TRANSP

Time dependent tokamak transport data analysis code used at PPPL and at tokamak sites around the world.

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TRANSP Facts

Early History:

TRANSP came into existence in 1977 as a modified version of BALDUR for use in analysis of PLT results. In 1979, a Monte Carlo neutral beam package was interfaced to TRANSP and 6 KeV high ion temperature results from PLT 1978 were successfully analyzed. Creation of RPLOT gave physicist-users online interactive graphics access to TRANSP's analysis results database for the first time in 1980.

The approach of using an analysis code with maximal reliance on diagnostic data proved fruitful in developing an understanding of experimental results, and so TRANSP has been in use at PPPL ever since its success with the PLT data.

Code status as of October 1995:

At PPPL over 7500 TRANSP runs have been archived, giving analyses of over 1200 different plasma conditions from PLT, PDX, PBX, PBX-M, and TFTR, as well as Tore Supra (shots run at PPPL under a collaboration agreement). Run results have been permanently archived since 1980.

Versions of TRANSP are running at JET, ASDEX-U, TEXTOR, D-III-D and C-MOD, and are actively engaged in data analysis.

The TRANSP source directory tree contains over 24 Mbytes of source code (Fortran and C) and documentation in 3400 files in 150 directories. About 20% of the executable code is written by code generators. There are over 3000 symbols in the OLYMPUS-generated main COMMON blocks and over 600 symbols in the input namelist.

TRANSP is available on the Internet. Network based TRANSP code development collaborations are now feasible and are ongoing between PPPL and JET, C-MOD, and TEXTOR.

Summary of TRANSP Code Operation

Diagnostic Input data: plasma current*, surface voltage, plasma boundary*, toroidal field*, λ, β, neutron flux, Hα, sawtooth and pellet times, ne(R,t)*, Zeff(R,t)*, Te(R,t)*, Ti(R,t), Vrot(r,t), Prad(r,t), neutral beam and ICRF parameters.

Control Input data: namelist controls*, physics assumptions ...

***items required to make a minimal TRANSP run**

TRANSP

MHD Equilibrium Calculation

Events: sawteeth and/or pellets

Heating: RF, neutral beams, fusion product ions

Poloidal Field Diffusion

Particle Balance with Neutral Transport

Momentum Balance

Ion Energy Balance

Electron Energy Balance

Diagnostic Simulations

Feedback Control

Output

Timestep Control and Advance

Analysis Results: up to 1500 scalar and profile functions of time detailing plasma transport and all events, auxilliary heating, balances, and diagnostic simulations. Accessed via RPLOT interactive graphics code.

