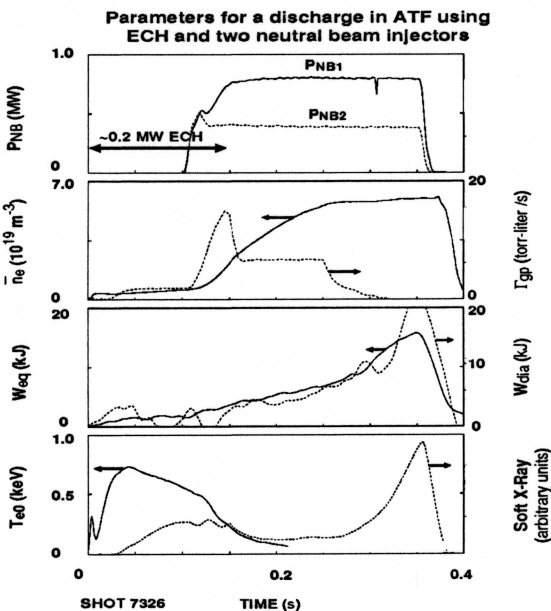


IEA/US–Japan Workshop on Next-Generation Experiments

The second IEA/US–Japan Workshop on Next-Generation Experiments will be held December 7–9 in Toki City, Japan, following the International Toki Conference on Plasma Physics and Controlled Nuclear Fusion announced in the last newsletter.

A previous workshop on this topic was held in Kyoto, Japan, in July 1988 and related US–Japan workshops on large, high-accuracy, superconducting helical windings for next-generation devices were held at MIT (January 1988) and at Kyoto Plasma Physics Laboratory (March 1989). This workshop will focus on the status of design studies for large, next-generation stellarator experiments: the Large Helical Device (Japan), Wendelstein VII-X (Federal Republic of Germany), and the Advanced Toroidal Facility-II (U.S.). A summary of the workshop will be published in a later newsletter.

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Around the Labs

Experimental Results on ATF

The ATF experimental program is currently focused on three main areas: (1) optimization of plasma performance; (2) bootstrap current; and (3) characterization of edge fluctuations. These studies utilize recently extended capabilities:

- Higher magnetic field (up to 2 T).
- Gettering (about 60% coverage with four Cr or Ti sources).
- Pellet injection (ORNL 8-barrel injector).
- Magnetic configuration control (addition of Mid-VF coils).
- New diagnostics.

Operation with 1.1 MW pulses of neutral beam injection (NBI) at 1.9 T in a gettered torus has been extended to a pulse length of 0.25 s with no evidence of thermal collapse (see figure at left). The stored energy has increased to 16 kJ, and the line-average density to $6.5 \times 10^{19} \text{ m}^{-3}$. Gross energy confinement times in this discharge and similar ones with co-injection alone are 15–20 ms, roughly equal to those predicted by LHD scaling. The optimal gas puffing (a strong puff at the beginning of a beam pulse and “reheating” after cessation of the fueling) has features similar to a successful pellet injection discharge with NBI; namely, a 0.9-mm pellet injected at a speed of 1.2 km/s has produced a stored energy as high as the best discharges with gas puffing at a field of 1.9 T.

The magnetic configuration control afforded by using the mid-VF coils has provided additional confirmation of the neoclassical prediction of bootstrap current in ECH plasmas. Analyses of the previous data from ATF supported the theoretical dependences of bootstrap current on plasma pressure, magnetic field, and geometrical factor (G_b), which was varied by a radial scan of the vacuum magnetic axis. With the mid-VF coils, the geo-

metrical factor is varied by changing the plasma shape. Plasma current normalized to plasma pressure has changed by a factor of 2, as expected from the theory.

In the transport area, initial efforts are aimed at characterization of the edge fluctuations with magnetic and electrostatic probes. The measurements are carried out using a fast reciprocating Langmuir probe array (provided by the University of Texas at Austin) in the region from 2 cm inside the nominal last closed flux surface to 5 cm outside the last surface ($0.95 < r/a < 1.13$) in ECH discharges. The fluctuation level of electron density are typically $\tilde{n}/n = 0.05\text{--}0.10$ and those of plasma space potential are $\tilde{\phi}/kT_e = 0.1\text{--}0.2$, with increasing departure from the Boltzmann relation ($\tilde{n}/n = \tilde{\phi}/kT_e$) inside the plasma where $T_e > 20$ eV, as in ohmically heated plasmas in the TEXT tokamak. The fluctuation-induced particle flux determined from these measurements is comparable to the flux obtained from the global particle balance.

