



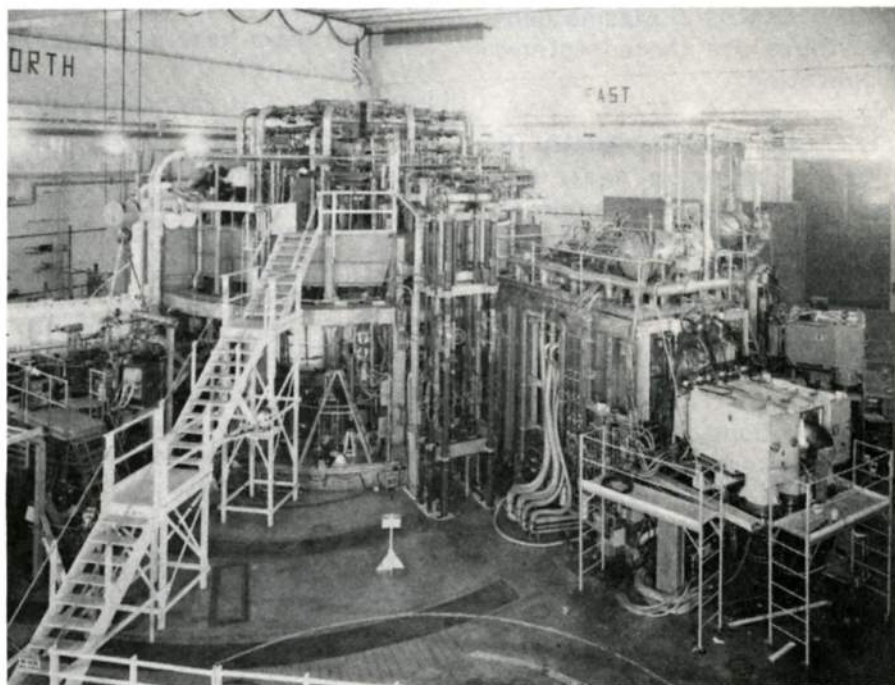
## TFTR RESULTS

With only 20% of its final heating power capability, TFTR has gathered new confinement physics knowledge over an unprecedented range of plasma parameters -- from high  $n\tau$  values to very high ion temperatures -- according to Dr. Dale Meade's April 26 report to the Spring Meeting of the American Physical Society in Arlington, VA.

TFTR experiments conducted between June 1984 and April 1985 have successfully accomplished essentially all their objectives. A major achievement has been the operation of the TFTR tokamak at its design magnetic field strength (5.2 T, or 52 kG) and at its design plasma current (2.5 MA) -- almost six months ahead of schedule.

**OHMIC HEATING:** The toroidal plasma current in tokamak devices such as TFTR provides magnetic confinement and also heats the plasma, just as electric current heats a copper wire. This ohmic heating provides about 2.5 MW of plasma heating for TFTR. Studies of plasma confinement in this ohmic heating regime have found maximum energy confinement times ( $\tau_E$ ) of 0.4 sec.

In tokamak experiments, room temperature deuterium gas is usually injected into the plas-



*The Tokamak Fusion Test Reactor, Spring 1985*

ma to raise the plasma electron density. In TFTR, a maximum density at the center of the plasma of  $n_e(0) \sim 7.5 \times 10^{19} \text{ m}^{-3}$  has been achieved by this technique. The corresponding  $n_e(0)\tau_E$  value was  $3.3 \times 10^{19} \text{ m}^{-3}\text{s}$ .