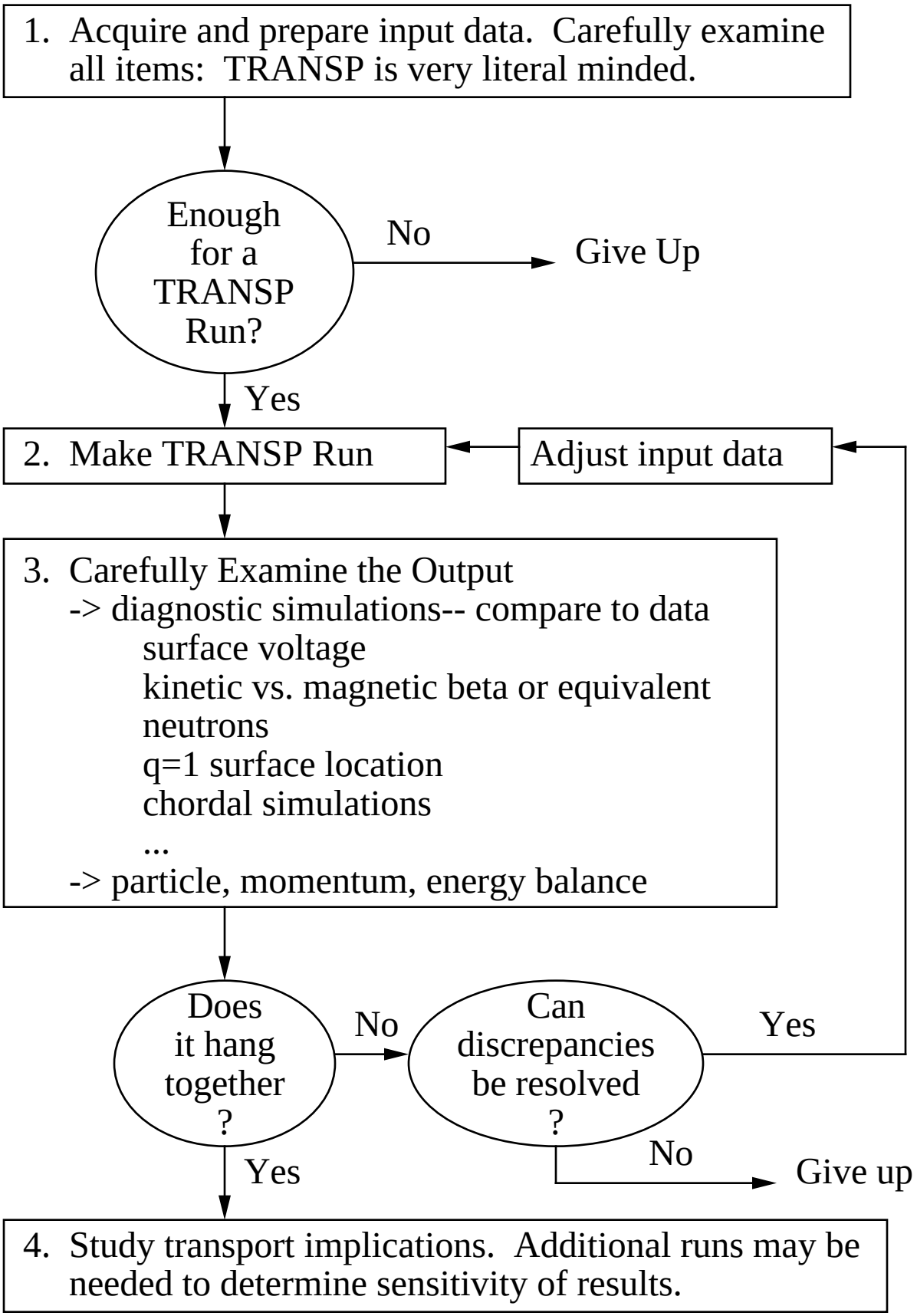
TRANSP

The Purpose of the TRANSP code is to provide a tool for analysis of tokamak experimental results data. Code development priorities are set by the needs of tokamak experimental physics community--especially, those in the community who have experimental data and a demonstrated interest in using TRANSP. Code architecture is optimized for responsiveness to the needs of the experimentalists.

