data from tokamak experiments (in UFILES format),
  and, after extensive computational modeling, creates analyzed results
  data files containing hundreds of scalar and profile functions of time
  describing the model plasma.

  TRANSP input diagnostic data UFILES must be carefully prepared.  UFILES are
  also useful in their own right.  For more information, see:
    HELP TRANSL (how to create UFILES from TFTR raw and waveform data)
    HELP UFILES
    hardcopy documentation--
      UFILES manual (D. McCune)
      Seminar on how to prepare input for TRANSP (D. McCune)
      Accessing TFTR Data on the VAX Cluster (TFTR overview, J.A. Murphy)



Press RETURN to continue ...
   TRANSP output may now be accessed directly from user accounts with a
plotting
  program.  More information in the subkeys.    ...D McCune 4-Jun-1987

  %DMC - last review/update of help module:  27-Nov-1989


  Additional information available:

  Basic_Info More_Info  JUNK_area

@USR TRANSP Subtopic?
```

By entering one of the subtopics, "Basic_Info", "More_Info" or "JUNK_area", the user can transverse the HELP tree to get further information. A carriage return in response to a prompt, takes the users back one level, in the HELP information tree.

In the remainder of the manual it will be assumed that the user has successfully followed the instructions under "HELP TRANSP". If so, the DCL symbols RPLOT and GETRUN will have been defined. RPLOT is the TRANSP output data plotting program. GETRUN is the TRANSP archive listing and retrieval program. Both programs will be described in detail. The user should also have a definition for the logical name RUNDATA. This logical name defines the list of disks where TRANSP run results data may be found. The user may test the definition of a DCL symbol e.g. with the command

"$ SHOW SYMBOL RPLOT";

a logical name definition may be tested with the command

"$ SHOW LOGICAL RUNDATA".

TRANSP output resides in subdirectories identified by logical disk and directory "RUNDATA:[TRANSP.dddd.yy]", where dddd is the experimental device such as "TFTR" or "PBX" and yy is the last two digits of the calender year of the shot such as "89" for 1989. To run RPLOT, one can first move to the subdirectory area for the tokamak that produced the data for the TRANSP run one wants to look at, or enter the information after queries from RPLOT. To move to the correct subdirectory on the VAX for TFTR for 1989, for example, one can enter the DCL command,

"$ SET DEFAULT RUNDATA:[TRANSP.TFTR.89]".

To determine what runs are available, one runs GETRUN as described below in Section 1.

A note of caution: procedures described herein may from time to time undergo revision. Occasional updates to this guide will be distributed if necessary.

SECTION 1.

LOCATING TRANSP RUNS

GETRUN

1. Locating TRANSP Runs

The output of a TRANSP run is initially stored on VAX disks logically named "RUNDATA", in the sub-directory corresponding to the year of the shot and the tokamak device that produced the data that the TRANSP run analyzed. For example, TFTR TRANSP run output for shots done in 1989 resides in RUNDATA:[TRANSP.TFTR.89]. However, due to limitations of disk space, runs that are not of special importance are usually transferred to magnetic tape and/or laser disk and removed from the main disk after a short period of time.

Each TRANSP run is identified by a **run id string** that is unique for the year of the shot and the tokamak device from which the data originated. Traditionally, these run id strings are four digit numbers known as **TRANSP run numbers**. In the future, a longer run id string imbedding a shot-try specification will be used to identify TRANSP runs, but this capability had not yet been implemented when this manual was printed. At the time of printing, all TRANSP runs were still identified by four digit run numbers. A sample run number for TFTR for 1989 is 2100. Contiguous sets of run numbers for the same tokamak-year generally identify related TRANSP runs (e.g. several TRANSP runs that analyzed the same input data). Typically, run numbers are "allocated" in blocks of 20, so that runs 2100 through 2119 would be reserved for 20 analyses of the same set of shot data. If more than 20 analyses are needed, a second block of 20 run numbers would be allocated. For a given shot, all existing TRANSP runs may be listed with the GETRUN program. For each run nnnn there exists a file, nnnnTR.INF, that contains some verbal information describing the run. This file is never deleted from the disk that has logical name TRINF, although other files associated with the run will be deleted when the run is transferred to magnetic tape or laser disk. The nnnnTR.INF file resides in the tokamak.year sub-area of the device producing the input data. Thus, to look at the nnnnTR.INF file for TFTR run 2100 for year 1989 one types

"$ SET DEFAULT TRINF:[TFTR.89]"

and then

"$ PRINT 2100TR.INF"

to send the file to a VAX printer (such as the one in the PPLCC output room), or

"$ TYPE 2100TR.INF"

to list the file on one's terminal. An example is given below. In Section 2 a means of entering new remarks about a run in its "TR.INF" file will be described.

Every time a TRANSP run is transferred to magnetic tape or laser disk, an entry is made in a TRANSP library database file to record the presence of the run there. Thus it is possible to locate any TRANSP run, whether it is on magnetic tape, main disk, laser disk or all three. To facilitate this, there is a program called GETRUN. This program functions as a librarian for TRANSP runs, allowing the listing of what TRANSP runs have been made, where the TRANSP run's output data is located, and also allowing the user to request that a TRANSP run, which is on magnetic tape but not on main disk, be recovered to main disk. Laser disk file recovery is done automatically from RPLOT, although there is a short time delay waiting for the files to be copied to the main disks. A sample terminal session with the GETRUN program is shown at the end of this section. The sample session shows (1) the generation of a list of all TFTR TRANSP runs that have been made for 1989 for run numbers between 1000 and 1100 and where they are located, and (2) the generation of a request to recover a TFTR TRANSP run to main disk. As will be seen, the use of GETRUN is, by and large, self-explanatory. To run GETRUN interactively and direct its listing output to one's terminal, enter "$ GETRUN" on the VAX. It will take a few moments for GETRUN to respond because directory listings of TRANSP runs must be read in and the lists of runs on magnetic tape and laser disk must be accessed and sorted by the routine. To speed GETRUN startup, disk directory listings of TRANSP runs are updated only once per day by a nightly batch job.

As will be seen by examining the sample terminal session at the end of this section, it is possible to restrict GETRUN's listing output to a particular tokamak and a range of dates, shot numbers and/or run numbers. Thus if one wants to determine if a particular experiment (shot) has been

analyzed by TRANSP, one may do this with GETRUN. A note of warning, however: often the input data for TRANSP is produced by averaging and/or concatenating the data from a series of similar shots, and from this series a single "nominal" shot number is chosen to identify the averaged/concatenated input data; it is this shot number (only) that shows up in the GETRUN output lists. Thus one should have GETRUN list a range of shot numbers wide enough to cover the entire range of shots of interest. Also, because of the labor involved, relatively few tokamak shots -- e.g. those actually requiring time dependent analysis, non-circular flux surface geometry, or some other feature unique to TRANSP -- are actually analyzed using the TRANSP code. On TFTR, the SNAP code analysis, which is faster and easier to use, is applied to a much wider range of shots.

GETRUN listings contain three status columns (T, L & D) indicating whether various runs are on magnetic tape, laser disk or magnetic disk (or on all three media). If the run is on magnetic disk or laser disk, RPLOT may be run to graph the output (Section 2 below). If not, i.e. the run is on magnetic tape, the files for the run must be copied to magnetic disk first. This may be done through GETRUN, as will be seen in the sample terminal session below. If one generates a request to recover a run, it will be submitted in batch when GETRUN is exited. Up to two hours delay is to be expected, as the operators in the PPLCC must locate and mount the magnetic tape on which the requested run resides. The PPLCC computer room extension is x3444. One may request as many runs as needed to be restored in a single GETRUN session. After each GETRUN session a batch job, "GETJOBdate", is submitted containing any requests for the recovery of runs. To see if this job is still executing simply type "$ BATCH" to the monitor (after exiting GETRUN); if "GETJOBdate" is still executing it will be listed in the "R_NORM" queue on the computer on which one is running. When it stops executing, all files for the runs will have been requested, i.e. queued for retrieval.

The following non-fatal error messages may be encountered running GETRUN:

"? NONE FOUND": There are no TRANSP runs for the device, date, range of shot numbers and range of run numbers that were specified.

"? RUN <device> <year> <number> HAS NOT BEEN SAVED ON MAGNETIC TAPE": The run requested is not in the magnetic tape library. Generate a list of runs to check using option 1.

"? TRANSP run <device>.<year> <number> IS ON MAGNETIC DISK": The run the user requested is already on disk; it need not be recovered, and its plotting output may be viewed forthwith.

There is an option in the GETRUN program to request that runs on disk be saved to magnetic tape. This option (which is protected by a password) need not be exercised by users, as the tape and laser disk archival of TRANSP runs is performed automatically by nightly TRANSP systems maintenance batch jobs.

Before one requests the recovery of a TRANSP run, the user will probably want to check the nnnnTR.INF file for run nnnn. This file is stored in TRINF:[dddd.yy]nnnnTR.INF where dddd is the device such as TFTR and yy is the last two digits of the year of the shot such as 89. This file will contain any information regarding possible defects in the run or its input data, as well as the shot date of the shot producing the data for the run, the charge-exchange ion temperature measurement for the run, and other notes. The procedure for printing or typing the file is given at the beginning of this section above. An example of accessing an INF file for TRANSP run 2100 for TFTR for 1989 follows:

CONVENTION: If a comma, ",", is entered in response to a prompt in RPLOT, the old value will be accepted as the default value.

NOTE: Examples is this guide are in a different font and smaller than the normal print. User input from the terminal to the computer is in full size bold print.

Example 1.a

```
RAX$
RAX$
RAX$ SET  DEFAULT   TRINF:[TFTR.89]
```

```
RAX$
RAX$ TYPE   2100TR.INF
<*=*><*=*>  REMARKS FILE "2100TR.INF" CREATED 17-JAN-90
D=17-JAN-90  BY:  TRANSP                          RUN 2100
 >>> EXPERT MODULE = 2100EX.FOR
Cris Barnes' short beam pulse experiment -- first try at
analysis.  There were unknown amounts of Helium in the
plasma so the D depletion factor is not well known.
<*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*>
D=18-JAN-90  BY:  TRANSP SYSTEM:  PLABEL=>TRFIL3 RUN 2100
     SHOT NO.:          42457
     START TIME:   2.500E+00       STOP TIME:    4.000E+00
VARIABLE GEOMETRY RUN: MINOR AND MAJOR RADIUS
AND TOROIDAL B FIELD MAY BE FUNCTIONS OF TIME
RUN USES SHAFRANOV SHIFTED CIRCLES EQUILIBRIUM
MAGNETICS CALCULATION:
     MAGDIF:      <TRUE>           SPITZER:     <FALSE>
 MAGDIF INITIALIZED WITH PARABOLIC V(R)
BALANCE CALCULATIONS:
     PTCL BAL:    <TRUE>           ION E. BAL:  <TRUE>
     ELEC E. BAL: <TRUE>           ANG.MO.BAL:  <FALSE>
DENSITY EVOLUTION MODEL:  CONSTANT V
NEUTRAL PENETRATION/SOURCE MODEL:  FRANTIC
     N0 EXTERNAL:  5.000E+11
     TAUP(G1):     2.000E-01       TAUP(G2):     2.000E-01
COLD GAS PUFF TEMPERATURES (EV):
     T0-GAS 1:     3.000E+00       T0-GAS 2:     3.000E+00
RECYCLING GAS TEMPERATURES (EV):
     T0-GAS 1:     1.500E+01       T0-GAS 2:     1.500E+01
     REFLECTIONS: <FALSE>          S0recombine: <FALSE>
PLASMA HEATING:       OHMIC:      <TRUE>
     BEAM*:       <TRUE>                ICRF:   <FALSE>
     LWR.HYBRID:  <FALSE>
*BEAM MONTE CARLO ORBITS IN SHAFRANOV GEOMETRY
<*=*><*=*>
* PLABEL=>TRFIL3  AUTOMATIC REMARKS -- PAGE 2 --
ION CONDUCTION MODEL:
     CHANG-HINTON
 ION CONDUCTIVITY MULTIPLIER *PROFILE* FORMED
 TO SET ION CONDUCTIVITY = XKFAC * ELECTRON CONDUCTIVITY
```

```
         XKFAC:    1.000E+00
ION CONVECTION MODEL:  QLOSSI=
     div(nkTv)i *  1.500E+00
ELECTRON CONVECTION MODEL:  QLOSSE=
<*=*><*=*>
* PLABEL=>TRFIL3  AUTOMATIC REMARKS -- PAGE 3 --
** FLOATING VOLTAGE MODE; RESISTIVITY ZEFF IS
      ZEFF(P.C.)*  1.000E+00
PLASMA COMPOSITION (ZEFF):
     =Z(MAGDIF)?  <FALSE>          =MEASURED?   <TRUE>
     Z-EXPONENT:   0.000E+00
     GAS NO. 1 Z=  1.000E+00                  A=  1.000E+00
     GAS NO. 2 Z=  1.000E+00                  A=  2.000E+00
     IMPURITY Z=   6.000E+00                  A=  1.200E+01
     BEAM      Z=  1.000E+00                  A=  2.000E+00
<*=*><*=*>
PHYSICS DATA-BASE (CF TRDAT):
  >1ST TRY INPUT UFILES DIRECTORY:
     CBARNES
T42457.CUR:  PLASMA CURRENT
T42457.RPL:  PLASMA POSITION
T42457.VSF:  SURFACE VOLTAGE
 *** COMPARE TO TRANSP PREDICTED SURFACE VOLTAGE ***
S42457.FMA:  NE PROFILE DATA
 *** ECE FREQUENCY TO POSITION MAP IN TRANSP
P42457.NBI:  NEUTRAL BEAM DATA
T42457.APL:  MINOR RADIUS
S42457.VBT:  VISIBLE BREMSTRAHLUNG
T42457.LAM:  LI/2+BETA(THETA) DATA
T42457.NE2:  PLASMA NEUTRON DATA
T42457.BPD:  DIAMAGNETIC BETA LOOP
T42457.DMF:  DIAMAGNETIC FLUX
T42457.RBZ:  R*VACUUM TOROIDAL FIELD
<*=*><*=*>
PHYSICS DATA TRANSMISSION INFORMATION:

DATA TYPE             LOCUS TYPE             # PTS
--------------------  --------------------   -----
ELECTRON TEMPERATURE  MIDPLANE  OUTSIDE        60
ELECTRON DENSITY      MIDPLANE  2-SIDED        60
```

```
NUMBER OF TIME PTS IN UNIFIED PHYSICS DATA FILE:
     F(X,T) DATA:         301        F(T) DATA:          301
<*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*><*=*>
RAX$
RAX$
```

The following is a sample terminal session using GETRUN. The following things are done: (1) a list of all TFTR TRANSP runs for 1989 with run numbers between 1000 and 1100 is produced (note that all these runs are on laser disk), (2) a list of all TFTR TRANSP runs for 1986 from TFTR shots 22870 through 22885 with TRANSP run numbers of between 4000 and 4010 is produced (note that none of these runs is on laser or magnetic disk), and (3) a batch request is generated to recover a TRANSP run from 1986 for TFTR with run number 4001 from magnetic tape to disk.

Example 1.b

```
HAX$
HAX$
HAX$ GETRUN
** CAUTION ** due to a systems problem, archive tape retrieves
do not work from node RAX, until further notice -DMC 14 Dec 89


  GETRUN ========================================
         ===  8 character run ID  ====  3/90  ===

 Type one of the following numbers :

1         -  Display run information
2         -  GET a run from archive tape or laser disk to magnetic disk.
3         -  SAVE a run from magnetic disk to archive tape. (privileged option)
             (run later copied to laser disk automatically)
4 or Q    -  Submit GET/SAVE archive tape requests, program exit.
5         -  Do not submit archive tape requests, program exit.

         --  Laser disk requests are processed immediately.
         --  Archive tape requests are submitted to a batch queue
```

```
            to be handled through operator intervention.

Option # :  1
[OLD VALUE:  ""]
  Display latest remarks ? (y/n) :  N
[OLD VALUE:  "N"]
  Select by date ? (y/n) :  N


TOKAMAK SELECT:
ENTER "*" TO LIST ALL RUNS FROM ALL DEVICES
ENTER "DEV" TO LIST ALL RUNS FROM SPECIFIED DEVICE
ENTER "DEV.YY" TO LIST RUNS FROM SPECIFIED DEVICE AND SHOT YEAR
EXAMPLES:  "PDX" FOR ALL PDX RUNS;
           "PLT.78" FOR PLT RUNS ON SHOTS FROM 1978

[OLD VALUE:  ""]
 DISPIX >> ENTER TOKAMAK SELECT:  TFTR.89

FOR INFO ON A *SINGLE* SHOT JUST ENTER SHOT NUMBER:
 DISPIX >> RESTRICT LISTING TO RANGE OF SHOT #S ? (Y/N)  N

In request by run ID enter either
    - old four digit run number (nnnn)
    - new eight character run ID (ssssxtt)

Intervals of run ID's are displayed with old run numbers appearing before new
run ID forms.


FOR INFO ON A *SINGLE* RUN JUST ENTER RUN ID:
[OLD VALUE:  ""]
 DISPIX >> RESTRICT LISTING TO RANGE OF RUN #S ? (Y/N)  Y
[OLD VALUE:  "    0000"]
 DISPIX: ENTER MINIMUM RUN ID (4 digits or 8 characters):  1000
[OLD VALUE:  "99999Z99"]
 DISPIX: ENTER MAXIMUM RUN ID (4 digits or 8 characters):  1100
```

==

DEV.YR	RUN ID	SHOT#	RUN DATE	T	L	PLATTER NAME	D	A
TFTR.89	1000	40050	08-OCT-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1020	41325	24-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1021	41325	25-DEC-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1040	41326	24-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1041	41326	31-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1042	41326	26-DEC-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1060	41327	24-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1061	41327	26-DEC-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1080	41683	31-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1081	41683	30-OCT-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1083	41683	04-NOV-1989	Y	Y	P10A$TFTR890	N	G
TFTR.89	1084	41683	03-NOV-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1085	41683	10-DEC-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1099	41683	27-NOV-1989	Y	Y	P10A$TFTR890	Y	G
TFTR.89	1100	41719	02-NOV-1989	Y	Y	P10A$TFTR890	Y	G

T=on tape [Y/N/O] L=on laser disk [Y/N/O]
D=on magnetic disk [Y/N/O] A=access code [W=world, G=group]
(value O = in progress; magnetic disk restore may be done.)

[USER ACKNOWLEDGE - HIT ANY KEY]

[OLD VALUE: "N"]
Make another display ? (Y/N) : **Y**
[OLD VALUE: "Y"]
Display latest remarks ? (y/n) : **N**
[OLD VALUE: "N"]
Select by date ? (y/n) : **N**

TOKAMAK SELECT:
ENTER "*" TO LIST ALL RUNS FROM ALL DEVICES
ENTER "DEV" TO LIST ALL RUNS FROM SPECIFIED DEVICE
ENTER "DEV.YY" TO LIST RUNS FROM SPECIFIED DEVICE AND SHOT YEAR
EXAMPLES: "PDX" FOR ALL PDX RUNS;
"PLT.78" FOR PLT RUNS ON SHOTS FROM 1978

```
[OLD VALUE:  "TFTR.89"]
 DISPIX >> ENTER TOKAMAK SELECT:  TFTR.86

FOR INFO ON A *SINGLE* SHOT JUST ENTER SHOT NUMBER:
 DISPIX >> RESTRICT LISTING TO RANGE OF SHOT #S ? (Y/N)  Y
 DISPIX >> ENTER MINIMUM SHOT NUMBER TO LIST (5 DIGITS):  22870
 DISPIX >> ENTER MAXIMUM SHOT NUMBER TO LIST (5 DIGITS):  22885

In request by run ID enter either
    - old four digit run number (nnnn)
    - new eight character run ID (ssssssxtt)

Intervals of run ID's are displayed with old run numbers appearing before new
run ID forms.


FOR INFO ON A *SINGLE* RUN JUST ENTER RUN ID:
[OLD VALUE:  "    9927"]
 DISPIX >> RESTRICT LISTING TO RANGE OF RUN #S ? (Y/N)  Y
[OLD VALUE:  "    0000"]
 DISPIX: ENTER MINIMUM RUN ID (4 digits or 8 characters):  4000
[OLD VALUE:  "99999Z99"]
 DISPIX: ENTER MAXIMUM RUN ID (4 digits or 8 characters):  4010
```

==========

DEV.YR	RUN ID	SHOT#	RUN DATE	T	L	PLATTER NAME	D	A
TFTR.86	4000	22871	17-NOV-1988	Y	N		N	G
TFTR.86	4001	22871	27-NOV-1988	Y	N		N	G
TFTR.86	4002	22871	08-DEC-1988	Y	N		N	G

```
   T=on tape [Y/N/O]                  L=on laser disk [Y/N/O]
   D=on magnetic disk [Y/N/O]         A=access code [W=world, G=group]
        (value O = in progress; magnetic disk restore may be done.)

[OLD VALUE:  "N"]
 Make another display ?  (Y/N) :  ,
```

```
% OLD VALUE RETAINED
** CAUTION ** due to a systems problem, archive tape retrieves
do not work from node RAX, until further notice -DMC 14 Dec 89


  GETRUN ========================================
         ===  8 character run ID  ====  3/90  ===

 Type one of the following numbers :

1         -  Display run information
2         -  GET a run from archive tape or laser disk to magnetic disk.
3         -  SAVE a run from magnetic disk to archive tape. (privileged option)
             (run later copied to laser disk automatically)
4 or Q    -  Submit GET/SAVE archive tape requests, program exit.
5         -  Do not submit archive tape requests, program exit.

          --  Laser disk requests are processed immediately.
          --  Archive tape requests are submitted to a batch queue
              to be handled through operator intervention.

Option # :  2
[OLD VALUE:  ""]
    device.year (DDD.YY or DDDD.YY,  Q=no more) : TFTR.86
[OLD VALUE:  ""]
 Run ID: nnnn or sssssCtt (0=new DEV.YR,  Q=no more) : 4001

 Run is only on archiver tape.
 archive retrieve request will be processed.

% RUN TFTR.86 ID      4001; SHOT 22871 QUEUED FOR RETRIEVAL ON NORMAL PROGRAM
EXIT
[OLD VALUE:  "    4001"]
 Run ID: nnnn or sssssCtt (0=new DEV.YR,  Q=no more) : Q
** CAUTION ** due to a systems problem, archive tape retrieves
do not work from node RAX, until further notice -DMC 14 Dec 89


  GETRUN ========================================
         ===  8 character run ID  ====  3/90  ===
```

```
 Type one of the following numbers :

1         -  Display run information
2         -  GET a run from archive tape or laser disk to magnetic disk.
3         -  SAVE a run from magnetic disk to archive tape. (privileged option)
             (run later copied to laser disk automatically)
4 or Q    -  Submit GET/SAVE archive tape requests, program exit.
5         -  Do not submit archive tape requests, program exit.

          --  Laser disk requests are processed immediately.
          --  Archive tape requests are submitted to a batch queue
              to be handled through operator intervention.

Option # :  Q
Job GETJOB05APR90143131 (queue H_NORM, entry 264) started on H_NORM
FORTRAN STOP
HAX$
HAX$
HAX$  BATCH
Batch queue CAD$BATCH, on USC::

Batch queue CITIC1_NORM, stopped, on CITIC1::

  Jobname          Username      Entry          Status
  -------          --------      -----          ------
  SHOW-STATS       CARROLL         707          Pending
  SHOW-STATS       CARROLL         153          Pending
.
.
.
.
Batch queue H_NORM, on HAX::

  Jobname          Username      Entry          Status
  -------          --------      -----          ------
  2521TR           TRANSP          474          Executing
   GETJOB05APR90143131
                    TERPSTRA       264           Executing
  TRMONITOR        TRANSP          241          Holding until  5-APR-1990 15:21
  CM_SPLPRESS001   SERVICES        251          Holding until  5-APR-1990 15:26
```

```
  TRMONITOR       DMCCUNE        252          Holding until  5-APR-1990 16:27
  TR_NIGHTLY      TRANSP         943          Holding until  5-APR-1990 23:59
  QUE_PERDAY      MURPHY         956          Holding until  6-APR-1990 01:00

Batch queue H_SYSTEM, on HAX::

  Jobname         Username     Entry          Status
  -------         --------     -----          ------
  SHOW-STATS      CARROLL        850          Executing
  BATCH_WATCH     SYSOPR         159          Holding until  5-APR-1990 14:37
  ACCOUNT         SYSOPR         804          Holding until  5-APR-1990 23:30
.
.
.
Batch queue VS06_NORM, on VS06::

  Jobname         Username     Entry          Status
  -------         --------     -----          ------
  SHOW-STATS      CARROLL        861          Executing
HAX$
HAX$
```

SECTION 2.

ACCESSING TRANSP GRAPHICS OUTPUT RPLOT

2. Accessing TRANSP Graphics Output

If the output files of a TRANSP run are on magnetic or laser disk, the run may be examined using an interactive VAX program called RPLOT. To access this program, one can first move to the subdirectory for the year and the tokamak which produced the data TRANSP was used to analyze, e.g. type

"$SET DEFAULT RUNDATA:[TRANSP.TFTR.89]"

then type

"$ RPLOT".

This command executes RPLOT with the user's terminal as the output device. Alternatively, one can select the disk and directory in RPLOT itself by specifying them in response to queries. One must have a terminal capable of supporting Tektronix 4010 plot commands. For best results, one should have defined the logical name TERMINAL_TYPE to correctly identify the type of terminal being used. For details see $ HELP SGLIB. RPLOT uses PPPL's SGLIB subroutine library to generate its plot displays. As one runs RPLOT with the terminal as an output device, on completion of each graph the bell on the terminal will be rung. The graph will remain on the screen until one hits any key on the terminal's keyboard. This allows one to study the graph or copy it to a file (depending on how SGLIB is being used). Type

"$ HELP SGLIB"

on the VAX for further information on graphics capabilities.

To use RPLOT to draw graphs from a particular run, four data files are required. If the TRANSP run number is 1234, these files are:

1234TF.PLN,
1234MF.PLN,
and 1234NF.PLN

as well as the previously mentioned

1234TR.INF.

These first three files reside in the tokamak/year subdirectory (e.g. [TRANSP.TFTR.89] if the data for run 1234 were produced by TFTR during

1989) on the RUNDATA disk. To verify that the required files to draw graphs of run 1234 are present, move to the appropriate subdirectory,

"$ SET DEFAULT RUNDATA:[TRANSP.TFTR.89]",

and then enter the command

"$ DIRECTORY 1234*.*".

The above names 1234TF.PLN, etc. should be in the list of file names produced in response to this command. If not, then run 1234 will have been skimmed from disk and removed to magnetic tape and/or laser disk; see Section 1 above. Runs made since September, 1989, should be on laser disk and are accessible directly with RPLOT even if not currently on magnetic disk.

The remainder of this User's Guide will be devoted to instructions on how to use RPLOT to produce various graphs of a previously made TRANSP run. Subsection 2.1 describes elementary RPLOT capabilities; Subsection 2.2 describes some of RPLOT's more advanced capabilities. Sample terminal sessions and RPLOT output will be presented to illustrate.

SECTION 2.1

RPLOT: ELEMENTARY CAPABILITIES

(A) GENERATING A TABLE OF CONTENTS OF A RUN'S GRAPHICS OUTPUT FILES.

(B) PLOTTING SCALAR FUNCTIONS VS. TIME.

(C) PLOTTING FUNCTIONS OF TIME AND AN ADDITIONAL COORDINATE.

(D) DRAWING MULTIGRAPHS OF FUNCTIONS OF TIME AND AN ADDITIONAL COORDINATE.

(E) CHANGING FUNCTION NAMES, ABBREVIATIONS, AND THE CONTENTS OF MULTIGRAPH PACKAGES.

(F) MAKING REMARKS ABOUT A RUN IN ITS nnnn TR.INF FILE.

(G) CONTROLLING THE SCALE OF 2-D GRAPHS.

(H) RADIAL INTEGRATION AND AVERAGING OF PROFILE FUNCTIONS DEFINED VS. TRANSP RADIAL VECTOR.

(J) SMOOTHING AND TIME-AVERAGING OPTIONS.

(K) USING THE CALCULATOR AND READING FUNCTIONS FROM MORE THAN ONE RUN.

(L) CREATING AND READING USER DEFINED UFILE OUTPUT.

(M) CHANGING X AXES.

(N) MISCELLANEOUS 1: SPECIAL INPUT CHARACTERS.

(O) MISCELLANEOUS 2: MAKING AN INDEX; EXITING RPLOT AND FETCHING A NEW RUN.

2.1 RPLOT: Elementary Capabilities

2.1(A) Generating a table of contents of a run's graphics output files.

To use RPLOT effectively one will need to know how to identify the functions that are wanted for plotting. One way to do this is to generate a table of contents and multigraph package table for the run of interest. The table of contents lists all of the functions in the graphics files output by the TRANSP run. The multigraph package table shows how some of these functions have been grouped together for simultaneous display. A typical example of a multigraph would be "ION POWER BALANCE", which includes all the terms of a power balance equation contributing to the determination of the ion temperature. On the following pages a sample terminal session is shown in which RPLOT is used to generate a table of contents and multigraph package list for TFTR run 2100 from 1989. Appendix Z contains a copy of the table of contents and multigraph package list for run 2100.

Each function and multigraph has a 32 character explanatory label and a 15 character optional units label. However, when RPLOT requests that a single function or multigraph be identified, an abbreviation of up to nine characters must be used. The abbreviation is included in the table of contents. For example, to identify the function "ELECTRON DENSITY", one should use the abbreviation "NE". This will be shown in several examples below.

Example 2.1 (A)

```
RAX$
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS
```

```
*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
D
>ENTER "D " TO RESTORE RMS DEFAULT DISK AND DIRECTORY
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
RPLOT_PLDIRN:  ENTER *PLOT DATA DISK NAME* OR "D ": RUNDATA

TRANSP SUBDIRECTORIES E.G. "TRANSP.TFTR.86" MAY BE ABBREVIATED
E.G. TO ".TFTR.86"

[OLD VALUE:  ""]
RPLOT_PLDIRN:  ENTER *PLOT DATA DIRECTORY NAME* OR "D ": .TFTR.89

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RUNDATA:
CURRENT DIRECTORY:  [TRANSP.TFTR.89]

[OLD VALUE:  "D     "]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
 2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
```

```
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
1
```

[See Appendix Z for the output of this option - the generated table of contents of the scalar functions of time and the functions of time and an additional coordinate (X).]

```
$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
```

4

[See Appendix Z for the output of this option - the generated table of contents of the multigraph packages.]

```
$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
Q

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RUNDATA:
CURRENT DIRECTORY:  [TRANSP.TFTR.89]

[OLD VALUE:  "2100  "]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
0
FORTRAN STOP
RAX$
RAX$
```

2.1(B) Plotting scalar functions vs. time.

Specifying option "2" from RPLOT's top node causes RPLOT to read the binary scalar functions of time file (nnnnTF.PLN) and gives access to plotting these functions. A sample terminal session using option "2" is shown at the end of this subsection. By and large, the user options presented are self-explanatory, or at least understood after a little experimentation. In the sample session below a scalar multigraph in which several scalar functions are grouped on the same pair of axes is constructed and drawn. To group functions on a multigraph, their units must be consistent; in the example shown the units of all terms in the multigraph are "WATTS", the terms plotted are loss terms from the beam ion population in a TFTR beam injection experiment. By referring to the table-of-contents (prior subsection), the abbreviations "BPTH", "BPLIM", and "BPWA" will be seen to refer to beam power losses through thermalization, "to the limiter" (i.e. bad orbits), and "to the wall" (i.e. shine-through). The (up to) 9 letter abbreviations are used throughout RPLOT both to identify functions and to label functions in multigraphs. The multigraph plotting routine uses various line-styles and symbols to distinguish separate curves; the symbols are for identification purposes only. The data is typically output once every 5 or 10 milliseconds. Scalars and profile functions of time and an additional coordinate come in the "pre-packaged" multigraphs listed in the previous subsection. Profile-function multigraphing is described in Subsection 2.1(D) below.

Alternative options when plotting scalar functions of time are:

(1) generating a table-of-contents just of the scalar functions;
(2) plotting individual scalar functions;
(3) changing scaling defaults (the initial default is to set the scale to show the whole graph);
(4) defining and plotting a temporary multigraph package (as shown below);
(5) exit (return to top node);
(6) defining and plotting a temporary multigraph package but with a log(y) axis;
(7) plotting permanent scalar multigraph packages;
(8) plotting permanent scalar multigraph packages with a log(y) axis;

(9) plotting one scalar versus another;
(10) modifying a scalar function label or physical units; and
(11) reading and storing in memory a scalar function from a second run.

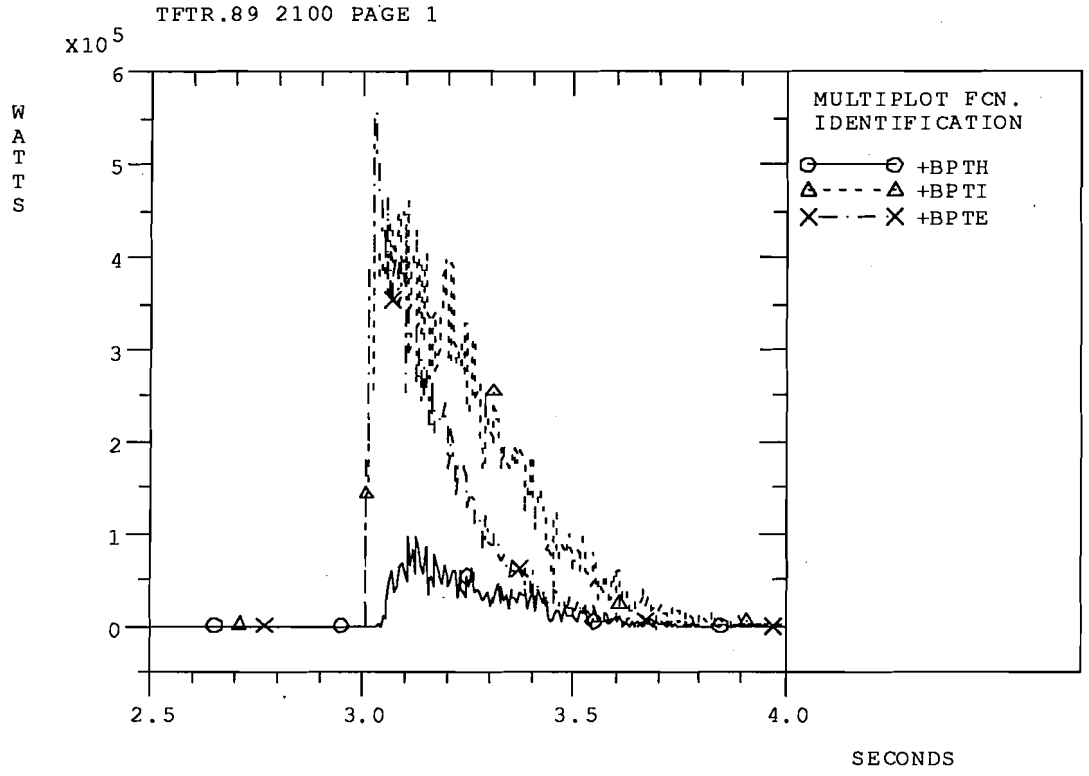
Note that after drawing any graph, there is a set of options with which to manage the data, such as smoothing, differentiating, and changing the axis or the scale. The rules for changing the scale and changing the scaling defaults of 2-D graphs are described below in Subsection 2.1(G). The smoothing algorithm is described in Subsection 2.1(J).

EXAMPLE 2.1 (B)

```
RAX$
RAX$
RAX$ SET  DEFAULT    RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
```

```
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
2

 OPTIONS:
(1)  DISPLAY SCALAR FUNCTION NAMES
(2)  SELECT AND DRAW GRAPH OF FUNCTION
(3)  CHANGE SCALING DEFAULTS
(4)  DEFINE AND PLOT TEMPORARY SCALAR MULTIGRAPH PACKAGE
(5)  QUIT
(6)  SAME AS (4) WITH LOG(Y) AXIS
(7)  PLOT PERMANENT SCALAR MULTIGRAPH PACKAGES
(8)  PLOT PERMANENT SCALAR MULTIGRAPH PACKAGES LOG(Y) AXIS
(9)  PLOT ONE SCALAR VS. ANOTHER
(10) *NEW* MODIFY SCALAR FCN LABEL OR PHYSICAL UNITS
(11) *NEW* READ & STORE A SCALAR FUNCTION FROM A 2ND RUNID

 SUB:TPLT2D >> ENTER OPTION NUMBER:
4
ENTER LIST OF FUNCTION ID.S, ONE PER LINE,
TERMINATED BY A "0";
PUT IN A MINUS ("-") SIGN FOR FUNCTION'S ADDITIVE INVERSE
SUB:TPLT2D >> ENTER FUNCTION I.D.S FOR MULTIPLOT
BPTE
BPTH
BPTI
0
OLD LABEL:
% UREAD TYPEAHEAD TURNED OFF FOR LABEL INPUT
```

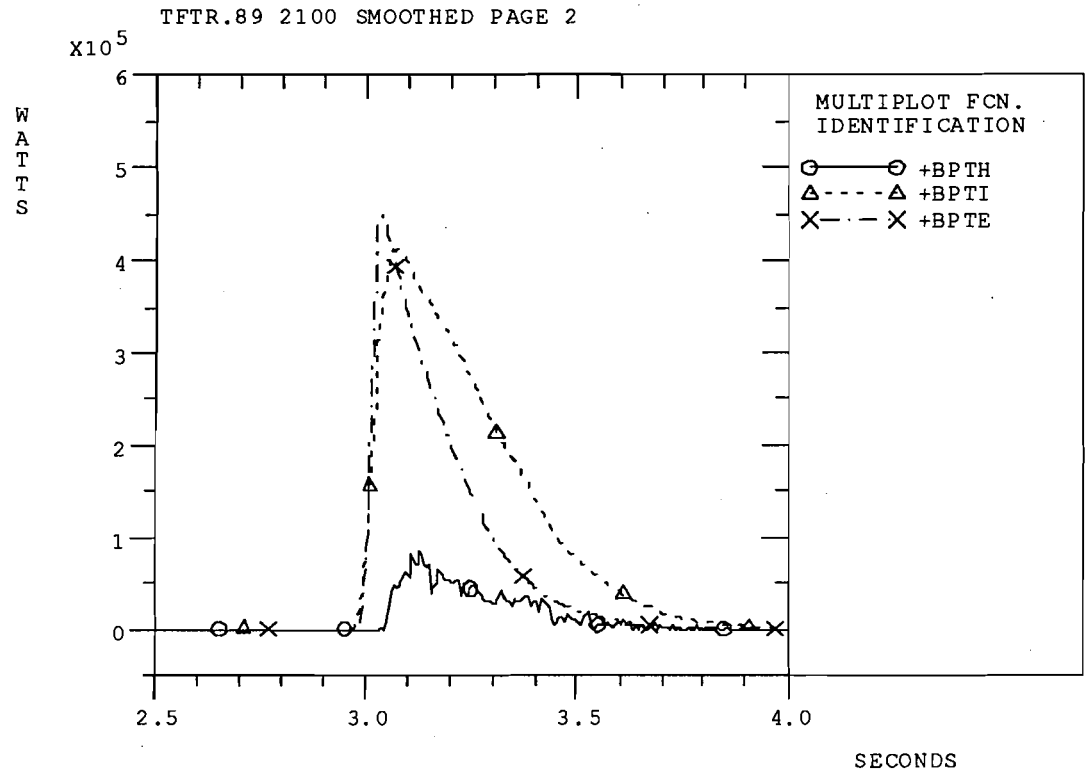
```
> ENTER NEW FUNCTION/PACKAGE LABEL
  SUB:GETNAM(1)    > ENTER "0" NOT TO CHANGE
BEAM POWER OUTPUT
%UREAD TYPEAHEAD RESTORED
```



BEAM POWER OUTPUT (USER.) VS TIME

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):    C

*AXIS TYPE CONTROL OPTIONS*
 "A" CHANGE AXIS TYPES (LOG/LINEAR) AND PLOT AGAIN
 "B" CHANGE AXIS DEFAULTS USED ON ENTRY TO PLOT ROUTINE

*PLOT RESCALE OPTIONS*
     --> ALSO TRY HITTING "S" ON UPAUSE BEEP
 "R" RESTORE SCALE FROM A PREVIOUSLY DRAWN PLOT
 "S" CHANGE SCALE OF PLOT (X AND Y) AND PLOT AGAIN
 "X" CHANGE X SCALE, AUTO-RESET Y SCALE, AND PLOT AGAIN
 "Z" ZOOM IN/OUT IN X, AUTO-RESET Y, AND PLOT AGAIN
```

```
 "T" CHANGE *DEFAULT SCALING* USED ON ENTRY TO PLOT ROUTINE
 "G" MODIFY MISC. PLOT DEFAULTS: GRID/FRAME/TIC/LINE STYLE

 "M" TO SMOOTH THE PLOT DATA
 "L" TO RESTORE UNPROCESSED PLOT DATA
 *NEW*  "D" TO DIFFERENTIATE THE PLOT DATA

 *ENTER "1" FOR SINGLE PT DISPLAY MODE
 *ENTER "I" FOR TIME INTEGRAL DISPLAY
 *ENTER "J" FOR TIME AVERAGE DISPLAY

 "P" JUST PLOT AGAIN (USING NEW DEFAULTS)
 "Q" OR "N" TO QUIT PLOTTING (ALTERNATE RETURN CONTROL)
GRAOPT:  ENTER ONE LETTER OPCODE (.../P/Q): M
 ENTER SMOOTHING DELTA D.  THE SMOOTHED FUNCTION
 AT X WILL BE A WEIGHTED AVERAGE OF THE UNSMOOTHED
 DATA FUNCTION FROM X-D TO X+D.  D SHOULD BE IN THE
 PHYSICAL UNITS OF THE X-AXIS OF THE GRAPH
 ** ENTER DELTA.LT.0 FOR DOUBLE INVERSE SMOOTHING:

 SUB:MULGRG >> ENTER SMOOTHING DELTA: (E10.3)
.1
 ENTER MAXIMUM ALLOWABLE CHANGE,IN PERCENT,
 OF THE SMOOTHED FUNCTION COMPARED TO THE UNSMOOTHED
 FUNCTION.  (E.G. 25% --> SMOOTHED FUNCTION MAY NOT
 DIFFER FROM UNSMOOTHED FUNCTION BY MORE THAN 25%);
 HOWEVER, IF THE FUNCTION CHANGES SIGN, THIS
 CONDITION APPLIES ONLY TO THE REGIONS OF THE
 FUNCTION'S MAXIMUM MODULUS.

 SUB:MULGRG >> ENTER SMOOTHING EPSLON (%):
25
```