**PELLET INJECTION:** In the most recent TFTR experiments, a pellet injector developed by the Oak Ridge National Laboratory Fusion Energy Division was used to inject 3-mm-diameter solid (i.e., frozen to  $\sim 12^\circ \text{ Kelvin}$ ) deuterium pellets at speeds of  $1.4 \times 10^3 \text{ m/s}$  into the plasma. Using this technique, which allows the deuterium

fuel to penetrate more deeply into the plasma, the maximum central plasma density was increased by  $\sim 50\%$ . The confinement quality  $n_e(0)\tau_E$  reached a maximum of about  $4 \times 10^{19} \text{ m}^{-3}\text{s}$  -- well into the range that will be required for TFTR breakeven experiments. In terms of a commonly used figure of merit,  $n_e(0)\tau_E T_i(0)$ , this ohmic regime has achieved  $8\text{--}9 \times 10^{19} \text{ keV m}^{-3} \text{ sec}$ , which is close to the record value of  $\sim 12 \times 10^{19} \text{ keV m}^{-3} \text{ sec}$  which was achieved by Alcator C.

**NEUTRAL BEAM HEATING:** Tokamaks and mirror fusion

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devices can be heated by energetic neutral beams. In this process, an energetic neutral atom is injected from the outside, passing readily through the magnetic field and becoming a "hot" ion near the center of the plasma. Depending on the density of these hot ions relative to the warm background plasma density, there are three regimes of operation:

1. The hot-ion density is low. The beam heats the warm plasma to a temperature  $T$ , and essentially all of the fusion reactions are produced by the warm plasma itself.

2. The hot-ion density equals about 10% of the warm plasma density. (This is the so called two-component case, which TFTR was designed to utilize in order to facilitate breakeven.) Here the reactions of the hot-ion component with the warm-ion component are roughly equal in number to the reactions produced by the warm ions with each other.

3. The hot-ion density is roughly equal to the warm plasma density. In this case, most all of the reactions are due to the reactions of hot ions with each other.

As the hot-ion density is increased, the  $n\tau$  value required to achieve a given fusion power multiplication factor  $Q$  is reduced. Near  $Q \sim 1$ , this can be an important effect, reducing the  $n\tau$  requirement by up to a factor of three relative to the case with low hot-ion density for TFTR. TFTR will explore the physics of

each of these reactor plasma regimes.

The initial exploratory neutral beam heating experiments were carried out with two neutral beam injectors, providing beam powers up to 6 MW and beam energies of up to 80 keV. The final TFTR neutral beam heating capability will be 27 MW from four injectors. For the conventional high-plasma-density regime, the plasma ion temperature was raised from 2 keV to approximately 6 keV (1 keV equals approximately 11.6 million degrees C). In terms of the ignition parameter  $n_e(0)\tau_E T_i(0)$ , this TFTR regime has reached  $7 \times 10^{19}$  keV m<sup>-3</sup> sec, a value roughly twice that of previous neutral beam experiments.

TFTR also operated in a low-plasma-density regime, where hot ions comprise almost 50% of the total ion density. This type of hot-ion regime was first produced on the 2XIIIB mirror machine at Livermore in 1976 and later on the PLT and PDX tokamaks (here) in 1978 and 1982. The hot-ion regime represents another mode of TFTR D-T operation, which has been discussed as a possible model for a steady-state D-T tokamak reactor.

The ions in TFTR can be grouped as hydrogenic fuel ions, which are heated up by the neutral beam; impurity ions which are preferentially heated by the beams and are in partial equilibrium with the hydrogenic fuel; and the primary beam ions, which are injected at high energy and are cooled to an average energy of about 35-40 keV. The impurity-ion temperatures are

in the range of 10-14 keV, and the hydrogen temperatures are in the range of 6-9 keV. The most relevant parameter for fusion neutron production is the average ion energy in the plasma, which is 20-30 keV and would correspond to an effective hot-ion temperature of 14-20 keV. The best high temperature case has hydrogenic temperatures around 9 keV, which corresponds to temperatures of 100 million °C.

This regime is also of interest because the neutral beams have driven almost 400 kA of plasma current, indicating that this concept could be extended to a steady-state beam-driven tokamak.

Two additional neutral beam injectors will be placed on TFTR during the current shutdown, in preparation for high power experiments with deuterium plasmas near plasma breakeven conditions in 1986. Preparations also continue for actual breakeven experiments, using deuterium-tritium plasmas, scheduled for late 1988.