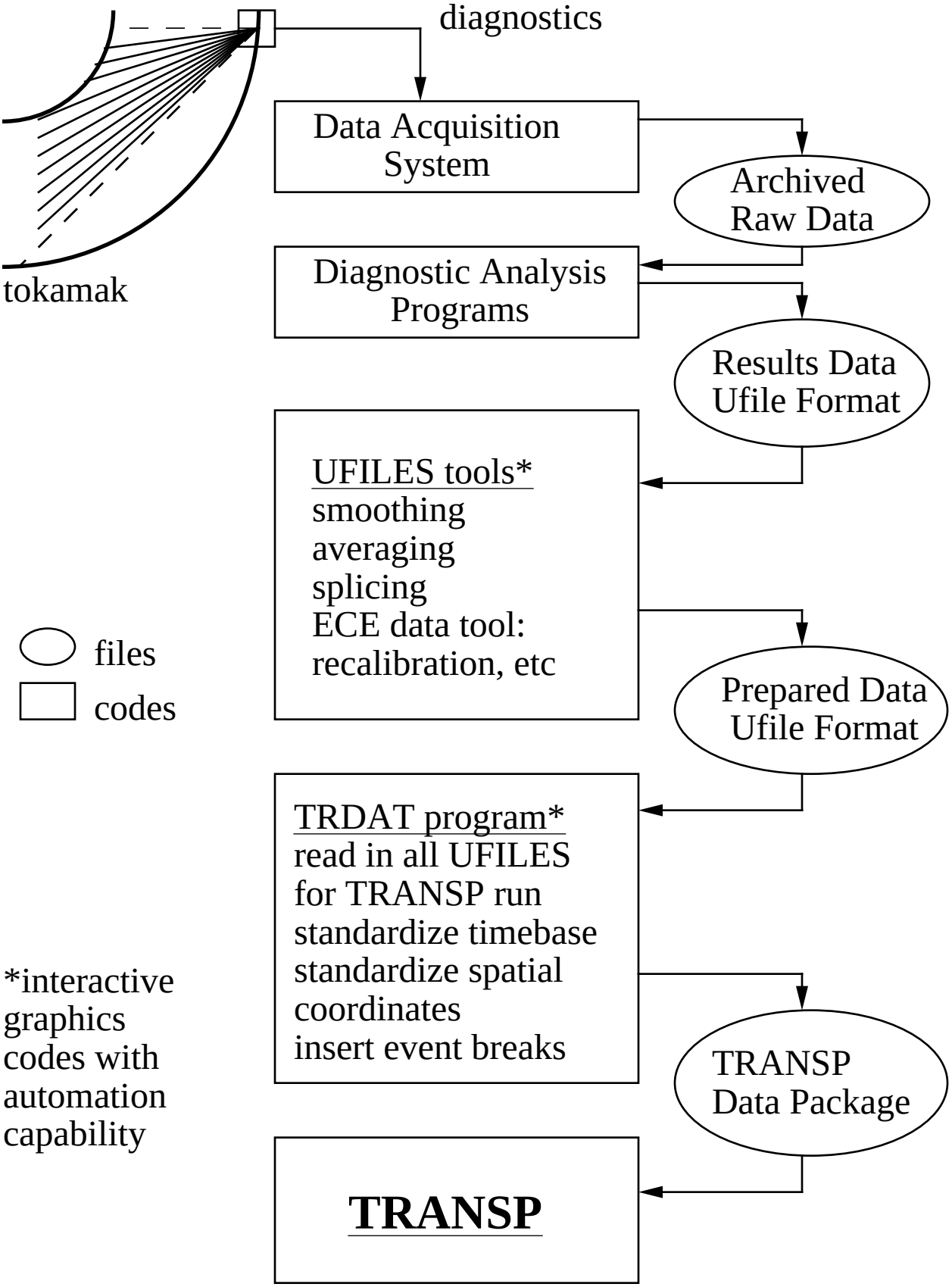
TRANSP FEATURES:

√ Time dependent analysis of profile data. Automatic timestep control on all physics calculations. "Zoom feature" allows user to specify high time-resolution intervals in the calculation and i/o.
√ Time varying non-circular geometry and MHD equilibrium.
√ Neutral transport and particle balance.
√ Kadomtsev sawtooth model. Pellet injection model.
√ Beam Deposition including rotation and beam-beam effects.
√ Beam Heating using Fokker Planck model with energy diffusion of fast ions or geometry generalized multiple species 2d Monte Carlo model with full orbit following and charge exchange including recapture and beam-beam atomic physics. Both models include effects of plasma rotation.
√ Beam-beam, beam-target, and thermonuclear neutrons.
√ Monte Carlo fusion product ions -- source, slowing down, plasma heating, distribution function, fusion Triton burnup.
√ ICRF heating. Lower Hybrid current drive.
√ Plasma and fast ion momentum balance.
√ Plasma and fast ion energy balance with adiabatic compression.
√ Generalized geometry poloidal field diffusion, including beam, RF and bootstrap drivent currents.
√ Extensive diagnostic simulations: charge exchange spectra, bolometry, chordal neutron emission, visible Bremsstrahlung, Faraday Rotation, Motional Stark Effect, ...
√ Feedback loops and prediction capabilities.
√ Interface to postprecessor models.