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Status of CHS

NBI power exceeds 1 MW

Since NBI experiments started in June, the power delivered through the port has been gradually increased by conditioning the ion source. The power exceeded 1 MW in September at a beam energy of 40 kV. However, experiments are usually done at a power level of 900 kW (35 kV). Target plasmas are produced by 28-GHz ECH (0.95 T), 53-GHz off-axis ECH (1.5 T), or 13-MHz ICRF (1.05 T). Plasma can be sustained with NBI only (tangential injection). Maximum pulse duration is limited to 250 ms because of beam shine-through. Because of this, perpendicular injection can only be done with short pulses. In order to eliminate this restriction, armor tile will be installed when the experiments of this fiscal year are over.

Density limit

During the NBI, strong gas puffing is applied to get a high-density plasma. The maximum average density obtained so far is $8 \times 10^{13} \text{ cm}^{-3}$ at 1.5 T with 900-kW NBI, above which density radiation collapse occurs. The maximum stored energy measured with a diamagnetic loop is over 4 kJ. As was reported previously, the

peak stored energy is usually obtained after the gas puffing is turned off. Details of this transition-like phenomenon are being studied through profile diagnostics and VUV spectroscopy.

Configuration study

Study of the effect of the magnetic axis shift on confinement continued using both NBI-heated and ECH plasmas. The central electron density and temperature are measured for different positions of the magnetic axis. The electron temperature changes from 150 eV ($R_{ax} = 101.6$ cm) to 400 eV ($R_{ax} = 92.1$ cm). The electron temperature is a weak function of the electron density in the range $(1\text{--}10) \times 10^{13} \text{ cm}^{-3}$. The experiment was performed at two different beam injection angles corresponding to beam tangency radii of 94 cm and 87 cm, but no noticeable difference was observed with this small change. The result that an inward shift of the magnetic axis gives better plasma parameters is similar to that obtained in 28-GHz ECH experiments in 1988. The effect of the change of the power deposition profiles with magnetic axis shift must be analyzed to get a final conclusion.

Transport study

Diagnostic instruments for profile measurements have been prepared to study transport in a low-aspect-ratio helical system, and they are now almost available. The electron density and temperature profiles are measured with a single-point, scannable Thomson scattering system. The ion temperature profile and poloidal rotation profile (associated with the radial electric field) are measured by charge-exchange recombination spectroscopy with a visible spectrometer and CCD camera. The radiation profile is measured by a pyroelectric detector array. A soft X-ray PIN diode array is also installed to study MHD activity. In a typical NBI experiment, the electron density profile is flattened and the temperature profile is parabolic, which is in contrast to the narrow profile in the ECH case. The central ion temperature is almost the same, but its radial profile is a little narrower than that for electrons. Transport analysis using the ORNL PROCTR code is under way. The estimate of the power deposition profile is considered to be the key issue for the analysis in our low-aspect-ratio helical system.

Impurity transport and radiation collapse have also been studied with a VUV spectrometer and the pyroelectric detector array. More precise experiments are planned using a plastic pellet injector and a grazing incidence spectrometer, which are already installed.

Plasma-material interaction study on CHS

A specially arranged graphite limiter (SL-1) has been installed with a view to plasma-material interaction studies on impurity release, particle and heat loading, and hydrogen recycling. In particular, the studies are aimed at the dependence of impurity release on the temperature of the limiter surface. For this goal, the movable and electrically insulated limiter (containing Langmuir probes) can be heated up to 1000°C by an internal heater. According to IR-TV measurements of the limiter temperature, when the limiter was inserted 4 cm in from the last closed flux surface, asymmetric heat loading was observed for an NBI-heated discharge.