BEAM POWER OUTPUT (USER.) VS TIME

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):    Q

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
```

```
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
Q

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  "2100  "]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
Q
FORTRAN STOP
RAX$
RAX$
```

2.1(C) Plotting functions of time and additional coordinate.

By specifying option "3" from RPLOT's top node one may access individual profile functions of time and an additional coordinate. This additional coordinate is usually "RADIUS" (i.e. the minor radius of a plasma flux surface), but some functions are defined vs. angle in radians in the plasma poloidal plane, and a few functions such as charge exchange eflux spectra are defined as functions of particle energy. In some cases it is advantageous to modify the additional coordinate definition, e.g. replace "RADIUS" with enclosed toroidal or poloidal magnetic flux. As will be seen, this can be done (see subsection 2.1(M)).

As in the case of scalar functions, profile functions are identified by a 9 character abbreviation. As will be seen in the sample terminal session at the end of this subsection, however, the layout for accessing plots of profile functions is different from the layout for plotting scalar functions. This is primarily due to the fact that each profile function consists of a lot more data than each scalar function, and therefore, while it is possible to read the run's entire set of scalar functions into memory, only a few profile functions may be held in RPLOT's memory at any one time.

After specifying option "3" from the top node, a variety of options is offered at the next node down. Most of these specify a mode of reading in the function to be plotted, namely, either read the function as is or perform a radial integration or average as the function is read in. The radial averaging/integration options will be explained in Subsection 2.1(H) below; however by specifying option "7", a "help" message on these options will be generated. Alternative options are: option 1, generate a list of available profile functions; option 6, change scaling defaults on 2-D graphs (see Subsection 2.1(G) below); and option 8, return to top node.

After specifying the mode of reading in a profile function, the function ID is requested. The function is read out of the random access file "nnnnMF.PLN" and various options are offered for plotting the function. These options include 2-D graphs versus one or the other of the

independent coordinates with any combination of linear or logarithmic axes, a contour plotting option, a 3-D isometric plotting option, and an option for smoothing or time-averaging the data (information on smoothing and time-averaging are given in Subsection 2.1(J) below). If one specifies a 2-D plot vs. one of the two independent variables of the profile function, the user will be prompted for a fixed value for the other independent variable. An example of the use of the 2-D plotting options is shown at the end of Subsection 2.1(G). In the sample terminal session at the end of this subsection a standard contour plot is generated (see page 5 of Example 2.1 C). This features linear axes and linear spacing of the contour values. It is also possible to generate contour plots with log(x) and/or log(y) axes and/or log spacing of contours; moreover, any rectangular subdomain within the domain covered by the two independent coordinates may be specified. This is done by requesting a non-default contour plot, or by specifying a default plot after the defaults have been redefined, or by redefining the controls after an initial contour plot has been drawn.

When one is finished drawing graphs of a particular function, option 4) exits the plotting subroutine to allow the selection of a new function.

This example contains five graphs:

Page 1 shows the 3-D depiction of ion temperature (TI) vs radius & time;
Page 2 shows TI vs radius at 3.51 seconds;
Page 3 shows TI vs time in zone 3;
Page 4 shows TI vs radius at several times (slice multiplotting).
Page 5 shows a contour plot of TI vs RZON and time.

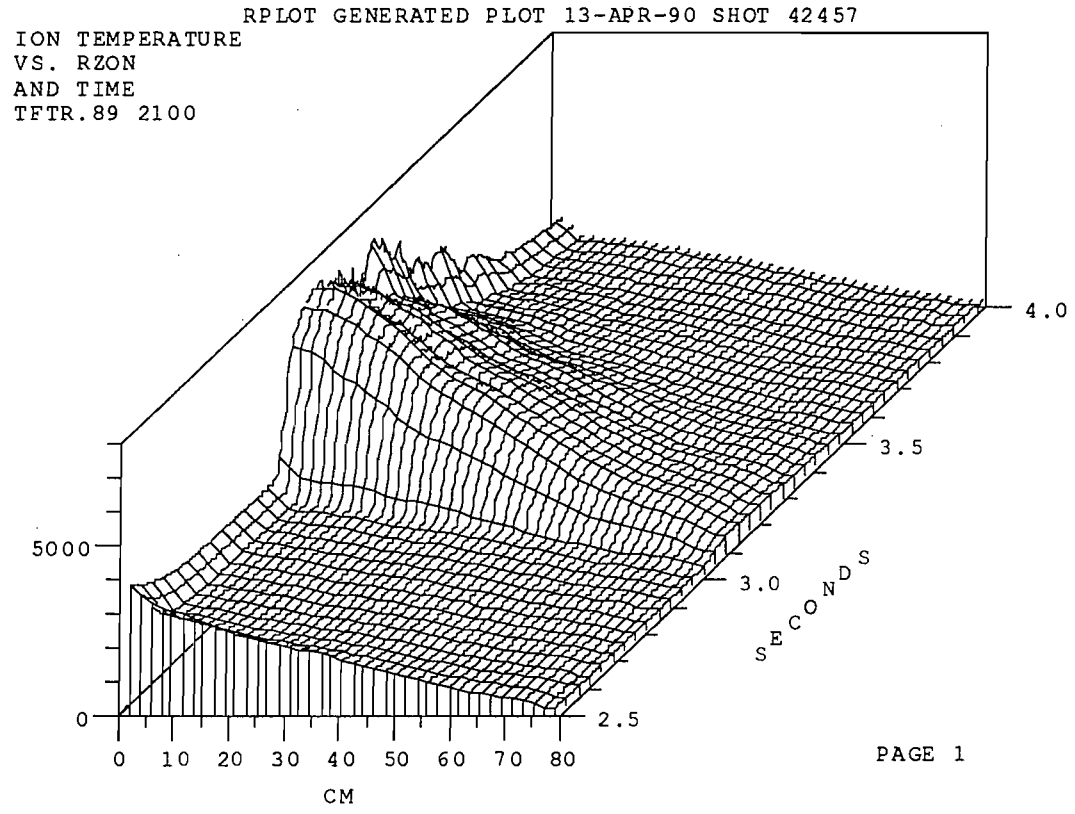
Example 2.1 (C)

```
EPX$
EPX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS
```

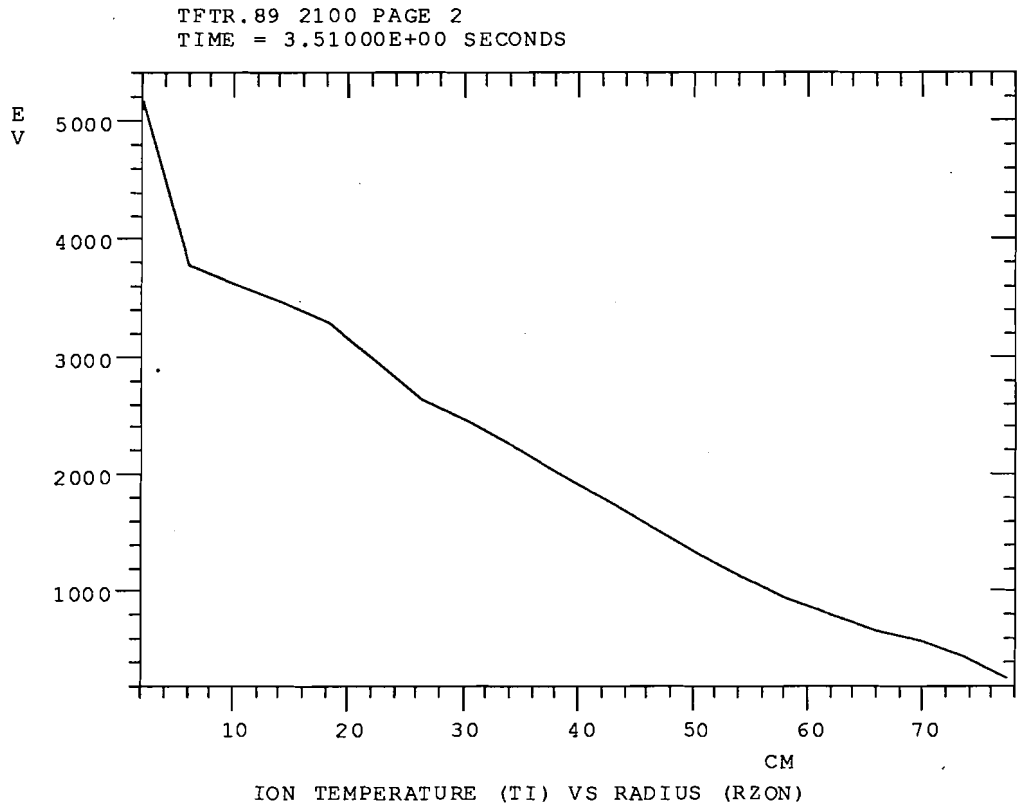
```
*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
D
>ENTER "D " TO RESTORE RMS DEFAULT DISK AND DIRECTORY
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
RPLOT_PLDIRN:  ENTER *PLOT DATA DISK NAME* OR "D ":RUNDATA

TRANSP SUBDIRECTORIES E.G. "TRANSP.TFTR.86" MAY BE ABBREVIATED
E.G. TO ".TFTR.86"

[OLD VALUE:  ""]
RPLOT_PLDIRN:  ENTER *PLOT DATA DIRECTORY NAME* OR "D ": .TFTR.89

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RUNDATA:
CURRENT DIRECTORY:  [TRANSP.TFTR.89]

[OLD VALUE:  "D     "]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
```

```
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
3
 SELECT/PLOT F(X,T) ... OPTIONS:
(0) *NEW* DRAW GRAPHS OF DERIVATIVE OF FCN
(1) DISPLAY PROFILE FUNCTION NAMES
(2) DRAW GRAPHS OF FUNCTION
(3) DRAW GRAPHS OF ROLLING VOLUME INTEGRAL OF FCN
(4) DRAW GRAPHS OF ROLLING FLUX INTEGRAL OF FCN
(5) DRAW GRAPHS OF ROLLING AREA INTEGRAL OF FCN
(6) CHANGE SCALING DEFAULTS ON 2D GRAPHS
(7) TYPE BRIEF EXPLANATION OF OPTIONS 3--5, 9--13
(8) OR "Q" = QUIT
(9) DRAW GRAPH OF ROLLING LINE AVERAGE OF FCN
(10) DRAW GRAPH OF ROLLING VOLUME AVERAGE OF FCN
(11) DRAW GRAPH OF ROLLING R.M.S. VOLUME AVERAGE OF FCN
(12) DRAW GRAPH OF DBL INVERSE LINE AVG. OF FCN
(13) DRAW GRAPH OF DBL INVERSE VOL. AVG. OF FCN
===> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER
     LIMIT X0 OF INTEGRATION OR AVERAGE (DEFAULT X0=0.0)
ENTER "M" TO MAP AND PLOT FUNCTION VS. MAJOR RADIUS
ENTER "U" TO CREATE USER DEFINED PROFILE FUNCTIONS
ENTER "X" TO MODIFY DEFINITION OF X AXES FOR PLOTTING
ENTER "R" FOR NORMALIZED PROFILE OPTIONS (E.G. H(R))

 SUB:3DMAIN >> ENTER OPTION NUMBER
2
 SUB:3DMAIN >> ENTER PROFILE FUNCTION ID:
TI
```

```
  FUNCTION:  ION TEMPERATURE
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 21-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
1
SET AXIS TYPES FOR 3D ISOMETRIC PLOT (ONLY):
 X AXIS - INDEP VAR. "RZON" LOG = F (T/F)
 Y AXIS - INDEP VAR. "TIME" LOG = F
 Z AXIS - FUNCTION "ION TEMPERATURE" LOG = F
OPTIONS:
 C - CHANGE MISCELLANEOUS PLOT CONTROLS
 M - MODIFY (X,Y,Z) DOMAIN TO BE PLOTTED OVER
 S - SET SKIP COUNT ON DRAWING LINES OF CONST. X, Y
 X - CHANGE X AXIS TYPE (TOGGLE LOG/LINEAR)
 Y - CHANGE Y AXIS TYPE
 Z - CHANGE Z AXIS TYPE
 D - ESTABLISH CURRENT AXIS TYPES AS PERMANENT DEFAULT
 P - PROCEED TO MAKE PLOT
 N or Q - QUIT (RETURN TO GRAPHICS OPTIONS NODE)
 R - QUIT (EXIT GRAPHICS SUBROUTINE)

GRF3SG:  SELECT 3D ISOMETRIC AXIS OPTION (X/Y/Z/D/P):
P
```

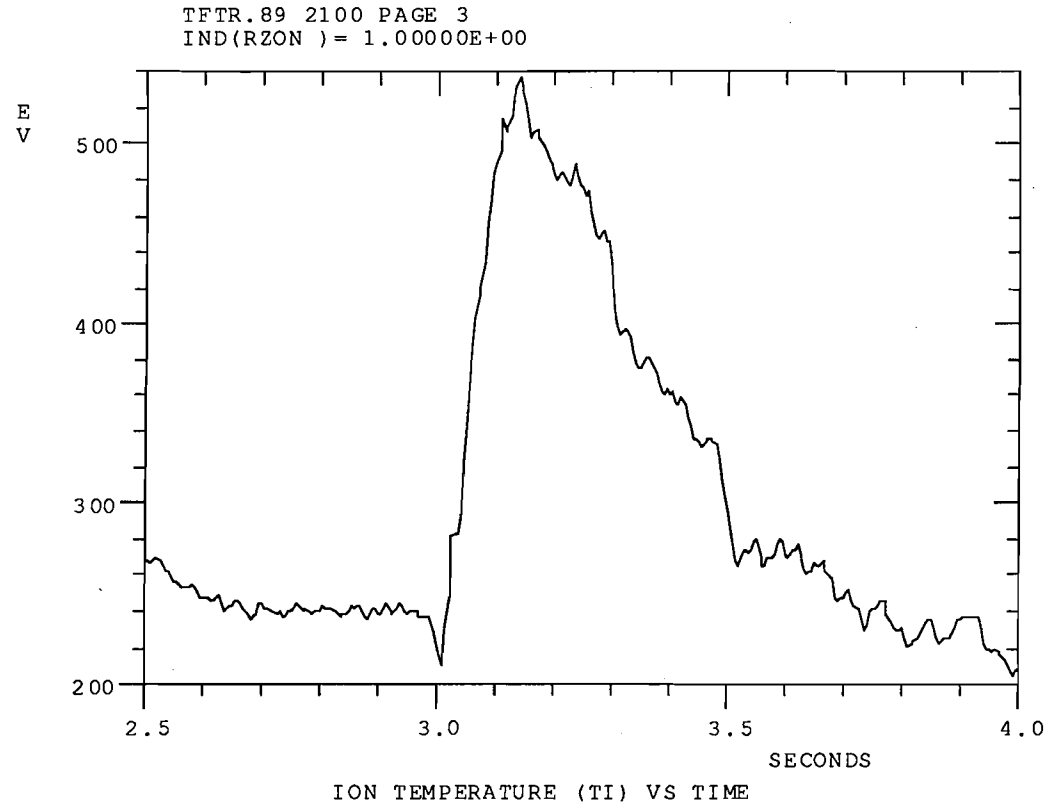

RPLOT GENERATED PLOT 13-APR-90 SHOT 42457
ION TEMPERATURE
VS. RZON
AND TIME
TFTR.89 2100
5000
0
0 10 20 30 40 50 60 70 80
CM
2.5
3.0
3.5
4.0
SECONDS
PAGE 1

```
SET AXIS TYPES FOR 3D ISOMETRIC PLOT (ONLY):
 X AXIS - INDEP VAR. "RZON" LOG = F (T/F)
 Y AXIS - INDEP VAR. "TIME" LOG = F
 Z AXIS - FUNCTION "ION TEMPERATURE" LOG = F
OPTIONS:
 C - CHANGE MISCELLANEOUS PLOT CONTROLS
 M - MODIFY (X,Y,Z) DOMAIN TO BE PLOTTED OVER
 S - SET SKIP COUNT ON DRAWING LINES OF CONST. X, Y
 X - CHANGE X AXIS TYPE (TOGGLE LOG/LINEAR)
 Y - CHANGE Y AXIS TYPE
 Z - CHANGE Z AXIS TYPE
 D - ESTABLISH CURRENT AXIS TYPES AS PERMANENT DEFAULT
 P - PROCEED TO MAKE PLOT
 N or Q - QUIT (RETURN TO GRAPHICS OPTIONS NODE)
 R - QUIT (EXIT GRAPHICS SUBROUTINE)

GRF3SG:  SELECT 3D ISOMETRIC AXIS OPTION (X/Y/Z/D/P):
N

  FUNCTION:  ION TEMPERATURE
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 21-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
2
 SUB:GRAF3D >>  ENTER FIXED TIME, SECONDS:
3.51
```




```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):    N

  FUNCTION:  ION TEMPERATURE
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 21-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
```

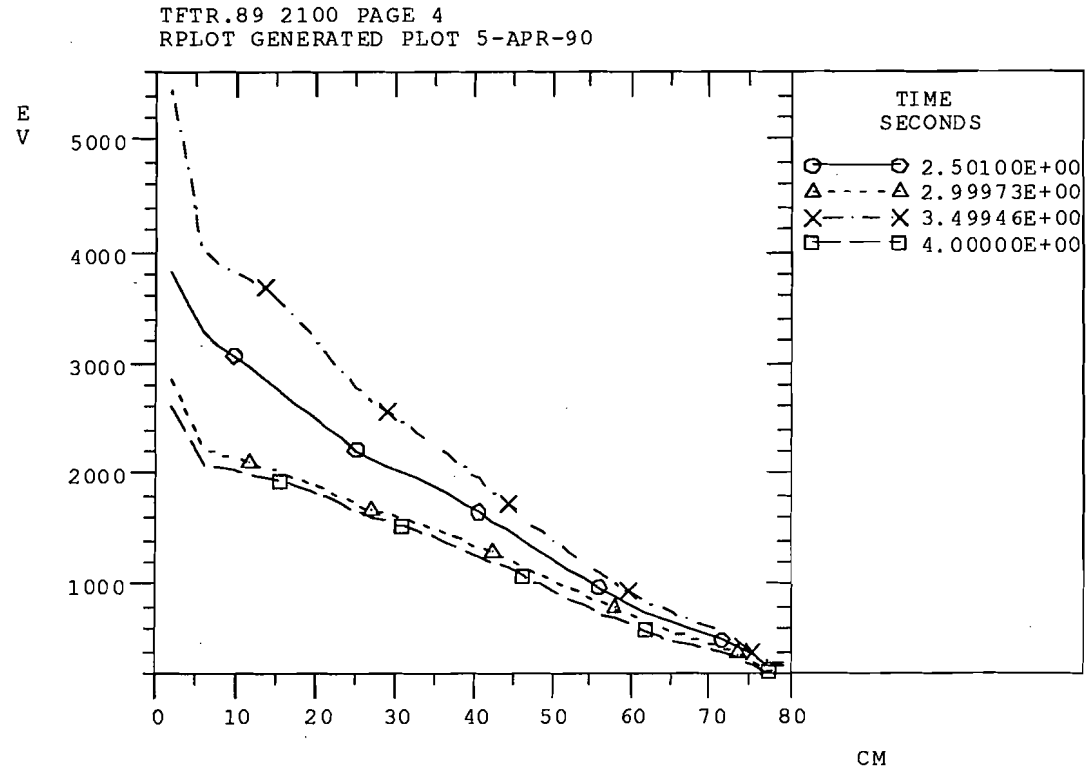
```
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
3
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:GRAF3D >>  ENTER FIXED RADIUS, CM:
I1.
```




```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): N

  FUNCTION:  ION TEMPERATURE
 SOURCE ID:  TFTR.89     2100
    TITLE:  RPLOT GENERATED PLOT  5-APR-90
```

```
**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
8

 DIMENSION #1: RADIUS
 DIMENSION #2: TIME

PLMSEL:  CHOOSE DIMENSION FOR X AXIS (1 OR 2):
1

 302 SLICES OF TIME                              AVAILABLE FROM
 2.5010E+00 TO  4.0000E+00 SECONDS          NO INTERPOLATIONS.

OPTIONS--
 A:  SPECIFY ALL SLICES
 B:  SPECIFY STARTING SLICE, SPACING INTERVAL AND NUMBER
 C:  SPECIFY STARTING SLICE INDEX, NUMBER AND INCREMENT
 X:  SWITCH X AXIS
 Q:  QUIT

PLMSEL:  ENTER SLICE OPCODE (A/B/C/X/Q):
A
SPECIFY TIME                              VALUES IN SECONDS
ENTER LIST OF VALUES, TERMINATE WITH AN "X"
NEAREST AVAILABLE SLICE WILL BE TAKEN

2.5
3.0
```

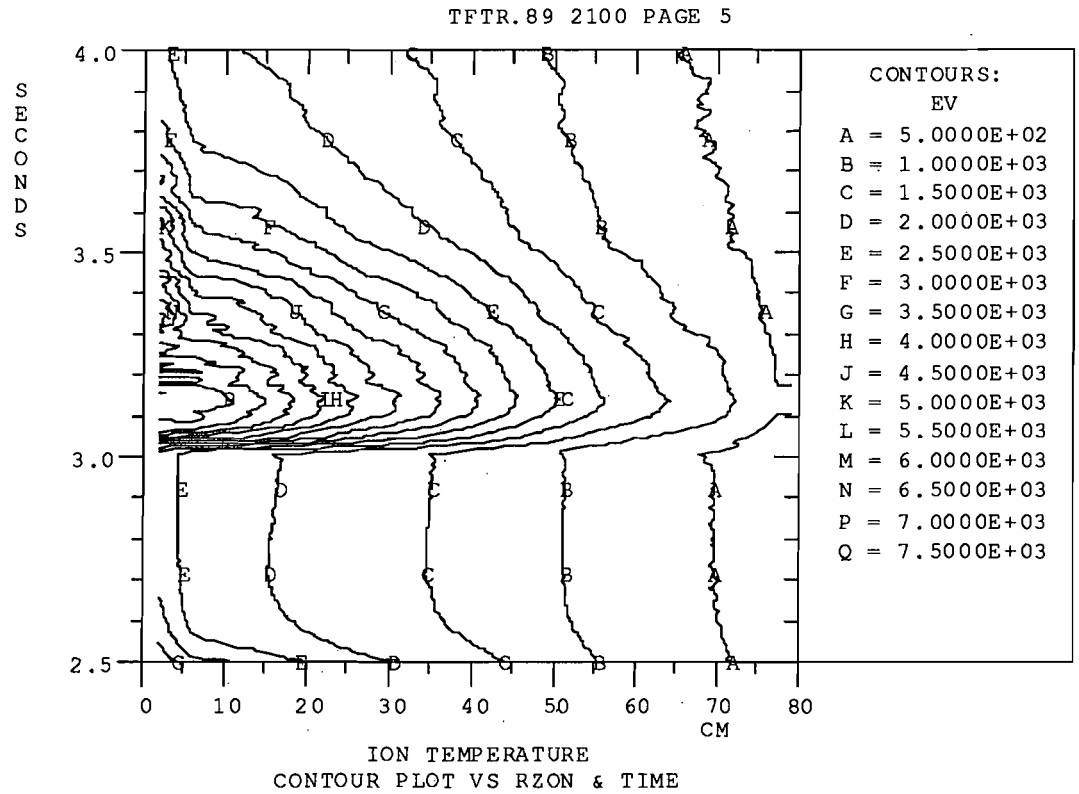
3.5
4.0
X



ION TEMPERATURE (TI) VS. RADIUS

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): Q

  FUNCTION:  ION TEMPERATURE
 SOURCE ID:  TFTR.89     2100
     TITLE:  RPLOT GENERATED PLOT  5-APR-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
```

```
   (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
   (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
   (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
5
*CONTOUR PLOTS CONTROLLER* OPTIONS:
 (1) MAKE DEFAULT PLOT
 (2) CHANGE DEFAULTS
 (3) MAKE NON-DEFAULT GRAPH
 (4) EXIT

 SUB:CONCTR >> ENTER OPTION #:
1
```



ION TEMPERATURE
CONTOUR PLOT VS RZON & TIME

```
*CONTOUR PLOTS CONTROLLER* OPTIONS:
 (1) MAKE DEFAULT PLOT
 (2) CHANGE DEFAULTS
 (3) MAKE NON-DEFAULT GRAPH
```

```
 (4) EXIT

 SUB:CONCTR >> ENTER OPTION #:
4

  FUNCTION:  ION TEMPERATURE
 SOURCE ID:  TFTR.89     2100
     TITLE:  RPLOT GENERATED PLOT  5-APR-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
Q Q Q Q
FORTRAN STOP
RAX$
RAX$
```

2.1(D) Drawing multigraphs of functions of time and an additional coordinate.

Multigraphs are associations of functions having the same units and the same independent geometric coordinate. Multigraph groupings allow several functions to be drawn on a single pair of axes. An example of a multigraph for scalar functions of time was presented above.

Multigraph groupings of scalars and functions of time and an additional coordinate are pre-defined for each run and stored in the run's graphics output files. However, as will be described in Subsection 2.1(E) below, the definitions may be amended and new multigraph associations may be defined.

Top node option "6" gives access to plotting multigraphs by prompting for the desired package ID. An example of how to fetch up a multigraph is shown at the end of this subsection. Like individual functions, multigraph groups are identified by a 9-character abbreviation. A listing of multigraphs and abbreviations, names and contents may be generated as described in Subsection 2.1(A) above

By entering the command "SCALE" in response to this prompt one may redefine the scaling defaults for the 2-D multiplots; - see Subsection 2.1(G) below. By entering the command "AVG" to this prompt, the time-averaging feature may be turned on. This feature is described in Subsection 2.1(J).

Usually, however, one will respond to the prompt

"SUB: MULDRW >> ENTER PACKAGE ID:"

by entering a multigraph package ID. If the specified multigraph package contains functions of radius, the next prompt will request the mode of reading in the functions from the random access file nnnnMF.PLN: namely whether to read the functions themselves or to perform a radial average

or integration while reading the functions. The radial averaging and integration options will be described in Subsection 2.1(H) below, but a "help" package will be printed if one enters "H" in response to the prompt,

"SUB: MULDRW >> ENTER INTEGRATION CODE".

After the mode of reading the multigraph functions has been specified, RPLOT requests selection of the independent variable against which to plot the functions. This is either "TIME" or the independent geometric coordinate. Whichever coordinate is chosen for the x-axis, a fixed value for the complementary coordinate will be requested. Then, the data will be retrieved from the random access data file, and the graph drawn.

After the graph is drawn, there are again many options such as smoothing, differentiating, changing scale or axis or exiting and selecting another multigraph.

The sample terminal session which follows shows the generation of a volume-integrated multiplot of the ion power balance volume-integrated from 0 to 20 cm for run TFTR.89 2100 and plotted vs. time. Additional examples of usage of RPLOT's multiplotting capabilities are shown in the sample terminal sessions at the ends of Subsections 2.1(E) and 2.1(H) below.

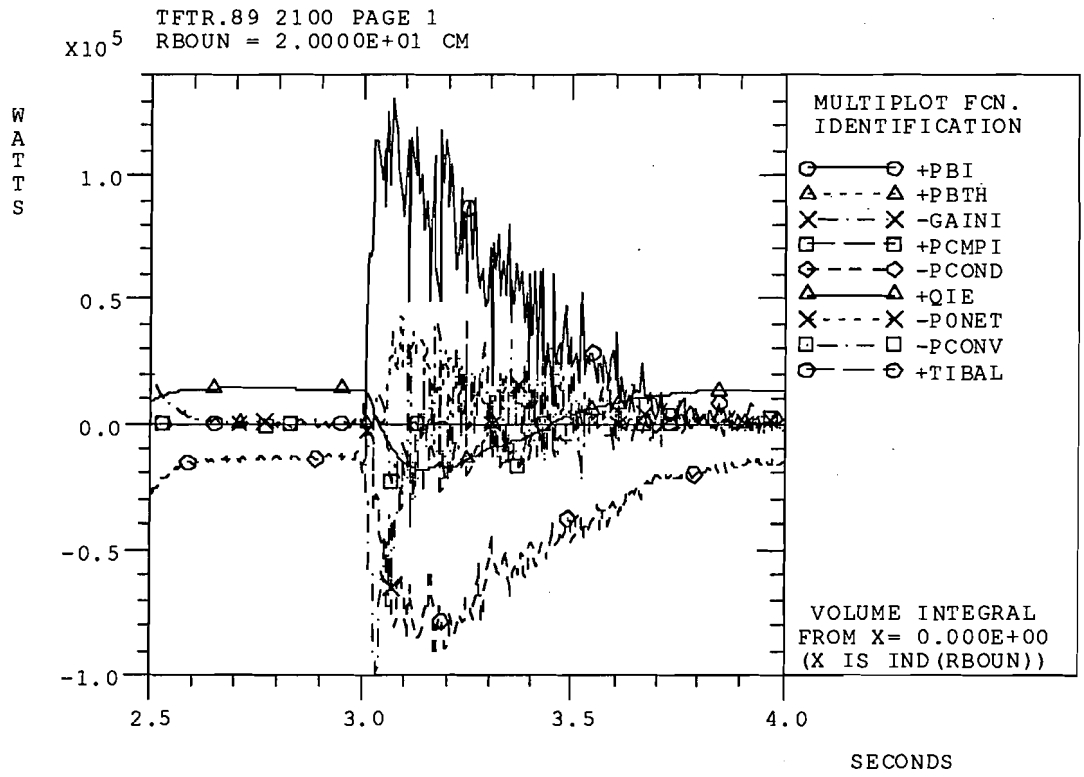
Example 2.1 (D)

```
RAX$
RAX$
RAX$ SET  DEFAULT    RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS
```

```
*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
6

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]
```

```
 SUB:MULDRW >> ENTER PACKAGE ID:
IEBAL


  GROUP NAME:  ION POWER BALANCE                 WATTS/CM3
         VS:  RADIUS                             CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
2


  GROUP NAME:  ION POWER BALANCE                 WATTS/CM3
         VS:  RADIUS                             CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
```

```
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
2
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:  MULDRW  >> ENTER FIXED X VALUE AT WHICH TO PLOT (E10.)
20
```



ION POWER BALANCE (IEBAL) VS TIME

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):   Q Q Q
FORTRAN STOP
RAX$
RAX$
```

2.1(E) Changing function names, abbreviations, and the contents of multigraph packages.

By specifying top-node option 10, the name and abbreviation for any function in a run's graphics files may be changed. Any such change is temporary and is remembered only until a new run is selected or RPLOT is terminated.

Via top node option "5" the contents of multigraph packages may be amended. Also, new packages may be created. These changes are "remembered" for the duration of the current RPLOT session only. Thus by amending the package "ECON", "ENERGY CONFINEMENT", by deleting the functions "TEEST", "TEIST", and "TAUES", a preliminary step is made which enables the creation of the multigraph shown at the end of this subsection. (The multigraph packages list shown using option 6 of the submenu reveals that the original "ECON" contained 6 functions, 2 definitions of energy confinement time each for electrons, ions, and total. The general definition of confinement is content divided by rate of loss. The confinement times plotted are defined including all energy loss processes; the deleted functions are "net transport" confinement times which include conductive and convective, but not radiative or charge-exchange loss processes in their definition.) Functions may be added or deleted to any multigraph, and many multigraph packages may be defined at any one time, but all functions within a multigraph package must have the same physical units. Thus a temperature and a density may not be entered in the same multigraph group; dual axis labeling is not supported.

NOTE: The use of typeahead in inputting data at the terminal is demonstrated in this example. This is useful when dealing with series of repetitive entries that change slightly and the upcoming prompts are known. Thus in the example, " 4 ECON TEIST Y" is treated as four separate inputs: "4", "ECON", "TEIST", and "Y" which are stacked until needed as input.

In the sample terminal session at the end of this subsection, an example of the usage of "AVG" time-averaging is also shown. This feature is described in Subsection 2.1(J) below.

An example of the creation of an entirely new multigraph package is shown at the end of Subsection 2.1(H) below.

Example 2.1 (E)

```
RAX$
RAX$
RAX$ SET  DEFAULT    RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
```

```
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
5
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
6
 SUB:MULDEF >> ENTER ID OF PACKAGE TO LIST:
ECON


 PROFILE PACKAGE "ECON      ", "ENERGY CONFINEMENT                ", CONTAINS:

     1.  +TEE          "ELECTRON ENERGY CONFINEMENT     " SECONDS
     2.  +TEEST        "ELECTRON ENERGY CONFINEMENT (*) " SECONDS
     3.  +TEI          "ION ENERGY CONFINEMENT          " SECONDS
     4.  +TEIST        "ION ENERGY CONFINEMENT (*)      " SECONDS
     5.  +TAUES        "PLASMA ENERGY CONFINEMENT (*)   " SECONDS
     6.  +TAUE         "PLASMA ENERGY CONFINEMENT       " SECONDS

FUNCTIONS VS. TIME AND RADIUS

[USER ACKNOWLEDGE - HIT ANY KEY]
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
```

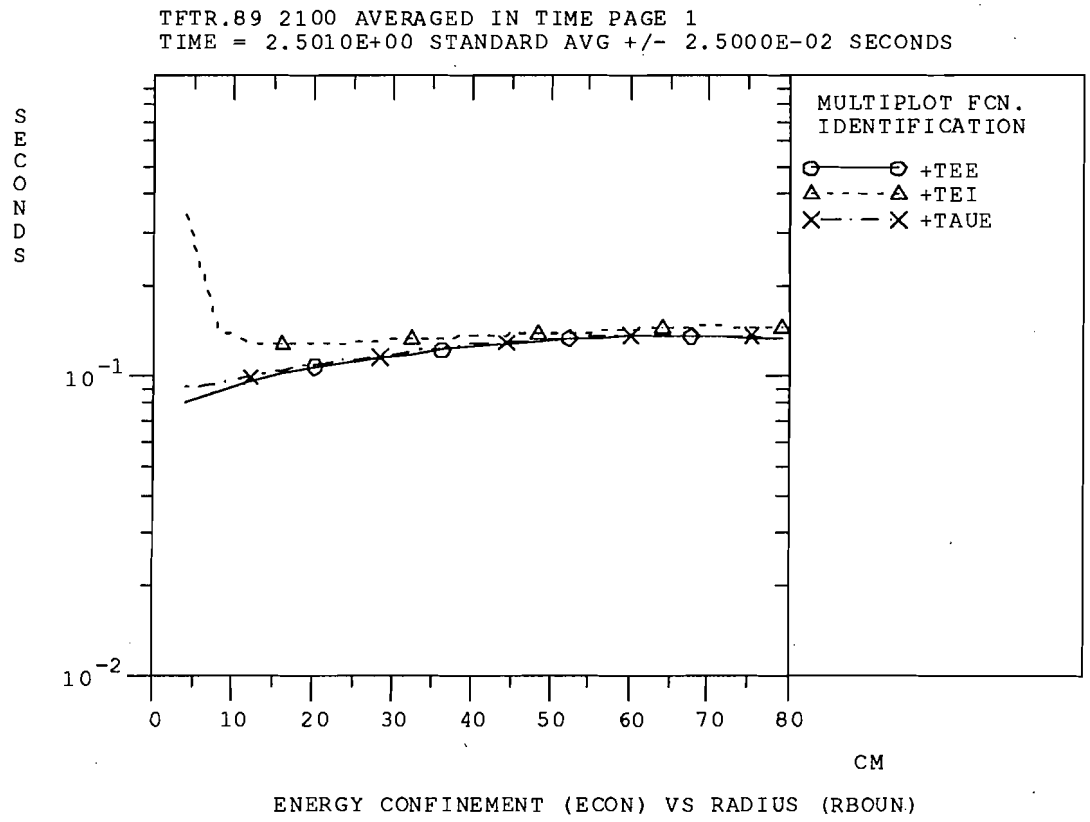
```
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
4
 SUB:MULDEF >> ENTER ID OF PACKAGE TO MODIFY:
ECON
   PACKAGE TYPE: PROFILE
>> ENTER FUNCTION ID.  IF THE FUNCTION IS
   ALREADY IN THE PACKAGE, IT WILL BE REMOVED;
   IF THE FUNCTION IS NOT IN THE PACKAGE IT WILL
   BE ADDED TO THE PACKAGE; HOWEVER, THE NEW FUNCTION'S
   PHYSICAL UNITS MUST AGREE WITH PRIOR
   CONTENTS OF THE PACKAGE

 SUB:MULDEF >> ENTER FUNCTION ID TO ADD/DELETE:
TAUES
MULDEF:  ENTER "Y" TO CONFIRM DELETION OF FUNCTION FROM PCKG: Y
FUNCTION # 275, "TAUES      " DELETED FROM PACKAGE
[USER ACKNOWLEDGE - HIT ANY KEY]
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
4    ECON    TEIST    Y
FUNCTION # 226, "TEIST      " DELETED FROM PACKAGE
[USER ACKNOWLEDGE - HIT ANY KEY]
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
```

```
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
4     ECON     TEEST     Y
FUNCTION # 152, "TEEST      " DELETED FROM PACKAGE
[USER ACKNOWLEDGE - HIT ANY KEY]
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
5

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA
```

```
 SUB:MAIN   ENTER OPTION NUMBER:
6

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]

 SUB:MULDRW >> ENTER PACKAGE ID:
AVG


TIME AVERAGING OF MULTIPLOTS IS "OFF"
TIME DELTA =  0.000E+00 SECONDS
   STANDARD TIME AVG = 1/N * [INTEGRAL] F * DT
   DBL INVERTED TIME AVG = N / [INTEGRAL] (1/F) * DT
WHERE [INTEGRAL] IS THE DEFINITE TIME INTEGRAL FROM
T-(TIME DELTA) TO T+(TIME DELTA), T THE TIME OF THE PLOT,
AND N IS THE NORMALIZING TIME PERIOD 2 * (TIME DELTA)