## Obey Posted Signs

When individuals at PPL disobey posted signs, they jeopardize their own personal safety, and perhaps the safety of others. Warning signs are posted for employee safety

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and must be observed. For example, areas where radioactive materials signs are posted might have a potential for radioactive contamination of unauthorized or untrained personnel. Disobeying laser

hazard signs presents the potential for personnel eye or skin exposure. Disregard of high voltage signs could result in an electrical shock.

Unless you are authorized to enter posted areas, and have

the required training -- stay out! If you feel that posted warning signs in certain areas are no longer applicable, point the situation out to your supervisor or safety representative for solution.

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## Safety Training

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The following Health and Safety training courses are scheduled for May:

Basic First Aid	S. Larson Ext. 3166	May 13, 15, and 17 1-3 p.m.
Fire Extinguisher Training	S. Larson Ext. 3166	May 14 and 28 2-3:30 p.m.
Self-Contained Breathing Apparatus	S. Larson Ext. 3166	May 15 9:30-11:30 a.m.
Cardiopulmonary Resuscitation (CPR)	S. Larson Ext. 3166	May 20, 22, and 24 9 a.m.-noon OR 1-4 p.m.
Employee Orientation	M.A. McBride Ext. 3468	May 22 1-2 p.m.
Back Injury Protection	J. McCormick, R.N. Ext. 3200	May 24 8:30 a.m.-noon
Respiratory Protection	K. Semel Ext. 2531	To Be Announced -- Contact Instructor

Employees must obtain permission from their immediate supervisor to attend these classes. Supervisors must call the responsible instructor to enroll their employees.

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## Patent Changes

A dramatic change concerning rights to inventions made with Federal assistance occurred November 9, 1984, when Public Law 98-620 was signed by President Reagan. The key change for laboratory inventors is that for the first time, if a patent is issued, the inventor and the University will share in royalties obtained

from licensing the patent to commercial interests.

However, the DOE will have a nonexclusive, nontransferable, irrevocable, paid-up license to practice any subject invention throughout the world on behalf of the U.S. government.

Any procedural changes in the laboratory's invention program required to conform to

this new law will be clarified when PPL's contract with the DOE is amended. Meanwhile, the lab's report processing, invention disclosure, and Patent Awareness Program procedures will remain the same.

However, if you have an invention or an idea that you think may be attractive for use in the private sector, please emphasize its commer-

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cial viability in your invention disclosure. A clear message to Princeton University will speed the receipt of a waiver from the DOE, the patent search, and the patent application process to your benefit.

## TRANSITIONS

The HOTLINE offers its congratulations to the following employees, who recently became proud parents:

Dennis Mansfield of TFTR Diagnostics and his wife, Beverly, whose daughter Jill was born March 21;

Bubba Vinson of TFTR Operations and his wife, Lori, whose son Ryan Michael was born April 9;

Bill Allen of Maintenance and his wife, Theresa, whose son David Edwin was born April 14.

## Volunteer For United Way Budget Committee

The United Way-Princeton Area Communities is looking for volunteers for its Budget Committee, which determines United Way funding levels for its member agencies.

Approximately 90 people participate in this annual effort. Volunteers are divided into panels of five or six committee members. Each panel reviews the budgets, programs, and financial support requests submitted by two member agencies. Panelists must then determine what the United Way can and should allocate.

A Budget Committee volunteer does not have to be a financial whiz to be an effective

committee member. The United Way has volunteer accountants on each panel to assist members in their deliberations.

An orientation and training session for the committee will be held on May 4. During the following week, volunteers will be asked to visit the agencies they have been charged with reviewing. During the weeks of May 13 and May 20, volunteers meet with agency representatives for budget review. The committee determines allocations on May 29 and 30, submitting them to the United Way's Board of Trustees for final approval on June 19.

Anyone interested in more information about the committee, or those interested in joining the group, should contact the United Way at 609-924-5882.