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Overview of Recent L-2 Stellarator Experiments at the Institute of General Physics

During the period from December 1988 through June 1989, the L-2 Group performed experiments of ECR currentless plasma production and heating. The second harmonic of an X-mode microwave beam was used in these experiments. One 75-GHz gyrotron with input power up to 280 kW and a pulse duration of 8 ms allowed the creation of a plasma with a mean density $\bar{n}_e \sim 2 \times 10^{13} \text{ cm}^{-3}$, central electron temperature $T_e(0) \sim 1 \text{ keV}$, and ion temperature $T_i(0) \sim 0.1 \text{ keV}$.

The theoretical one-pass absorption coefficient for such conditions is more than 95% of the input power. Indeed, experiments have shown that the absorption length along the torus is very small (less than 20 cm). Central electron temperature increases with input power approximately as $P^{0.3-0.4}$ and does not depend very strongly on mean electron density. The electron temperature and its profile do not contradict the predictions of neoclassical stellarator transport theory, but the ECR power balance should be studied more carefully in future experiments. The experiments have also shown that ECRH creates a good target plasma for a future ICRH experiment to study ion confinement in currentless stellarators.

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Initial Edge Turbulence Studies on ATF

Fluctuations in electron density (\tilde{n}) and plasma space potential ($\tilde{\phi}$) and the associated fluctuation-driven particle flux have been measured in the edge region of the ATF torsatron plasma at positions ranging from 2 cm inside the nominal last closed flux surface to 5 cm outside the last surface ($0.95 < r/a < 1.13$) in ECH discharges. This work was undertaken in order to make comparisons with similar measurements in the TEXT tokamak and with theoretical modeling of resistivity-gradient/radiative instability-driven turbulence (which is a prime candidate for an enhanced transport mechanism in the tokamak edge). This comparison of results from a stellarator having zero induced toroidal electric field and ohmic current and from a conventional ohmically heated tokamak will be valuable in determining the underlying physics of the experimentally observed fluctuations. The work is being carried out as a collaboration involving ORNL, the University of Texas, and CIEMAT (Madrid, Spain).

The measurements use a fast reciprocating Langmuir probe array similar to that used in experiments on TEXT. The probe is moved 5 cm into the edge plasma in 50 ms, and remains at its innermost position for 100 ms to facilitate fluctuation measurements.

The equilibrium parameters of the ATF edge plasma for the ECH discharges studied so far ($P_{\text{ECH}} \approx 200 \text{ kW}$, $\bar{n}_e \approx (3-5) \times 10^{12} \text{ cm}^{-3}$, $B = 1 \text{ T}$) range from $n_e \approx 4 \times 10^{11} \text{ cm}^{-3}$, $T_e \approx 15 \text{ eV}$ at $r/a = 1.13$ to $n_e \approx 1.3 \times 10^{12} \text{ cm}^{-3}$, $T_e \approx 30-40 \text{ eV}$ at $r/a = 0.95$.

These values are comparable (within a factor of 2) to those for ohmically heated TEXT plasmas.

The fluctuation spectra of \tilde{n} and $\tilde{\phi}$ have been examined for frequencies below 400 kHz and are dominated by frequency components in the range 40-200 kHz having perpendicular wave numbers $k_{\perp} \approx 1-3 \text{ cm}^{-1}$.

The fluctuation levels are somewhat lower (factor ~ 2) than in TEXT, with normalized amplitudes ranging from $\tilde{n}/n \approx 0.2$, $\tilde{\phi}/kT_e \approx 0.2$ at $r/a = 1.13$ to $\tilde{n}/n \approx 0.05-0.10$, $\tilde{\phi}/kT_e \approx 0.1-0.2$ at $r/a = 0.95$. As in TEXT [Ch.P. Ritz et al, Phys. Rev. Lett. 62, 1844 (1989)], the fluctuations depart increasingly from the Boltzmann relation $\tilde{\phi}/kT_e = \tilde{n}/n$ as the probe is moved into the plasma, where $T_e > 20 \text{ eV}$, with $\tilde{\phi}/kT_e \approx 2\tilde{n}/n$ at $r/a = 0.95$.

Measurements at different local edge densities (obtained by taking advantage of shot-to-shot density variations) indicate that the Boltzmann ratio $(\tilde{\phi}/kT_e)/(\tilde{n}/n)$ increases with density. This may be evidence that $(\tilde{\phi}/kT_e)/(\tilde{n}/n)$ increases with impurity radiation, as has been found in TEXT (C. Hidalgo et al, to be submitted to Nuclear Fusion).