Procedure for Making Use of TRANSP

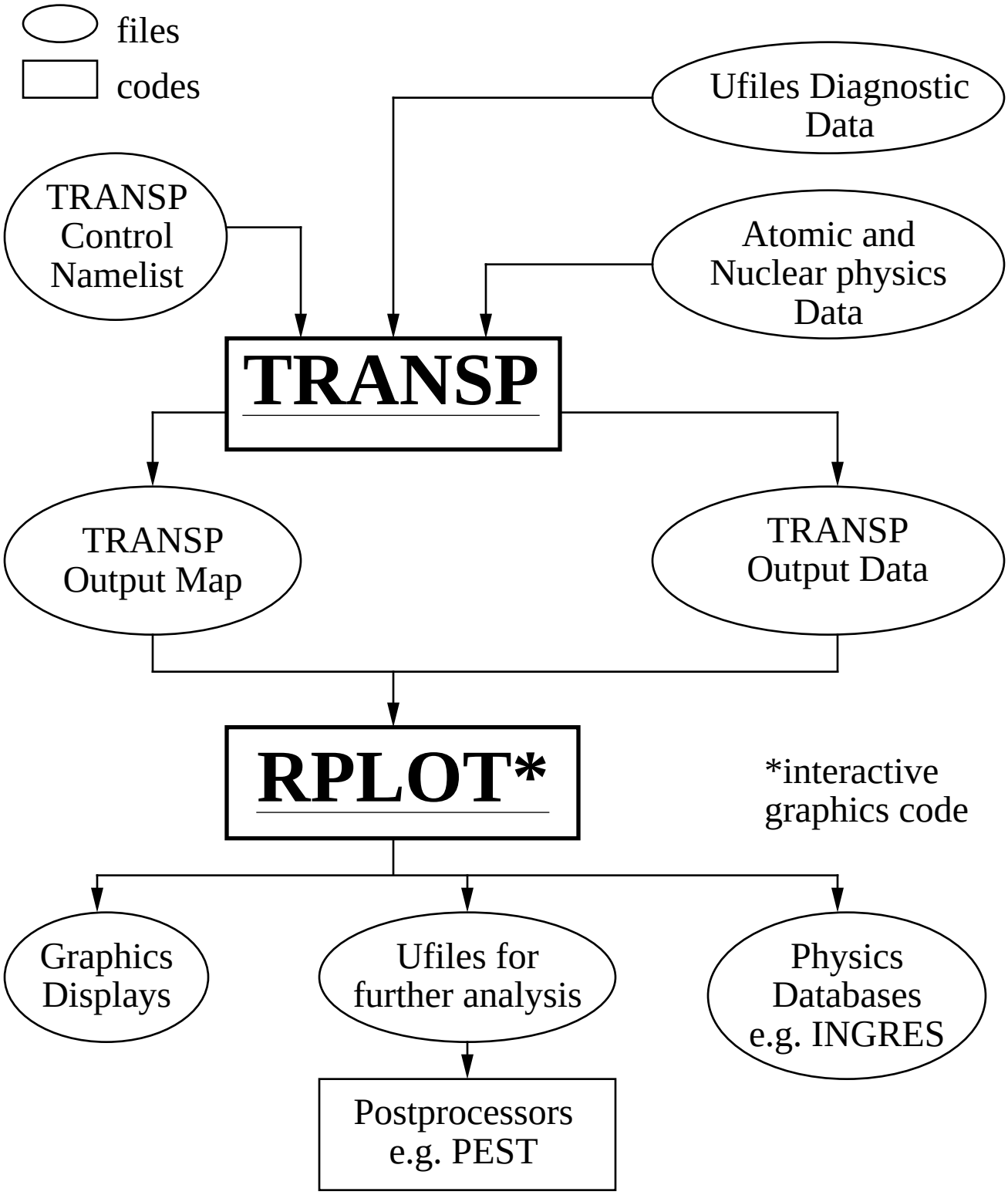


TRANSP DATA ACQUISITION



*interactive graphics codes with automation capability

TRANSP DATA FLOW



RPLOT is completely independent of TRANSP namelist files and COMMON, so modification of TRANSP has no effect on access to old analysis results data. RPLOT is portable-- e.g. BALDUR now uses the RPLOT system.