*Marianne Weissenburger (left), the first chairwoman of the Secretarial and Office Support Staff (SOSS) Seminar Committee, helps current chairwoman Chris Ritter select a door prize winner at the SOSS luncheon held April 17 in conjunction with National Secretaries' Week. Members enjoyed both a buffet luncheon at the Ramada Inn (right), and a talk delivered by Rosemary Yaecker of the Blessing-White Corporation.*



*Benefits Administrator Mary Moore explains the finer points of the PPL benefits program to members of the Procurement and Purchasing Departments. The meeting was part of a continuing series of discussions with groups throughout the lab aimed at answering employee benefits questions.*

## Nursery Openings

The University-NOW Day Nursery, located at 171 Broadmead Street in Princeton, currently has openings in the four- and five-year-old classes for the 1985-86 school year.

The school is dedicated to providing a lively learning experience for its students, in which all aspects of a child's growth are equally important. The Nursery is also committed to providing children with an environment free of sex-role stereotyping, prejudice, and authoritarianism.

With the exception of the last week in August, the Nursery is open from 8 a.m. to 6 p.m. on a yearly basis. Students range in age from 21 months to six years. Classes include a state-certified kindergarten.

Staff members interested in these current openings, or in future openings at the school, should call 924-4214.

## TRANSITIONS

The HOTLINE offers its congratulations to the following employees, who recently became proud parents:

Charles Skinner of the Experimental Division and his wife, Dagmar, whose son Patrick was born March 15;

Carl Bunting of TFTR and his wife, Laura, whose daughter Alanna was born March 17;

Ken Brink of the Vacuum Shop and his wife, Dawn, whose daughter Kristal was born March 22.



## Spray Gun Danger

All spray guns, whether airless or compressed air type, are dangerous. The spray guns that shoot a thin line of oil, gas, paint, or other chemical compounds are especially dangerous. The introduction of the airless sprayers brought on an increase in spray gun accidents.

That thin line propelled by the

gun can pierce a leather glove and enter a finger or hand from as far away as eight inches. Poisonous liquids can travel into fissures of connective tissue and muscle and into the bloodstream if the injury isn't treated promptly. Chemical infection can result in massive tissue damage and amputation of the body part can result.

The initial injury is often painless and looks like a small puncture wound. Many don't bleed, often causing victims to ignore treatment until an infection sets in. At that point, treatment may not be effective.

If you suffer such an injury, report for treatment at once. Take any spray gun injury seriously.

## Jetlag Diet

You've planned for weeks, gone into hock, and flown halfway around the world for your vacation, and have to spend the first three days exhausted, mentally foggy, and perhaps even nauseous from jet lag. Happens all the time -- except to people who use the Argonne Jetlag Diet.

Jet lag is caused by your body's efforts to adjust to drastic changes in time zones. The signals the body receives from stimuli such as temperature, food, activity, and exposure to light are occurring on an unfamiliar schedule. The more time zones you cross, the longer the jet lag lasts.

But hundreds of thousands of travelers, including President and Mrs. Reagan and the Minnesota Vikings football team, have beaten jet lag with the Argonne Diet.

The diet was developed at the Department of Energy's Argonne National Laboratory as a direct spinoff of basic research by biologist Charles F. Ehret, who has studied the effects of diet, chemicals, and environment on the biological clocks of bacteria and animals for 35 years.

All animals, including humans, have biological clocks. They follow a circadian rhythm, a sort of 24-hour pattern that reflects changes in temperature, amounts of light, body temperature, food intake, and exercise. When you move quickly across several time zones, that biological rhythm becomes confused. Your body reacts in part to your normal timing pattern, and in part to the signals it receives in your new environment.

Based on Ehret's studies, a regimen was developed using natural cues, particularly type of food and eating cycles, to help travelers quickly adjust their body clocks to match the time zones at their destination.