>>> ENTER "1" FOR STANDARD TIME AVERAGING
    ENTER "-1" FOR DOUBLE-INVERSE TIME AVERAGING
    ANY OTHER NUMBER FOR NO TIME AVERAGING,
 SUB: MULDRW >> ENTER CODE FOR TIME AVERAGING:
1
 SUB: MULDRW >> ENTER TIME DELTA FOR AVERAGING (E10.0):
.025

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
```

```
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]

 SUB:MULDRW >> ENTER PACKAGE ID:
ECON


  GROUP NAME:  ENERGY CONFINEMENT                SECONDS
          VS:  RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
1


  GROUP NAME:  ENERGY CONFINEMENT                SECONDS
          VS:  RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
```

```
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
3
 SUB: MULDRW >> ENTER FIXED TIME AT WHICH TO PLOT (E10.3):
.57
```




```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):   Q Q Q
FORTRAN STOP
RAX$
RAX$
```

2.1(F) Making remarks about a TRANSP run in its nnnnTR.INF file.

As described in Section 1 above, each run has a nnnnTR.INF file for comments, notes and warnings pertaining to that run. Run number 1234's TR.INF file is 1234TR.INF. The TR.INF file for a TRANSP run can be accessed by invoking RPLOT's top node option 7. Then, one may either read all comments made by prior users regarding the current TRANSP run, or enter one's own remarks. The user can describe perhaps what has been learned by looking at graphs of data from the run, or make comments on the physical validity of the calculation, or make comments on the data measurements that pertain to this run, or even suggest what methods might be used to check assumptions.

It is strongly recommended that users of RPLOT make use of this feature. It provides a vehicle of communication between TRANSP users and a log of observations which may in the end assist in understanding the results of an experiment which has been put through the TRANSP analysis.

If one makes a remark on a run, that person will be requested to give his/her name. Remarks should pertain to the particular run one was just examining.

2.1(G) Controlling the scale of 2-D graphs.

Most of the graphs drawn by RPLOT are 2-D graphs consisting of an independent coordinate along the graph's x-axis, and a dependent coordinate along the graph's y-axis. When such a graph is requested, its initial scale is determined by the current scaling defaults. However, the scale of any graph can be changed immediately after doing a plot by choosing option "S" from the Options After a Plot menu. If one chooses to change the scale of a graph, new "XMIN" and "XMAX" for the x-axis will be requested and "YMIN" and "YMAX" for the y-axis can be specified or be automatically rescaled. The scale of an actual graph drawn by the plotting subroutines will be big enough to include the specified minimum and maximum values plus an added margin which allows the limits of the graph to be "rounded" numbers. A little experimentation will reveal the properties of the scaling routines. An example is shown in the terminal session at the end of this subsection. Also shown is an example of the usage of the smoothing algorithm (described in Subsection 2.1(J) below) which can be accessed after the scaling option.

At the "Options After Plot" node, RPLOT also offers the opportunity to revise the scaling defaults. The initial default is to choose a scale just big enough to include all of the data in a plot. Changes to the scaling can be done by choosing the following options:

"R" Restore scale from a previously drawn plot.
"S" Change scale of plot (X & Y) and plot again.
"X" Change the X scale, auto-reset Y, and plot again.
"Z" Zoom in/out in X, auto-reset Y, and plot again.
"T" Change the default scaling used on entry to the plot routine.

Of course, modified scaling defaults will produce "nice" graphs only for a limited choice of functions. Therefore, it will generally be convenient to restore the original default set of choosing a scale big enough to include all of the data in both the x and y directions, once the set of graphs for which the revised defaults are useful has been drawn.

The scaling default features apply only to 2-D plots. However, RPLOT maintains several "classes" of scaling defaults, which do not interfere with each other. Thus one may set modified scaling defaults for plots vs. time without interfering with plots vs. radius. At various nodes in the RPLOT code, options are available to view and/or modify scaling defaults for all classes of 2-D plots: option 14 from RPLOT's top node; command "SCALE" from the RPLOT's profile multigraph control nodes.

The following example will give the flavor of the RPLOT plot scale control options. Four graphs are produced by this example:

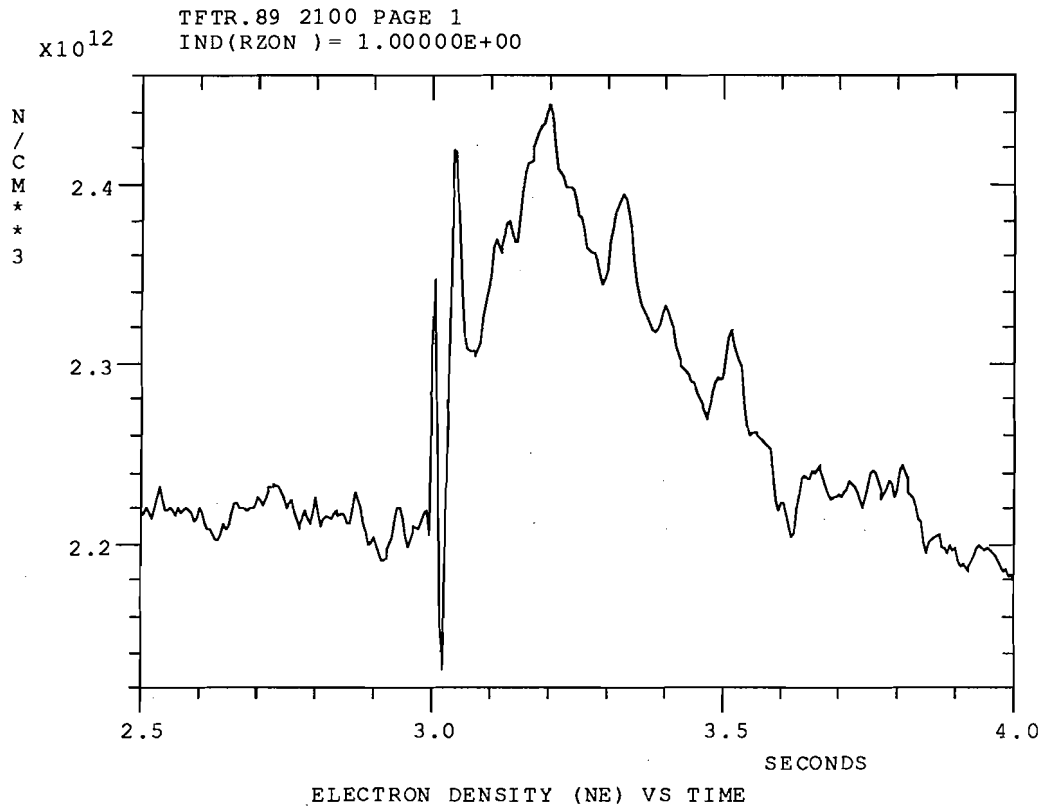
Page 1 shows electron density (NE) vs time (2.5 to 4.0 seconds);
Page 2 shows NE vs time (3.1 to 3.5 seconds);
Page 3 shows NE vs time (3.1 to 3.5 seconds) using smooth data.
Page 4 shows the original scale restored using smooth data.

Example 2.1 (G)

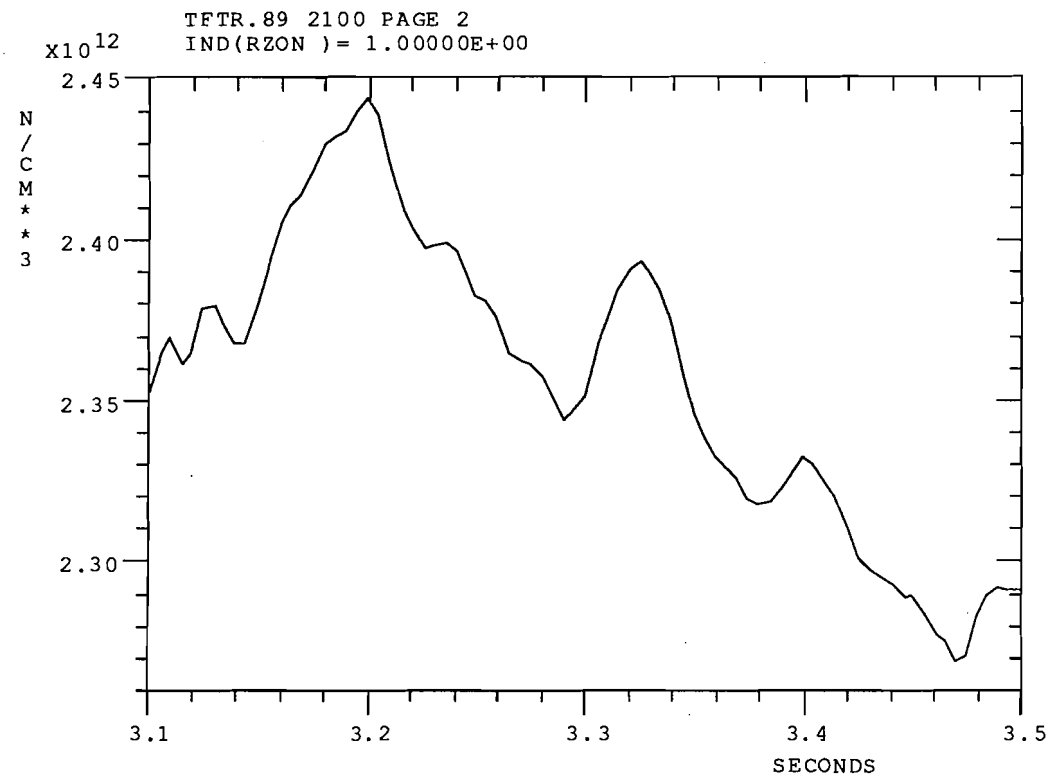
```
RAX$ SET  DEFAULT    RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
```

```
 (3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
 (4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
 (5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
 (6) DRAW A PROFILE MULTIGRAPH
 (7) READ/RECORD COMMENTS ON THIS TRANSP RUN
 (8 OR "Q") QUIT
 (9) CREATE INDEX OF GRAPHS DRAWN SO FAR
 (10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
 (11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
 (12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
  "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
 (13) PLOT THE PLASMA MHD EQUILIBRIUM
 (14) SET SCALING DEFAULTS
 (15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
 (16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

  SUB:MAIN   ENTER OPTION NUMBER:
3
  SELECT/PLOT F(X,T) ... OPTIONS:
 (0) *NEW* DRAW GRAPHS OF DERIVATIVE OF FCN
 (1) DISPLAY PROFILE FUNCTION NAMES
 (2) DRAW GRAPHS OF FUNCTION
 (3) DRAW GRAPHS OF ROLLING VOLUME INTEGRAL OF FCN
 (4) DRAW GRAPHS OF ROLLING FLUX INTEGRAL OF FCN
 (5) DRAW GRAPHS OF ROLLING AREA INTEGRAL OF FCN
 (6) CHANGE SCALING DEFAULTS ON 2D GRAPHS
 (7) TYPE BRIEF EXPLANATION OF OPTIONS 3--5, 9--13
 (8) OR "Q" = QUIT
 (9) DRAW GRAPH OF ROLLING LINE AVERAGE OF FCN
 (10) DRAW GRAPH OF ROLLING VOLUME AVERAGE OF FCN
 (11) DRAW GRAPH OF ROLLING R.M.S. VOLUME AVERAGE OF FCN
 (12) DRAW GRAPH OF DBL INVERSE LINE AVG. OF FCN
 (13) DRAW GRAPH OF DBL INVERSE VOL. AVG. OF FCN
 ===> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER
      LIMIT X0 OF INTEGRATION OR AVERAGE (DEFAULT X0=0.0)
 ENTER "M" TO MAP AND PLOT FUNCTION VS. MAJOR RADIUS
 ENTER "U" TO CREATE USER DEFINED PROFILE FUNCTIONS
 ENTER "X" TO MODIFY DEFINITION OF X AXES FOR PLOTTING
 ENTER "R" FOR NORMALIZED PROFILE OPTIONS (E.G. H(R))

  SUB:3DMAIN >> ENTER OPTION NUMBER
```

```
2
 SUB:3DMAIN >> ENTER PROFILE FUNCTION ID:
NE

  FUNCTION:  ELECTRON DENSITY
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 13-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
3
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:GRAF3D >>  ENTER FIXED RADIUS, CM:
I1.
```



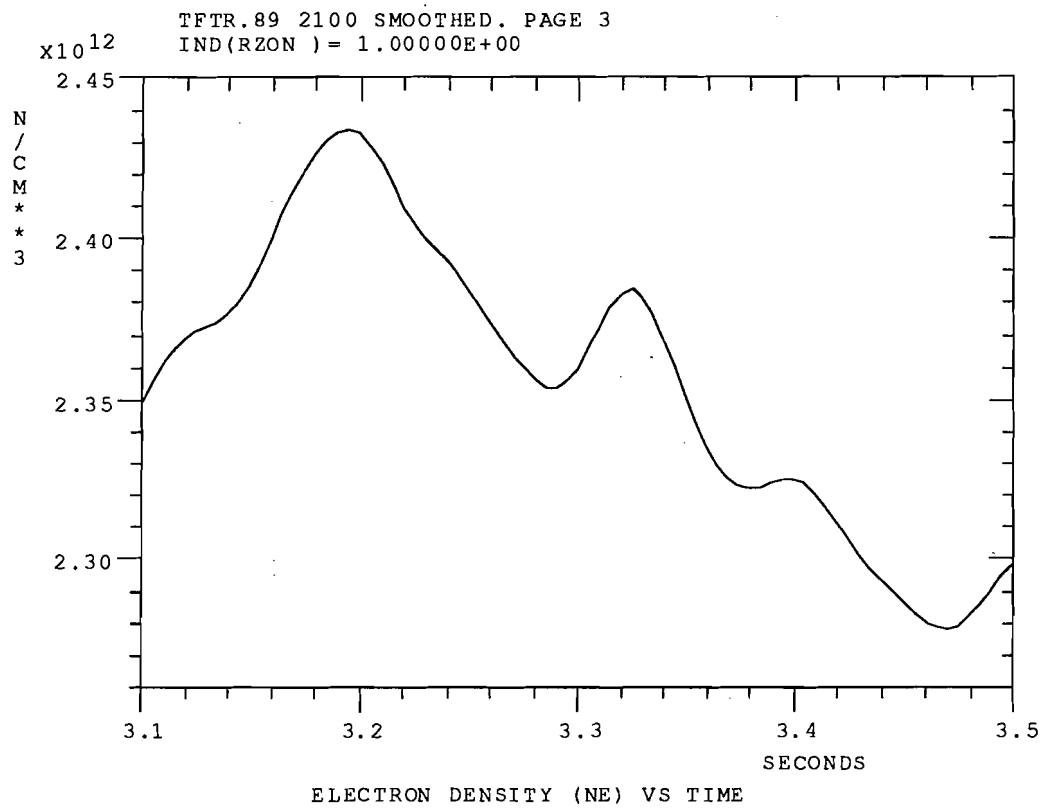

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): S
GRAOPT>> ENTER NEW XMIN: 3.1
GRAOPT>> ENTER NEW XMAX: 3.5
ENTER "R" TO AUTO RESCALE Y USING NEW X SCALE
GRAOPT>> ENTER NEW YMIN: R
```



ELECTRON DENSITY (NE) VS TIME

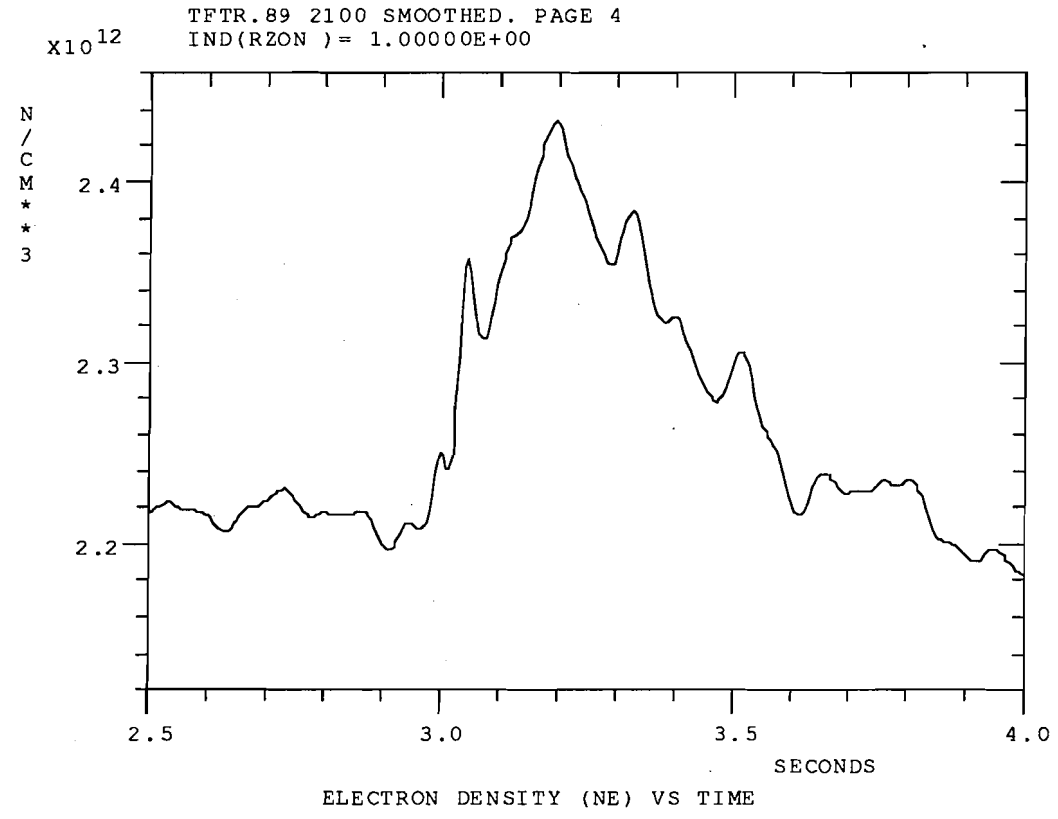
```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): M
ENTER SMOOTHING DELTA D.  THE VALUE OF THE
SMOOTHED FUNCTION AT X WILL BE A WEIGHTED AVERAGE
OF THE VALUES OF THE UNSMOOTHED FUNCTION FROM
X-D TO X+D.  D IN X-AXIS PHYSICAL UNITS
*** ENTER DELTA .LT. 0.0 FOR DOUBLE INVERSE SMOOTHING
 SUB:GRFAH4 >> ENTER SMOOTHING DELTA (E10.3)
.025
ENTER MAXIMUM ALLOWABLE CHANGE, IN PERCENT,
 OF THE SMOOTHED CURVE COMPARED TO THE UNSMOOTHED
 CURVE.  FOR EXAMPLE, 25%==> SMOOTHED CURVE MAY
 NOT DIFFER FROM UNSMOOTHED CURVE BY MORE THAN 25%
 AT ANY POINT.  HOWEVER, IF THE CURVE CHANGES SIGN
 THIS CONDITION APPLIES ONLY IN THE REGION OF THE
 CURVE'S MAXIMUM MODULUS.

 SUB:GRFAH4 >> ENTER SMOOTHIN EPSLON (%, E10.3):
```

33




```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): C
GRAOPT - OPTIONS AFTER PLOT:

*AXIS TYPE CONTROL OPTIONS*
 "A" CHANGE AXIS TYPES (LOG/LINEAR) AND PLOT AGAIN
 "B" CHANGE AXIS DEFAULTS USED ON ENTRY TO PLOT ROUTINE

*PLOT RESCALE OPTIONS*
     --> ALSO TRY HITTING "S" ON UPAUSE BEEP
 "R" RESTORE SCALE FROM A PREVIOUSLY DRAWN PLOT
 "S" CHANGE SCALE OF PLOT (X AND Y) AND PLOT AGAIN
 "X" CHANGE X SCALE, AUTO-RESET Y SCALE, AND PLOT AGAIN
 "Z" ZOOM IN/OUT IN X, AUTO-RESET Y, AND PLOT AGAIN
 "T" CHANGE *DEFAULT SCALING* USED ON ENTRY TO PLOT ROUTINE
 "G" MODIFY MISC. PLOT DEFAULTS: GRID/FRAME/TIC/LINE SYTLE
 "U" TO WRITE 1D *BINARY* UFILE OF DATA IN PLOT ROUTINE
```

```
 "V" TO WRITE 1D *ASCII* UFILE OF DATA IN PLOT ROUTINE

 "M" TO SMOOTH THE PLOT DATA
 "L" TO RESTORE UNPROCESSED PLOT DATA
 *NEW*  "D" TO DIFFERENTIATE THE PLOT DATA
 *ENTER "F" TO STORE DATA AS RPLOT SCALAR FUNCTION

 "P" JUST PLOT AGAIN (USING NEW DEFAULTS)
 "Q" OR "N" TO QUIT PLOTTING (ALTERNATE RETURN CONTROL)
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): R
*SCALES OF RECENTLY DRAWN GRAPHS (1 = MOST RECENT)
  N   XMIN         XMAX         YMIN         YMAX
 --  ---------- ---------- ---------- ----------
  1   3.1000E+00  3.5000E+00  2.2687E+12  2.4440E+12
  2   2.5010E+00  4.0000E+00  2.1297E+12  2.4440E+12
GSCRSC:  ENTER NUMBER N TO SELECT SCALE OR "Q" TO QUIT: 2
```



```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): Q Q Q Q Q
FORTRAN STOP
RAX$
RAX$
```

2.1(H) Radial integration and averaging of profile functions defined vs. TRANSP radial vector.

As will have been observed, RPLOT supports various radial integration and averaging options for plotting individual functions or multigraphs of functions of time and the TRANSP radial coordinate. A "help" package, which may be interactively accessed when running RPLOT, and which describes these radial integral operators, is presented in the following example. These integral operators allow the plotting of a function or multigraph group of functions integrated or averaged over the entire range of the radial coordinate or any subset thereof. Thus, for a TFTR 80 cm plasma, one may volume-integrate the beam heating profiles to get the total beam heating for the inner part of the plasma (0 to 40 cm) and for the outer part of the plasma (40 to 80 cm). This is illustrated in the sample terminal session below, which includes the one page HELP package. HELP shows the definition of the various integral operators. It is invoked by entering "H" to the prompt:

"SUB:MULDRW >> ENTER INTEGRATION CODE:"

Usually one would plot such integrated profiles vs. time, but plots vs. radius are also supported. In integrated plots vs. radius, the radial coordinate refers to the upper limit of the integral operation performed; the lower limit is fixed.

Volume integrals are generally used on profiles which are defined "per unit volume"; the operation removes the "/CM**3" from the integrated profile units, thus "WATTS/CM**3" is transformed to "WATTS". Area integrals are provided for integrating current density profiles. Also supported is a "flux integral" which integrates by volume a profile and then divides by the surface area of the toroidal shell at the integration's upper limit; this can be used to convert a source function (e.g. ptcls/cm**3/sec) to an equivalent flux (ptcls/cm**2/sec) at the specified surface.

Averaging operators do not transform the units of the averaged profile(s). Averaging can be useful, for example, in extracting an average

value of a particle diffusivity when that quantity contains "noise" because the data input to the run does not smoothly define the gradient of the particle species' density.

In the following example, a new profile multigraph package, PBEAM, is created from profiles PBI and PBE. This package is then used in demonstrating volume integration.

Five graphs are produced by this example:

Page 1 shows beam heating (PBEAM) vs radius at time 3.1;
Page 2 shows PBEAM volume integral vs radius from x=0.0.
Page 3 shows PBEAM volume integral vs radius from x=40.0 cm.
Page 4 shows PBEAM volume integral vs time for volume 40-78 cm.
Page 5 shows PBEAM volume integral vs time for volume 0.0-40 cm.

Example 2.1 (H)

```
RAX$
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
D
>ENTER "D " TO RESTORE RMS DEFAULT DISK AND DIRECTORY
CURRENT DISK:  RMS DEFAULT
```

```
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
RPLOT_PLDIRN:  ENTER *PLOT DATA DISK NAME* OR "D ": RUNDATA

TRANSP SUBDIRECTORIES E.G. "TRANSP.TFTR.86" MAY BE ABBREVIATED
E.G. TO ".TFTR.86"

[OLD VALUE:  ""]
RPLOT_PLDIRN:  ENTER *PLOT DATA DIRECTORY NAME* OR "D ": .TFTR.89

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RUNDATA:
CURRENT DIRECTORY:  [TRANSP.TFTR.89]

[OLD VALUE:  "D     "]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
```

```
5
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
  (1) DELETE A MULTIGRAPH PACKAGE
  (2) ADD A MULTIGRAPH PACKAGE
  (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
  (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
  (5) QUIT
  (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
  (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
2
% UREAD TYPEAHEAD TURNED OFF FOR LABEL INPUT
> ENTER PACKAGE LABEL (32 CHARACTERS OR LESS)
BEAM  HEATING
% UREAD TYPEAHEAD RESTORED.  ENTER "Q" TO QUIT OUT...
> ENTER ABBREVIATION FOR PACKAGE (10 CHARS OR LESS)
PBEAM
... PACKAGE "BEAM HEATING                    " ... ID "PBEAM     "
>>> ENTER LIST OF FUNCTION ID'S (1 TO 5 CHAR. ABBREVIATIONS,
NUMERIC ID'S NOT ALLOWED), ONE PER LINE.  IF YOU PRECEDE THE
ID WITH A MINUS SIGN ("-"), THE ADDITIVE INVERSE OF THE
FUNCTION INSTEAD OF THE FUNCTION ITSELF WILL BE INCLUDED IN
THE MULTIGRAPH PACKAGE.  UNITS AND INDEPENDANT COORDINATES
OF THE SPECIFIED FUNCTIONS MUST ALL BE CONSISTANT.  **SCALAR
FUNCTIONS ARE ALLOWED**

**TERMINATE LIST WITH A "0"
 SUB:MULDEF >> ENTER FUNCTION ID.S FOR MULTIGRAPH
PBI
PBE
0
NEW PACKAGE ACCEPTED

[USER ACKNOWLEDGE - HIT ANY KEY]
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
```

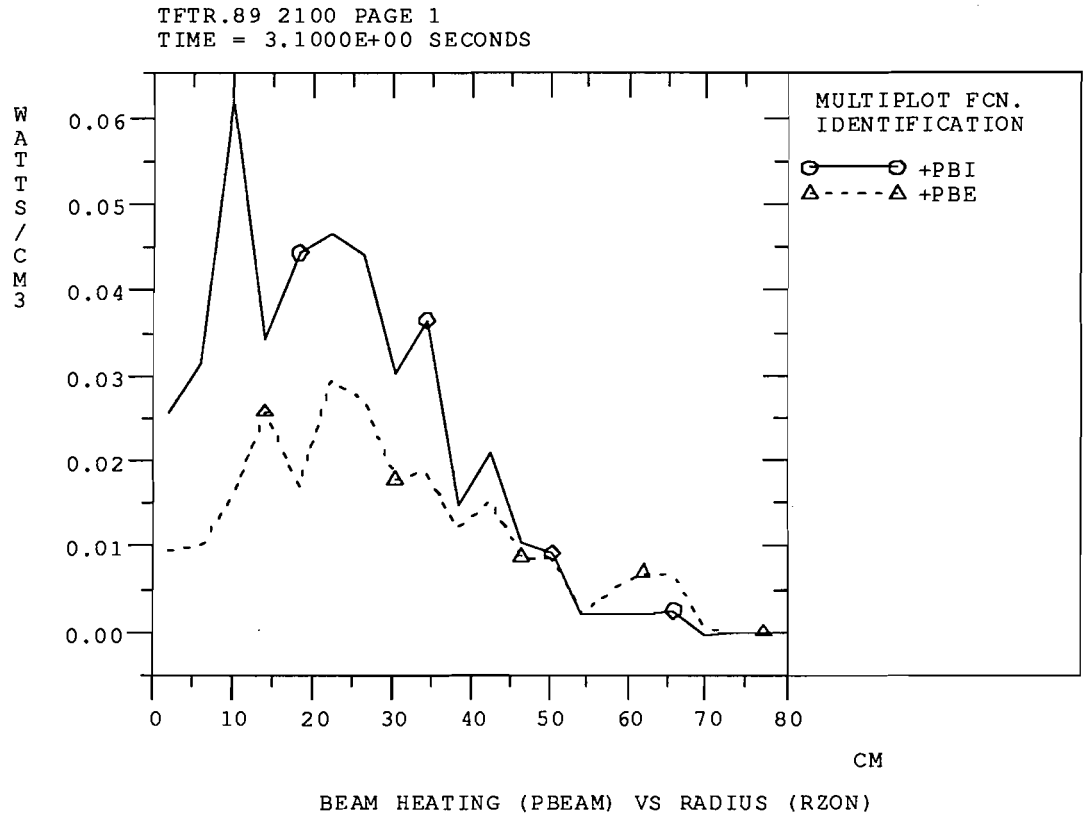
```
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
5

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
6

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]

 SUB:MULDRW >> ENTER PACKAGE ID:
```

PBEAM

```
  GROUP NAME:  BEAM HEATING                          WATTS/CM3
          VS:  RADIUS                                CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
H
```

```
>>>HELP FILE "TRANSP :[DOC]IXHELP.INF " PAGE 1

RPLOT geometric integral operators, e.g. VOLUME INTEGRAL,
are computed using time dependent metric information
generated by the main code run (if available), unless
information from the run indicates that a time independent
concentric circular geometry was used, in which case
metric information is generated analytically.

The default starting location for all integrals is the
magnetic axis (r/a = 0); however this default can be
overridden by the user. Selection of integral is done
via an integer "opcode" i; specifying -i causes RPLOT
to prompt for a non-default lower integration limit.

The integration upper limit subsequently becomes either
an independent coordinate (axis) or a constant depending on
the plot type requested.

Integral operators sometimes imply a units change on the
y axis of the data to be plotted; if this units change
cannot be resolved from a table of standard transformations,
the user is prompted for a y axis units label.

(this note written by D. McCune 19-Oct-1987 PPL x2731)



[ GFLIB/SGLIB -- output to plot screen or file ]


  GROUP NAME:  BEAM HEATING                        WATTS/CM3
         VS:   RADIUS                              CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
```

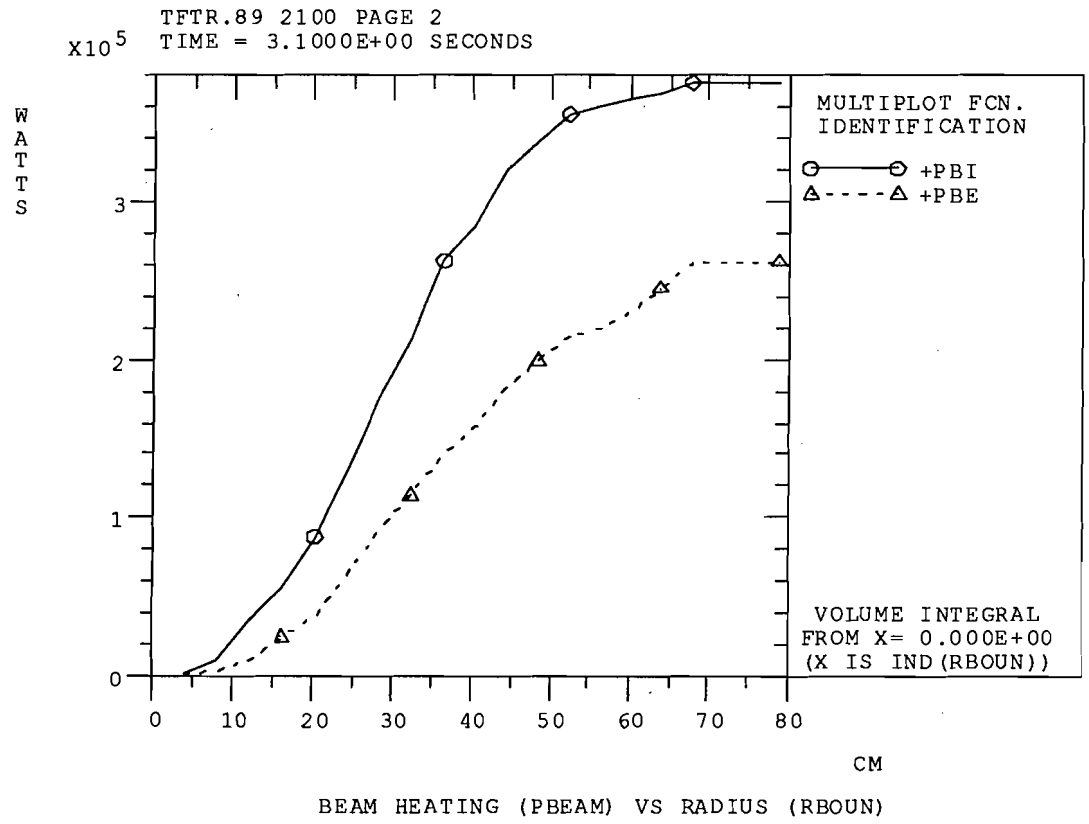
```
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
1


  GROUP NAME:  BEAM HEATING                        WATTS/CM3
         VS:   RADIUS                              CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
1
 SUB: MULDRW >> ENTER FIXED TIME AT WHICH TO PLOT (E10.3):
3.1
```




```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):    N

  GROUP NAME:  BEAM HEATING                        WATTS/CM3
         VS:   RADIUS                              CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
```

```
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
I


  GROUP NAME:  BEAM HEATING                        WATTS/CM3
          VS:  RADIUS                              CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
2


  GROUP NAME:  BEAM HEATING                        WATTS/CM3
          VS:  RADIUS                              CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
```

```
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
1
 SUB: MULDRW >> ENTER FIXED TIME AT WHICH TO PLOT (E10.3):
3.1
```

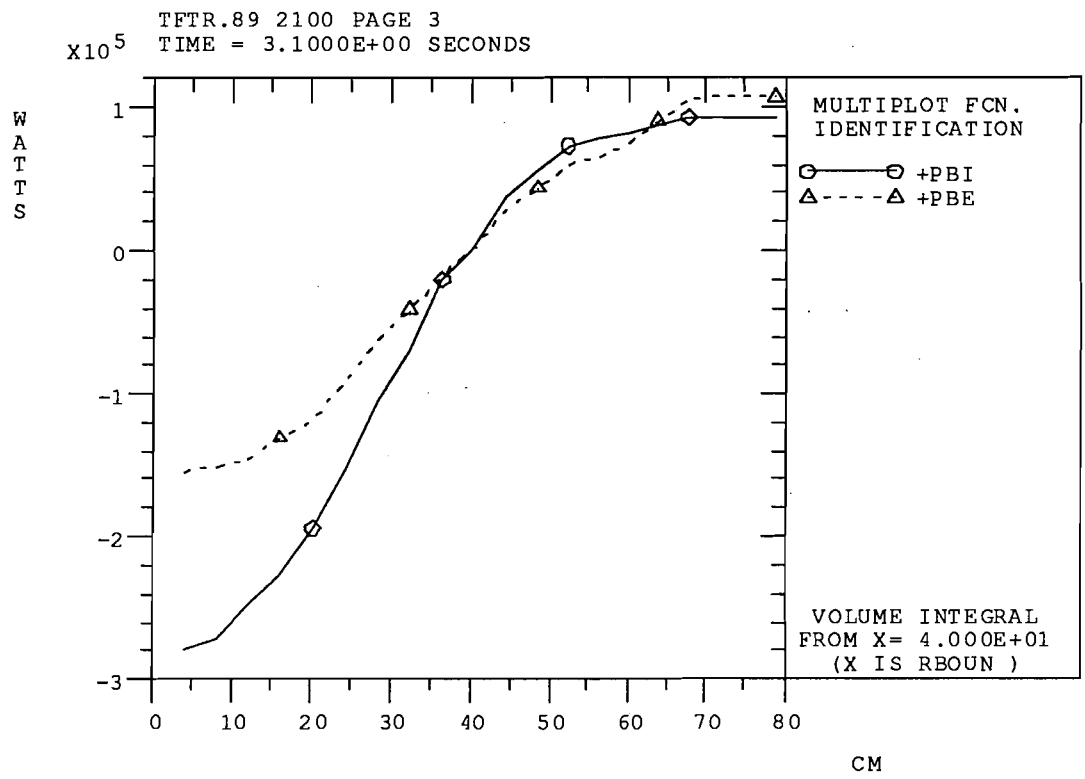


BEAM HEATING (PBEAM) VS RADIUS (RBOUN)

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): N

  GROUP NAME:  BEAM HEATING                    WATTS/CM3
         VS:   RADIUS                          CM
```

```
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
 I

  GROUP NAME:  BEAM HEATING                      WATTS/CM3
         VS:  RADIUS                             CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
-2
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
```

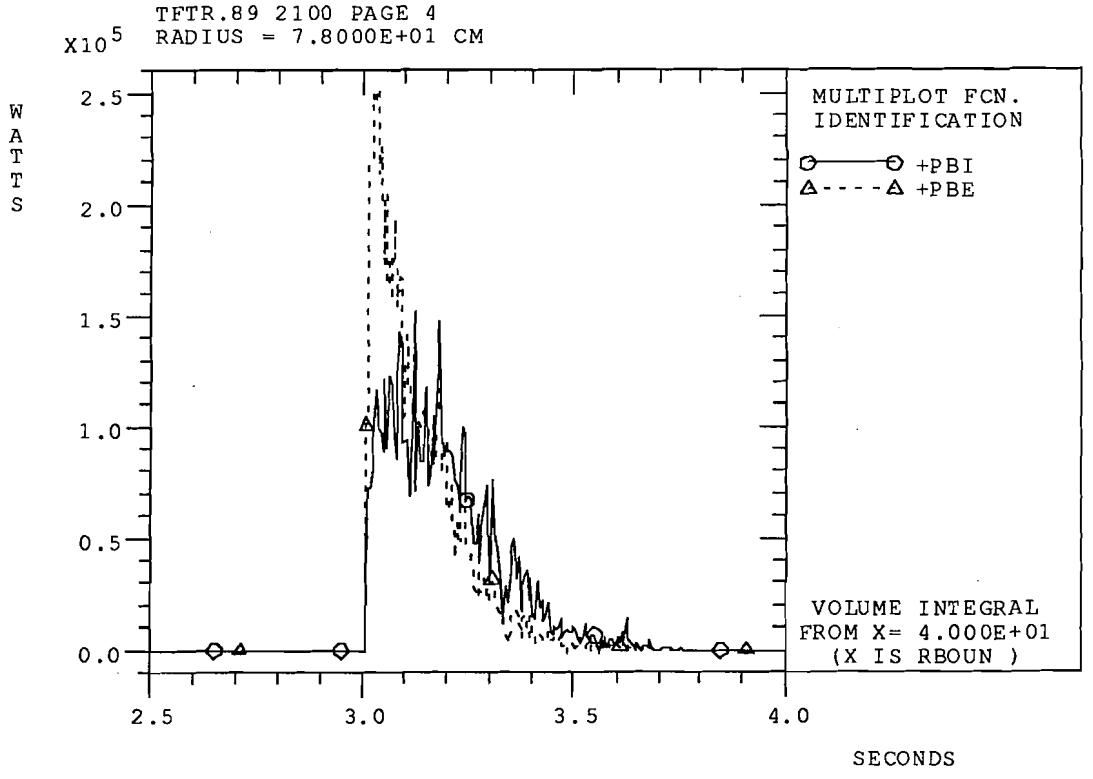
```
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:MULDRW >> ENTER LOWER INTEGRATION LIMIT X0:
40

  GROUP NAME:  BEAM HEATING                    WATTS/CM3
         VS:   RADIUS                          CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
1
 SUB: MULDRW >> ENTER FIXED TIME AT WHICH TO PLOT (E10.3):
3.1
```



BEAM HEATING (PBEAM) VS RADIUS (RBOUN)

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):   N


  GROUP NAME:  BEAM HEATING                      WATTS/CM3
         VS:   RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
```

```
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
2
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:  MULDRW  >> ENTER FIXED X VALUE AT WHICH TO PLOT (E10.)
7 8
```



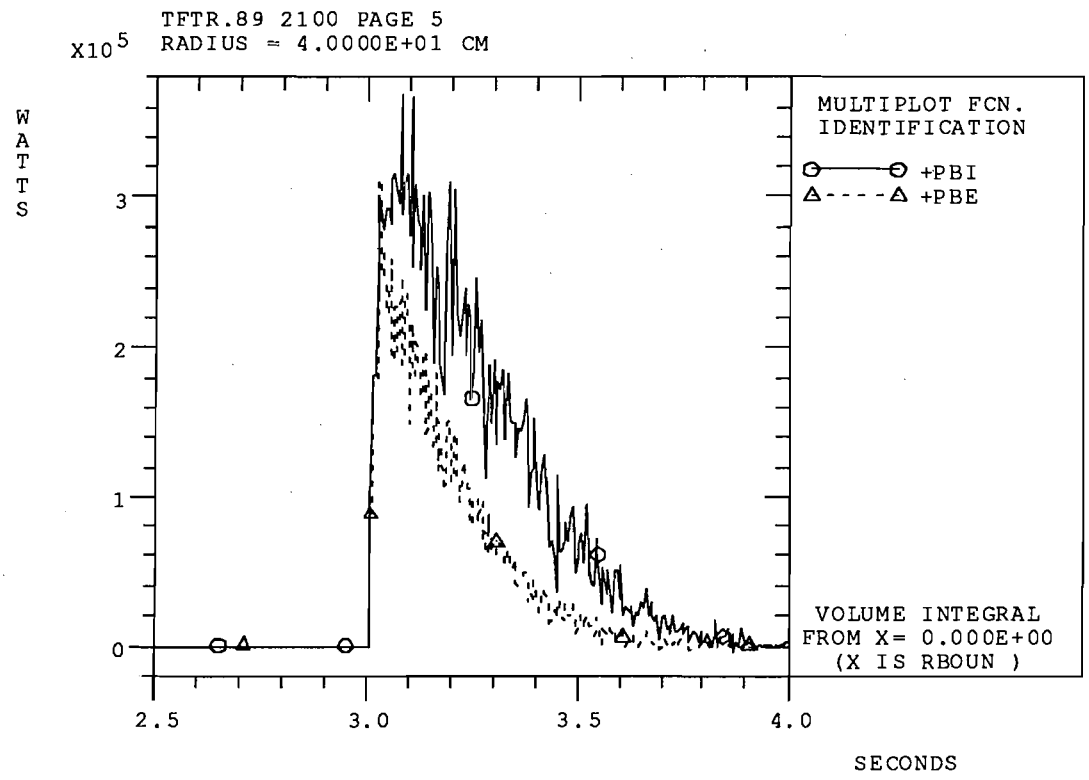
BEAM HEATING (PBEAM) VS TIME

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): N  I
```

```
  GROUP NAME:  BEAM HEATING                          WATTS/CM3
         VS:  RADIUS                                 CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
2

  GROUP NAME:  BEAM HEATING                          WATTS/CM3
         VS:  RADIUS                                 CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
2
```

```
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:  MULDRW  >> ENTER FIXED X VALUE AT WHICH TO PLOT (E10.)
```

4 0



BEAM HEATING (PBEAM) VS TIME

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):   Q Q Q
FORTRAN STOP
RAX$
RAX$
RAX$
```

2.1(J) Smoothing and time-averaging options.

Monte-Carlo algorithms are utilized in TRANSP to calculate neutral penetration and the beam-plasma interaction. Because these algorithms are expensive in cpu-time it is necessary to be content with some statistical variance in their output. This shows up as "noise" in the time-dependence of many TRANSP graphics output quantities. Experimental data, and especially gradients of the input data, also generate a type of noise. In order to provide a means of reducing the appearance of this noise in RPLOT's output graphs, smoothing and time-averaging features have been built into RPLOT. The smoothing algorithm will be described first.

After any 2-D RPLOT graph is drawn, many options are offered to the user which include:

(a) changing the axis types;
(b) changing the axis defaults;
(d) differentiating the plot data;
(f) storing the data as an RPLOT scalar function;
(g) modifying miscellaneous plot defaults;
(l) restoring the original unprocessed plot data;
(m) smoothing the plot data;
(n) quitting plotting;
(p) plotting the data again;
(q) quitting plotting -- alternate control path;
(r) restoring previously drawn scales;
(s) changing the scale of the plot;
(t) changing the default scaling;
(u) writing a 1-D binary UFILE of data;
(v) writing a 1-D ASCII UFILE of data;
(x) changing the x scale;
(z) zooming in/out in the X direction;

If one chooses to smooth the curve, two input parameters to control the smoothing operation will be requested. The first is a "delta(x)" value, expressed in the units of the x-axis of the graph just drawn, which defines the averaging range for the smoothing operation. Each point y(x0)

of the final smoothed curve will be a triangularly weighted average of the unsmoothed curve from (x0 - delta(x)) to (x0 + delta(x)). The second input parameter that will be requested as input to the smoothing operation is an upper limit to impose on how much the smoothed curve should differ from the unsmoothed curve. This is expressed in percent change. The interpretation depends on whether the curve being smoothed changes sign over the range plotted. If the curve changes sign, the maximum change of the smoothed curve from the unsmoothed curve at any point is equal to (n%)/100 * the maximum modulus of the curve being smoothed, where n is the maximum percentage change requested. If the curve does not change sign, the more restrictive condition is applied that no point in the smoothed curve shall differ by more than n% from the corresponding point in the unsmoothed curve. These maximum-change conditions are achieved by iterations in the smoothing algorithm, which locally reduce the range of the triangular weighted average. An example is shown in the sample terminal session at the end of Subsection 2.1(G).

After the data in a 2-D plot is smoothed the original unsmoothed data may be recovered by choosing option "L".

The "3-D" smoothing option offered when plotting individual profile functions of time and additional coordinate, and the multiplotting "AVG" option , offer a feature called time averaging, which is similar to smoothing the data. Two modes of time-averaging are offered: "straight" time averaging, which produces an average profile at experimental time t0 by adding up all the profiles within the range t0 +/- delta(t) and dividing by the number of profiles in that range; and "double inverse" time averaging, which works by adding up the multiplicative inverse of all the profiles in the range t0 +/- delta(t), dividing by the number of such profiles found, and inverting the result. "Double inverse" averaging is useful for functions, such as confinement times, where the dominant noise is expected to come from terms in the denominator of the function's definition. For obvious reasons "double inverse" time averaging should not be used if the function to be averaged goes to zero. If one requests time-averaging, the user will be prompted to specify "straight" or "double-inverse" averaging, and to provide the value delta(t) in seconds. If one applies time-averaging to an individual function of time and radius, the time-averaging operator will replace the operand function with the new

function of time and radius defined by the operation. As with the smoothing operation, the original data can be recovered only by exiting the graphics subroutine and having the data re-read from the disk file. If one utilizes the "AVG" option when drawing multigraphs, a default is established such that the time-averaging operator will be applied to all multigraphs drawn vs. a coordinate other than time; this default is revised only by specifying the "AVG" option again. Time-averaged multiplots are labeled with the values t0 and delta(t) defining the operation shown. An example of setting the time-averaging default for multigraphs is shown in the sample terminal session at the end of Subsection 2.1(E) above. The "AVG" option is accessible in response to several prompts from subroutine MULDRW, e.g.

"SUB:MULDRW >> ENTER PACKAGE ID:".

When using the time-averaging operator, it is useful to know the frequency of output of profile functions. For many TFTR TRANSP runs, profile functions are output once every 10 milliseconds of experimental time. Thus, if one sets time-averaging with delta(t) = 25 milliseconds and requests a multiplot at time t0, the resulting graph will be the average of 5 sets of profiles. t0 will have been reset to the output time nearest to the time the user requested, and delta(t) = 25 milliseconds will result in the profiles 10 and 20 milliseconds removed from t0 both before and after t0 being included in the average. Thus, the period of time averaging is in effect 50 milliseconds.

There is no restriction in using combinations of time-averaging and the radial averaging/integration operators defined in Subsection 2.1(H) above.

2.1(K) Using the calculator and reading functions from more than one run.

The calculator is a feature in RPLOT that enables the users to do various arithmetic calculations to a function. The calculator is accessed through top node option 16. In the following example, all of the operators available are listed. Specifically shown, the electron temperature for run 2101 has 200 ev added to it, so that it will be distinguished during plotting from the data from run 2100. The example also shows how functions from more than one run can be read in, renamed, and used in a profile multigraph package.

```
EPX$
EPX$ '
EPX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
D   RUNDATA   .TFTR.89   2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
```

```
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
16
THE RPLOT ACCUMULATOR "$" is UNDEFINED

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
L

MONADIC OPERATORS with USAGE FORMAT:  operator operand
    =              assignment operator
    -              negation operator

MONADIC OPERATORS with USAGE FORMAT:  operator(operand)
  Some operators incorporate a prophylaxis, e.g. SQRT(X)
  is actually SQRT(MAX(0,X)) to prevent arithmetic fault
    SQRT           square root
    LOG            natural (base e) logarithm
    LOG10          base 10 logarithm
```

```
    EXP             exponential e**x
    SIN             sin (argument in radians)
    COS             cos (argument in radians)
    TAN             tan - overflow caution
    ASIN            arc sine
    ACOS            arc cosine
    ATAN            arc tangent
    SINH            hyperbolic sine
    COSH            hyperbolic cosine
    TANH            hyperbolic tangent
    ABS             absolute value
[USER ACKNOWLEDGE - HIT ANY KEY]

DYADIC OPERATORS with USAGE FORMAT:  operand operator operand
    **              exponentiation
    *               multiplication
    /               division
    +               addition
    -               subtraction

DYADIC OPERATORS with USAGE FORMAT:  operator( operand, operand )
    MIN             pt by pt MIN operator
    MAX             pt by pt MAX operator
[USER ACKNOWLEDGE - HIT ANY KEY]
THE RPLOT ACCUMULATOR "$" is UNDEFINED

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
```

```
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
R

*PLDIR2: ENTER "D " TO SET DISK  AND DIRECTORY FOR NEW FILE

CURRENT DISK:  RUNDATA:
CURRENT DIRECTORY:  [TRANSP.TFTR.89]

[OLD VALUE:  ""]
*RPLOT* PLDIR2:  ENTER RUN ID (MAX 8 CHARS), "D ", OR 0 TO QUIT
2101
[OLD VALUE:  ""]
RPLOT_NEWRUN  ENTER *ABBREVIATION OF FUNCTION TO BE READ* or "QUIT"  TE

%SECOND RUNID READ SUCCESSFULLY.  DEV=DEV2 DATE=TODAY
    SOURCE SECOND RUNID
INPUT DATA TIMEBASE,    # =   302 RANGE= 2.5010E+00 TO  4.0000E+00
RPLOT F(X,T) TIMEBASE, # =   302 RANGE= 2.5010E+00 TO  4.0000E+00
INPUT DATA LABEL = "ELECTRON TEMPERATURE             "
UNITS = EV

DATA WILL BE INTERPOLATED TO RPLOT F(X,T) TIMEBASE AND WILL BE
ACCESSABLE FOR ALL RPLOT PROFILE PLOTTING DISPLAYS

**WARNING** GEOMETRIC/MAPPING DATA FROM THE **CURRENT RUN**
IS **ASSUMED** APPLICABLE TO THIS DATA WITHOUT CHECKING


PLUFXT:  ENTER "Y" TO VERIFY USE OF DATA: Y
[OLD VALUE:  ""]
PLSFXA:  ENTER RPLOT ID FOR NEW DATA FUNCTION: TE2101
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE          FROM 2101    ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
===========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
```

```
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
$+200
%PLCKIN - OPERAND "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
%PLCKIN - OPERAND "200" is a CONSTANT
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = $+200 ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
S

% DESCRIPTIVE LABEL -- UP TO 32 CHARACTERS
% PHYSICAL UNITS -- UP TO 16 CHARACTERS
PLSFXT: ENTER DESCRIPTIVE LABEL OF ACCUMULATOR DATA:
TE 2101 + 200
```

```
PLSFXT: ENTER PHYSICAL UNITS LABEL OF ACCUMULATOR DATA:
EV
[OLD VALUE:  "TE2101     "]
PLSFXA:  ENTER RPLOT ID FOR NEW DATA FUNCTION: TE2101P
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = $+200 ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
R

*PLDIR2: ENTER "D " TO SET DISK  AND DIRECTORY FOR NEW FILE

CURRENT DISK:  RUNDATA:
CURRENT DIRECTORY:  [TRANSP.TFTR.89]

[OLD VALUE:  "2101  "]
*RPLOT* PLDIR2:  ENTER RUN ID (MAX 8 CHARS), "D ", OR 0 TO QUIT
1000
[OLD VALUE:  "TE        "]
RPLOT_NEWRUN  ENTER *ABBREVIATION OF FUNCTION TO BE READ* or "QUIT" TE

%SECOND RUNID READ SUCCESSFULLY.  DEV=DEV2 DATE=TODAY
    SOURCE SECOND RUNID
INPUT DATA TIMEBASE,    # =   171 RANGE= 3.3010E+00 TO  5.0000E+00
```

```
RPLOT F(X,T) TIMEBASE, # =   302 RANGE= 2.5010E+00 TO  4.0000E+00
INPUT DATA LABEL = "ELECTRON TEMPERATURE              "
UNITS = EV

DATA WILL BE INTERPOLATED TO RPLOT F(X,T) TIMEBASE AND WILL BE
ACCESSABLE FOR ALL RPLOT PROFILE PLOTTING DISPLAYS

**WARNING** GEOMETRIC/MAPPING DATA FROM THE **CURRENT RUN**
IS **ASSUMED** APPLICABLE TO THIS DATA WITHOUT CHECKING


PLUFXT:  ENTER "Y" TO VERIFY USE OF DATA: Y
[OLD VALUE:  "TE2101P   "]
PLSFXA:  ENTER RPLOT ID FOR NEW DATA FUNCTION:  TE1000
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE          FROM 1000   ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
R

*PLDIR2: ENTER "D " TO SET DISK  AND DIRECTORY FOR NEW FILE

CURRENT DISK:  RUNDATA:
CURRENT DIRECTORY:  [TRANSP.TFTR.89]
```

```
[OLD VALUE:  "1000  "]
*RPLOT* PLDIR2:  ENTER RUN ID (MAX 8 CHARS), "D ", OR 0 TO QUIT
1100
[OLD VALUE:  "TE        "]
RPLOT_NEWRUN  ENTER *ABBREVIATION OF FUNCTION TO BE READ* or "QUIT" TE

%SECOND RUNID READ SUCCESSFULLY.  DEV=DEV2 DATE=TODAY
    SOURCE SECOND RUNID
INPUT DATA TIMEBASE,   # =    76 RANGE= 4.2510E+00 TO  5.0000E+00
RPLOT F(X,T) TIMEBASE, # =   302 RANGE= 2.5010E+00 TO  4.0000E+00
INPUT DATA LABEL = "ELECTRON TEMPERATURE            "
UNITS = EV

DATA WILL BE INTERPOLATED TO RPLOT F(X,T) TIMEBASE AND WILL BE
ACCESSABLE FOR ALL RPLOT PROFILE PLOTTING DISPLAYS

**WARNING** GEOMETRIC/MAPPING DATA FROM THE **CURRENT RUN**
IS **ASSUMED** APPLICABLE TO THIS DATA WITHOUT CHECKING


PLUFXT:  ENTER "Y" TO VERIFY USE OF DATA: Y
[OLD VALUE:  "TE1000    "]
PLSFXA:  ENTER RPLOT ID FOR NEW DATA FUNCTION:  TE1100
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE          FROM 1100   ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
```

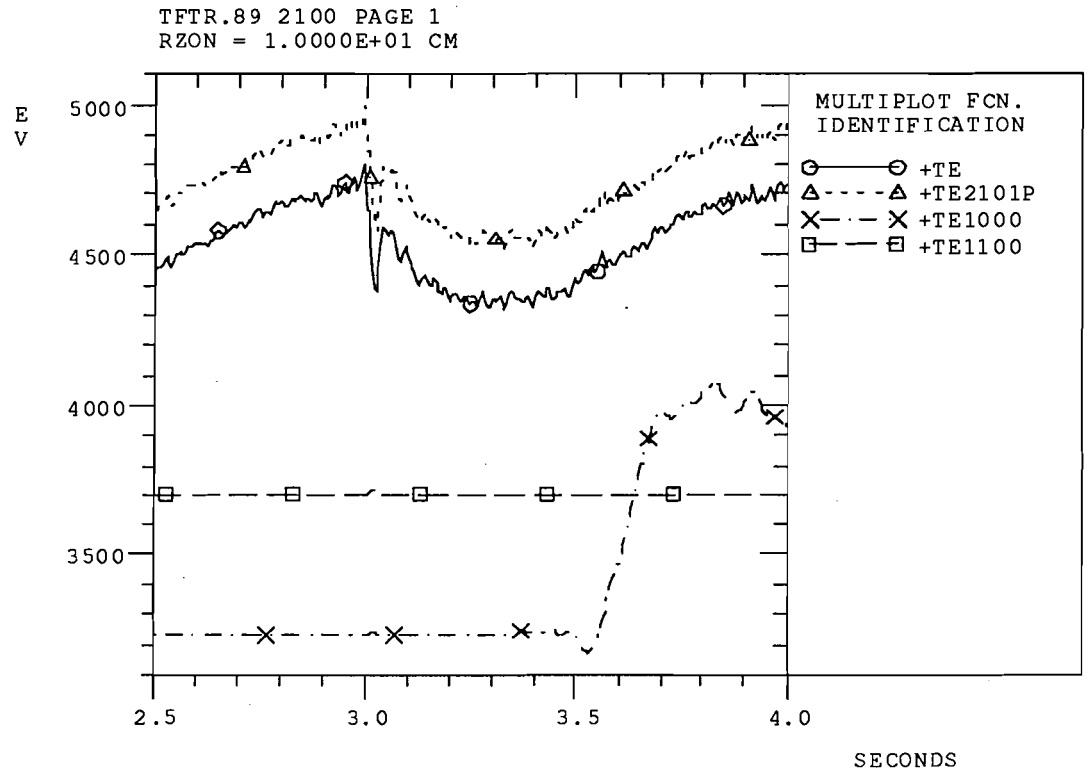
```
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
Q

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
5
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
2
% UREAD TYPEAHEAD TURNED OFF FOR LABEL INPUT
> ENTER PACKAGE LABEL (32 CHARACTERS OR LESS)
```

```
ELECTRON TEMPERATURE (4 SHOTS)
% UREAD TYPEAHEAD RESTORED.  ENTER "Q" TO QUIT OUT...
> ENTER ABBREVIATION FOR PACKAGE (10 CHARS OR LESS)
TES
... PACKAGE "ELECTRON TEMPERATURE (4 SHOTS)  " ... ID "TES       "
>>> ENTER LIST OF FUNCTION ID'S (1 TO 5 CHAR. ABBREVIATIONS,
NUMERIC ID'S NOT ALLOWED), ONE PER LINE.  IF YOU PRECEDE THE
ID WITH A MINUS SIGN ("-"), THE ADDITIVE INVERSE OF THE
FUNCTION INSTEAD OF THE FUNCTION ITSELF WILL BE INCLUDED IN
THE MULTIGRAPH PACKAGE.  UNITS AND INDEPENDANT COORDINATES
OF THE SPECIFIED FUNCTIONS MUST ALL BE CONSISTANT.  **SCALAR
FUNCTIONS ARE ALLOWED**

**TERMINATE LIST WITH A "0"
 SUB:MULDEF >> ENTER FUNCTION ID.S FOR MULTIGRAPH
TE
TE2101P
TE1000
TE1100
0
NEW PACKAGE ACCEPTED

[USER ACKNOWLEDGE - HIT ANY KEY]
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
6
 SUB:MULDEF >> ENTER ID OF PACKAGE TO LIST:
TES


 PROFILE PACKAGE "TES       ", "ELECTRON TEMPERATURE (4 SHOTS)  ", CONTAINS:
```

```
     1.  +TE           "ELECTRON TEMPERATURE            " EV
     2.  +TE2101P      "TE 2101 + 200                   " EV
     3.  +TE1000       "ELECTRON TEMPERATURE            " EV
     4.  +TE1100       "ELECTRON TEMPERATURE            " EV

FUNCTIONS VS. TIME AND RADIUS

[USER ACKNOWLEDGE - HIT ANY KEY]
> MODIFICATIONS OF SCALAR/ PROFILE MULTIGRAPH PACKAGES
> OPTIONS:
 (1) DELETE A MULTIGRAPH PACKAGE
 (2) ADD A MULTIGRAPH PACKAGE
 (3) CHANGE A MULTIGRAPH NAME OR ABBREVIATION
 (4) ADD/DELETE A FUNCTION IN A MULTIGRAPH PACKAGE
 (5) QUIT
 (6) TYPE OUT THE CONTENTS OF A MULTIGRAPH PACKAGE
 (7) *NEW* CHANGE A FUNCTION NAME, UNITS OR ABBREVIATION

 SUB:MULDEF >>ENTER OPTION NUMBER:
Q

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA
```

```
 SUB:MAIN   ENTER OPTION NUMBER:
6

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]

 SUB:MULDRW >> ENTER PACKAGE ID:
TES


  GROUP NAME:  ELECTRON TEMPERATURE (4 SHOTS)   EV
         VS:  RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
1


  GROUP NAME:  ELECTRON TEMPERATURE (4 SHOTS)   EV
```

```
          VS:  RADIUS                              CM
  TIME RANGE:    2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
2
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:  MULDRW  >> ENTER FIXED X VALUE AT WHICH TO PLOT (E10.)
10
```



ELECTRON TEMPERATURE (4 SHOTS) (TES) VS TIME

```
[ GFLIB/SGLIB -- output to plot screen or file ]

GRAOPT - OPTIONS AFTER PLOT:
  ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):    Q  Q  Q
FORTRAN STOP
EPX$
EPX$
```

2.1(L) Creating and reading user defined UFILE output.

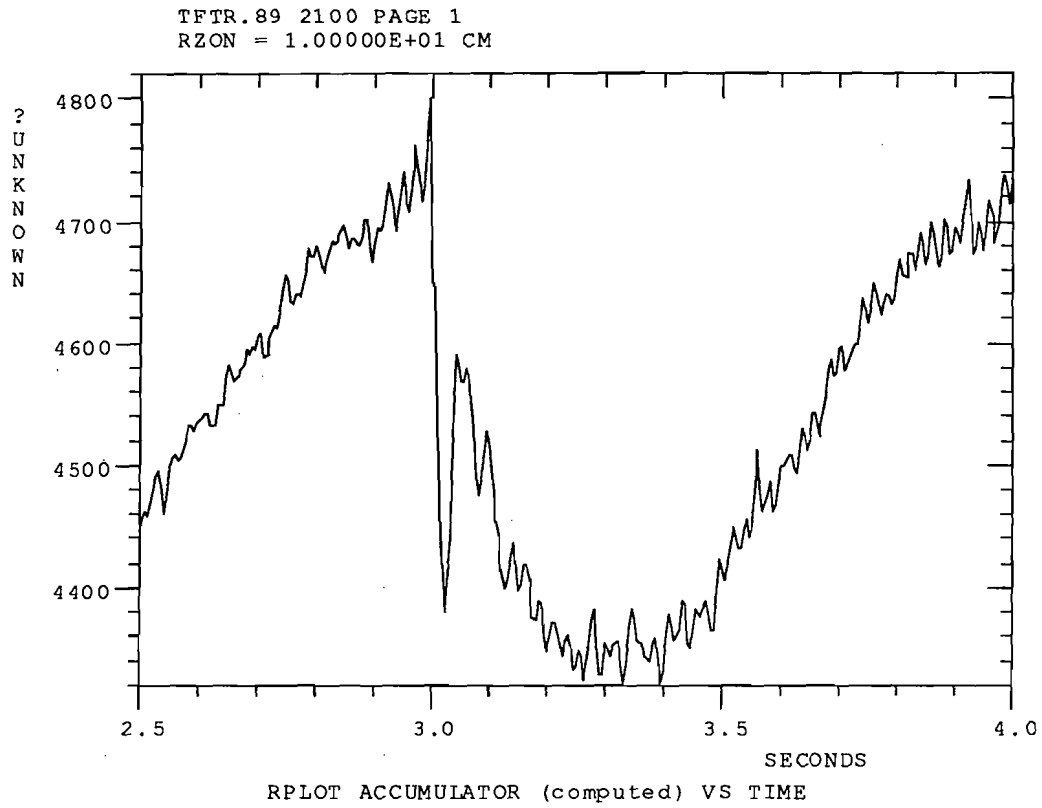
On occasion, an RPLOT user will create a function in the calculator that will be needed for further examination or use in a future RPLOT run. Rather than redo the calculation in that future run, it is possible for the user to save off the function in a separate file which is created by RPLOT using UFILE package utilities. The new file then can be read again when needed. A note of caution, however - UFILES written to a RUNDATA directory will be skimmed eventually off the disk.

Example 2.1(L)

```
RAX$
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
D   RUNDATA   .TFTR.89   2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
```

```
 (10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
 (11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
 (12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
  "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
 (13) PLOT THE PLASMA MHD EQUILIBRIUM
 (14) SET SCALING DEFAULTS
 (15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
 (16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

  SUB:MAIN   ENTER OPTION NUMBER:
16
THE RPLOT ACCUMULATOR "$" is UNDEFINED

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
=TE
%PLCKIN - OPERAND "TE" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = =TE ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
```

```
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
P

  FUNCTION:  RPLOT ACCUMULATOR
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 26-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
3
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:GRAF3D >>  ENTER FIXED RADIUS, CM:
10
```

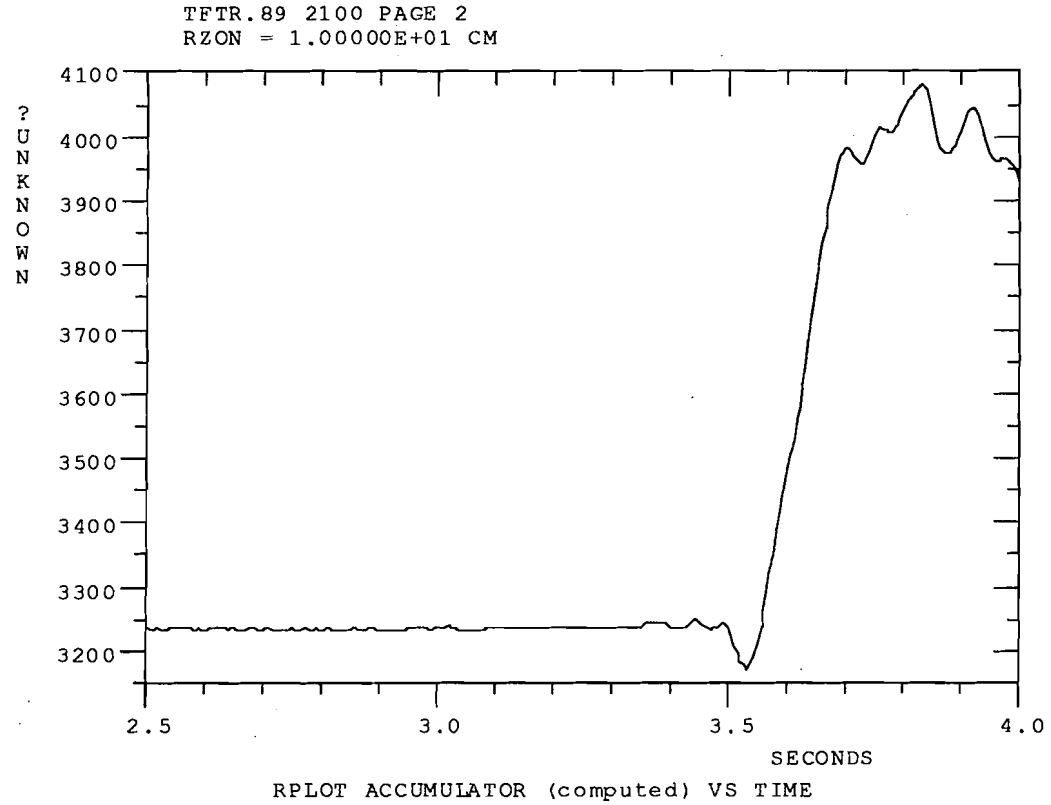



```
[ GFLIB/SGLIB -- output to plot screen or file ]

GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):   Q

  FUNCTION:  RPLOT ACCUMULATOR
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 26-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
```

```
   (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
   (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
   (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
 Q
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
   [ = TE*1 ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
R

*PLDIR2: ENTER "D " TO SET DISK  AND DIRECTORY FOR NEW FILE

CURRENT DISK:  RUNDATA:
CURRENT DIRECTORY:  [TRANSP.TFTR.89]

[OLD VALUE:  "TE     "]
*RPLOT* PLDIR2:  ENTER RUN ID (MAX 8 CHARS), "D ", OR 0 TO QUIT
1000
[OLD VALUE:  "Q          "]
RPLOT_NEWRUN  ENTER *ABBREVIATION OF FUNCTION TO BE READ* or "QUIT" TE

%SECOND RUNID READ SUCCESSFULLY.  DEV=DEV2 DATE=TODAY
    SOURCE SECOND RUNID
```

```
INPUT DATA TIMEBASE,    # =    171 RANGE= 3.3010E+00 TO  5.0000E+00
RPLOT F(X,T) TIMEBASE, # =    302 RANGE= 2.5010E+00 TO  4.0000E+00
INPUT DATA LABEL = "ELECTRON TEMPERATURE                "
UNITS = EV

DATA WILL BE INTERPOLATED TO RPLOT F(X,T) TIMEBASE AND WILL BE
ACCESSABLE FOR ALL RPLOT PROFILE PLOTTING DISPLAYS

**WARNING** GEOMETRIC/MAPPING DATA FROM THE **CURRENT RUN**
IS **ASSUMED** APPLICABLE TO THIS DATA WITHOUT CHECKING


PLUFXT:  ENTER "Y" TO VERIFY USE OF DATA:  Y
[OLD VALUE:  ""]
PLSFXA:  ENTER RPLOT ID FOR NEW DATA FUNCTION: TE1000
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE          FROM 1000   ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
P

  FUNCTION:  RPLOT ACCUMULATOR
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 26-FEB-90
```

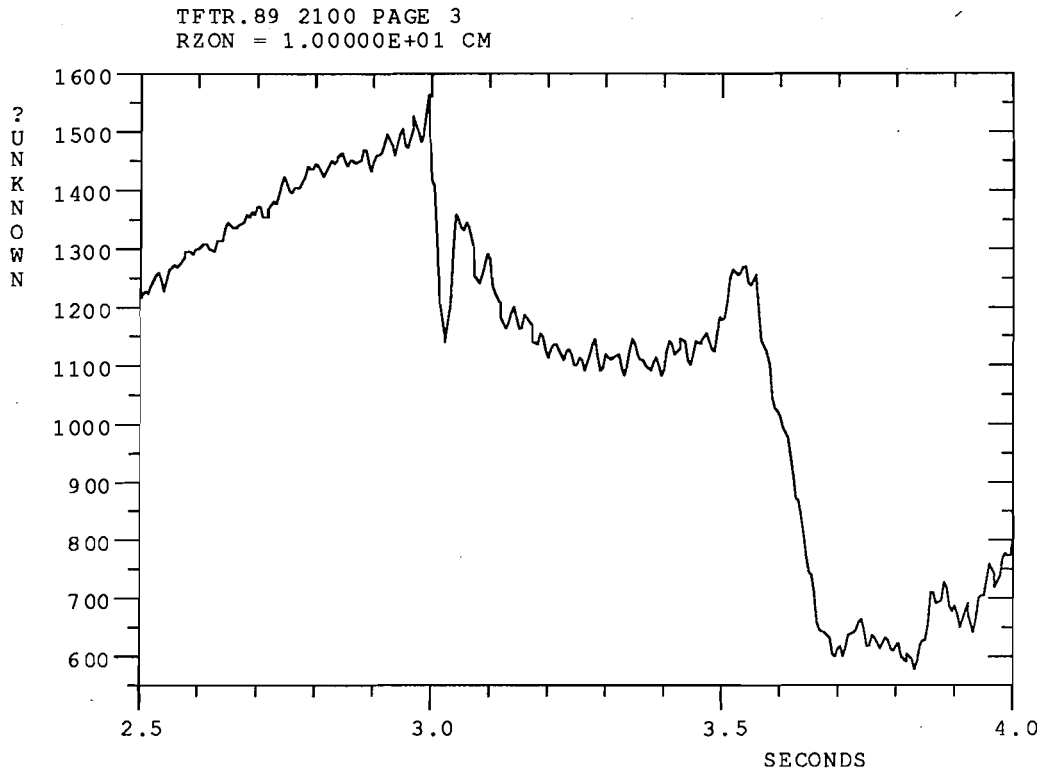
```
**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
3
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:GRAF3D >>  ENTER FIXED RADIUS, CM:
10
```




```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):   Q

  FUNCTION:  RPLOT ACCUMULATOR
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 26-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
```

```
   (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
   (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
   (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
Q
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE          FROM 1000           ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
===========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
TE-TE1000
%PLCKIN - OPERAND "TE" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
%PLCKIN - OPERAND "TE1000" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE-TE1000 ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
===========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
```

```
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
P

  FUNCTION:  RPLOT ACCUMULATOR
 SOURCE ID:  TFTR.89 2100
     TITLE:  RPLOT GENERATED PLOT 26-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
3
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:GRAF3D >>  ENTER FIXED RADIUS, CM:
10
```



RPLOT ACCUMULATOR (computed) VS TIME

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q): Q

  FUNCTION:  RPLOT ACCUMULATOR
 SOURCE ID:  TFTR.89     2100
     TITLE:  RPLOT GENERATED PLOT  6-APR-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
```

```
 GRF3SG:  ENTER OPTION #:
Q
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE-TE1000 ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
S

% DESCRIPTIVE LABEL -- UP TO 32 CHARACTERS
% PHYSICAL UNITS -- UP TO 16 CHARACTERS
PLSFXT: ENTER DESCRIPTIVE LABEL OF ACCUMULATOR DATA:
TE  DIFFERENCES  (2100-1000)
PLSFXT: ENTER PHYSICAL UNITS LABEL OF ACCUMULATOR DATA:
EV
[OLD VALUE:  "TE1000     "]
PLSFXA:  ENTER RPLOT ID FOR NEW DATA FUNCTION:  TEDIFF
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE-TE1000 ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
```

```
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
W
PLUFXT:  ENTER ID OF PROFILE FUNCTION TO WRITE:
TEDIFF
PLUFXT: WRITE DATA IN A=ASCII OR B=BINARY FORMAT (A/B/Q):
B

<<UFNTER>> SET UFILES FILENAME FORM FOR:

PLOTR 2D OUTPUT FILE:  Z######.ZZZ

WHERE ###### IS THE VARIABLE SHOT NUMBER;
IF DISK OR DIRECTORY NOT SPECIFIED, RMS DEFAULT IS USED
OPTIONS:
 D - CHANGE DISK (DEVICE) NAME
 E - CHANGE DIRECTORY NAME
 F - CHANGE FILENAME 1 CHAR PREFIX AND .EXT SUFFIX
 G - GENERATE LONGER UFILES FILENAME PREFIX AND SUFFIX
 I - INCLUDE SHOT NUMBER ENCODED IN UFILES FILE NAME (default)
 J - ACCESS UFILE WITHOUT SHOT NUMBER ENCODED IN FILE NAME
 N - SPECIFY COMPLETE UFILE NAME - SAVE SHOT NUMBER
 P - CHANGE SINGLE CHARACTER FILENAME PREFIX
 S - CHANGE FILENAME SUFFIX
 Q - QUIT

UFNTER:  ENTER OPCODE (D/E/F/P/S/Q... ):
F
UFNTER:  ENTER FILE PREFIX, A SINGLE LETTER:  T
UFNTER:  ENTER FILE .EXT EXTENSION (3 LETTER COMBO): TED
```

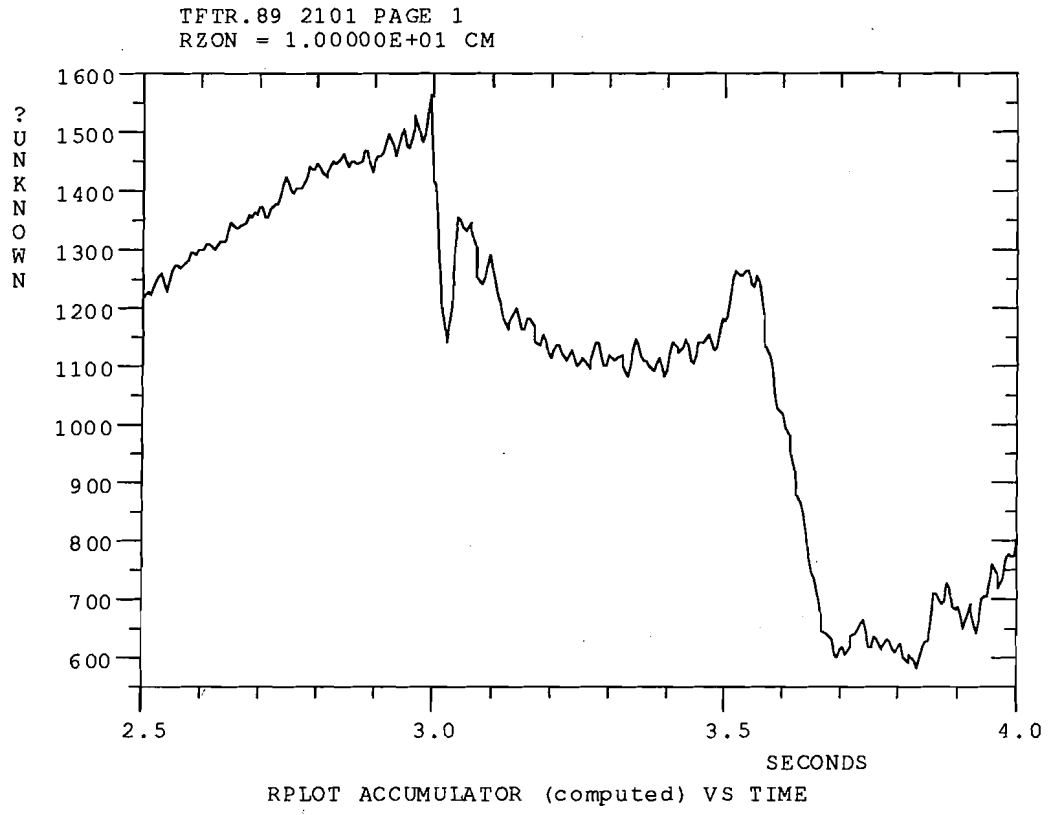
```
<<UFNTER>> SET UFILES FILENAME FORM FOR:

PLOTR 2D OUTPUT FILE:  T######.TED

WHERE ###### IS THE VARIABLE SHOT NUMBER;
IF DISK OR DIRECTORY NOT SPECIFIED, RMS DEFAULT IS USED
OPTIONS:
 D - CHANGE DISK (DEVICE) NAME
 E - CHANGE DIRECTORY NAME
 F - CHANGE FILENAME 1 CHAR PREFIX AND .EXT SUFFIX
 G - GENERATE LONGER UFILES FILENAME PREFIX AND SUFFIX
 I - INCLUDE SHOT NUMBER ENCODED IN UFILES FILE NAME (default)
 J - ACCESS UFILE WITHOUT SHOT NUMBER ENCODED IN FILE NAME
 N - SPECIFY COMPLETE UFILE NAME - SAVE SHOT NUMBER
 P - CHANGE SINGLE CHARACTER FILENAME PREFIX
 S - CHANGE FILENAME SUFFIX
 Q - QUIT

UFNTER:  ENTER OPCODE (D/E/F/P/S/Q... ):
Q
[OLD VALUE:       42457]
TRUFLS:  ENTER SHOT OR ID NUMBER FOR UFILE: 12345
NAMED FILE:  T12345.TED
% UREAD typeahead turned off.  Lower case indented
  comments may be typed.  To exit, type "x" or "X" in the
  FIRST character position followed by a carriage return
UFACOM:  ENTER COMMENTS FOR OUTPUT FILE (max 80 CHARS/LINE):
   File contains the difference of electron temperatures
of run 2100 - run 1000 from RUNDATA:[TRANSP.TFTR.89]
x
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = TE-TE1000 ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
```

```
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
Q Q Q
FORTRAN STOP
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
D  RUNDATA  .TFTR.89  2101  16
THE RPLOT ACCUMULATOR "$" is UNDEFINED

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
===========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
```

```
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
U

<<UFNTER>> SET UFILES FILENAME FORM FOR:

RPLOT 2D INPUT FILE:  Z######.ZZZ

WHERE ###### IS THE VARIABLE SHOT NUMBER;
IF DISK OR DIRECTORY NOT SPECIFIED, RMS DEFAULT IS USED
OPTIONS:
 D - CHANGE DISK (DEVICE) NAME
 E - CHANGE DIRECTORY NAME
 F - CHANGE FILENAME 1 CHAR PREFIX AND .EXT SUFFIX
 G - GENERATE LONGER UFILES FILENAME PREFIX AND SUFFIX
 I - INCLUDE SHOT NUMBER ENCODED IN UFILES FILE NAME (default)
 J - ACCESS UFILE WITHOUT SHOT NUMBER ENCODED IN FILE NAME
 N - SPECIFY COMPLETE UFILE NAME - SAVE SHOT NUMBER
 P - CHANGE SINGLE CHARACTER FILENAME PREFIX
 S - CHANGE FILENAME SUFFIX
 Q - QUIT

UFNTER:  ENTER OPCODE (D/E/F/P/S/Q... ):
F
UFNTER:  ENTER FILE PREFIX, A SINGLE LETTER: T
UFNTER:  ENTER FILE .EXT EXTENSION (3 LETTER COMBO): TED

<<UFNTER>> SET UFILES FILENAME FORM FOR:

RPLOT 2D INPUT FILE:  T######.TED

WHERE ###### IS THE VARIABLE SHOT NUMBER;
IF DISK OR DIRECTORY NOT SPECIFIED, RMS DEFAULT IS USED
OPTIONS:
 D - CHANGE DISK (DEVICE) NAME
 E - CHANGE DIRECTORY NAME
 F - CHANGE FILENAME 1 CHAR PREFIX AND .EXT SUFFIX
```

```
 G - GENERATE LONGER UFILES FILENAME PREFIX AND SUFFIX
 I - INCLUDE SHOT NUMBER ENCODED IN UFILES FILE NAME (default)
 J - ACCESS UFILE WITHOUT SHOT NUMBER ENCODED IN FILE NAME
 N - SPECIFY COMPLETE UFILE NAME - SAVE SHOT NUMBER
 P - CHANGE SINGLE CHARACTER FILENAME PREFIX
 S - CHANGE FILENAME SUFFIX
 Q - QUIT

UFNTER:  ENTER OPCODE (D/E/F/P/S/Q... ):
Q
[OLD VALUE:       42457]
PLUFXT:  ENTER SHOT OR ID NUMBER FOR UFILE: 12345
NAMED FILE:  T12345.TED
% READING SCALAR COMPRESSED BINARY DATA WRITTEN 26-FEB-90
% UF0DRD WARNING:  DIMENSIONALITY OF INPUT FILE = 2
NAMED FILE:  T12345.TED
% READING 2D COMPRESSED BINARY DATA WRITTEN 26-FEB-90

%UFILE READ SUCCESSFULLY.  DEV=RUN  DATE=TR:[TERPST
    SOURCE RUNID:    2100      TFTR.89
INPUT DATA TIMEBASE,   # =   302 RANGE= 2.5010E+00 TO  4.0000E+00
RPLOT F(X,T) TIMEBASE, # =   302 RANGE= 2.5010E+00 TO  4.0000E+00
INPUT DATA LABEL = "TE DIFFERENCES (2100 EV        "

DATA WILL BE INTERPOLATED TO RPLOT F(X,T) TIMEBASE AND WILL BE
ACCESSABLE FOR ALL RPLOT PROFILE PLOTTING DISPLAYS

**WARNING** GEOMETRIC/MAPPING DATA FROM THE **CURRENT RUN**
IS **ASSUMED** APPLICABLE TO THIS DATA WITHOUT CHECKING

PLUFXT:  ENTER "Y" TO VERIFY USE OF DATA: Y
[OLD VALUE:  ""]
PLSFXA:  ENTER RPLOT ID FOR NEW DATA FUNCTION: TEDIFF
THE RPLOT ACCUMULATOR "$" is a FUNCTION of TIME and PLASMA ZONE CTR INDEX
  [ = UFILE ]

RPLOT USER DEFINED PLOT FUNCTION CALCULATOR
==========================================
OPTIONS:
 enter an expression for "$", or ...
 H for HELP
```

```
 L for LIST of defined operators usable in an expression
 P to PLOT current contents of "$" (unlabeled)
 R to READ new RPLOT profile function from a new RUN
 S to SAVE current contents of "$" as an RPLOT function with labels
 U to READ new RPLOT profile fcn from the contents of a UFILE
   said UFILE previously written via BY RPLOT; "$" overwritten
 W to WRITE UFILE containing RPLOT profile function data
 X to modify an X axis (other than time) for plotting
 Z to ZONE/BDY shift the "$" accumulator data
 I to apply INTEGRO/DIFFERENTIAL operator to "$" data
 Q to QUIT
PLCFXT: RPLOT CALCULATOR PROMPT:
P

  FUNCTION:  RPLOT ACCUMULATOR
 SOURCE ID:  TFTR.89 2101
     TITLE:  RPLOT GENERATED PLOT 26-FEB-90

**> ENTER "S" TO SMOOTH PLOT DATA
**> ENTER "U" TO WRITE PLOT DATA TO UFILE
GRAPHICS OPTIONS:
  (1) 3-D GRAPH OF FUNCTION VS. RADIUS AND TIME
  (2) 2-D GRAPH VS. RADIUS AT FIXED TIME
  (3) 2-D GRAPH VS. TIME AT FIXED RADIUS
  (4)  (OR "Q")  QUIT GRAPHICS
  (5) CONTOUR PLOT; FOR "FAST" PLOT ENTER "5F"
  (6) CHANGE DEFAULT PLOT TYPE FOR 2D PLOTS
  (7) CHANGE SCALING DEFAULTS FOR 2D PLOTS
  (8) RADIUS OR TIME - SLICE MULTIPLOT
>ENTER CHOICE NUMBER BETWEEN 1 AND 8<
 GRF3SG:  ENTER OPTION #:
3
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:GRAF3D >>  ENTER FIXED RADIUS, CM:
10
```




```
[ GFLIB/SGLIB -- output to plot screen or file ]

GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):  :  Q  Q  Q  Q  Q
FORTRAN STOP
RAX$
RAX$
RAX$
```

2.1(M) Changing X Axes.

RPLOT offers the option of redefining non-temporal X axes for plotting. In the following example, the PTEMP multigraph package is first plotted using the default X axis of radius (RZON). Then, using option 11 of the Top Node menu to redefine the X axis to be toroidal flux (TRFLX), PTEMP is plotted again.

This ability to change the X axis can also be invoked after taking Top Node menu option 6 (Draw a Profile Multigraph) at the prompts for "Package ID", "Integration Code" or "X-Axis". This feature is demonstrated in the example as the X axis is changed from TRFLX to PLFLX, the poloidal flux.

Some popular choices for the replacement of "radius" as the flux surface label are the following:

X	- normalized flux surface label (0 on the axis and 1 at the boundary. Intermediate surfaces enclose the fraction X**2 of the total enclosed toroidal flux.).
TRFLX	- enclosed toroidal flux
PLFLX	- enclosed poloidal flux
RMNMP	- "midplane" minor radius (half width of flux surface midplane intercept).

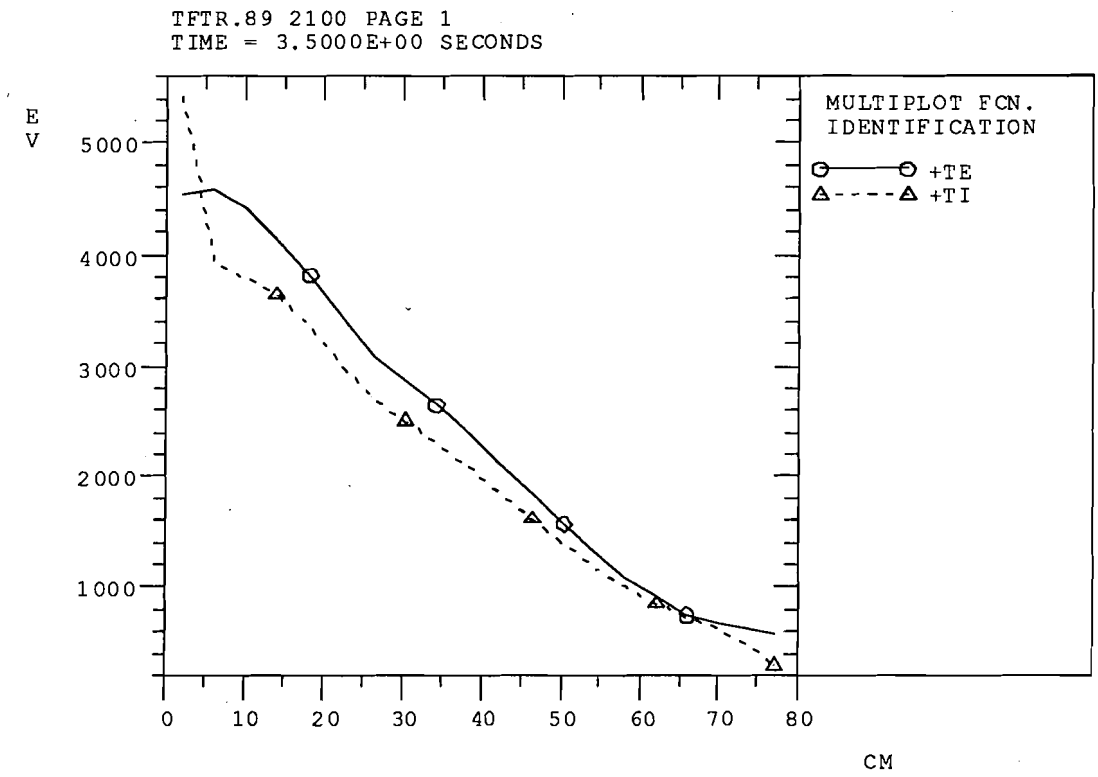
Example 2.1(M)

```
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS



*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
```

```
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
D  RUNDATA  .TFTR.89  2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
6

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]

 SUB:MULDRW >> ENTER PACKAGE ID:
PTEMP
```

```
  GROUP NAME:  PLASMA TEMPERATURES              EV
         VS:  RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
1


  GROUP NAME:  PLASMA TEMPERATURES              EV
         VS:  RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
```

```
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
1
 SUB: MULDRW >> ENTER FIXED TIME AT WHICH TO PLOT (E10.3):
3.5
[ GFLIB/SGLIB -- output to plot screen or file ]
```

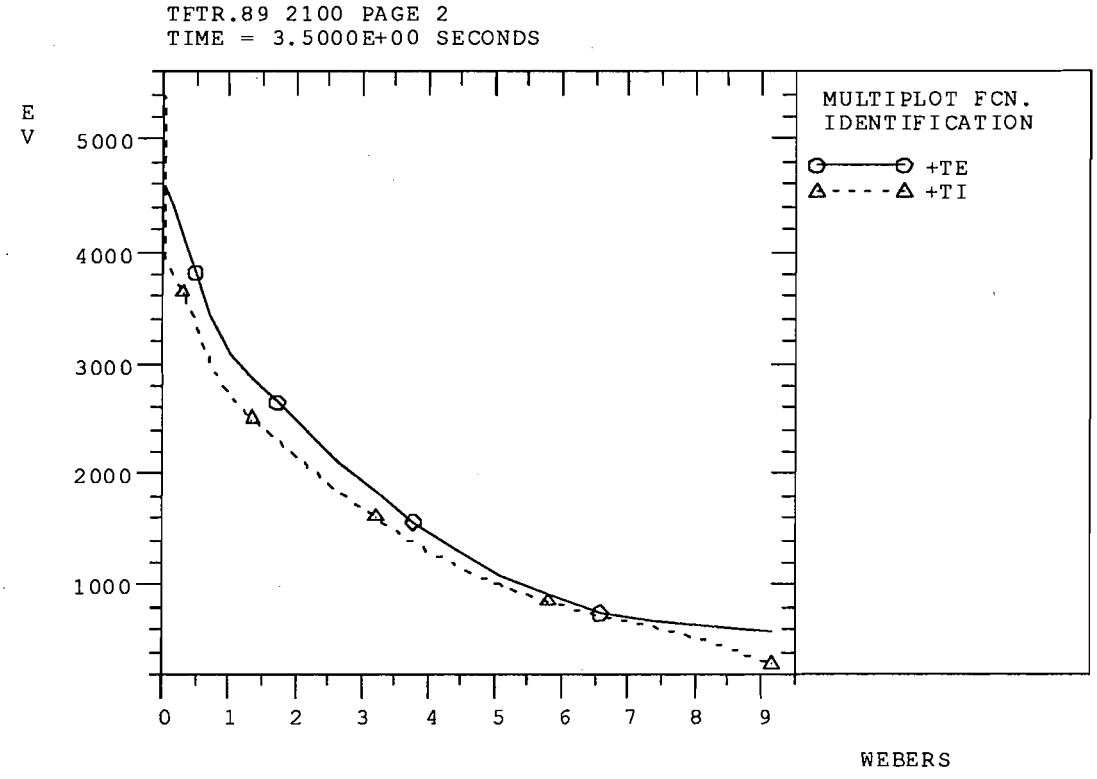


PLASMA TEMPERATURES (PTEMP) VS RADIUS (RZON)

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):    Q

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
```

```
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
11

 #  LABEL                              ABBREV.    F(T)?  MONOTONIC?
-------------------------------------------------------------------
 1A RADIUS                             RZON         T      T
 1B RADIUS                             RBOUN        T      T
 2  POL. ANGLE                         THETA        T      T
 3  ION ENERGY                         EION         T      T
 4  VPLL/V                             KSID         T      T
 5  NE POSITIONS                       POSNE        T      T
 6  TE POSITIONS                       POSTE        T      T
 7  MIDPLANE RADII                     RMAJM        T      T
 8  CX DECTECTOR ENERGY (DEUTERIUM)    ECXD         T      T
 9  CX DECTECTOR ENERGY (HYDROGEN)     ECXH         T      T
10  CHORD IND. (VB CHORDS)             IVISB        T      T
MAY ENTER X AXIS RPLOT ABBREV. ID INSTEAD OF # HERE:
FXPLOT:  ENTER # TO MODIFY X AXIS, 0 TO QUIT:
1
> ENTER "0" TO RESTORE DEFAULT DEFINITION
FXPLOT:  ENTER ID OF FUNCTION TO USE AS NEW X AXIS:
TRFLX

 #  LABEL                              ABBREV.    F(T)?  MONOTONIC?
-------------------------------------------------------------------
 1A TOROIDAL FLUX                      TRFLX        T      T
 1B TOROIDAL FLUX                      TRFLX        T      T
 2  POL. ANGLE                         THETA        T      T
 3  ION ENERGY                         EION         T      T
```

```
 4  VPLL/V                              KSID          T      T
 5  NE POSITIONS                        POSNE         T      T
 6  TE POSITIONS                        POSTE         T      T
 7  MIDPLANE RADII                      RMAJM         T      T
 8  CX DECTECTOR ENERGY (DEUTERIUM)     ECXD          T      T
 9  CX DECTECTOR ENERGY (HYDROGEN)      ECXH          T      T
10  CHORD IND. (VB CHORDS)              IVISB         T      T
MAY ENTER X AXIS RPLOT ABBREV. ID INSTEAD OF # HERE:
FXPLOT:  ENTER # TO MODIFY X AXIS, 0 TO QUIT:
0   6   PTEMP   1

  GROUP NAME:  PLASMA TEMPERATURES              EV
         VS:  TOROIDAL FLUX                     WEBERS
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. TOROIDAL FLUX (WEBERS), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. TOROIDAL FLUX (WEBERS), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. TOROIDAL FLUX (WEBERS), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
1
 SUB: MULDRW >> ENTER FIXED TIME AT WHICH TO PLOT (E10.3):
3.5
```

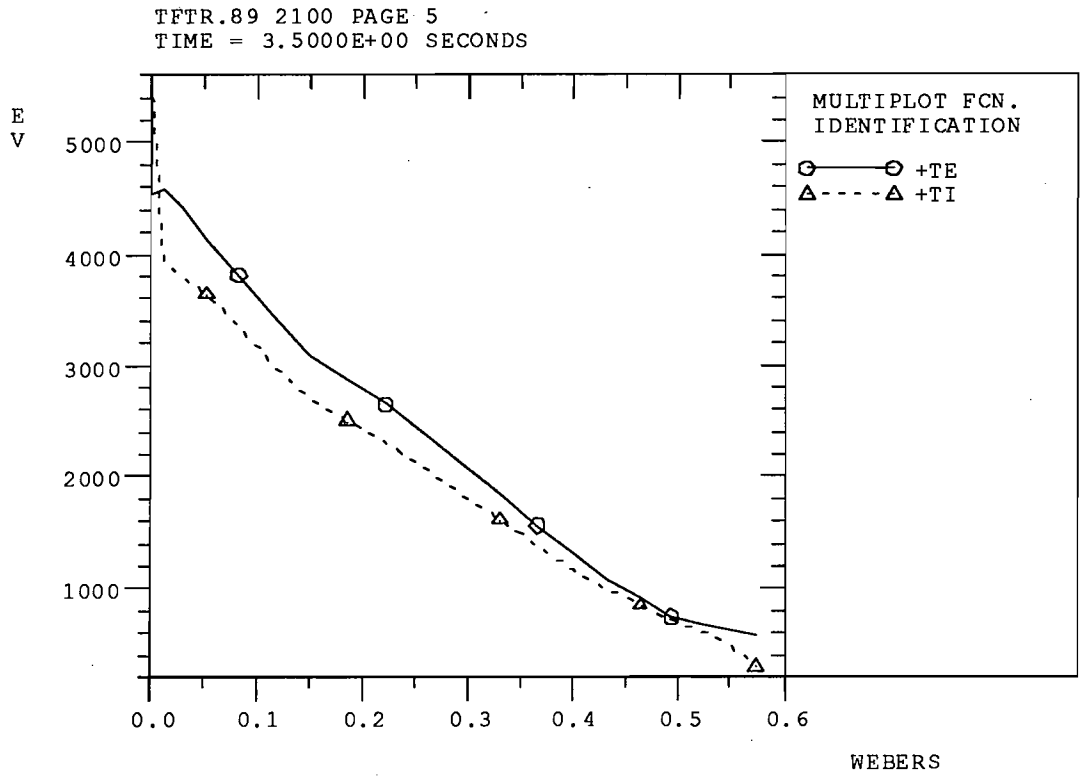


PLASMA TEMPERATURES (PTEMP) VS TOROIDAL FLUX (TRFLX)

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):  N


  GROUP NAME:  PLASMA TEMPERATURES                EV
          VS:  TOROIDAL FLUX                      WEBERS
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. TOROIDAL FLUX (WEBERS), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. TOROIDAL FLUX (WEBERS), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
```

```
(5) A PLOT VS. TOROIDAL FLUX (WEBERS), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
XAXIS

 #  LABEL                                ABBREV.    F(T)?  MONOTONIC?
-------------------------------------------------------------------
 1A TOROIDAL FLUX                        TRFLX        T      T
 1B TOROIDAL FLUX                        TRFLX        T      T
 2  POL. ANGLE                           THETA        T      T
 3  ION ENERGY                           EION         T      T
 4  VPLL/V                               KSID         T      T
 5  NE POSITIONS                         POSNE        T      T
 6  TE POSITIONS                         POSTE        T      T
 7  MIDPLANE RADII                       RMAJM        T      T
 8  CX DECTECTOR ENERGY (DEUTERIUM)      ECXD         T      T
 9  CX DECTECTOR ENERGY (HYDROGEN)       ECXH         T      T
10  CHORD IND. (VB CHORDS)               IVISB        T      T
MAY ENTER X AXIS RPLOT ABBREV. ID INSTEAD OF # HERE:
FXPLOT:  ENTER # TO MODIFY X AXIS, 0 TO QUIT:
1
> ENTER "0" TO RESTORE DEFAULT DEFINITION
FXPLOT:  ENTER ID OF FUNCTION TO USE AS NEW X AXIS:
PLFLX

 #  LABEL                                ABBREV.    F(T)?  MONOTONIC?
-------------------------------------------------------------------
 1A POLOIDAL FLUX                        PLFLX        T      T
 1B POLOIDAL FLUX                        PLFLX        T      T
 2  POL. ANGLE                           THETA        T      T
 3  ION ENERGY                           EION         T      T
 4  VPLL/V                               KSID         T      T
 5  NE POSITIONS                         POSNE        T      T
 6  TE POSITIONS                         POSTE        T      T
 7  MIDPLANE RADII                       RMAJM        T      T
 8  CX DECTECTOR ENERGY (DEUTERIUM)      ECXD         T      T
 9  CX DECTECTOR ENERGY (HYDROGEN)       ECXH         T      T
```

```
10  CHORD IND. (VB CHORDS)            IVISB         T      T
MAY ENTER X AXIS RPLOT ABBREV. ID INSTEAD OF # HERE:
FXPLOT:  ENTER # TO MODIFY X AXIS, 0 TO QUIT:
0


  GROUP NAME:  PLASMA TEMPERATURES                EV
         VS:  POLOIDAL FLUX                       WEBERS
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. POLOIDAL FLUX (WEBERS), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. POLOIDAL FLUX (WEBERS), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. POLOIDAL FLUX (WEBERS), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
1
 SUB: MULDRW >> ENTER FIXED TIME AT WHICH TO PLOT (E10.3):
3.5
```



PLASMA TEMPERATURES (PTEMP) VS POLOIDAL FLUX (PLFLX)

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):  Q  Q  Q
FORTRAN STOP
RAX$
RAX$
```

2.1(N) Miscellaneous 1: Special keyboard characters.

Certain nonstandard characters and combinations of characters are used to perform special functions when running RPLOT. These special characters fall into two classes: "system" characters that are universal to interactive I/O on the VAX, and "program" characters that allow special I/O functions known only to the RPLOT program. The system characters are listed first:

"Rub-out" or "del" key (the "delete" key on the Macintosh). This deletes the last character of the input line that the user has typed in, thus allowing for the correction of typographical errors.

Ctrl(U) is formed by depressing the CTRL key (the "control" key on the Macintosh) and the letter "U" simultaneously. The current input line is deleted.

Ctrl(R) types out the current input line as it is understood by the VAX. If a lot of rubouts have been employed, this shows the current status of the input line.

Ctrl(C) aborts the program. It can be restarted by typing "CONTINUE" to the monitor, provided that no other program is run which deletes the executing image of RPLOT.

Ctrl(O) suspends output. One can abort the drawing of a graph or the typing out of a table with this key-code.

Ctrl(S) suspends execution of RPLOT.

Ctrl(Q) resumes execution after a ctrl(S).

The codes "rub-out", Ctrl(U), and Ctrl(R) may be typed as one

enters input to RPLOT. The other codes may be typed at any time.

The non-system special characters are used by the FORTRAN I/O subroutines of RPLOT. These should be avoided unless one has familiarized himself with the advanced capabilities of RPLOT described in Subsection 2.2 below. These are:

">" open or close an indirect input file for output.

"@" open an indirect file for input.

"/" define or utilized a pre-defined character-substitution parameter.

";" initiates a comment line. The line is ignored.

2.1(O) Miscellaneous 2.

RPLOT top node option 9) allows the generation of an alphabetized index of graphs drawn from the current TRANSP run. This is mainly a feature for batch execution of RPLOT, where it is desirable to have an aid to locating particular graphs in a sheaf of hardcopy output containing say 200 graphs. Each graph when drawn has a page number; the numeric entries in the index refer to these page numbers. An interactive user might want to invoke this feature if sending a large number of plots to the hard copy printer. However, the index only covers the graphs drawn while examining the current run.

RPLOT's top node option 8) is the exit option. One may select either a new TRANSP run or quit altogether by entering a "0".

SECTION 2.2

RPLOT: ADVANCED CAPABILITIES

2.2 RPLOT: Advanced Capabilities

After one has had a little experience in running RPLOT, the structure of the program will be transparent. RPLOT is organized as a hierarchy of user options. Each time the program needs more information to continue executing, it prompts the user. The user's response determines uniquely RPLOT's subsequent course of action, up to and including its next prompt for information or instruction from the user. Some prompts are strictly informational, requesting the number of a TRANSP run, the ID of a function, or the scale of a graph. Most prompts, however, represent user-controlled branch points, or nodes, meaning that the user's response constitutes a selection amongst a variety of widely divergent options, usually corresponding to distinct subroutines in the RPLOT code. The user's choice determines whether RPLOT will take immediate action (e.g. draw a graph), or will move up or down in the hierarchy of options to a new node, in order to offer the user a new set of options.

The relative position of any RPLOT node in the hierarchy is determined by its proximity to the highest, the "top node", where options covering the widest range of RPLOT capabilities are offered.

This organization is adequate for producing a small number of graphs interactively. However, to mass-produce large numbers of graphs for a large number of cases it becomes repetitive to enter the same instructions again and again for each graph, as one repeatedly traverses the same path in the program's hierarchy of options. Therefore the user-input routines for RPLOT have been re-organized to enable the recording of a piece of the "conversation" between RPLOT and the user. This "conversation" will consist of both RPLOT prompts, which are unique for each node, and user instructions which result in the traversal from one particular node in RPLOT to another particular node. This conversation may be saved in a disk file which, later on, if one finds oneself at the same node at which the recorded "conversation" started, this "conversation" file may be invoked as a substitute for the user typing at the terminal, as the input control file for RPLOT. This is known as "indirect input". The result is the same as if the user had typed in the responses saved in the

"conversation" file, i.e. the same set of graphs is drawn. Furthermore, an indirect input file may itself invoke another indirect input file, in a manner similar to a FORTRAN subroutine calling another subroutine, and this is supported up to 10 levels. By using this technique one may create an indirect input file for RPLOT that results in the drawing of a certain set of graphs, set A. Next, a second indirect input file is created that results in the drawing a second set of graphs, set B. Then a master indirect input file is created that moves to the correct RPLOT node, invokes the instructions to draw the graphs of set A, moves again to the correct RPLOT node, invokes the instructions to draw the graphs in set B, and then moves to top node and exits. Then, one could run "RPLOT" to send output to the hard copy printer, and invoke the master indirect input file for a sequence of several TRANSP runs, and then quit. The result would be the same sets A and B of graphs for all the TRANSP runs. This is a handy technique for setting up to compare a sequence of runs.

The set of I/O routines that support user input and the creation of indirect input files are known collectively as the UREAD system (not to be confused with the UFILES numeric data file system). Extensive online help is available on UREAD by entering the command "*H" at any RPLOT prompt. The online help surveys UREAD features in more detail than is provided in this manual. UREAD is not unique to RPLOT, but is used in many interactive codes at PPPL.

Anytime one is running RPLOT, an indirect input file may be created, but only one indirect file at a time. As will be seen in the sample terminal sessions at the end of this subsection, the format for requesting the creation of an indirect input file is ">name", where name can be any alphanumeric character string which is a legal VAX file name; if the .ext in the file name is omitted, a default .ext extension is used. Thus for example the specification ">ZTEST" creates the file "ZTEST.TMI"; ".TMI" is RPLOT's default extension. The request to create an indirect input file is ignored as far as being a command to the graphics program RPLOT; after creating the file the same RPLOT prompt is active and a response is still expected. All RPLOT prompts and user responses are now recorded in the indirect input file, until the file is closed. To close the file just enter ">" (right angle bracket, carriage return). From the time of closing onward, the file ZTEST.TMI may be invoked as an input file to RPLOT, provided one

has reached the correct node, i.e. the same node at which ZTEST.TMI was created. When the correct node is reached the file is invoked by entering "@ZTEST"; the ".TMI" can be left off since it is the default extension. Then all the commands to RPLOT that were recorded in ZTEST.TMI are executed again. Moreover, the meta-command "@ZTEST" may be invoked while creating a further indirect input file; in other words, indirect input files may reference indirect input files. There is a limit of 10 levels of "indirectness" which are supported in this manner. At the end of this section an example of an indirect input file, "QKDAT2.TMI", which invokes another indirect input file, "QKDAT.TMI", is shown. The terminal session wherein the file "QKDAT.TMI" was created is also shown.

Occasionally it is desirable to have "parameters" in the indirect input files rather than fixed responses, so that the same indirect input file may be invoked but with the value of one of its parameters changed so that what the file does is slightly different. The file "QKDAT.TMI" has such a parameter, "NRUN", which specifies which TRANSP run to access to draw the same pair of multigraphs. Parameters for an indirect input file are defined when the file is created. This is done by entering "/<parameter name>" in response to the RPLOT prompt, the answer to which it is desired to have under parameter control. <Parameter name> may consist of up to 10 alphanumeric characters with no imbedded blanks. The form "/<parameter name>" will be saved in the indirect file being created, and holds the place of the response to the current prompt; meanwhile RPLOT will prompt further, if necessary, for the current value of the parameter. Parameter values are arbitrary character strings of length at most 10 characters (restriction: a parameter value may not be an indirect input file reference). An indirect input file may contain up to 50 parameters. After creation of the indirect file with parameters, the indirect file may be referenced with a command of the form

"@<filename>/<name1>=<value1>/<name2>=<value2>..."

where <filename>.TMI is the name of the indirect file and <name1>,<name2>, etc. are the parameter names, and <value1>, <value2>, etc. are the corresponding parameter values. Examples of this form of invocation of an indirect input file are shown at the end of this section in the file "QKDAT2.TMI". The parameter values are defined for the specified indirect input file only. An alternative form of setting the value of a parameter is to specify

"/<parameter name> = <parameter value>"

at any time when RPLOT is expecting user input. This does not constitute a response to RPLOT but sets up the parameter named <parameter name> to have the value <parameter value> as a "global" parameter such that if the string "/<parameter name> (carriage return)" is encountered at any level of direct or especially indirect input, the form /<parameter name> will be replaced by the assigned parameter value <parameter value>, and that will be treated as the current response to the current RPLOT prompt. This substitution occurs only on input; the form "/<parameter name>" is always retained in any output ".TMI" file for maximal flexibility. An example of the usage of parameters in this form is also shown in the files "QKDAT.TMI" and "QKDAT2.TMI" below.

It is possible to insert comments to document a ".TMI" file or the parameters it contains. This is done by typing in a line which begins with a semicolon (";") when the .TMI file is being created. Lines commencing with a semicolon are ignored as far as being input to RPLOT, but are recorded in the TMI file.

In order that RPLOT may execute a TMI file and be sure that the commands contained therein line up correctly with a corresponding sequence of RPLOT prompts, the TMI file must contain at each node an exact replica of the one line prompt that RPLOT sends to the terminal immediately preceding acceptance of input. If the correct prompt is not found in an indirect input file, the error message "PROMPT MIS-MATCH" is generated, and commands in the indirect input file are skipped while the file is searched for a matching prompt. This error should not occur except when, by user error, an indirect input file is invoked from the wrong node. On rare occasions, however, the form of a particular prompt in RPLOT may change, in which case all TMI files containing the old version of the prompt will be invalidated. It is usually a simple matter to fix the affected TMI file using a text editor. Prompts are recorded in TMI files beginning with a semicolon (";") and delimited by a dollar-sign ("$").

Using the combination of indirect input files and parameters

allows a considerable easing of the task of creating large numbers of similar sets of graphs from RPLOT, once one understands the technique. In the example below, the creation of indirect input file "QKDAT.TMI" is shown, and "QKDAT.TMI" and "QKDAT2.TMI" are used to generate central temperature and line average density plots vs. time from a single TRANSP run for several TFTR beam-heated cases that has been analyzed by TRANSP.

Finally, an example is given on how to spool the graphics output from an RPLOT task to a file by defining a logical file name to accept PLOT data. This file can then be sent to the VAX laser printer.

If one has an application of RPLOT which involves execution of repetitive sequences and/or generation of large numbers of similar graphs or sets of graphs, one may want to use these techniques.

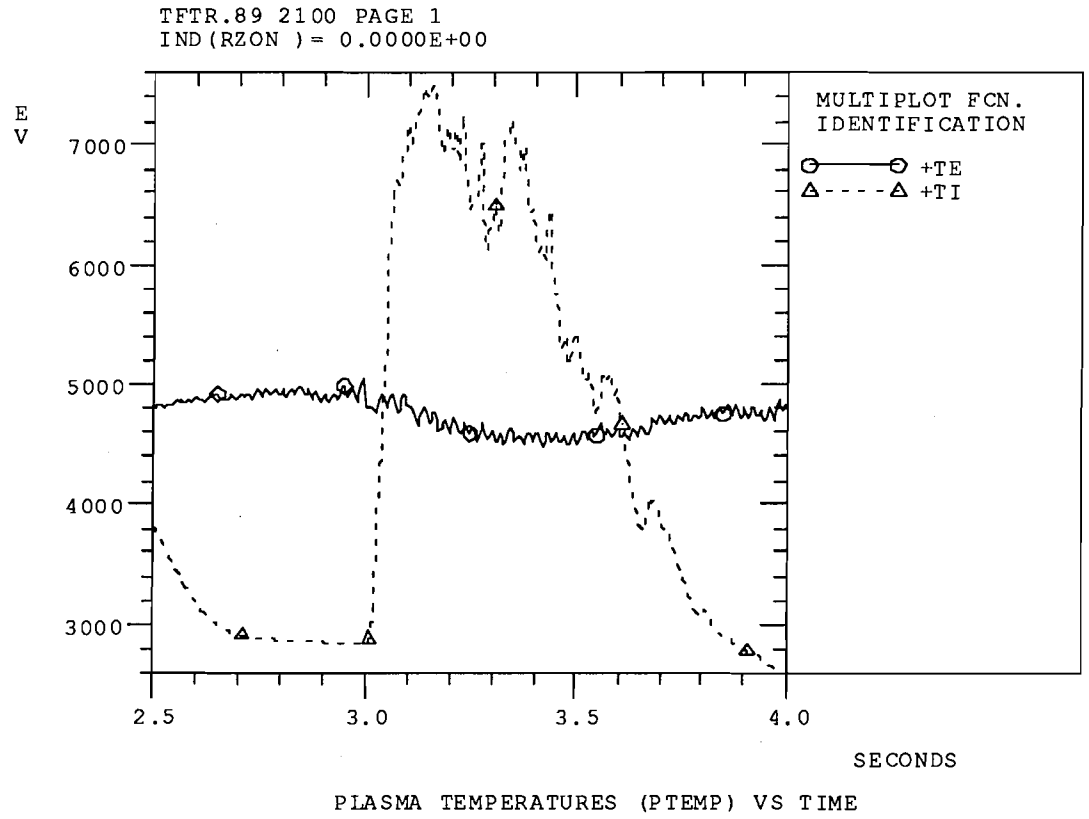
Example 2.2 (A)

```
RAX$
RAX$ SET  DEFAULT    RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
>QKDAT
>CREATING UREAD FILE "QKDAT.TMI"
```

```
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
/NRUN
% UNDEFINED UREAD STRING PARAMETER "NRUN" ENCOUNTERED.
  ENTER VALUE (MAX 48 CHARACTERS):2100

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
6

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]

 SUB:MULDRW >> ENTER PACKAGE ID:
PTEMP


  GROUP NAME:  PLASMA TEMPERATURES              EV
```

```
         VS:  RADIUS                              CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
1


  GROUP NAME:  PLASMA TEMPERATURES             EV
         VS:  RADIUS                           CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
```

```
2
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
 SUB:  MULDRW  >> ENTER FIXED X VALUE AT WHICH TO PLOT (E10.)
I0
```



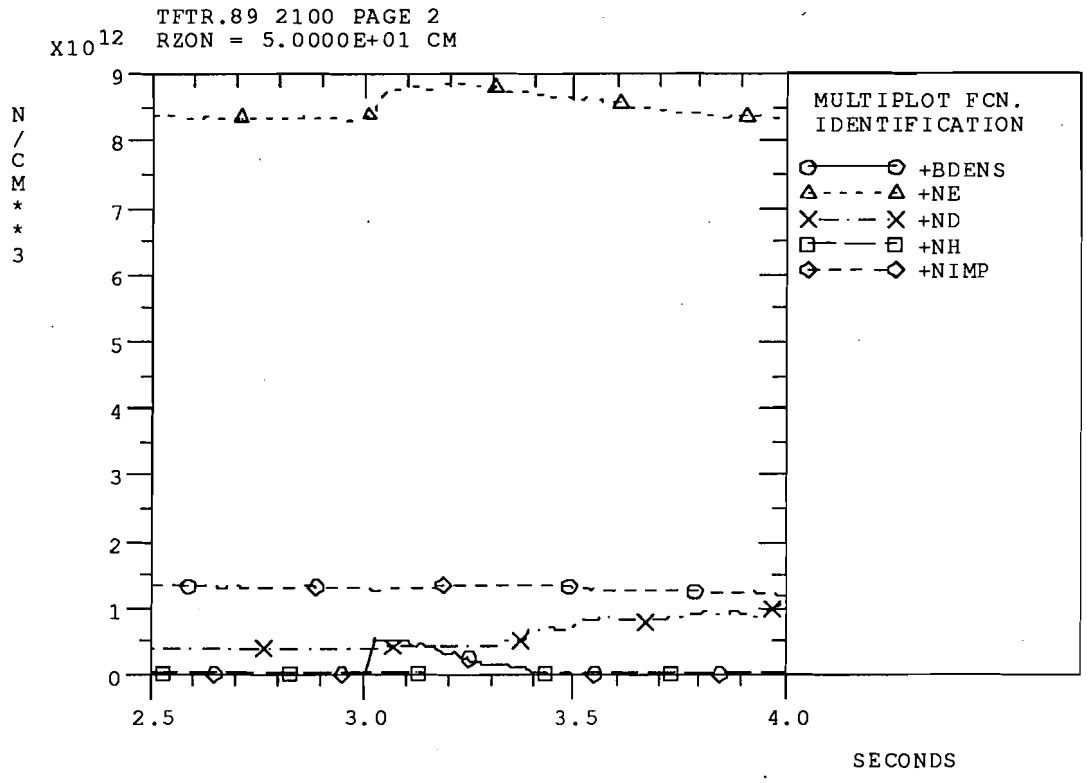
PLASMA TEMPERATURES (PTEMP) VS TIME

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):   N
```

```
  GROUP NAME:  PLASMA TEMPERATURES              EV
         VS:  RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
0

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]

 SUB:MULDRW >> ENTER PACKAGE ID:
PDENS


  GROUP NAME:  PLASMA DENSITIES                 N/CM**3
         VS:  RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

> DO YOU WANT:  [... TYPE "H" FOR HELP]
(1) A GRAPH OF THE FUNCTIONS THEMSELVES
(2) A GRAPH OF THE FUNCTIONS' VOLUME INTEGRALS
```

```
(3) A GRAPH OF THE FUNCTIONS' FLUX INTEGRALS
(4) A GRAPH OF THE FUNCTIONS' AREA INTEGRALS
(5) A GRAPH OF THE FUNCTIONS LINE-AVERAGED X0 TO X
(6) A GRAPH OF THE FUNCTIONS VOLUME-AVERAGED X0 TO X
(7) A GRAPH OF THE FUNCTIONS RMS VOLUME AVERAGED X0 TO X
(8) A GRAPH OF THE FCNS' DBL. INVERSE LINE AVG X0 TO X
(9) A GRAPH OF THE FCNS' DBL. INVERSE VOL. AVG X0 TO X
***  ENTER "0" FOR A DIFFERENTIAL TRANSFORMATION OF FCNS
*NEW ENTER "R" FOR PROFILE RENORMALIZATION OPTIONS E.G. H(R)

==> ENTER NEGATIVE OPTION NO. TO CONTROL LOWER LIMIT OF
    INTEGRATION (DEFAULT INTEGRATION STARTS AT MAGNETIC AXIS)

 SUB:MULDRW >> ENTER INTEGRATION CODE:
1

  GROUP NAME:  PLASMA DENSITIES                N/CM**3
         VS:   RADIUS                          CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS


 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
2
> SPECIFY ABSOLUTE X VALUE, OR LETTER "I", "N" OR "R" FOLLOWED
BY A NUMBER BETWEEN 0 AND 1:
 "I" = "INDICIAL": 0= "FIRST ZONE" ... 1= "LAST ZONE"
 "N" = "NORMALIZED": "N0.7" MEANS TAKE .7*MAX(X) AS FIXED X AT EACH TIME
 "R" = "RELATIVE": "R.1" MEANS TAKE X VALUE 1/10TH OF WAY FROM
       MIN TO MAX AT EACH TIME
```

```
 SUB:  MULDRW  >> ENTER FIXED X VALUE AT WHICH TO PLOT (E10.)
50
```



PLASMA DENSITIES (PDENS) VS TIME

```
GRAOPT - OPTIONS AFTER PLOT:
   ENTER "C" TO SEE THE ENTIRE MENU
GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):   N