Here's how it works: if you plan to leave Washington, D.C. at 8 a.m. February 1 for a vacation in Paris, you start the regimen on January 28 by feasting on proteins at breakfast and lunch and on carbohydrates at dinner. On January 29, you fast on light meals of salads, soups, fruits, and juices. January 30 is another feast day, and January 31 is another fast day. The fast is broken at 2 a.m. on February 1, which would be 7 a.m. (or breakfast time) in Paris. You then eat normal meals on a Paris schedule until you're ready to prepare for the trip back home.

Hundreds of travel agents distribute copies of the diet with overseas tickets, and scores of private corporations have reproduced it for their executives who travel. It has appeared in more than 500 publications, and the Argonne Laboratory has distributed nearly 150,000 free copies of the diet. In return, the laboratory has thousands of letters from happy users.

The President and Mrs. Reagan have used the diet to prepare for two trips to the Orient and one to Europe. The Minnesota Vikings used it before flying to London in August 1983 for a pre-season game, in which they beat the St. Louis Cardinals 28-10.

Travelers can get a free wallet-sized card summarizing

the diet by sending a self-addressed stamped envelope to Jet Lag Diet, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL 60539. It's one way taxpayers can get an individual payback for their support of basic research.



**United Way**

# AT WORK

## Deaf Are Heard by United Way Service

If you live alone and wake up one morning too sick to go to work, you simply call the office and say you will not be in. How would a deaf individual, alone and sick, make that same phone call? For that matter, how do deaf people make appointments, call family or friends, or check on schedules? It is much more difficult for them than it is for those of us who can hear.

A service now available in Mercer County helps the deaf and hard of hearing over these obstacles. DEAF CONTACT is a seven-day-a-week, 24-hour service staffed by trained volunteers, who are on duty to answer the calls that put the deaf in touch with the rest of the world.

Without this free service, the only one of its kind in Mercer County, the deaf would either have to communicate with people in person, write to them, or ask relatives to place calls for them. DEAF CONTACT offers its clients anonymity, confidentiality, convenience, and personal independence.

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DEAF CONTACT, which is partially funded by the United Way-Princeton Area Communities, handles 200 calls a month from and for the deaf and hard of hearing. The process begins when a deaf person uses a teletype to call DEAF CONTACT, typing out a request that a phone call be made. A volunteer communicates with the deaf client by typing on a teletype. Once the client's desired message is received, the phone call is placed.

Thanks to its United Way funding, DEAF CONTACT has been able to expand its important service by opening a telephone office at the Katzenbach School for the Deaf on Sullivan Way in West Trenton. To continue expanding its service area, however, the program needs more volunteer staff members. The two job requirements are minimal typing skills and a willingness to lend an ear to help the deaf. For more information, call DEAF CONTACT at 609-585-2244, 609-888-2111, or 609-896-2120.

This service is possible in large part because caring people, businesses and other organizations contributed to the United Way.

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## Volunteers: People People

The following volunteer opportunities were submitted to HOTLINE by the Princeton Area Council of Community Services, a member agency of the United Way-Princeton Area Communities. For further information on any volunteer position, contact each agency directly.

- The Association for the Advancement of Mental Health needs assistants to tutor mentally handicapped adults in life skills, or to accompany them to a variety of recreational activities. Typing and clerical assistance, transportation, and aid with educational group activities are also needed. For more details, call 609-924-7174.
- The West Windsor Recreation Department is responsible for administering all township recreation programs. The group also takes an active role in the planning and development of township owned parkland. Volunteers are needed to serve as either voting or advisory members of the recreation policy-making Recreation Commission. Interested individuals may also serve on one of the Commission's many subcommittees, or may choose to help plan or direct a variety of programs throughout the year. To offer your aid, call 609-799-2400.
- Volunteers in Probation needs individuals willing to be a friend and counselor to a troubled juvenile who has become involved with the police and the court system. Training is available for volunteers who pledge one hour per week to a child for one year. A call to 609-989-6260 will get you the details.
- The Riverside Elementary School PTO needs volunteers to share their exper-

tise in science, music, art, or literature during special school programs. Volunteers may also help tutor children, or serve as a resource in their field of expertise for the school's teachers. Call 609-924-5600 to lend a hand.