  GROUP NAME:  PLASMA DENSITIES                  N/CM**3
          VS:  RADIUS                            CM
  TIME RANGE:   2.5010E+00 TO  4.0000E+00 SECONDS

 DO YOU WANT:
(1) A PLOT VS. RADIUS (CM), AXES AS PER DEFAULT SETTINGS
(2) A PLOT VS. TIME (SECONDS), AXES AS PER DEFAULT SETTINGS
(3) A PLOT VS. RADIUS (CM), LOG(Y) AXIS FORCED
(4) A PLOT VS. TIME (SECONDS), LOG(Y) AXIS FORCED
(5) A PLOT VS. RADIUS (CM), LINEAR(Y) AXIS FORCED
(6) A PLOT VS. TIME (SECONDS), LINEAR(Y) AXIS FORCED
```

```
>> ENTER A NUMBER BETWEEN 1 AND 8,
   OR ANY OTHER NUMBER TO GET A NEW PACKAGE
   ENTER "SCALE" TO CONTROL AXES/SCALING DEFAULTS
   ENTER "I" TO CHANGE INTEGRATION CODE
 SUB:MULDRW >> CHOOSE X-AXIS
0

ENTER PROFILE MULTIGRAPH PACKAGE ID OR "0" TO QUIT, OR:
  "LIST " FOR SELECTIVE LIST OF MULTIGRAPH PACKAGES
  "SCALE" TO CHANGE SCALING DEFAULTS ON 2D PLOTS
  "AVG  " TO INVOKE TIME AVERAGING OF PLOTS
  "XAXIS" TO MODIFY NON-TEMPORAL X AXIS DEFINITIONS

[NOTE THESE COMMANDS MAY ALSO BE INVOKED FROM THE NODES
"ENTER INTEGRATION CODE" OR "CHOOSE X-AXIS"]

 SUB:MULDRW >> ENTER PACKAGE ID:
Q

$TOP NODE  OPTIONS:
(1) GENERATE TABLE OF CONTENTS (LIST OF SELECT NAMES)
(2) GRAPH SCALAR FUNCTIONS AND MULTIGRAPHS VS. TIME
(3) GRAPH FUNCTIONS OF TIME AND ADDL. COORDINATE
(4) LIST CONTENTS OF SELECT MULTIGRAPH PACKAGES
(5) ADD/DELETE A SCALAR OR PROFILE MULTIGRAPH PACKAGE
(6) DRAW A PROFILE MULTIGRAPH
(7) READ/RECORD COMMENTS ON THIS TRANSP RUN
(8 OR "Q") QUIT
(9) CREATE INDEX OF GRAPHS DRAWN SO FAR
(10) CHANGE THE NAME (OR ABBREV.) OF A FUNCTION
(11) REDEFINE NON-TEMPORAL X AXES FOR PLOTTING
(12) RESET LISTING SELECTOR SUBSTRING (CURRENTLY "*          ";
 "*" DENOTES WILDCARD; "["/"]" DENOTE START/END-OF-STRING)
(13) PLOT THE PLASMA MHD EQUILIBRIUM
(14) SET SCALING DEFAULTS
(15) READ/EXTRACT UFILES TIME SERIES DATA FOR SCALAR MULTIPLOT
(16) COMPUTE OR READ/WRITE 2D UFILE OF USER F(X,T) PLOT DATA

 SUB:MAIN   ENTER OPTION NUMBER:
8
```

```
*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  "2100  "]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
 >
% OUTPUT FILE "QKDAT.TMI " CLOSED
% NO MORE OUTPUT FILES OPEN
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
0
FORTRAN STOP
RAX$
RAX$
```

Example 2.2 (B)

This is an example of an indirect input file to RPLOT which was produced by ">QKDAT" in RPLOT.

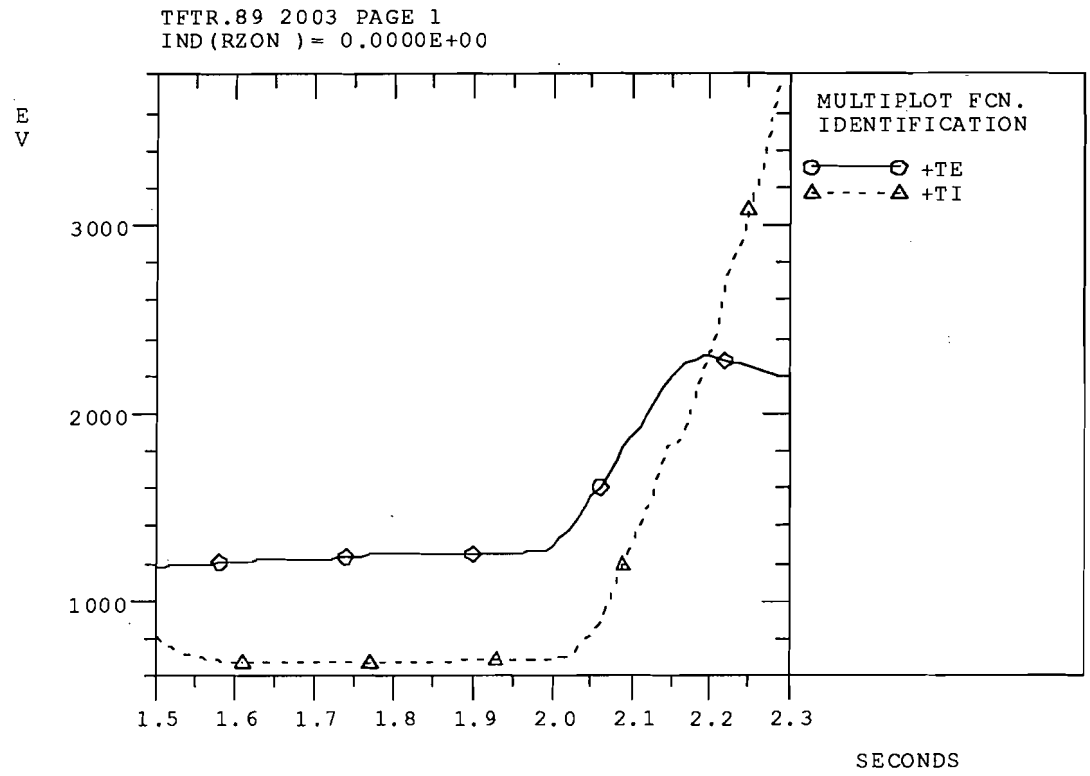
```
RAX$
RAX$
RAX$ SET  DEFAULT  RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ TYPE   QKDAT.TMI
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
/NRUN
; SUB:MAIN   ENTER OPTION NUMBER:$
6
; SUB:MULDRW >> ENTER PACKAGE ID:$
PTEMP
; SUB:MULDRW >> ENTER INTEGRATION CODE:$
1
; SUB:MULDRW >> CHOOSE X-AXIS $
2
; SUB:  MULDRW  >> ENTER FIXED X VALUE AT WHICH TO PLOT (E10.)$
```

```
I0
;GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):$
N
; SUB:MULDRW >> CHOOSE X-AXIS $
0
; SUB:MULDRW >> ENTER PACKAGE ID:$
PDENS
; SUB:MULDRW >> ENTER INTEGRATION CODE:$
1
; SUB:MULDRW >> CHOOSE X-AXIS $
2
; SUB:  MULDRW  >> ENTER FIXED X VALUE AT WHICH TO PLOT (E10.)$
50
;GRAOPT:  ENTER ONE LETTER OPCODE (...A/S/X/Z/G/P/Q):  $
N
; SUB:MULDRW >> CHOOSE X-AXIS $
0
; SUB:MULDRW >> ENTER PACKAGE ID:$
0
; SUB:MAIN   ENTER OPTION NUMBER:$
8
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
>
RAX$
RAX$
RAX$
```

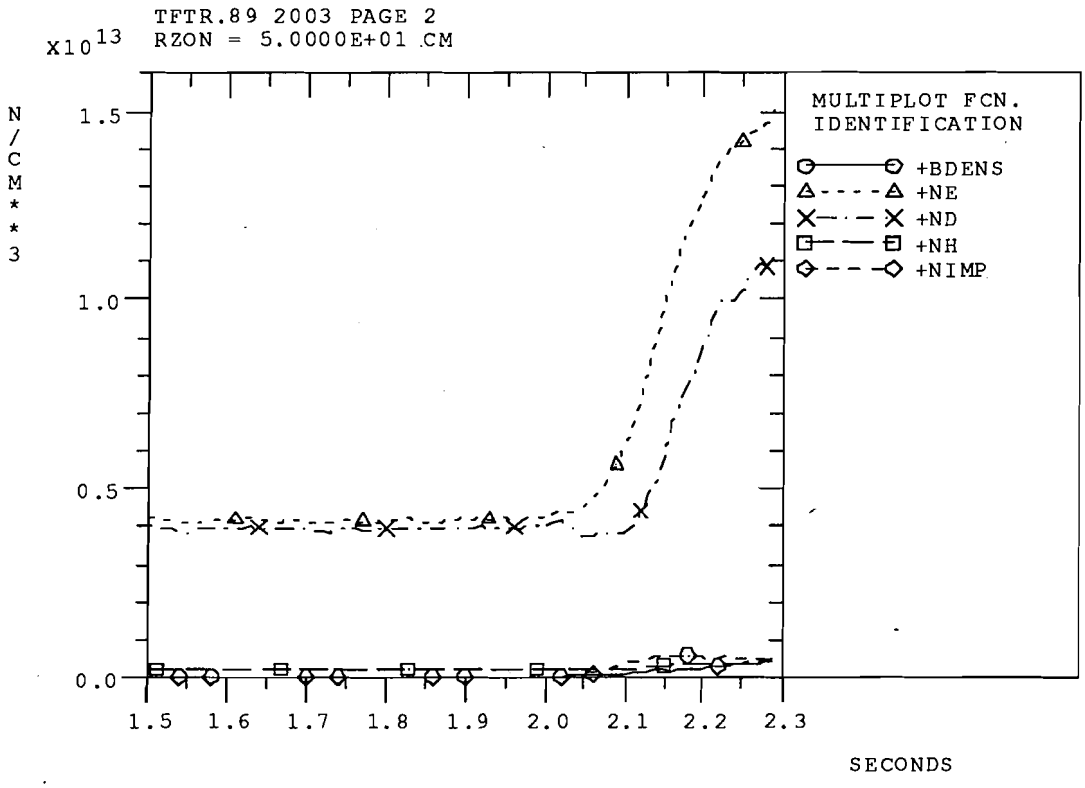
Example 2.2 (C)

This is an example of how the recently created indirect input file, QKDAT.TMI is used to make graphs from several TRANSP runs. A secondary indirect input file QKDAT2.TMI is created in this task.

```
RAX$
RAX$
RAX$ SET  DEFAULT  RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
>QKDAT2
>CREATING UREAD FILE "QKDAT2.TMI"
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
@QKDAT/NRUN=2003
@FILENAME=QKDAT.TMI
```

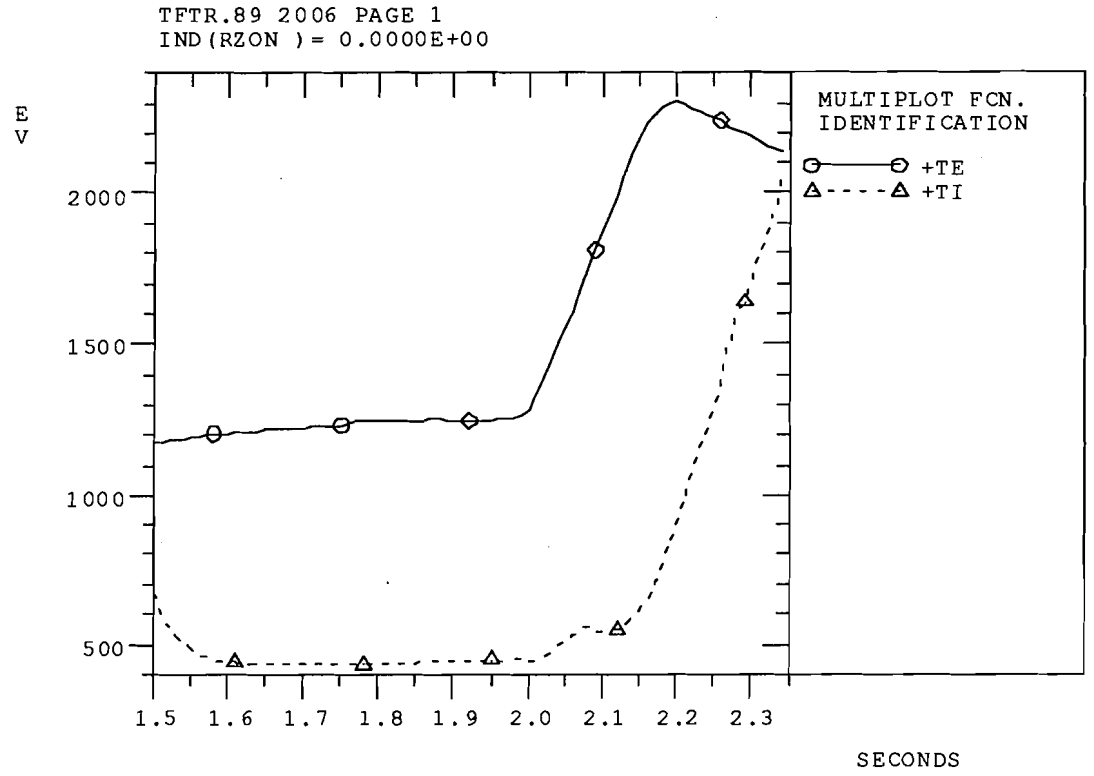


PLASMA TEMPERATURES (PTEMP) VS TIME

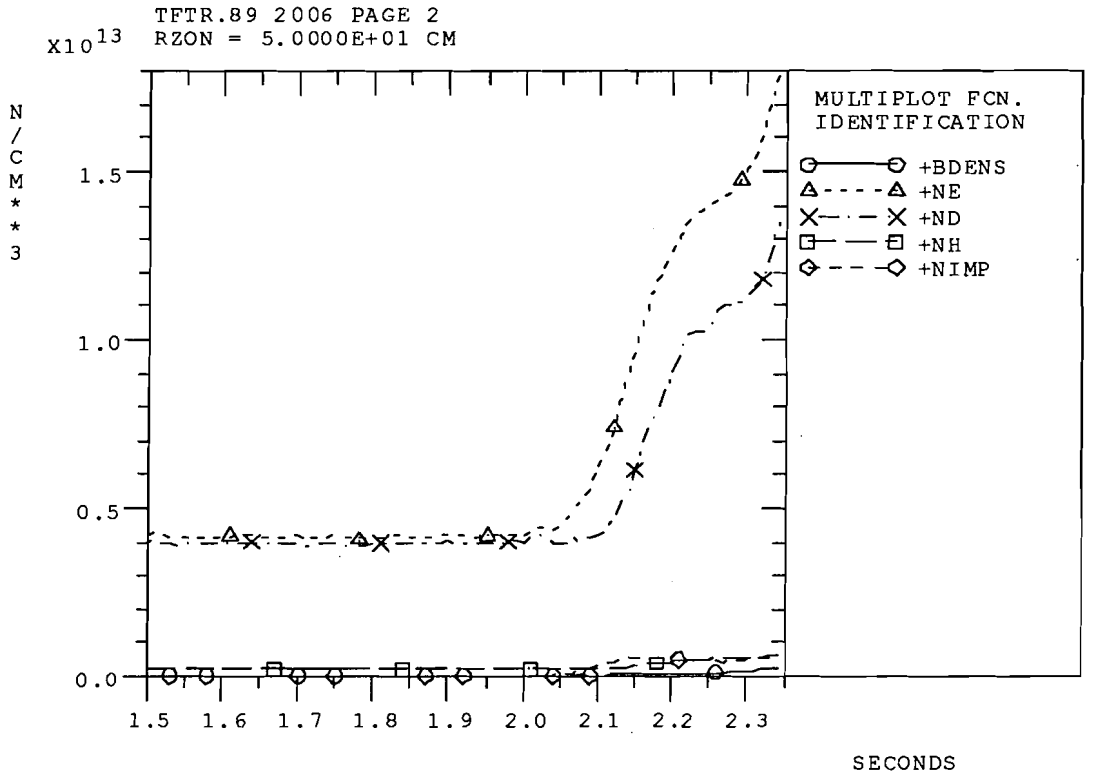


PLASMA DENSITIES (PDENS) VS TIME

```
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT

@QKDAT/NRUN=2006

@FILENAME=QKDAT.TMI [INTERNAL]
```

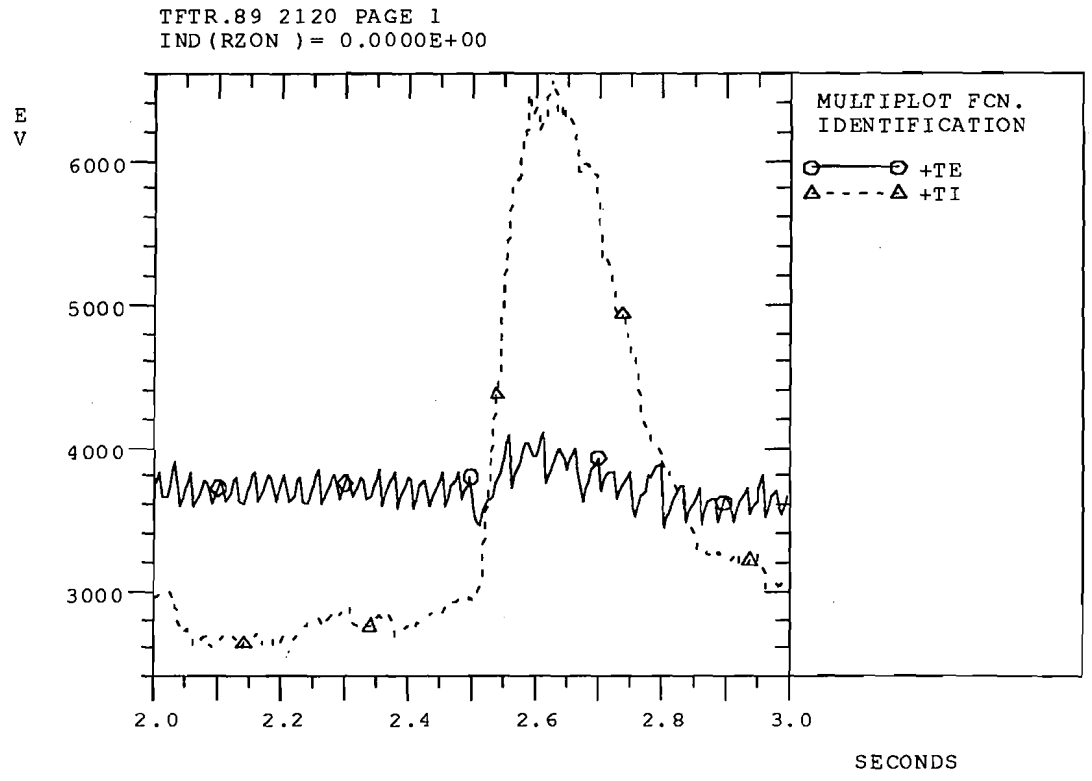


PLASMA TEMPERATURES (PTEMP) VS TIME

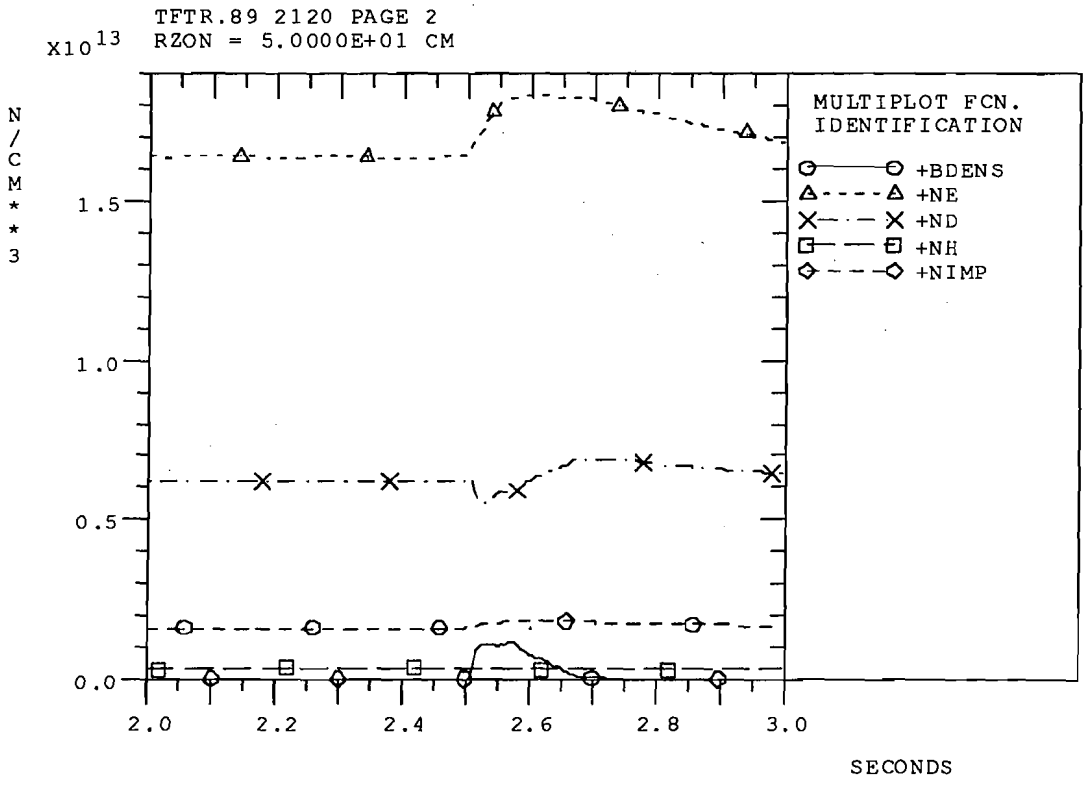


PLASMA DENSITIES (PDENS) VS TIME

```
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
/NRUN==2120
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
@QKDAT

@FILENAME=QKDAT.TMI [INTERNAL]
```

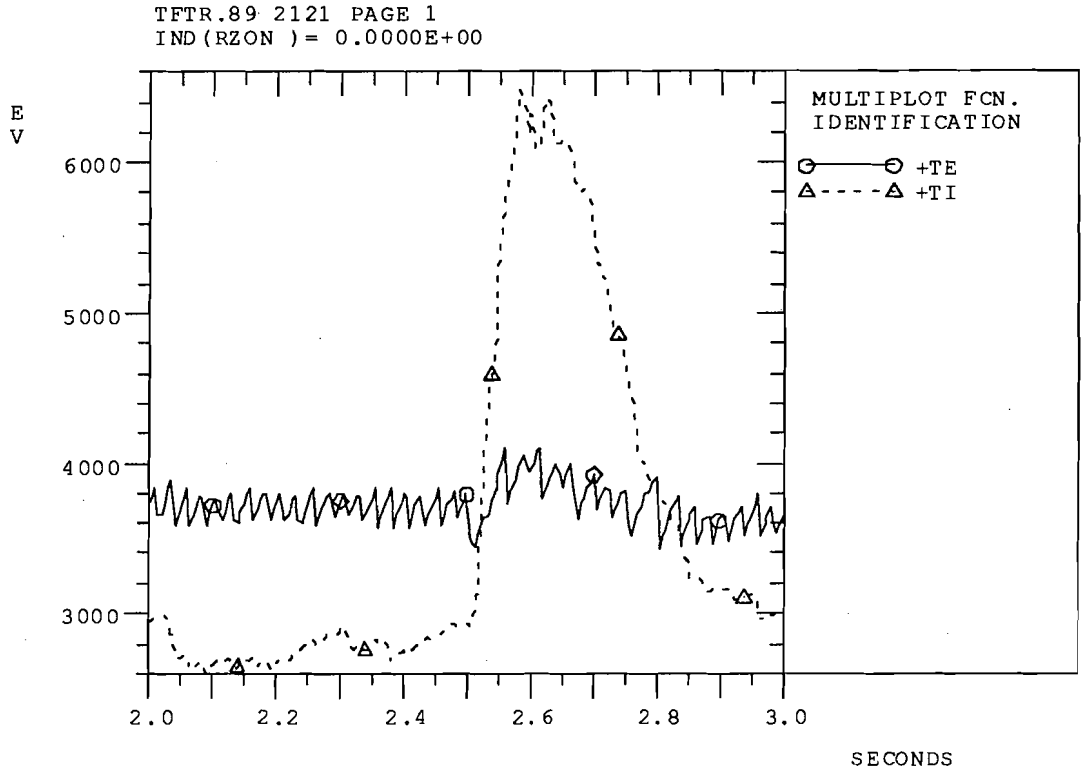


PLASMA TEMPERATURES (PTEMP) VS TIME

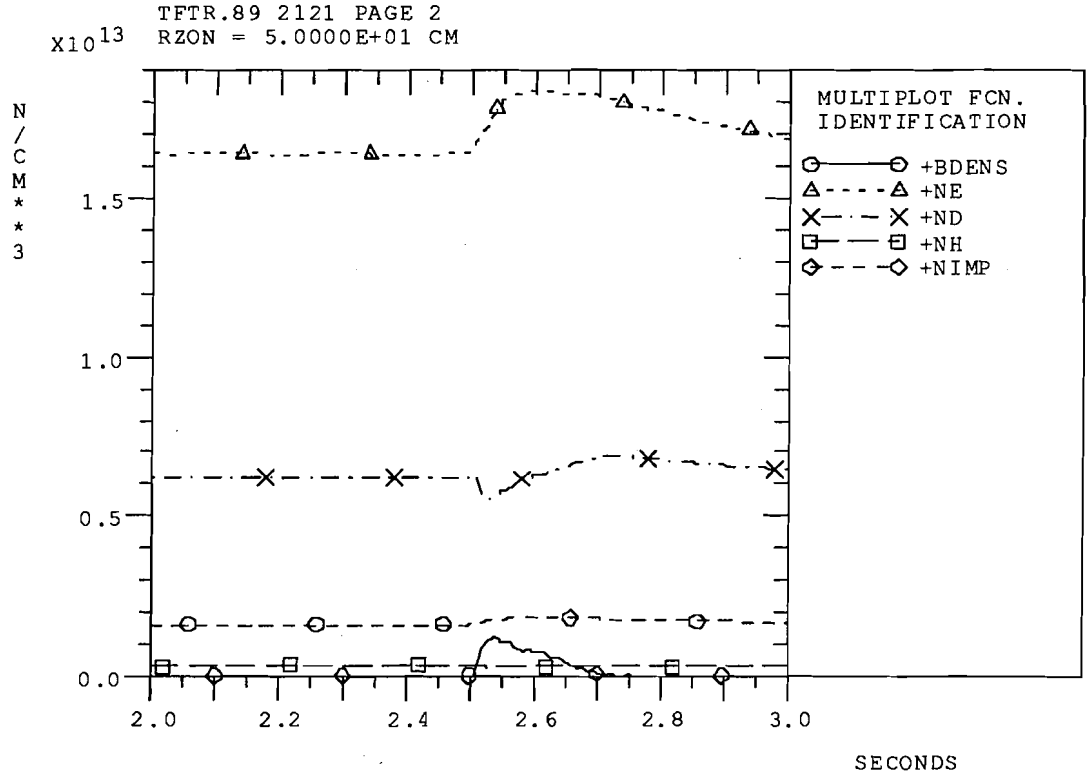


PLASMA DENSITIES (PDENS) VS TIME

```
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
/NRUN==2121
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
@QKDAT

@FILENAME=QKDAT.TMI [INTERNAL]
```



PLASMA TEMPERATURES (PTEMP) VS TIME



PLASMA DENSITIES (PDENS) VS TIME

```
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
 >
% OUTPUT FILE "QKDAT2.TMI " CLOSED
% NO MORE OUTPUT FILES OPEN
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
0
FORTRAN STOP
RAX$
RAX$
RAX$
RAX$
```

Example 2.2 (D)

Below is the listing of the secondary indirect input file QKDAT2.TMI and its use within RPLOT. The example run of RPLOT would produce the same eight graphs produced for the previous run above.

```
RAX$
RAX$
RAX$
RAX$ SET  DEFAULT  RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ TYPE  QKDAT2.TMI
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
@QKDAT/NRUN=2003
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
@QKDAT/NRUN=2006
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
/NRUN==2120
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
@QKDAT
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
/NRUN==2121
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
@QKDAT
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
;*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT$
>
RAX$
RAX$
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
```

```
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
@QKDAT2
@FILENAME=QKDAT2.TMI
[ GFLIB/SGLIB -- output to plot screen or file ]
% END OF INPUT FILE:  QKDAT2.TMI

*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
0
FORTRAN STOP
RAX$
RAX$
RAX$
```

Example 2.2 (E)

Below is an example of spooling the plots generated in RPLOT to a disk file, MANYPLOTS.PLT, and then printing the graphs to the default VAX laser printer.

```
RAX$
RAX$
RAX$ SET  DEFAULT    RUNDATA:[TRANSP.TFTR.89]
RAX$
RAX$ DEFINE   PLOT   MANYPLOTS.PLT
RAX$
RAX$ RPLOT

RPLOT - VERSION 2.06 - FEBRUARY 28, 1990 - TBT
        DIRECTORY PRINTED ON TABLE OF CONTENTS

*ENTER "D " TO SET DISK AND DIRECTORY FOR PLOT DATA
*ENTER "W " TO SET MINIMUM RPLOT MEMORY WORKSPACE SIZE,
 CURRENTLY ISMIN= 16384
CURRENT DISK:  RMS DEFAULT
CURRENT DIRECTORY:  RMS DEFAULT

[OLD VALUE:  ""]
*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
@QKDAT2
@FILENAME=QKDAT2.TMI
[ GFLIB/SGLIB -- output to plot screen or file ]
% END OF INPUT FILE:  QKDAT2.TMI

*RPLOT* MAIN:  ENTER RUN ID (MAX 8 CHARS) OR 0 TO QUIT
0
FORTRAN STOP
RAX$
RAX$ PRINT    MANYPLOTS.PLT
Job MANYPLOTS (queue RL0, entry 444) started on RL0_LPA0
RAX$
RAX$
```

SECTION 3.

ACCESSING TRANSP DATA WITH SUBROUTINES TRSCALAR & TRPROFIL

3. Accessing TRANSP Data with Subroutines

For users who want to use TRANSP data within their own separate FORTRAN programs, two subroutines are available: TRSCALAR and TRPROFIL. These subroutines respectively read a scalar, f(t), and a profile, f(x,t), from a TRANSP data file. Calling lists for both routines are below. The source is stored in the TRANSP CMS/MMS system on the VAX cluster. These routines are included in a VAX library with the pathname

HX3:[TRANSP.OBJ.LIB]TRREAD.OLB

Other libraries needed are:

HX3:[TRANSP.OBJ.LIB]TR_VAXDATA.OLB
USR:[LIB]JUKELIB_SHR.OLB

They can be incorporated into a VAX LINK command in the following manner:

```
$HAX   LINK   PLOTTER,HX3:[TRANSP.OBJ.LIB]TRREAD/LIBRARY,-
_HAX$         TR_VAXDATA/LIBRARY,USR:[LIB]JUKELIB_SHR/LIBRARY
```

where it is assumed that the object code for the main program, PLOTTER, is contained in the local directory in a file called PLOTTER.OBJ. Any other libraries that are needed can be concatenated onto the end of the link statement:

...,LIB1/LIBRARY,LIB2/LIBRARY...

A hyphen, "-", at the end of a VAX/VMS line will allow continuation of a long statement onto the next line.

```
C       ***************** START FILE  TRSCALAR.FOR  ;  GROUP  TRREAD_LIB ******
C     IN LIBRARY HX3:[TRANSP.OBJ.LIB]TRREAD.OLB

      SUBROUTINE  TRSCALAR( DISK,
     1                      DIR,     RUNID, ABBREV, MAXTIMES,
     2                      LABEL,   UNITS,
     3                      NTIMES,  TIMES, SDATA,  IERR     )
```

```
C       SUBROUTINE TRSCALAR READS IN A SPECIFIED SCALAR FUNCTION AND ASSOCIATED
C                          TIMES, LABEL AND UNITS FROM A TRANSP RUN.

C       ARGUMENTS:
C                  NOTE 1: UNIT LUN (77) IS USED TO READ IN TRANSP FILES.
C                  NOTE 2: UNIT LUOUT (6) IS USED TO OUTPUT ERROR MESSAGES.


C          INPUT:  DISK     - CHARACTER*64 DISK NAME WHERE DATA IS LOCATED.
C                             IF DISK=' ', ASSUME NAME IS LOGICAL DISK "RUNDATA"
C                  DIR      - C*64 FILE DIRECTORY, E.G. 'TRANSP.TFTR.86  '
C                             NO '[' OR ']' ALLOWED.
C                  RUNID    - C*8 VARIABLE DEFINING THE RUNID, E.G. '4058  ' or '12345A01'
C                             DIR & RUNID WILL BE USED TO MAKE TRANSP FILE NAMES
C                              E.G. 'RUNDATA:[TRANSP.TFTR.86]4058MF.PLN    '
C                                   'RUNDATA:[TRANSP.TFTR.86]4058TF.PLN    '
C                                   'RUNDATA:[TRANSP.TFTR.86]4058NF.PLN    '
C                  ABBREV   - C*10 ABBREVIATION OF THE SCALAR TO READ IN.
C                  MAXTIMES - INTEGER DIMENSION OF ARRAY TIMES.

C          RETURNED:
C                  LABEL    - C*32 LABEL FOR SCALAR
C                  UNITS    - C*16 UNITS OF SCALAR
C                  NTIMES   - INTEGER # OF TIMES READ IN FROM TRANSP FILE.
C                  TIMES    - REAL ARRAY OF DIMENSION MAXTIMES INTO WHICH
C                             TIMES ARE READ FROM DISK.
C                  SDATA    - REAL ARRAY OF DIMENSION MAXTIMES INTO WHICH NTIMES
C                             SCALAR VALUES ARE READ.


C                  IERR     - INTEGER ERROR MESSAGE. RETURNED = 0 IF OK.
C                               0 = OK
C                               2 = ERROR READING NF FILE.
C                               3 = UNEXPECTED EOF READING NF FILE.
C                               5 = TRIED TO READ OLD FORMAT TF FILE.
C                              15 = SCALAR ABBREVIATION NOT FOUND
C                              16 = COULDN'T OPEN NF FILE
C                              17 = COULDN'T OPEN TF FILE
C                             102 = # OF SCALARS > DIMENSION OF BUFFER.
```

```
C                              NO DATA READ IN.
C                         101 = # OF TIMES IN  FILE > MAXTIMES.
C                              MAXTIMES TIMES WERE READ IN.

      IMPLICIT NONE

      INTEGER    NAXFOT
      PARAMETER (NAXFOT=750)     ! MAXIMUM # OF SCALAR FUNCTIONS




C     ***************  START FILE TRPROFIL.FOR  ;  GROUP TRREAD_LIB  ********
C     IN LIBRARY HX3:[TRANSP.OBJ.LIB]TRREAD.OLB.

      SUBROUTINE  TRPROFIL( DISK,
     1                      DIR,     RUNID, ABBREV, MAXTIMES, MAXDATA,
     2                      LABEL,   UNITS, ITYPE,  INX,
     3                      NTIMES,  TIMES, DATA,   IERR     )

C     SUBROUTINE TRPROFIL READS IN A SPECIFIED FUNCTION OF TIME AND
C                         ANOTHER COORDINATE AS WELL AS THE ASSOCIATED
C                         TIMES, LABEL AND UNITS FROM A TRANSP RUN.

C     ARGUMENTS:
C               NOTE 1: UNIT LUN (77) IS USED TO READ IN THE TRANSP FILES.
C               NOTE 2: UNIT LUOUT (6) IS USED TO OUTPUT ERROR MESSAGES.


C        INPUT: DISK     - C*64 DISK WHERE DATA RESIDES.
C                          IF = ' ', ASSUME LOGICAL DISK "RUNDATA"
C               DIR      - C*64 FILE DIRECTORY, E.G. 'TRANSP.TFTR.86'
C                          NO '[' OR ']' IS ALLOWED IN DIRECTORY.
C               RUNID    - C*8 VARIABLE DEFINING THE RUNID, E.G. '4058  ' or '12345A01'
C                          DIR & RUNID WILL BE USED TO MAKE TRANSP FILE NAMES
C                           E.G. 'RUNDATA:[TRANSP.TFTR.86]4058MF.PLN    '
C                                'RUNDATA:[TRANSP.TFTR.86]4058TF.PLN    '
C                                'RUNDATA:[TRANSP.TFTR.86]4058NF.PLN    '
```

```
C                ABBREV   - C*10 ABBREVIATION OF THE PROFILE TO READ IN.
C                MAXTIMES - INTEGER DIMENSION OF ARRAY TIMES.
C                MAXDATA  - INTEGER DIMENSION OF ARRAY DATA

C          RETURNED:
C                LABEL    - C*32 LABEL FOR PROFILE
C                UNITS    - C*16 UNITS OF PROFILE
C                ITYPE    - INTEGER TYPE OF PROFILE.
C                INX      - INTEGER # OF POINTS IN THE X DIRECTION
C                NTIMES   - INTEGER # OF TIMES READ FROM DISK.
C                TIMES    - REAL ARRAY OF DIMENSION MAXTIMES INTO WHICH
C                           TIMES ARE READ FROM DISK.
C                DATA     - REAL ARRAY OF DIMENSION MAXDATA INTO WHICH
C                           INX * NTIMES PROFILE VALUES ARE READ.
C                           DATA IS ORDERED BY X AND THEN T
C                           .I.E - 1ST INX VALUES ARE FOR X AT 1ST TIME.
C
C                IERR     - INTEGER ERROR MESSAGE. RETURNED = 0 IF OK.
C                             0 = OK
C                             2 = ERROR READING MF FILE.
C                             3 = UNEXPECTED EOF READING MF FILE.
C                             5 = TRIED TO READ OLD FORMAT TF FILE.
C                            15 = PROFILE ABBREVIATION NOT FOUND
C                            16 = COULDN'T OPEN MF FILE
C                            17 = COULDN'T OPEN TF FILE
C                           101 = # OF TIMES IN  FILE > MAXTIMES.
C                                 MAXTIMES TIMES WERE READ IN.
C                           102 = # OF PROFILES > DIMENSION OF BUFFER.
C                                 NO DATA READ IN.
c                           103 = TIMES RETURNED ARE NOT MONOTONICALLY
C                                 INCREASING. DATA IS ALSO RETURNED.
C                           104 = # OF TIMES * # IN X DIRECTIONS > MAXDATA

C       SEE SUBROUTINE TFILRD FOR ORIGINAL VERSION.....


        IMPLICIT NONE

        INTEGER    IBLKSZ
        PARAMETER (IBLKSZ=128)
```

```
INTEGER    NAXFOT
PARAMETER (NAXFOT=750)     ! MAXIMUM # OF SCALAR FUNCTIONS
INTEGER    NAXXVR
PARAMETER (NAXXVR=50)      ! MAXIMUM # OF NON-TIME COORDINATES DEFINED.
```

APPENDIX X.

GUIDE TO SAMPLE TERMINAL SESSIONS

X. Guide to Sample Terminal Sessions

The procedures in this User's Guide are illustrated with sample terminal sessions. These were generated using a Macintosh connected to the VAX via VERSATERM PRO terminal emulator via PPLNET. Hardcopy was produced on the Apple laser printer. Each sample session is presented with the graphs interspersed within the text of the user/program interaction at the terminal in the same order as would be if one were sitting at the terminal. Responses typed in by the user are in bold type and are larger (12 point instead of 10).

The following is a list of sample terminal sessions in this guide, in order of appearance:

Subsection 1.(A): A typical TRANSP INF file is listed.

Subsection 1.(B): GETRUN is run and a list of TFTR TRANSP runs is generated. A request to recover a TRANSP run from magnetic tape to main disk is submitted for batch execution.

Subsection 2.1(A): RPLOT is run and a table-of-contents of the graphics files for TFTR TRANSP run 2100 of 1989 is generated.

Subsection 2.1(B): RPLOT is run and a scalar multiplot is generated from TFTR TRANSP run 2100 for 1989.

Subsection 2.1(C): RPLOT is run and various plots of Ion Temperature, which is a profile function of time and an additional coordinate, are generated. See also a related sample session in Subsection 2.1(G).

Subsection 2.1(D): RPLOT is run and a volume-integrated multiplot of profile functions for ion power balance is generated. See also the sample sessions of Subsections 2.1 (E) and 2.1 (H) .

Subsection 2.1(E): RPLOT is run and the contents of a multigraph package are revised, and the revised package is plotted on a log(y) axis with time-averaging. (Time averaging is described in Subsection 2.1(J)).

Subsection 2.1(G): RPLOT is run and a plot of the profile function NE, the electron density function from TFTR run 2100 for 1989, is generated, the scale of the graph is revised, and the graph is smoothed. Smoothing is described in Subsection 2.1(J).

Subsection 2.1(H): RPLOT is run and a new multigraph package "PBEAM", containing the beam ion heating profile and the beam electron heating profile, is defined; graphs of the functions themselves and various volume integrations of the functions are generated.

Subsection 2.1(K): RPLOT is run and the calculator is accessed and functions from more than one run are read. A graph of electron temperature for four shots is shown.

Subsection 2.1(L): RPLOT is run and a user defined UFILE output file is created and then read back.

Subsection 2.1(M): RPLOT is run and the X axis is changed from radius to toroidal flux to poloidal flux. Graphs are done for each X axis.

Subsection 2.2: RPLOT is run and the following occur:
(A) An indirect input file is created.
(B) The indirect input file "QKDAT.TMI" is shown.

(C) The indirect input file QKDAT2 is created.
(D) The indirect input file QKDAT2 is shown and invoked for the automatic generation of 8 multiplots from 4 different TFTR TRANSP runs.
(E) Finally a plot file, MANYPLOTS.PLT is defined to hold spooled graphics data. After RPLOT is run using indirect file QKDAT2, the graphs are printed to the VAX laser printer.

APPENDIX Y.

REFERENCES

Y. References

[1] Hawryluk, R. J. "An Empirical Approach to Tokamak Transport". Reprints from the Varenna, Italy conference of 27 Aug.—8 Sept. 1979 are available in R. J. Hawryluk's office @PPPL. This document gives an overview of the TRANSP model.

[2] Goldston, R. J., et. al. "New Techniques for Calculating Heat and Particle Source Rates Due to Neutral Beam Injection in Axisymmetric Tokamaks", describes techniques used in Monte-Carlo simulation of neutral beam injection for TRANSP, MATT report PPPL-1753 UC-20. Copies available in R.J. Goldston's office @PPPL

APPENDIX Z.

TABLES OF FUNCTIONS & ABBREVIATIONS

Z. Tables of Functions and Abbreviations

1) Scalar Functions of Time

2) Functions of Time and an Additional Coordinate (X).

3) Scalar Multigraph Packages

4) Profile Multigraph Packages

Z.1 Scalar Functions of Time

SCALAR FUNCTIONS OF TIME RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS
ALPC	MAG:ALPHA, CALCULATED	
ASHAF	SHAFRANOV AXIS SHIFT	CM
ASHFT	SHIFT OF PEAK TE DATA	CM
BBNTS	BEAM-BEAM NEUTRONS	N/SEC
BBNTS_DD	DD BEAM-BEAM NEUTRONS	N/SEC
BBPAR	BEAM BETA(POLOIDAL) PLL	
BBPER	BEAM BETA(POLOIDAL) PERP	
BDNDT	D/DT(BEAM ION POPULATION)	N/SEC
BETAE	ELECTRON BETA (POLOIDAL)	
BETAI	THERMAL ION BETA POLOIDAL	
BETAR	ROTATION BETA (POLOIDAL)	
BETAT	TOTAL BETA(POLOIDAL)	
BPABS	BEAM POWER ABSORBED	WATTS
BPBAL	BEAM POWER BALANCE	WATTS
BPCI0	BEAM CX SCE POWER (INT)	WATTS
BPCPR	POWER: COMPRESSION OF BEAM	WATTS
BPCRI	BEAM CX RECAPTURE (INT)	WATTS
BPCRX	BEAM CX RECAPTURE (EXT)	WATTS
BPCX0	BEAM CX SCE POWER (EXT)	WATTS
BPCXE	BEAM CX TRACKER ERROR	WATTS
BPCXI	BEAM POWER TO CX (INT)	WATTS
BPCXX	BEAM POWER TO CX (EXT)	WATTS
BPDA1	1D DIAMAGNETIC BETA(POLOIDAL)	
BPDC	KINETIC BETA(DIA)	
BPDIA	DIAMAGNETIC BETA(POLOIDAL)	
BPDM	MAGNETICS EST. BETA(DIA)	

SCALAR FUNCTIONS OF TIME RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS
BPEQ	EQUILIBRIUM BETA(POLOIDAL)	
BPEQ1	1D EQUILIBRIUM BETA(POLOIDAL)	
BPERR	BEAM ORBIT POWER ERROR	WATTS
BPHCK	NB ROT: BALANCE CHECK	NT-M
BPHCL	NB ROT: COLLISIONAL TORQUE	NT-M
BPHCX	NB ROT: CX LOSS	NT-M
BPHDP	NB ROT: DEPOSITION	NT-M
BPHER	NB ORBIT TORQUE ERROR	NT-M
BPHI	NB ION ANGULAR MOMENTUM	NT-M-SEC
BPHOH	NB ROT: FROM OH	NT-M
BPHOR	NB ROT: ORBIT LOSS	NT-M
BPHRC	NB ROT: CX RECAPTURE	NT-M
BPHST	NB ROT: ANGULAR MOMENTUM GAIN	NT-M
BPHTH	NB ROT: THERMALIZATION	NT-M
BPHTO	TOTAL BEAM HEATING	WATTS
BPHW0	NB ROT: NEUTRAL ESCAPE	NT-M
BPHXB	NB ROT: JXB TORQUE	NT-M
BPLIM	BEAM POWER TO LIMITER	WATTS
BPOH	POWER: OH CIRCUIT TO BEAM	WATTS
BPSHI	BEAM SHINE-THRU POWER	WATTS
BPST	BEAM POWER STORED	WATTS
BPTE	BEAM POWER TO ELECTRONS	WATTS
BPTH	BEAM POWER THERMALIZED	WATTS
BPTI	BEAM POWER TO IONS	WATTS
BSBAL	BEAM PTCL BALANCE	N/SEC
BSCX	BEAM SCE-- CX DEPOSITION	N/SEC

SCALAR FUNCTIONS OF TIME RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS
BSINZ	BEAM SCE--IONIZATION	N/SEC
BSNXI	BEAM CX SINK (INT)	N/SEC
BSNXO	BEAM CX SINK (EXT)	N/SEC
BSORB	BEAM ORBIT LOSSES	N/SEC
BSTH	BEAM THERMALIZATIONS	N/SEC
BTDIA	DIAMAGNETIC BETA(TOROIDAL)	
BTEQ	EQUILIBRIUM BETA(TOROIDAL)	
BTNTS	BEAM-TARGET NEUTRONS	N/SEC
BTNTS_DD	DD BEAM-TARGET NEUTRONS	N/SEC
BZ	BZ @R=RMAJOR OUTSIDE PLASMA	TESLA
BZXR	VACUUM FIELD "BZ*R"	TESLA*CM
COFRC	BEAM FRACTION "CO"	
CPBCX	CPU: BEAM CX	HOURS
CPBDP	CPU: BEAM DEPOSITION	HOURS
CPBFP	CPU: BEAM FP COLLISIONS	HOURS
CPBOR	CPU: BEAM ORBITS	HOURS
CPNBI	CPU: BEAM CODE	HOURS
CPOUT	CPU TIME: OUTPUT SYSTEM	HOURS
CPSC0	CPU: NEUTRAL TRANSPORT MODEL	HOURS
CPTIM	CPU TIME USED SO FAR	HOURS
CPTRK	CPU TIME: STRAIGHT LINE TRACKER	HOURS
DFLUX	COMPUTED DIAMAGNETIC FLUX	WEBERS
DFLXM	MEASURED DIAMAGNETIC FLUX	WEBERS
DT	ENERGY BALANCE TIMESTEP	SECONDS
E0INR	T0 (RECYCLING) @EDGE	EV
EINJ	MAX INITIAL BEAM ENERGY	EV

SCALAR FUNCTIONS OF TIME RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS
ELDOT	ELDOT: GRID MOTION	1/SEC
FLSTA	FALSI ERROR CODE	0=NORMAL
HIO2	INDUCTANCE (HI/2)	
IPXVS	PCUR * VSUR	WATTS
KAINT	K(ALPHA) LINE INTENSITY	ARB.UNITS
KATX	COMPUTED K(ALPHA) T(IMPURITY)	EV
KGAM1	BONOLI-COPPI GAMMA	
L2PB1	1D DEFINITION LI/2+BETA	
LAMDC	KINETIC+J EST. LAMDA	
LAMDM	MAGNETICS EST. LAMDA	
LI2PB	LI/2 + BETA(POLOIDAL)	
LIO2	INDUCTANCE (LI/2)	
LIO21	1D DEFINITION OF LI/2	
LIO2C	LI/2 (COMPUTED FROM J PROFILE)	
LIO2M	LI/2 (MAGNETICS DATA ESTIMATE)	
MNEUT	MEASURED NEUTRONS	N/SEC
MUIC	TRANSP EST. MU(DIA) MHD EQ	
MUIM	MAGNETICS EST. MU(DIA)	
NEUTT	TOTAL NEUTRONS	N/SEC
NEUTX	THERMONUCLEAR NEUTRONS	N/SEC
NEUTX_DD	DD THERMONUCLEAR NEUTRONS	N/SEC
P0BAL	NEUTRAL POWER BALANCE CHECK	WATTS
P0CXT	TOTAL CX POWER	WATTS
P0ESC	NEUTRAL POWER ESCAPED	WATTS
P0FIN	NEUTRAL INFLUX POWER	WATTS
P0INZ	NEUTRAL POWER IONIZED	WATTS

SCALAR FUNCTIONS OF TIME RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS
P0RFL	NEUTRAL POWER REFLECTED IN	WATTS
PAREA	PLASMA CROSS SECTION AREA	CM**2
PCUR	MEASURED PLASMA CURRENT	AMPS
PCURC	CALCULATED PLASMA CURRENT	AMPS
PEEDG	ELECTRON ENERGY VIA BDY	WATTS
PIEDG	ION ENERGY VIA BDY	WATTS
PINJ	TOTAL INJECTED POWER	WATTS
POHT	OHMIC INPUT POWER	WATTS
PVOL	PLASMA VOLUME	CM**3
Q0	Q ON AXIS	
RECYC	GAS RECYCLING COEFFICIENT	
RMAJR	MAJOR RADIUS	CM
RMINR	MINOR RADIUS	CM
RTPC	MAG:RT, CALCULATED	CM
RTXUV	UV DOPPLER TI RADIUS	CM
SBCXX	CX BEAM ION LOSS	N/SEC
SEEDG	ELECTRONS VIA BDY	N/SEC
SHFSC	CALCULATED S1+S2	
SHFSM	MAGNETICS EST. S1+S2	
SINJ	FAST NEUTRALS INJECTED	N/SEC
TAUA1	ENERGY CONFINEMENT (TOTAL)	SECONDS
TAUB	BEAM ENERGY CONFINEMENT	SECONDS
TAUB2	BEAM ENERGY CONFINEMENT (*)	SECONDS
TAUEA	ENERGY CONFINEMENT (THERMAL)	SECONDS
TAUEE	ELECTRON ENERGY CONFINEMENT	SECONDS
TAUP	PTCL CONFINEMENT	SECONDS

SCALAR FUNCTIONS OF TIME RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS
TE0	ELECTRON TEMPERATURE ON AXIS	EV
TEEDG	ELECTRON TEMPERATURE AT BDY	EV
TEPHA	SIMULATED PHA TE	EV
TFLUX	ENCLOSED TOROIDAL FLUX	WEBERS
TI0	ION TEMPERATURE ON AXIS	EV
TIDAT	TI DATA (FOR COMPARISON)	EV
TIEDG	ION TEMPERATURE AT BDY	EV
TXUV	UV DOPPLER T(IMPURITY)	EV
UBDIA	UFILE BETA(DIAMAGNETIC)	
UL2PB	LI/2+BETA(POLOIDAL) UFILE	
VISBC	CHORDAL VB LIGHT (CALCULATED)	VB UNITS
VISBM	CHORDAL VB LIGHT (MEASURED)	VB UNITS
VSUR	MEAS.AVG. SURFACE VOLTAGE	VOLTS
VSUR0	SURFACE VOLTAGE	VOLTS
VSURC	CALC.AVG. SURFACE VOLTAGE	VOLTS
XBFAC	MHD BETA ADJUSTMENT FACTOR	
XKFA1	ION CHI(I) MULTIPLIER	
XKFA2	Q<1 ION NC CHI(I) MULTIPLIER	
ZEFFC	AXIAL PLASMA COMPOSITION ZEFF	
ZEFFI0	INPUT AXIAL ZEFF (UNCONSTRAINED)	
ZEFFM	AXIAL MAGDIF. ZEFF	
ZPLAS	PLASMA MIDPLANE ELEVATION	CM

Z.2 Functions of Time and an Additional Coordinate (X)

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
AMAG	BZ**2/BPOL**2 PROFILE		RZON
ARAT	ASPECT RATIO		RBOUN
BALE0	NEUTRAL POWER BALANCE	WATTS/CM3	RZON
BALN0	BALANCE CHECK	N/CM3/SEC	RZON
BBETA	BEAM BETA POLOIDAL		RZON
BBNTX	BEAM-BEAM NEUTRONS	N/CM3/SEC	RZON
BBNTX_DD	DD BEAM-BEAM NEUTRONS	N/CM3/SEC	RZON
BBPLL	BEAM BETA PLL (POLOIDAL)		RZON
BBPRP	BEAM BETA PERP (POLOIDAL)		RZON
BDENS	BEAM ION DENSITY	N/CM**3	RZON
BN0T1	N0(BEAM):1.GEN 1/1*EB	N/CM**3	RZON
BN0T2	N0(BEAM):1.GEN 1/2*EB	N/CM**3	RZON
BN0T3	N0(BEAM):1.GEN 1/3*EB	N/CM**3	RZON
BPOL	POLOIDAL FIELD	TESLA	RBOUN
BTBE	BEAM BETA TOROIDAL		RZON
BTE	ELECTRON BETA TOROIDAL		RZON
BTI	ION BETA TOROIDAL		RZON
BTNTX	BEAM-TARGET NEUTRONS	N/CM3/SEC	RZON
BTNTX_DD	DD BEAM-TARGET NEUTRONS	N/CM3/SEC	RZON
BTPL	PLASMA BETA TOROIDAL		RZON
BTROT	ROTATION BETA TOROIDAL		RZON
BTTOT	TOTAL BETA TOROIDAL		RZON
BTX	|BT(EXTERNAL)|	TESLA	RMAJM
CLOGE	ELECTRON COULOMB LOG		RZON
CLOGI	ION COULOMB LOG		RZON
CONDE	ELECTRON HEAT DIFFUSIVITY	CM**2/SEC	RBOUN

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
CONDEF	1 FLUID "EFFECTIVE" CHI	CM**2/SEC	RBOUN
CONDI	ION HEAT DIFFUSIVITY	CM**2/SEC	RBOUN
CRBGP	BEAM GRAD(P) TOROIDAL CUR	AMPS/CM2	RZON
CRPGP	THERMAL GRAD(P) TOROIDAL CUR	AMPS/CM2	RZON
CUR	TOTAL PLASMA CURRENT	AMPS/CM2	RZON
CURB	BEAM DRIVEN CURRENT	AMPS/CM2	RZON
CURBS	BOOTSTRAP CURRENT	AMPS/CM2	RZON
DAREA	ZONE CROSS SECTIONAL AREA	CM**2	RZON
DEINT	INTOR ELECTRON DIFFUSIVITY	CM**2/SEC	RBOUN
DFIMP	DIV(IMPURITY FLUX)	N/CM3/SEC	RZON
DIFCD	D+ DIFFUS. COEFF.	CM**2/SEC	RBOUN
DIFCH	H+ DIFFUS. COEFF.	CM**2/SEC	RBOUN
DIFFE	ELEC PTCL DIFFUSIVITY	CM**2/SEC	RBOUN
DIFFI	ION PTCL DIFFUSIVITY	CM**2/SEC	RBOUN
DIFWE	ELEC PTCL DIFFUSIVITY (WARE)	CM**2/SEC	RBOUN
DIVFD	DIV(ION FLUX D+)	N/CM3/SEC	RZON
DIVFE	DIV(ELECTRON FLUX)	N/CM3/SEC	RZON
DIVFI	DIV(TOTAL ION FLUX)	N/CM3/SEC	RZON
DIVHT	DIV(ION FLUX H+)	N/CM3/SEC	RZON
DN0VD	VOL NEUTRAL DENSITY G=D	N/CM**3	RZON
DN0VH	VOL NEUTRAL DENSITY G=H	N/CM**3	RZON
DN0WD	WALL NEUTRAL DENS G=D	N/CM**3	RZON
DN0WH	WALL NEUTRAL DENS G=H	N/CM**3	RZON
DNBDT	D/DT(BEAM ION DENS)	N/CM3/SEC	RZON
DNDDT	D/DT(ION DENS D+)	N/CM3/SEC	RZON
DNEDT	D/DT(ELECTRON DENSITY)	N/CM3/SEC	RZON

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
DNHDT	D/DT(ION DENS H+)	N/CM3/SEC	RZON
DNIDT	D/DT(TOTAL ION DENSITY)	N/CM3/SEC	RZON
DNIMP	D/DT(IMPURITY DENSITY)	N/CM3/SEC	RZON
DRAV	FLUX SURFACE AVG <DR>	CM	RZON
DVOL	ZONE VOLUME	CM**3	RZON
EBEAM	AVG BEAM ION ENERGY	EV	RZON
ECXD	CX DECTECTOR ENERGY (DEUTERIUM)	EV	ECXD
ECXH	CX DECTECTOR ENERGY (HYDROGEN)	EV	ECXH
EION	ION ENERGY	EV	EION
ETA	RESISTIVITY	OHM*CM	RZON
ETAE	D(LN(TE))/D(LN(NE))		RBOUN
ETAI	D(LN(TI))/D(LN("NI"))		RBOUN
ETAIE	D(LN(TI))/D(LN(NE))		RBOUN
FBPBT	|BP|/|BT| COMPUTED		RMAJM
FBTH1	NB DIST 0.< R/A <.2	N/CM**3	THETA
FBTH2	NB DIST .2< R/A <.4	N/CM**3	THETA
FBTH3	NB DIST .4< R/A <.6	N/CM**3	THETA
FBTH4	NB DIST .6< R/A <.8	N/CM**3	THETA
FBTH5	NB DIST .8< R/A <1.	N/CM**3	THETA
FBTX	|BT|/|BT(EXTERNAL)|		RMAJM
FBX	|B|/|BT(EXTERNAL)|		RMAJM
FKBOL	CHI(I) NC BOLTON	CM**2/SEC	RBOUN
FKCH2	CHI(I) NC CHANG-HINTON VSN 2	CM**2/SEC	RBOUN
FKCHH	CHI(I) NC CHANG-HINTON ORIGINAL	CM**2/SEC	RBOUN
FKCHZ	CHI(I) NC CHANG-HINTON Z-CORR	CM**2/SEC	RBOUN
FKHZH	CHI(I) NC HAZELTINE-HINTON	CM**2/SEC	RBOUN

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
FKJUL	CHI(I) NC RUTHERFORD-JULICH	CM**2/SEC	RBOUN
FL0EI	DIV(NEUTRAL E-INFLUX)	WATTS/CM3	RZON
FL0EX	DIV(NEUTRAL E-OUTFLUX)	WATTS/CM3	RZON
FLX0I	DIV(NEUTRAL E-INFLUX)	N/CM3/SEC	RZON
FLX0X	DIV(NEUTRAL E-OUTFLUX)	N/CM3/SEC	RZON
FPAX_D	D BEAM SCATTERING >IMPURITIES		RZON
FPBX_D	D BEAM DRAG >IMPURITIES		RZON
GAINE	ELECTRON GAIN	WATTS/CM3	RZON
GAINI	ION GAIN	WATTS/CM3	RZON
GFUN	G: PARA/DIAMAGNETISM		RBOUN
GFUNC	G: GRAD-SHAF EQUILIBRIUM CHECK		RBOUN
GMAG	GMAG (RT) PRESSURE PROFILE	JLES/CM3	RZON
HLFLX	M,N=1 HELICAL FLUX	WEBERS	RBOUN
HLFMP	HELICAL FLUX	WEBERS	RMAJM
IVISB	CHORD IND. (VB CHORDS)		IVISB
KEBOH	BOHM THERMAL CHI(E)	CM**2/SEC	RBOUN
KEBON	BONOLI-COPPI CHI(E)	CM**2/SEC	RBOUN
KECAR	CARDI/DIAMOND CHI(E)	CM**2/SEC	RBOUN
KECMG	GRUBER CHI(E)	CM**2/SEC	RBOUN
KECOP	COPPI CHI(E) THRMAL NO. 1	CM**2/SEC	RBOUN
KEDRK	DRAKE CHI(E) THERMAL	CM**2/SEC	RBOUN
KEINT	INTOR CHI(E) THERMAL	CM**2/SEC	RBOUN
KEKAW	KAW ANOMOLOUS CHI(E)	CM**2/SEC	RBOUN
KEKG	KAYE-GOLDSTON CHI(E)	CM**2/SEC	RBOUN
KEMOL	MOLVIG CHI(E) THERMAL	CM**2/SEC	RBOUN
KEOHK	OHKAWA CHI(E)	CM**2/SEC	RBOUN

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
KEPLT	PLT CHI(E) THERMAL	CM**2/SEC	RBOUN
KEPP1	PARAIL-POGUTSE CHI(E)1	CM**2/SEC	RBOUN
KEPP2	PARAIL-POGUTSE CHI(E)2	CM**2/SEC	RBOUN
KETAN	TANG ANOMOLOUS CHI(E)	CM**2/SEC	RBOUN
KETOT	CHI(E) "COUNTING" CONVECTION	CM**2/SEC	RBOUN
KSID	VPLL/V		KSID
KTFR1	TFR Q<1 CHI(E)	CM**2/SEC	RBOUN
KTFR2	TFR 1<Q<2 CHI(E)	CM**2/SEC	RBOUN
KTFR3	TFR 2<Q CHI(E)	CM**2/SEC	RBOUN
N0BCXD0	CX FAST NEUTRAL DENSITY (D0)	N/CM**3	RZON
N0BD0	1.GEN FAST NEUTRAL DENSITY (D0)	N/CM**3	RZON
ND	DEUTERIUM ION DENSITY	N/CM**3	RZON
NE	ELECTRON DENSITY	N/CM**3	RZON
NEIN	NE INPUT PROFILE	N/CM**3	POSNE
NETW	NE(R) ASSYMMETRY	N/CM**3	RZON
NEUSE	NE DATA AS USED	N/CM**3	POSNE
NH	HYDROGEN ION DENSITY	N/CM**3	RZON
NI	TOTAL ION DENSITY	N/CM**3	RZON
NIMP	IMPURITY DENSITY	N/CM**3	RZON
NUSTE	ELECTRON COLLISIONALITY		RZON
NUSTI	ION COLLISIONALITY		RZON
OMEGB	BEAM ION AVG ANG.VELOCITY	SEC**-1	RZON
P0NET	NET CHARGE EXCHANGE LOSS	WATTS/CM3	RZON
PBCX	THERMAL ION POWER LOSS, BEAM CX	WATTS/CM3	RZON
PBE	BEAM ELECTRON HEATING	WATTS/CM3	RZON
PBI	BEAM ION HEATING	WATTS/CM3	RZON

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
PBTH	BEAM THERMALIZATION POWER	WATTS/CM3	RZON
PCMPE	ELECTRON COMPRESSION	WATTS/CM3	RZON
PCMPI	ION COMPRESSION	WATTS/CM3	RZON
PCNDE	ELECTRON CONDUCTION LOSS	WATTS/CM3	RZON
PCNVE	ELECTRON CONVECTION LOSS	WATTS/CM3	RZON
PCOND	ION CONDUCTION LOSS	WATTS/CM3	RZON
PCONV	ION CONVECTION LOSS	WATTS/CM3	RZON
PCPRB	POWER: COMPRESSION OF BEAM	WATTS/CM3	RZON
PCX	CHARGE EXCHANGE LOSS	WATTS/CM3	RZON
PION	NEUTRAL IONIZATION WORK	WATTS/CM3	RZON
PLCRB	POLOIDAL CUR (J PERP BI)	AMPS	RBOUN
PLCRM	POLOIDAL CUR (J PLL)	AMPS	RBOUN
PLCRP	POLOIDAL CUR (J PERP TH)	AMPS	RBOUN
PLCRT	TOTAL POLOIDAL CUR TO WALL	AMPS	RBOUN
PLFLX	POLOIDAL FLUX	WEBERS	RBOUN
PLFMP	POLOIDAL FLUX	WEBERS	RMAJM
PNI	NEUTRAL IONIZATION SOURCE	WATTS/CM3	RZON
POH	OHMIC HEATING POWER	WATTS/CM3	RZON
POHB	POWER: OH CIRCUIT TO BEAM	WATTS/CM3	RZON
POSNE	NE POSITIONS	CM	POSNE
POSTE	TE POSITIONS	CM	POSTE
PPLAS	PLASMA PRESSURE	PASCALS	RZON
PRAD	ADJUSTED RADIATION LOSS	WATTS/CM3	RZON
PRAD0	RADIATION: BOLO DATA	WATTS/CM3	RZON
PTOWB	TOTAL MHD PRESSURE INCL. BEAMS	PASCALS	RZON
Q	Q PROFILE		RBOUN

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
QCHK	MHD EQUILIBRIUM Q CHECK		RBOUN
QIE	ION-ELECTRON COUPLING	WATTS/CM3	RZON
QMP	ROTATIONAL TRANSFORM		RMAJM
RBOUN	RADIUS	CM	RBOUN
RMAJM	MIDPLANE RADII	CM	RMAJM
RMJMP	FLUX SURFACE CTRS	CM	RBOUN
RMNMP	MIDPLANE RADII	CM	RBOUN
RZON	RADIUS	CM	RZON
S0RCD	RECOMB NEUTRAL SCE G=D	N/CM3/SEC	RZON
S0RCH	RECOMB NEUTRAL SCE G=H	N/CM3/SEC	RZON
S0VLE	TOTAL NEUTRAL VOL SCE	WATTS/CM3	RZON
S0VOL	TOTAL NEUTRAL VOL E-SCE	N/CM3/SEC	RZON
SB0ID	D0 NEUTRAL SINK BEAM II	N/CM3/SEC	RZON
SB0IH	H0 NEUTRAL SINK BEAM II	N/CM3/SEC	RZON
SB0XD	D0 NEUTRAL SINK BEAM CX	N/CM3/SEC	RZON
SB0XH	H0 NEUTRAL SINK BEAM CX	N/CM3/SEC	RZON
SBCX0	BEAM CX: NEUTRALS BORN	N/CM3/SEC	RZON
SBCXD	D0 NEUTRAL SOURCE BEAM CX	N/CM3/SEC	RZON
SBCXH	H0 NEUTRAL SOURCE BEAM CX	N/CM3/SEC	RZON
SBE	ELECTRON SCE BEAM DEPOSITION	N/CM3/SEC	RZON
SBHD	D+ ION SCE DUE TO BEAM	N/CM3/SEC	RZON
SBHH	H+ ION SCE DUE TO BEAM	N/CM3/SEC	RZON
SBTH	BEAM TOTAL THERMALIZATION SOURCE	N/CM3/SEC	RZON
SBTOT	TOTAL ION SCE(VOL. NEUTRALS)	N/CM3/SEC	RZON
SBXRB	BEAM CX: RECAPTURE: BEAM-BEAM	N/CM3/SEC	RZON
SBXRD	BEAM CX: RECAPTURE BY CX W/D+	N/CM3/SEC	RZON

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
SBXRD_D	D BEAM CX: RECAPTURE BY CX W/D+	N/CM3/SEC	RZON
SBXRH	BEAM CX: RECAPTURE BY CX W/H+	N/CM3/SEC	RZON
SBXRH_D	D BEAM CX: RECAPTURE BY CX W/H+	N/CM3/SEC	RZON
SBXRI	BEAM CX: RECAPTURE BY IONIZATION	N/CM3/SEC	RZON
SCEE	ELECTRON SOURCE (TH.NEUTRALS)	N/CM3/SEC	RZON
SCEV	ELECTRON SCE (VOL. NEUTRALS)	N/CM3/SEC	RZON
SCEW	ELECTRON SCE (WALL NEUTRALS)	N/CM3/SEC	RZON
SCIMP	IMPURITY SOURCE	N/CM3/SEC	RZON
SDBBI	BEAM DEPOSITION: BEAM-BEAM II	N/CM3/SEC	RZON
SDBBX	BEAM DEPOSITION: BEAM-BEAM CX	N/CM3/SEC	RZON
SDBEI	BEAM DEPOSITION: IONIZATION	N/CM3/SEC	RZON
SDCXD	BEAM DEPOSITION: CX W/D+ IONS	N/CM3/SEC	RZON
SDCXD_D	D BEAM DEPOSITION: CX W/D+ IONS	N/CM3/SEC	RZON
SDCXH	BEAM DEPOSITION: CX W/H+ IONS	N/CM3/SEC	RZON
SDCXH_D	D BEAM DEPOSITION: CX W/H+ IONS	N/CM3/SEC	RZON
SDHE3	0.01*NE*NB D(HE3)FUSION EST.	N/CM3/SEC	RZON
SERUN	RUNAWAY ELEC SOURCE RATE	N/CM3/SEC	RZON
SFETO	ELECTRONS -> FAST NEUTRALS	N/CM3/SEC	RZON
SSHAF	SHAFRANOV SHIFT	CM	RBOUN
SURF	FLUX SURFACE AREA	CM**2	RBOUN
SVD	TOT ION SCE VOL. D+	N/CM3/SEC	RZON
SVH	TOT ION SCE VOL. H+	N/CM3/SEC	RZON
SWD	TOT ION SCE WALL D+	N/CM3/SEC	RZON
SWH	TOT ION SCE WALL H+	N/CM3/SEC	RZON
SWTOT	TOTAL ION SCE(WALL NEUTRALS)	N/CM3/SEC	RZON
TOVD	VOL NEUTRAL TEMP G=D	EV	RZON

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
T0VH	VOL NEUTRAL TEMP G=H	EV	RZON
T0WD	WALL NEUTRAL TEMP G=D	EV	RZON
T0WH	WALL NEUTRAL TEMP G=H	EV	RZON
TAPWE	ELECTRON TAU(P) WARE CORRECTION	SECONDS	RBOUN
TAU1	TOTAL ENERGY CONFINEMENT	SECONDS	RBOUN
TAUE	PLASMA ENERGY CONFINEMENT	SECONDS	RBOUN
TAUES	PLASMA ENERGY CONFINEMENT (*)	SECONDS	RBOUN
TAUPD	D+ ION PTCL CONFINEMENT	SECONDS	RBOUN
TAUPE	ELECTRON PTCL CONFINEMNT	SECONDS	RBOUN
TAUPH	H+ ION PTCL CONFINEMENT	SECONDS	RBOUN
TAUPI	ION PTCL CONFINEMENT	SECONDS	RBOUN
TAUS1	TOTAL ENERGY CONFINEMENT (*)	SECONDS	RBOUN
TE	ELECTRON TEMPERATURE	EV	RZON
TEBAL	ELECTRON POWER BALANCE	WATTS/CM3	RZON
TEE	ELECTRON ENERGY CONFINEMENT	SECONDS	RBOUN
TEEST	ELECTRON ENERGY CONFINEMENT (*)	SECONDS	RBOUN
TEI	ION ENERGY CONFINEMENT	SECONDS	RBOUN
TEIN	TE INPUT PROFILE	EV	POSTE
TEIST	ION ENERGY CONFINEMENT (*)	SECONDS	RBOUN
TEUSE	TE DATA AS USED	EV	POSTE
THETA	POL. ANGLE	RADIANS	THETA
THNTX	THERMONUCLEAR NEUTRONS	N/CM3/SEC	RZON
THNTX_DD	DD THERMONUCLEAR NEUTRONS	N/CM3/SEC	RZON
TI	ION TEMPERATURE	EV	RZON
TIBAL	ION POWER BALANCE	WATTS/CM3	RZON
TPA1A_D	D FULL E TAU(SCATTERING,CO)	SECONDS	RZON

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
TPA1B_D	D FULL E TAU(SCATTERING,CTR)	SECONDS	RZON
TPA2A_D	D HALF E TAU(SCATTERING,CO)	SECONDS	RZON
TPA2B_D	D HALF E TAU(SCATTERING,CTR)	SECONDS	RZON
TPA3A_D	D 1/3 E TAU(SCATTERING,CO)	SECONDS	RZON
TPA3B_D	D 1/3 E TAU(SCATTERING,CTR)	SECONDS	RZON
TRFCK	MHD TOROIDAL FLUX CHECK	WEBERS	RBOUN
TRFLX	TOROIDAL FLUX	WEBERS	RBOUN
TRFMP	TOROIDAL FLUX	WEBERS	RMAJM
TSHFT	TE DATA SHIFT	CM	RBOUN
TSL1A_D	D FULL E TAU(SLOWING DOWN,CO)	SECONDS	RZON
TSL1B_D	D FULL E TAU(SLOWING DOWN,CTR)	SECONDS	RZON
TSL2A_D	D HALF E TAU(SLOWING DOWN,CO)	SECONDS	RZON
TSL2B_D	D HALF E TAU(SLOWING DOWN,CTR)	SECONDS	RZON
TSL3A_D	D 1/3 E TAU(SLOWING DOWN,CO)	SECONDS	RZON
TSL3B_D	D 1/3 E TAU(SLOWING DOWN,CTR)	SECONDS	RZON
TX	IMPURITY TEMPERATURE	EV	RZON
UBCMP	B(POL) COMPRESSION	WATTS/CM3	RZON
UBPAR	BEAM PLL ENERGY DENSITY	JLES/CM3	RZON
UBPDT	D/DT(POLOIDAL FIELD ENERGY)	WATTS/CM3	RZON
UBPOL	POLOIDAL FIELD ENERGY	JLES/CM3	RZON
UBPRP	BEAM PERP ENERGY DENSITY	JLES/CM3	RZON
UBTDT	D/DT(FIELD ENERGY)	WATTS/CM3	RZON
UBTOR	TOROIDAL FIELD ENERGY	JLES/CM3	RZON
UCURB	UNSHIELDED BEAM CURRENT	AMPS/CM2	RZON
UDEXB	E CROSS B POWER	WATTS/CM3	RZON
UE	ELECTRON ENERGY DENSITY	JLES/CM3	RZON

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
UI	ION ENERGY DENSITY	JLES/CM3	RZON
UJBCO	UNSHIELDED BEAM CUR (CO BEAMS)	AMPS/CM2	RZON
UJBCR	UNSHIELDED BEAM CUR (CTR BEAMS)	AMPS/CM2	RZON
UMGBA	MAGDIF ENERGY BALANCE	WATTS/CM3	RZON
UTHRM	THERMAL ENERGY DENSITY	JLES/CM3	RZON
UTOTL	TOTAL ENERGY DENSITY	JLES/CM3	RZON
V	VOLTAGE	VOLTS	RZON
VBINT	VB CHORD INTEGRALS	VB UNITS	IVISB
VBRC	VB PROFILE (CALCULATED)	VB INTENS	RZON
VCHEK	VOLTAGE CHECK	VOLTS	RZON
VELD	ION VELOCITY D+	CM/SEC	RBOUN
VELE	ELECTRON RADIAL VELOCITY	CM/SEC	RBOUN
VELH	ION VELOCITY H+	CM/SEC	RBOUN
VELIM	IMPURITY RADIAL VELOCITY	CM/SEC	RBOUN
VELWE	ELECTRON WARE VELOCITY	CM/SEC	RBOUN
VETAE	ETA(E) VALIDITY CHK		RBOUN
VETAI	ETA(I) VALIDITY CHECK		RBOUN
X	x"r/a" ctr		RZON
XB	x"r/a" bdy		RBOUN
XETAE	CHI:E(ETA(E)) ACTIVE	CM**2/SEC	RBOUN
XETE0	CHI:E(ETA(E)) GUZDAR	CM**2/SEC	RBOUN
XETI0	CHI(ETA(I)) RAW	CM**2/SEC	RBOUN
XILMP	TOROIDAL FLUX LABEL		RMAJM
XKFAC	CHI(I) MULTIPLIER		RBOUN
XKINC	NEOCLASSICAL CHI(I)	CM**2/SEC	RBOUN
ZEFFI	INPUT ZEFF (UNCONSTRAINED)		RZON

FUNCTIONS OF TIME AND ADDL COORD RUN TFTR.89 2100 SHOT 42457

ABBREV.	FULL LABEL	UNITS	(X)
ZEFFP	PLASMA COMPOSITION ZEFF PROFILE		RZON
ZEFMD	MAGDIF ZEFF PROFILE		RZON

Z.3 Scalar Multigraph Packages

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 SCALAR MULTIGRAPH PACKAGES   RUN TFTR.89     2100 SHOT  42457

>ALPHA        is "MAGNETIC ALPHA COMPARISON          " in
       1. +("ALPC       ")   MAG:ALPHA, CALCULATED
            [VS. TIME ONLY.]

>BHEAT        is "BEAM HEATING                       " in WATTS
       1. +("BPTH       ")   BEAM POWER THERMALIZED
       2. +("BPTI       ")   BEAM POWER TO IONS
       3. +("BPTE       ")   BEAM POWER TO ELECTRONS
            [VS. TIME ONLY.]

>BMCPU        is "CPU TIME USE: BEAM CODE            " in HOURS
       1. +("CPNBI      ")   CPU: BEAM CODE
       2. +("CPBDP      ")   CPU: BEAM DEPOSITION
       3. +("CPBCX      ")   CPU: BEAM CX
       4. +("CPBFP      ")   CPU: BEAM FP COLLISIONS
       5. +("CPBOR      ")   CPU: BEAM ORBITS
            [VS. TIME ONLY.]
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 SCALAR MULTIGRAPH PACKAGES   RUN TFTR.89     2100 SHOT  42457

>BPHBA        is "BEAM MOMENTUM BALANCE              " in NT-M
       1. -("BPHST      ")    NB ROT: ANGULAR MOMENTUM GAIN
       2. +("BPHCK      ")    NB ROT: BALANCE CHECK
       3. +("BPHER      ")    NB ORBIT TORQUE ERROR
       4. +("BPHDP      ")    NB ROT: DEPOSITION
       5. +("BPHOH      ")    NB ROT: FROM OH
       6. -("BPHW0      ")    NB ROT: NEUTRAL ESCAPE
       7. -("BPHTH      ")    NB ROT: THERMALIZATION
       8. -("BPHOR      ")    NB ROT: ORBIT LOSS
       9. -("BPHXB      ")    NB ROT: JXB TORQUE
      10. -("BPHCL      ")    NB ROT: COLLISIONAL TORQUE
           [VS. TIME ONLY.]

>BPHBX        is "BEAM CX MOMENTUM BALANCE           " in NT-M
       1. -("BPHW0      ")    NB ROT: NEUTRAL ESCAPE
       2. +("BPHCX      ")    NB ROT: CX LOSS
       3. -("BPHRC      ")    NB ROT: CX RECAPTURE
           [VS. TIME ONLY.]

>BPHIS        is "BEAM ION ANGULAR MOMENTA           " in NT-M-SEC
       1. +("BPHI       ")    NB ION ANGULAR MOMENTUM
           [VS. TIME ONLY.]
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 SCALAR MULTIGRAPH PACKAGES   RUN TFTR.89      2100 SHOT  42457

>CPDIS        is "CPU TIME DISTRIBUTION              " in HOURS
       1. +("CPTIM      ")    CPU TIME USED SO FAR
       2. +("CPOUT      ")    CPU TIME: OUTPUT SYSTEM
       3. +("CPTRK      ")    CPU TIME: STRAIGHT LINE TRACKER
       4. +("CPNBI      ")    CPU: BEAM CODE
       5. +("CPSC0      ")    CPU: NEUTRAL TRANSPORT MODEL
            [VS. TIME ONLY.]

>DFLX         is "PARA/DIAMAGNETIC FLUX              " in WEBERS
       1. +("DFLXM      ")    MEASURED DIAMAGNETIC FLUX
       2. +("DFLUX      ")    COMPUTED DIAMAGNETIC FLUX
            [VS. TIME ONLY.]

>IPCMP        is "PLASMA CURRENT COMPARISON          " in AMPS
       1. +("PCUR       ")    MEASURED PLASMA CURRENT
       2. +("PCURC      ")    CALCULATED PLASMA CURRENT
            [VS. TIME ONLY.]

>L2COM        is "MAGNETIC LI/2 COMPARISON           " in
       1. +("LIO2M      ")    LI/2 (MAGNETICS DATA ESTIMATE)
       2. +("LIO2C      ")    LI/2 (COMPUTED FROM J PROFILE)
            [VS. TIME ONLY.]

>LAMDA        is "LAMDA COMPARISON                   " in
       1. +("LAMDM      ")    MAGNETICS EST. LAMDA
       2. +("LAMDC      ")    KINETIC+J EST. LAMDA
            [VS. TIME ONLY.]
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 SCALAR MULTIGRAPH PACKAGES   RUN TFTR.89     2100 SHOT  42457

>LBPOL        is "POLOIDAL BETAS, LI/2+BETA          " in
       1. +("UL2PB      ")   LI/2+BETA(POLOIDAL) UFILE
       2. +("BBPER      ")   BEAM BETA(POLOIDAL) PERP
       3. +("BBPAR      ")   BEAM BETA(POLOIDAL) PLL
       4. +("BETAE      ")   ELECTRON BETA (POLOIDAL)
       5. +("BETAR      ")   ROTATION BETA (POLOIDAL)
       6. +("BETAI      ")   THERMAL ION BETA POLOIDAL
       7. +("LI2PB      ")   LI/2 + BETA(POLOIDAL)
       8. +("BPEQ       ")   EQUILIBRIUM BETA(POLOIDAL)
       9. +("BPEQ1      ")   1D EQUILIBRIUM BETA(POLOIDAL)
      10. +("L2PB1      ")   1D DEFINITION LI/2+BETA
           [VS. TIME ONLY.]

>LIHI2        is "INDUCTANCE                         " in
       1. +("LIO2       ")   INDUCTANCE (LI/2)
       2. +("HIO2       ")   INDUCTANCE (HI/2)
       3. +("LIO21      ")   1D DEFINITION OF LI/2
           [VS. TIME ONLY.]

>MBPOL        is "EQ. + DIA. BETA(POLOIDAL)          " in
       1. +("UBDIA      ")   UFILE BETA(DIAMAGNETIC)
       2. +("BPDM       ")   MAGNETICS EST. BETA(DIA)
       3. +("BPDC       ")   KINETIC BETA(DIA)
       4. +("BPEQ       ")   EQUILIBRIUM BETA(POLOIDAL)
       5. +("BPDIA      ")   DIAMAGNETIC BETA(POLOIDAL)
       6. +("BPEQ1      ")   1D EQUILIBRIUM BETA(POLOIDAL)
       7. +("BPDA1      ")   1D DIAMAGNETIC BETA(POLOIDAL)
           [VS. TIME ONLY.]
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 SCALAR MULTIGRAPH PACKAGES    RUN TFTR.89      2100 SHOT   42457

>MBTOR          is "EQ. + DIA. BETA(TOROIDAL)          " in
       1. +("BTEQ         ")    EQUILIBRIUM BETA(TOROIDAL)
       2. +("BTDIA        ")    DIAMAGNETIC BETA(TOROIDAL)
            [VS. TIME ONLY.]

>MUCOM          is "MAGNETIC MUDIA COMPARISON          " in
       1. +("MUIM         ")    MAGNETICS EST. MU(DIA)
       2. +("MUIC         ")    TRANSP EST. MU(DIA) MHD EQ
            [VS. TIME ONLY.]

>P0BLC          is "LAB FRAME NEUTRAL POWER BALANCE    " in WATTS
       1. +("P0FIN        ")    NEUTRAL INFLUX POWER
       2. +("P0RFL        ")    NEUTRAL POWER REFLECTED IN
       3. +("P0CXT        ")    TOTAL CX POWER