The next three volunteer positions were provided to the HOTLINE by the United Way of Somerset Valley. To learn more about any listing, contact each agency directly.

- The Easter Seals Adult Training Centers need caring individuals willing to assist instructors in any of the five program areas for retarded adults in a prevocational setting. Volunteers could become involved in kitchen work, arts and crafts, ceramics, woodworking, personal awareness, and daily living skills. Call 201-363-6677 for more information.
- Middle Earth is a Somerville-based group that teaches decision making and self-awareness skills to teenagers. Volunteer threshold counselors accompany small groups of teens on weekend retreats, where they can participate in a program designed to help change their self-conception. To lend your support, call 201-725-7223.
- Vision of Peace, Incorporated is seeking volunteers to do research or office work. Individuals willing to speak at schools are also

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being sought. Call 201-271-1506 for the particulars.

The following volunteer posts were supplied by the Voluntary Action Center of Middlesex County. For more details about any listing, contact the VAC at 201-249-8910.

- An agency that serves the handicapped is seeking both writers and photographers to develop a slide presentation, while another group needs writers and graphic artists to develop a brochure. A wide variety of a-

gencies are also need public relations assistance. If you think you can help tell their stories, call the VAC.

- Volunteers are needed to participate in a speaker's bureau on diabetes. The organization will train all volunteers, and can provide sample topics, slides, and other materials to illustrate your talk. To get involved, begin by talking to the VAC.
- A foundation that makes dreams come true for terminally ill children needs

fundraising volunteers. The group meets every third Tuesday in the North Brunswick library.

- A master of ceremonies, a house manager, a stage manager, and registration desk workers are being sought for a teen arts festival, scheduled for May 28 through 30.

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*The PPL Hotline is issued by the Princeton University Plasma Physics Laboratory, a research facility supported by the U. S. Department of Energy. Correspondence should be directed to PPL Information Services, Module 2, C-Site, James Forrestal Campus, ext. 2754.*



## Tour Guides



It was standing room only for the PPL tour program during the first three months of 1985, as a total of 1,217 visitors got a glimpse of the laboratory's experiments. March was the high-water mark of the period, as warming weather brought 691 visitors with it. Our thanks to the following staff members, who served as "leaders of the pack" during the start of our new tour year:

### JANUARY

Charlie Ancher  
Ernst deHaas  
Robert Fleming  
Naren Kokatnur  
David O'Neill  
Hal Wexler

Dennis Mansfield  
Dale Meade  
Loran Meray  
Ernst Neischmidt  
David O'Neill  
Michael Periera  
Greg Rewoldt  
Robert Smart  
Irving Zatz

Robert Forester  
James French  
Jeff Gettlefinger  
Boris Grek  
Phil Heitzenroeder  
John Johnson  
David Kaufman  
Randy Knize  
Naren Kokatnur  
Don Knutson  
George Levitsky  
Thomas Locke  
Peter Materna  
Dale Meade  
David Meyerhofer  
Robert Mills  
Don Monticello  
John Murray  
Donald McNeill  
Ernst Neischmidt  
Michael Periera  
Allan Reiman  
Ken Young  
Neil Young  
Irving Zatz  
Howard Zuvers

### FEBRUARY

Lee Benson  
Kees Bol  
John Bradish  
Norton Bretz  
Harold Bush  
Diane L. Carroll  
Dave Ciotti  
John G. Edwards  
Robert Fleming  
Robert Forester  
James French  
Jeff Gettlefinger  
Don Grove,  
John Johnson  
Naren Kokatnur  
Benoit Leblanc

### MARCH

Charlie Ancher  
Jeff Alton  
Lee Benson  
Nelson Bowen  
Charlie Bushnell  
Diane L. Carroll  
John Coonrod  
Fred Dahlgren  
Ernst deHaas  
Anthony DeMEO  
John Doane  
Larry Dudek  
Robert Ellis  
Robert Fleming