       4. -("P0INZ        ")    NEUTRAL POWER IONIZED
       5. -("P0ESC        ")    NEUTRAL POWER ESCAPED
       6. -("P0BAL        ")    NEUTRAL POWER BALANCE CHECK
            [VS. TIME ONLY.]

>PBBAL          is "BEAM POWER BALANCE                 " in WATTS
       1. +("BPST         ")    BEAM POWER STORED
       2. +("BPOH         ")    POWER: OH CIRCUIT TO BEAM
       3. +("BPCPR        ")    POWER: COMPRESSION OF BEAM
       4. +("BPBAL        ")    BEAM POWER BALANCE
       5. +("BPERR        ")    BEAM ORBIT POWER ERROR
       6. +("PINJ         ")    TOTAL INJECTED POWER
            [VS. TIME ONLY.]
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 SCALAR MULTIGRAPH PACKAGES   RUN TFTR.89     2100 SHOT  42457

>PBCXB        is "BEAM CX POWER TERMS                  " in WATTS
       1. +("BPCXI      ")   BEAM POWER TO CX (INT)
       2. +("BPCXX      ")   BEAM POWER TO CX (EXT)
       3. +("BPCI0      ")   BEAM CX SCE POWER (INT)
       4. +("BPCX0      ")   BEAM CX SCE POWER (EXT)
       5. +("BPCRI      ")   BEAM CX RECAPTURE (INT)
       6. +("BPCRX      ")   BEAM CX RECAPTURE (EXT)
       7. +("BPCXE      ")   BEAM CX TRACKER ERROR
            [VS. TIME ONLY.]

>PBLOS        is "BEAM POWER LOSSES                    " in WATTS
       1. +("BPLIM      ")   BEAM POWER TO LIMITER
       2. +("BPSHI      ")   BEAM SHINE-THRU POWER
       3. +("BPCXI      ")   BEAM POWER TO CX (INT)
       4. +("BPCXX      ")   BEAM POWER TO CX (EXT)
       5. +("BPTH       ")   BEAM POWER THERMALIZED
            [VS. TIME ONLY.]

>PEDGE        is "EXPANSION/SCRAPEOFF POWER            " in WATTS
       1. +("PEEDG      ")   ELECTRON ENERGY VIA BDY
       2. +("PIEDG      ")   ION ENERGY VIA BDY
            [VS. TIME ONLY.]

>PHEAT        is "HEATING POWERS                       " in WATTS
       1. +("POHT       ")   OHMIC INPUT POWER
       2. +("BPHTO      ")   TOTAL BEAM HEATING
       3. +("BPABS      ")   BEAM POWER ABSORBED
       4. +("PINJ       ")   TOTAL INJECTED POWER
            [VS. TIME ONLY.]
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 SCALAR MULTIGRAPH PACKAGES   RUN TFTR.89      2100 SHOT  42457

>POHC          is "OHMIC HEATING, IP*VS                " in WATTS
       1. +("POHT        ")    OHMIC INPUT POWER
       2. +("IPXVS       ")    PCUR * VSUR
            [VS. TIME ONLY.]

>RPLAS         is "PLASMA DIMENSIONS                   " in CM
       1. +("ZPLAS       ")    PLASMA MIDPLANE ELEVATION
       2. +("RMINR       ")    MINOR RADIUS
       3. +("RMAJR       ")    MAJOR RADIUS
            [VS. TIME ONLY.]

>RTCOM         is "MAGNETIC RT COMPARISON              " in CM
       1. +("RTPC        ")    MAG:RT, CALCULATED
            [VS. TIME ONLY.]

>SBBAL         is "BEAM PTCL BALANCE                   " in N/SEC
       1. -("BDNDT       ")    D/DT(BEAM ION POPULATION)
       2. +("BSINZ       ")    BEAM SCE--IONIZATION
       3. +("BSCX        ")    BEAM SCE-- CX DEPOSITION
       4. -("BSTH        ")    BEAM THERMALIZATIONS
       5. -("BSORB       ")    BEAM ORBIT LOSSES
       6. -("BSNXI       ")    BEAM CX SINK (INT)
       7. -("BSNXO       ")    BEAM CX SINK (EXT)
       8. -("BSBAL       ")    BEAM PTCL BALANCE
            [VS. TIME ONLY.]
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 SCALAR MULTIGRAPH PACKAGES   RUN TFTR.89     2100 SHOT  42457

>SHCOM        is "MAGNETIC S1+S2 COMPARISON        " in
      1. +("SHFSM      ")   MAGNETICS EST. S1+S2
      2. +("SHFSC      ")   CALCULATED S1+S2
          [VS. TIME ONLY.]

>TSHF0        is "SHAFRANOV & TE SHIFT ON AXIS     " in CM
      1. +("ASHAF      ")   SHAFRANOV AXIS SHIFT
      2. +("ASHFT      ")   SHIFT OF PEAK TE DATA
          [VS. TIME ONLY.]

>VISBR        is "SINGLE CHORD VB LIGHT            " in VB UNITS
      1. +("VISBM      ")   CHORDAL VB LIGHT (MEASURED)
      2. +("VISBC      ")   CHORDAL VB LIGHT (CALCULATED)
          [VS. TIME ONLY.]

>VSCMP        is "SURFACE VOLTAGE COMPARISON       " in VOLTS
      1. +("VSUR       ")   MEAS.AVG. SURFACE VOLTAGE
      2. +("VSURC      ")   CALC.AVG. SURFACE VOLTAGE
          [VS. TIME ONLY.]

>XKFMG        is "ION NEOCLASSICAL MULTIPLIERS     " in
      1. +("XKFA1      ")   ION CHI(I) MULTIPLIER
      2. +("XKFA2      ")   Q<1 ION NC CHI(I) MULTIPLIER
          [VS. TIME ONLY.]
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 SCALAR MULTIGRAPH PACKAGES   RUN TFTR.89      2100 SHOT  42457

>XNEUT        is "NEUTRON EMISSION                    " in N/SEC
       1. +("MNEUT      ")    MEASURED NEUTRONS
       2. +("BTNTS      ")    BEAM-TARGET NEUTRONS
       3. +("BBNTS      ")    BEAM-BEAM NEUTRONS
       4. +("NEUTX      ")    THERMONUCLEAR NEUTRONS
       5. +("NEUTT      ")    TOTAL NEUTRONS
            [VS. TIME ONLY.]

>XNEUT_DD     is "DD NEUTRON EMISSION                 " in N/SEC
       1. +("BBNTS_DD   ")    DD BEAM-BEAM NEUTRONS
       2. +("BTNTS_DD   ")    DD BEAM-TARGET NEUTRONS
       3. +("NEUTX_DD   ")    DD THERMONUCLEAR NEUTRONS
            [VS. TIME ONLY.]

>ZEFF0        is "RESIS. & COMPOSITION ZEFF @AXIS   " in
       1. +("ZEFFM      ")    AXIAL MAGDIF. ZEFF
       2. +("ZEFFC      ")    AXIAL PLASMA COMPOSITION ZEFF
       3. +("ZEFFI0     ")    INPUT AXIAL ZEFF (UNCONSTRAINED)
            [VS. TIME ONLY.]
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Z.4 Profile Multigraph Packages

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 PROFILE MULTIGRAPH PACKAGES  RUN TFTR.89      2100 SHOT  42457

>BDEP0        is "BEAM DEPOSITION                      " in N/CM3/SEC
       1. +("SDBBI      ")    BEAM DEPOSITION: BEAM-BEAM II
       2. +("SDBBX      ")    BEAM DEPOSITION: BEAM-BEAM CX
       3. +("SDBEI      ")    BEAM DEPOSITION: IONIZATION
       4. +("SDCXD      ")    BEAM DEPOSITION: CX W/D+ IONS
       5. +("SDCXH      ")    BEAM DEPOSITION: CX W/H+ IONS
            [VS. RADIUS AND TIME]

>BDEP0_D      is "BEAM DEPOSITION (D)                  " in N/CM3/SEC
       1. +("SDCXD_D    ")    D BEAM DEPOSITION: CX W/D+ IONS
       2. +("SDCXH_D    ")    D BEAM DEPOSITION: CX W/H+ IONS
            [VS. RADIUS AND TIME]

>BETOR        is "BETA TOROIDALS                       " in
       1. +("BTBE       ")    BEAM BETA TOROIDAL
       2. +("BTE        ")    ELECTRON BETA TOROIDAL
       3. +("BTI        ")    ION BETA TOROIDAL
       4. +("BTPL       ")    PLASMA BETA TOROIDAL
       5. +("BTTOT      ")    TOTAL BETA TOROIDAL
       6. +("BTROT      ")    ROTATION BETA TOROIDAL
            [VS. RADIUS AND TIME]

>BMHTG        is "BEAM HEATING PROFILES                " in WATTS/CM3
       1. +("PBI        ")    BEAM ION HEATING
       2. +("PBTH       ")    BEAM THERMALIZATION POWER
       3. +("PBE        ")    BEAM ELECTRON HEATING
            [VS. RADIUS AND TIME]
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 PROFILE MULTIGRAPH PACKAGES  RUN TFTR.89     2100 SHOT  42457

>BN00          is "BEAM 1.GEN NEUTRAL DENSITY          " in N/CM**3
       1. +("BN0T1      ")    N0(BEAM):1.GEN 1/1*EB
       2. +("BN0T2      ")    N0(BEAM):1.GEN 1/2*EB
       3. +("BN0T3      ")    N0(BEAM):1.GEN 1/3*EB
            [VS. RADIUS AND TIME]

>BRCAP         is "BEAM RECAPTURE                      " in N/CM3/SEC
       1. +("SBCX0      ")    BEAM CX: NEUTRALS BORN
       2. +("SBXRI      ")    BEAM CX: RECAPTURE BY IONIZATION
       3. +("SBXRB      ")    BEAM CX: RECAPTURE: BEAM-BEAM
       4. +("SBXRD      ")    BEAM CX: RECAPTURE BY CX W/D+
       5. +("SBXRH      ")    BEAM CX: RECAPTURE BY CX W/H+
            [VS. RADIUS AND TIME]

>BRCAP_D       is "BEAM RECAPTURE (D)                  " in N/CM3/SEC
       1. +("SBXRD_D    ")    D BEAM CX: RECAPTURE BY CX W/D+
       2. +("SBXRH_D    ")    D BEAM CX: RECAPTURE BY CX W/H+
            [VS. RADIUS AND TIME]

>CHIS          is "DIFFUSIVITIES                       " in CM**2/SEC
       1. +("CONDE      ")    ELECTRON HEAT DIFFUSIVITY
       2. +("CONDEF     ")    1 FLUID "EFFECTIVE" CHI
       3. +("DIFFE      ")    ELEC PTCL DIFFUSIVITY
       4. +("DIFWE      ")    ELEC PTCL DIFFUSIVITY (WARE)
       5. +("CONDI      ")    ION HEAT DIFFUSIVITY
            [VS. RADIUS AND TIME]
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 PROFILE MULTIGRAPH PACKAGES  RUN TFTR.89      2100 SHOT  42457

>DENS0          is "THERMAL NEUTRAL DENSITIES          " in N/CM**3
       1. +("DN0VD       ")    VOL NEUTRAL DENSITY G=D
       2. +("DN0WD       ")    WALL NEUTRAL DENS G=D
       3. +("DN0VH       ")    VOL NEUTRAL DENSITY G=H
       4. +("DN0WH       ")    WALL NEUTRAL DENS G=H
            [VS. RADIUS AND TIME]

>DNSB0          is "BEAM NEUTRAL DENSITIES             " in N/CM**3
       1. +("N0BCXD0     ")    CX FAST NEUTRAL DENSITY (D0)
       2. +("N0BD0       ")    1.GEN FAST NEUTRAL DENSITY (D0)
            [VS. RADIUS AND TIME]

>E0BAL          is "PLASMA FRAME NEUTRAL POWER BAL    " in WATTS/CM3
       1. +("PCX         ")    CHARGE EXCHANGE LOSS
       2. -("PNI         ")    NEUTRAL IONIZATION SOURCE
       3. -("BALE0       ")    NEUTRAL POWER BALANCE
       4. +("S0VLE       ")    TOTAL NEUTRAL VOL SCE
       5. +("FL0EI       ")    DIV(NEUTRAL E-INFLUX)
       6. -("FL0EX       ")    DIV(NEUTRAL E-OUTFLUX)
            [VS. RADIUS AND TIME]

>ECON           is "ENERGY CONFINEMENT                 " in SECONDS
       1. +("TEE         ")    ELECTRON ENERGY CONFINEMENT
       2. +("TEEST       ")    ELECTRON ENERGY CONFINEMENT (*)
       3. +("TEI         ")    ION ENERGY CONFINEMENT
       4. +("TEIST       ")    ION ENERGY CONFINEMENT (*)
       5. +("TAUES       ")    PLASMA ENERGY CONFINEMENT (*)
       6. +("TAUE        ")    PLASMA ENERGY CONFINEMENT
            [VS. RADIUS AND TIME]
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 PROFILE MULTIGRAPH PACKAGES  RUN TFTR.89      2100 SHOT  42457

>ECON1        is "ENERGY CONFINEMENT 1                " in SECONDS
       1. +("TAUS1      ")    TOTAL ENERGY CONFINEMENT (*)
       2. +("TAU1       ")    TOTAL ENERGY CONFINEMENT
            [VS. RADIUS AND TIME]

>EEBAL        is "ELECTRON POWER BALANCE              " in WATTS/CM3
       1. +("POH        ")    OHMIC HEATING POWER
       2. +("PBE        ")    BEAM ELECTRON HEATING
       3. -("PION       ")    NEUTRAL IONIZATION WORK
       4. -("PRAD       ")    ADJUSTED RADIATION LOSS
       5. -("PCNVE      ")    ELECTRON CONVECTION LOSS
       6. -("GAINE      ")    ELECTRON GAIN
       7. +("PCMPE      ")    ELECTRON COMPRESSION
       8. -("PCNDE      ")    ELECTRON CONDUCTION LOSS
       9. -("QIE        ")    ION-ELECTRON COUPLING
      10. +("TEBAL      ")    ELECTRON POWER BALANCE
            [VS. RADIUS AND TIME]

>EECON        is "ELECTRON ENERGY CONFINEMENT         " in SECONDS
       1. +("TEE        ")    ELECTRON ENERGY CONFINEMENT
       2. +("TEEST      ")    ELECTRON ENERGY CONFINEMENT (*)
            [VS. RADIUS AND TIME]

>EICON        is "ION ENERGY CONFINEMENT              " in SECONDS
       1. +("TEI        ")    ION ENERGY CONFINEMENT
       2. +("TEIST      ")    ION ENERGY CONFINEMENT (*)
            [VS. RADIUS AND TIME]
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 PROFILE MULTIGRAPH PACKAGES  RUN TFTR.89      2100 SHOT  42457

>EPBAL          is "ELECTRON PTCL BALANCE                 " in N/CM3/SEC
       1. +("SBE          ")    ELECTRON SCE BEAM DEPOSITION
       2. -("DNEDT        ")    D/DT(ELECTRON DENSITY)
       3. -("DIVFE        ")    DIV(ELECTRON FLUX)
       4. +("SCEW         ")    ELECTRON SCE (WALL NEUTRALS)
       5. +("SCEV         ")    ELECTRON SCE (VOL. NEUTRALS)
            [VS. RADIUS AND TIME]

>ETATH          is "ETA(THERMAL)S                         " in
       1. +("ETAE         ")    D(LN(TE))/D(LN(NE))
       2. +("ETAI         ")    D(LN(TI))/D(LN("NI"))
       3. +("ETAIE        ")    D(LN(TI))/D(LN(NE))
            [VS. RADIUS AND TIME]

>FB             is "B FIELD FACTORS                       " in
       1. +("FBX          ")    |B|/|BT(EXTERNAL)|
       2. +("FBTX         ")    |BT|/|BT(EXTERNAL)|
            [VS. MIDPLANE RADII AND TIME]

>FBP            is "|BP|/|BT| COMPARISON                  " in
       1. +("FBPBT        ")    |BP|/|BT| COMPUTED
            [VS. MIDPLANE RADII AND TIME]
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 PROFILE MULTIGRAPH PACKAGES  RUN TFTR.89      2100 SHOT  42457

>FBTH          is "BEAM ION DENSITIES                    " in N/CM**3
       1. +("FBTH1       ")    NB DIST 0.< R/A <.2
       2. +("FBTH2       ")    NB DIST .2< R/A <.4
       3. +("FBTH3       ")    NB DIST .4< R/A <.6
       4. +("FBTH4       ")    NB DIST .6< R/A <.8
       5. +("FBTH5       ")    NB DIST .8< R/A <1.
            [VS. POL. ANGLE AND TIME]

>FPAX          is "FRAC. BEAM SCATTERING>IMPURITIES " in
       1. +("FPAX_D      ")    D BEAM SCATTERING >IMPURITIES
            [VS. RADIUS AND TIME]

>FPBX          is "FRACTIONAL BEAM DRAG->IMPURITIES " in
       1. +("FPBX_D      ")    D BEAM DRAG >IMPURITIES
            [VS. RADIUS AND TIME]

>GCHK          is "G PARA/DIAMAGNETIC CHECK              " in
       1. +("GFUN        ")    G: PARA/DIAMAGNETISM
       2. +("GFUNC       ")    G: GRAD-SHAF EQUILIBRIUM CHECK
            [VS. RADIUS AND TIME]

>GDBAL         is "PTCL BALANCE ION (D+)                 " in N/CM3/SEC
       1. -("DNDDT       ")    D/DT(ION DENS D+)
       2. -("DIVFD       ")    DIV(ION FLUX D+)
       3. +("SVD         ")    TOT ION SCE VOL. D+
       4. +("SWD         ")    TOT ION SCE WALL D+
            [VS. RADIUS AND TIME]
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 PROFILE MULTIGRAPH PACKAGES  RUN TFTR.89      2100 SHOT  42457

>GHBAL        is "PTCL BALANCE ION (H+)                " in N/CM3/SEC
       1. -("DNHDT      ")    D/DT(ION DENS H+)
       2. -("DIVHT      ")    DIV(ION FLUX H+)
       3. +("SVH        ")    TOT ION SCE VOL. H+
       4. +("SWH        ")    TOT ION SCE WALL H+
            [VS. RADIUS AND TIME]

>IEBAL        is "ION POWER BALANCE                    " in WATTS/CM3
       1. +("PBI        ")    BEAM ION HEATING
       2. +("PBTH       ")    BEAM THERMALIZATION POWER
       3. -("GAINI      ")    ION GAIN
       4. +("PCMPI      ")    ION COMPRESSION
       5. -("PCOND      ")    ION CONDUCTION LOSS
       6. +("QIE        ")    ION-ELECTRON COUPLING
       7. -("P0NET      ")    NET CHARGE EXCHANGE LOSS
       8. -("PCONV      ")    ION CONVECTION LOSS
       9. +("TIBAL      ")    ION POWER BALANCE
            [VS. RADIUS AND TIME]

>IMBAL        is "IMPURITY PTCL BALANCE                " in N/CM3/SEC
       1. -("DNIMP      ")    D/DT(IMPURITY DENSITY)
       2. -("DFIMP      ")    DIV(IMPURITY FLUX)
       3. +("SCIMP      ")    IMPURITY SOURCE
            [VS. RADIUS AND TIME]
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>IPBAL        is "ION PTCL BALANCE                    " in N/CM3/SEC
       1. -("DNIDT      ")    D/DT(TOTAL ION DENSITY)
       2. -("DIVFI      ")    DIV(TOTAL ION FLUX)
       3. +("SBTOT      ")    TOTAL ION SCE(VOL. NEUTRALS)
       4. +("SWTOT      ")    TOTAL ION SCE(WALL NEUTRALS)
            [VS. RADIUS AND TIME]

>KAPA         is "THERMAL DIFFUSIVITY 1               " in CM**2/SEC
       1. +("CONDE      ")    ELECTRON HEAT DIFFUSIVITY
       2. +("CONDEF     ")    1 FLUID "EFFECTIVE" CHI
       3. +("KETOT      ")    CHI(E) "COUNTING" CONVECTION
       4. +("KECMG      ")    GRUBER CHI(E)
       5. +("KEPLT      ")    PLT CHI(E) THERMAL
       6. +("KEKG       ")    KAYE-GOLDSTON CHI(E)
       7. +("CONDI      ")    ION HEAT DIFFUSIVITY
       8. +("XKINC      ")    NEOCLASSICAL CHI(I)
            [VS. RADIUS AND TIME]

>KAPA2        is "THERMAL DIFFUSIVITY 2               " in CM**2/SEC
       1. +("CONDE      ")    ELECTRON HEAT DIFFUSIVITY
       2. +("KETOT      ")    CHI(E) "COUNTING" CONVECTION
       3. +("KEINT      ")    INTOR CHI(E) THERMAL
       4. +("KECOP      ")    COPPI CHI(E) THRMAL NO. 1
       5. +("KEBON      ")    BONOLI-COPPI CHI(E)
       6. +("KEMOL      ")    MOLVIG CHI(E) THERMAL
       7. +("KEDRK      ")    DRAKE CHI(E) THERMAL
            [VS. RADIUS AND TIME]
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>KAPA3         is "THERMAL DIFFUSIVITY 3              " in CM**2/SEC
       1. +("CONDE      ")    ELECTRON HEAT DIFFUSIVITY
       2. +("KETOT      ")    CHI(E) "COUNTING" CONVECTION
       3. +("KEOHK      ")    OHKAWA CHI(E)
       4. +("KEPP1      ")    PARAIL-POGUTSE CHI(E)1
       5. +("KEPP2      ")    PARAIL-POGUTSE CHI(E)2
       6. +("KECAR      ")    CARDI/DIAMOND CHI(E)
            [VS. RADIUS AND TIME]

>KAPA4         is "THERMAL DIFFUSIVITY 4              " in CM**2/SEC
       1. +("CONDE      ")    ELECTRON HEAT DIFFUSIVITY
       2. +("KETOT      ")    CHI(E) "COUNTING" CONVECTION
       3. +("KEBOH      ")    BOHM THERMAL CHI(E)
       4. +("KEKAW      ")    KAW ANOMOLOUS CHI(E)
       5. +("KETAN      ")    TANG ANOMOLOUS CHI(E)
            [VS. RADIUS AND TIME]

>KAPA5         is "THERMAL DIFFUSIVITY 5              " in CM**2/SEC
       1. +("CONDE      ")    ELECTRON HEAT DIFFUSIVITY
       2. +("KETOT      ")    CHI(E) "COUNTING" CONVECTION
       3. +("KTFR1      ")    TFR Q<1 CHI(E)
       4. +("KTFR2      ")    TFR 1<Q<2 CHI(E)
       5. +("KTFR3      ")    TFR 2<Q CHI(E)
            [VS. RADIUS AND TIME]
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>KAPA6        is "THERMAL DIFFUSIVITY 6              " in CM**2/SEC
      1. +("CONDE      ")   ELECTRON HEAT DIFFUSIVITY
      2. +("KETOT      ")   CHI(E) "COUNTING" CONVECTION
      3. +("XETE0      ")   CHI:E(ETA(E)) GUZDAR
      4. +("XETAE      ")   CHI:E(ETA(E)) ACTIVE
         [VS. RADIUS AND TIME]

>MFLUX        is "MAGNETIC FLUXES                    " in WEBERS
      1. +("PLFLX      ")   POLOIDAL FLUX
      2. +("TRFLX      ")   TOROIDAL FLUX
         [VS. RADIUS AND TIME]

>MGBAL        is "MAGDIF ENERGY BALANCE              " in WATTS/CM3
      1. -("POH        ")   OHMIC HEATING POWER
      2. +("UDEXB      ")   E CROSS B POWER
      3. -("UBPDT      ")   D/DT(POLOIDAL FIELD ENERGY)
      4. +("UBCMP      ")   B(POL) COMPRESSION
      5. +("UMGBA      ")   MAGDIF ENERGY BALANCE
      6. -("POHB       ")   POWER: OH CIRCUIT TO BEAM
         [VS. RADIUS AND TIME]

>N0BAL        is "NEUTRAL PTCL BALANCE (E-)          " in N/CM3/SEC
      1. -("BALN0      ")   BALANCE CHECK
      2. +("S0VOL      ")   TOTAL NEUTRAL VOL E-SCE
      3. +("FLX0I      ")   DIV(NEUTRAL E-INFLUX)
      4. -("FLX0X      ")   DIV(NEUTRAL E-OUTFLUX)
      5. -("SFETO      ")   ELECTRONS -> FAST NEUTRALS
      6. -("SCEE       ")   ELECTRON SOURCE (TH.NEUTRALS)
         [VS. RADIUS AND TIME]
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>NCFKI        is "FITS TO NEOCLASSICAL KAPA(I)       " in CM**2/SEC
       1. +("FKJUL      ")    CHI(I) NC RUTHERFORD-JULICH
       2. +("FKHZH      ")    CHI(I) NC HAZELTINE-HINTON
       3. +("FKBOL      ")    CHI(I) NC BOLTON
       4. +("FKCHH      ")    CHI(I) NC CHANG-HINTON ORIGINAL
       5. +("FKCH2      ")    CHI(I) NC CHANG-HINTON VSN 2
       6. +("FKCHZ      ")    CHI(I) NC CHANG-HINTON Z-CORR
       7. +("XETI0      ")    CHI(ETA(I)) RAW
       8. +("CONDI      ")    ION HEAT DIFFUSIVITY
            [VS. RADIUS AND TIME]

>NECOM        is "NE DATA INPUT                      " in N/CM**3
       1. +("NEIN       ")    NE INPUT PROFILE
       2. +("NEUSE      ")    NE DATA AS USED
            [VS. NE POSITIONS AND TIME]

>NETWD        is "NE DATA PROFILE ASYMMETRY          " in N/CM**3
       1. +("NE         ")    ELECTRON DENSITY
       2. +("NETW       ")    NE(R) ASSYMMETRY
            [VS. RADIUS AND TIME]

>OMEGS        is "PLASMA ANGULAR VELOCITIES          " in SEC**-1
       1. +("OMEGB      ")    BEAM ION AVG ANG.VELOCITY
            [VS. RADIUS AND TIME]

>PBOLO        is "PRAD USED AND BOLOMETER DATA       " in WATTS/CM3
       1. +("PRAD       ")    ADJUSTED RADIATION LOSS
       2. +("PRAD0      ")    RADIATION: BOLO DATA
            [VS. RADIUS AND TIME]
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>PCMPR        is "COMPRESSION POWERS                  " in WATTS/CM3
       1. +("UBCMP      ")    B(POL) COMPRESSION
       2. +("PCPRB      ")    POWER: COMPRESSION OF BEAM
       3. +("PCMPE      ")    ELECTRON COMPRESSION
       4. +("PCMPI      ")    ION COMPRESSION
            [VS. RADIUS AND TIME]

>PCON         is "PTCL CONFINEMENT                    " in SECONDS
       1. +("TAUPE      ")    ELECTRON PTCL CONFINEMNT
       2. +("TAPWE      ")    ELECTRON TAU(P) WARE CORRECTION
       3. +("TAUPD      ")    D+ ION PTCL CONFINEMENT
       4. +("TAUPH      ")    H+ ION PTCL CONFINEMENT
       5. +("TAUPI      ")    ION PTCL CONFINEMENT
            [VS. RADIUS AND TIME]

>PCURS        is "PLASMA CURRENTS                     " in AMPS/CM2
       1. +("CUR        ")    TOTAL PLASMA CURRENT
       2. +("CRPGP      ")    THERMAL GRAD(P) TOROIDAL CUR
       3. +("CRBGP      ")    BEAM GRAD(P) TOROIDAL CUR
       4. +("CURBS      ")    BOOTSTRAP CURRENT
       5. +("CURB       ")    BEAM DRIVEN CURRENT
            [VS. RADIUS AND TIME]
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>PDENS        is "PLASMA DENSITIES                    " in N/CM**3
       1. +("BDENS      ")    BEAM ION DENSITY
       2. +("NE         ")    ELECTRON DENSITY
       3. +("ND         ")    DEUTERIUM ION DENSITY
       4. +("NH         ")    HYDROGEN ION DENSITY
       5. +("NIMP       ")    IMPURITY DENSITY
            [VS. RADIUS AND TIME]

>PDIFF        is "PTCL DIFFUSIVITIES                  " in CM**2/SEC
       1. +("DIFFE      ")    ELEC PTCL DIFFUSIVITY
       2. +("DIFWE      ")    ELEC PTCL DIFFUSIVITY (WARE)
       3. +("DEINT      ")    INTOR ELECTRON DIFFUSIVITY
       4. +("DIFFI      ")    ION PTCL DIFFUSIVITY
            [VS. RADIUS AND TIME]

>PLCUR        is "POLOIDAL CURRENT TO BOUNDARY        " in AMPS
       1. +("PLCRM      ")    POLOIDAL CUR (J PLL)
       2. +("PLCRP      ")    POLOIDAL CUR (J PERP TH)
       3. +("PLCRB      ")    POLOIDAL CUR (J PERP BI)
       4. +("PLCRT      ")    TOTAL POLOIDAL CUR TO WALL
            [VS. RADIUS AND TIME]

>PNTNS        is "NEUTRON EMISSIVITIES                " in N/CM3/SEC
       1. +("BTNTX      ")    BEAM-TARGET NEUTRONS
       2. +("BBNTX      ")    BEAM-BEAM NEUTRONS
       3. +("THNTX      ")    THERMONUCLEAR NEUTRONS
            [VS. RADIUS AND TIME]
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>PNTNS_DD     is "DD NEUTRON EMISSIVITIES              " in N/CM3/SEC
       1. +("BBNTX_DD   ")    DD BEAM-BEAM NEUTRONS
       2. +("BTNTX_DD   ")    DD BEAM-TARGET NEUTRONS
       3. +("THNTX_DD   ")    DD THERMONUCLEAR NEUTRONS
            [VS. RADIUS AND TIME]

>PRESS        is "PLASMA PRESSURE                      " in PASCALS
       1. +("PTOWB      ")    TOTAL MHD PRESSURE INCL. BEAMS
       2. +("PPLAS      ")    PLASMA PRESSURE
            [VS. RADIUS AND TIME]

>PRVEL        is "PTCL RADIAL VELOCITIES               " in CM/SEC
       1. +("VELE       ")    ELECTRON RADIAL VELOCITY
       2. +("VELWE      ")    ELECTRON WARE VELOCITY
       3. +("VELIM      ")    IMPURITY RADIAL VELOCITY
       4. +("VELD       ")    ION VELOCITY D+
       5. +("VELH       ")    ION VELOCITY H+
            [VS. RADIUS AND TIME]

>PTEMP        is "PLASMA TEMPERATURES                  " in EV
       1. +("TE         ")    ELECTRON TEMPERATURE
       2. +("TI         ")    ION TEMPERATURE
            [VS. RADIUS AND TIME]

>QP           is "Q PROFILES                           " in
       1. +("QCHK       ")    MHD EQUILIBRIUM Q CHECK
       2. +("Q          ")    Q PROFILE
            [VS. RADIUS AND TIME]
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>T0            is "THERMAL NEUTRAL TEMPERATURES      " in EV
       1. +("T0VD        ")    VOL NEUTRAL TEMP G=D
       2. +("T0WD        ")    WALL NEUTRAL TEMP G=D
       3. +("T0VH        ")    VOL NEUTRAL TEMP G=H
       4. +("T0WH        ")    WALL NEUTRAL TEMP G=H
            [VS. RADIUS AND TIME]

>TBPA_D        is "D BEAM PITCH ANGLE SCATTERING     " in SECONDS
       1. +("TPA1A_D     ")    D FULL E TAU(SCATTERING,CO)
       2. +("TPA2A_D     ")    D HALF E TAU(SCATTERING,CO)
       3. +("TPA3A_D     ")    D 1/3 E TAU(SCATTERING,CO)
       4. +("TPA1B_D     ")    D FULL E TAU(SCATTERING,CTR)
       5. +("TPA2B_D     ")    D HALF E TAU(SCATTERING,CTR)
       6. +("TPA3B_D     ")    D 1/3 E TAU(SCATTERING,CTR)
            [VS. RADIUS AND TIME]

>TBSL_D        is "D BEAM SLOWING DOWN TIMES         " in SECONDS
       1. +("TSL1A_D     ")    D FULL E TAU(SLOWING DOWN,CO)
       2. +("TSL2A_D     ")    D HALF E TAU(SLOWING DOWN,CO)
       3. +("TSL3A_D     ")    D 1/3 E TAU(SLOWING DOWN,CO)
       4. +("TSL1B_D     ")    D FULL E TAU(SLOWING DOWN,CTR)
       5. +("TSL2B_D     ")    D HALF E TAU(SLOWING DOWN,CTR)
       6. +("TSL3B_D     ")    D 1/3 E TAU(SLOWING DOWN,CTR)
            [VS. RADIUS AND TIME]

>TCHK          is "TOROIDAL FLUX CHECK               " in WEBERS
       1. +("TRFLX       ")    TOROIDAL FLUX
       2. +("TRFCK       ")    MHD TOROIDAL FLUX CHECK
            [VS. RADIUS AND TIME]
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>TCONS        is "CONFINEMENT TIMES                    " in SECONDS
       1. +("TAUPE      ")    ELECTRON PTCL CONFINEMNT
       2. +("TAPWE      ")    ELECTRON TAU(P) WARE CORRECTION
       3. +("TEE        ")    ELECTRON ENERGY CONFINEMENT
       4. +("TAUE       ")    PLASMA ENERGY CONFINEMENT
            [VS. RADIUS AND TIME]

>TECOM        is "TE DATA INPUT                        " in EV
       1. +("TEIN       ")    TE INPUT PROFILE
       2. +("TEUSE      ")    TE DATA AS USED
            [VS. TE POSITIONS AND TIME]

>TESAW        is "SAWTOOTH DATA: TE                    " in EV
       1. +("TE         ")    ELECTRON TEMPERATURE
            [VS. RADIUS AND TIME]

>TSHAF        is "SHAFRANOV & TE DATA SHIFT            " in CM
       1. +("SSHAF      ")    SHAFRANOV SHIFT
       2. +("TSHFT      ")    TE DATA SHIFT
            [VS. RADIUS AND TIME]

>UBCUR        is "UNSHIELDED BEAM CURRENTS             " in AMPS/CM2
       1. +("UCURB      ")    UNSHIELDED BEAM CURRENT
       2. +("UJBCO      ")    UNSHIELDED BEAM CUR (CO BEAMS)
       3. +("UJBCR      ")    UNSHIELDED BEAM CUR (CTR BEAMS)
            [VS. RADIUS AND TIME]
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>UBDOT          is "FIELD ENERGY GAIN                    " in WATTS/CM3
       1. +("UBTDT       ")    D/DT(FIELD ENERGY)
       2. +("UBPDT       ")    D/DT(POLOIDAL FIELD ENERGY)
            [VS. RADIUS AND TIME]

>UDENS          is "ENERGY DENSITY                       " in JLES/CM3
       1. +("UE          ")    ELECTRON ENERGY DENSITY
       2. +("UTOTL       ")    TOTAL ENERGY DENSITY
       3. +("UBPRP       ")    BEAM PERP ENERGY DENSITY
       4. +("UBPAR       ")    BEAM PLL ENERGY DENSITY
       5. +("UI          ")    ION ENERGY DENSITY
       6. +("UTHRM       ")    THERMAL ENERGY DENSITY
            [VS. RADIUS AND TIME]

>VCHK           is "VOLTAGE CHECK                        " in VOLTS
       1. +("V           ")    VOLTAGE
       2. +("VCHEK       ")    VOLTAGE CHECK
            [VS. RADIUS AND TIME]

>VISBP          is "PROFILE VB LIGHT                     " in VB INTENS
       1. +("VBRC        ")    VB PROFILE (CALCULATED)
            [VS. RADIUS AND TIME]

>ZEFF           is "Z-EFFECTIVE PROFILES                 " in
       1. +("ZEFMD       ")    MAGDIF ZEFF PROFILE
       2. +("ZEFFP       ")    PLASMA COMPOSITION ZEFF PROFILE
       3. +("ZEFFI       ")    INPUT ZEFF (UNCONSTRAINED)
            [VS. RADIUS AND TIME]
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The End

The End