If we assume that the particle flux is toroidally and poloidally uniform, we find that the fluctuation-induced flux $\Gamma_{\tilde{n}\tilde{\phi}}$ is comparable to the total flux estimated from the global particle balance, as has also been seen on TEXT [W. L. Rowan et al., Nucl. Fusion 27, 1105 (1987)]. The effective diffusion coefficient $D_{\text{eff}} = \Gamma_{\tilde{n}\tilde{\phi}} / \nabla n \sim D_{\text{Bohm}}$. As with the TEXT data, these observations appear to be qualitatively consistent with the theoretical expectations for resistivity-gradient/radiative instability-driven turbulence [see for example, D. R. Thayer and P. H. Diamond, Phys. Fluids 30, 3724 (1987) and references therein]. For a tokamak, this model involves the interplay of a resistivity gradient instability (originally termed the rippling mode) driven by the toroidal electric field and a radiative cooling effect in which radiation losses decrease with increasing temperature (as can happen in the tokamak edge).

In the currentless ATF stellarator configuration, the underlying physics differs in that the toroidal electric field is absent, while the average unfavorable curvature in the edge region contributes an additional destabilizing mechanism. Additional work to modify the theory to account for the effects emphasized in the stellarator limit should elucidate the physics of the radiative condensation picture. Work in the immediate future (through November 1989) will concentrate on firming up the experimental observations by extending measurements further into the plasma (to $T_e \approx 50$ eV) and carrying out parameter scans of density and magnetic field. The connection of the density and potential fluctuations with magnetic fluctuations (measured outside the plasma) will also be investigated. These extended observations will serve as a basis for a detailed comparison with TEXT data that will be carried out in connection with an experiment/theory workshop tentatively scheduled for December 1989. Longer term (beginning early 1990) plans include studies of neutral-beam-heated plasmas, the incorporation of new fluctuation diagnostics (microwave reflectometry, heavy-ion beam probe), and the use of externally imposed field errors (ergodic fields).

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Heliotron E Continues to Optimize Magnetic Surface Configuration

Heliotron E started experiments to optimize the magnetic surface configuration using auxiliary toroidal and vertical field coils in April. The experiments have continued since the vacuum chamber wall was carbon coated in September. The main objective of the experiments is to further optimize the magnetic configuration of the high-rotational-transform, strong-shear helical system to achieve better transport and MHD stability. Changing the external toroidal field B_{T0}/B_{H0} from -0.1 to 0.15 varies $\epsilon(0)$ from 0.64 to 0.39 , $\epsilon(a)$ from 2.6 to $2.7-3.1$, and the average radius \bar{a} from 0.182 to 0.252 m. Changing the vertical field B_{V0}/B_{H0} from -0.171 to -0.199 varies the magnetic axis shift Δ_v from $+4$ cm to -4 cm. The optimization was carried out mainly in the above parameter range.

For the toroidal field variation, it was found that the plasma parameters are optimum for $\Delta_v \approx -2$ cm ($B_{V0}/B_{H0} \approx -0.192$) for low- β plasmas. This indicates that minimizing the particle orbit loss cone is important to obtain favorable plasma parameters. Typically, the temperature and the internal energy increase by about 20% from those of the standard configuration. Until now, the investigations have been done mainly in low- β plasmas. Summaries of confinement and MHD stability follow.

Confinement of NBI plasma, $P_{inj} \leq 2.5$ MW:

- The global energy confinement scaling of $\tau_E^G \propto a^2$ holds when $\Delta_v \sim 0$ ($B_{V0}/B_{H0} \sim -0.185$) and $-0.1 \leq B_{T0}/B_{H0} \leq 0.05$.
- The $\tau_E^G \propto a^2$ scaling holds when $\Delta_v \sim -2$ cm ($B_{V0}/B_{H0} = -0.192$) and $-0.1 \leq B_{T0}/B_{H0} \leq 0.1$. The coefficient becomes larger by $\sim 20\%$ than that of the standard configuration.
- When $B_{T0}/B_{H0} \geq 0.1$, confinement becomes poor. This might be attributed to increased interactions between the plasma and the wall or a carbon plate protecting a joint of the vacuum chamber.

MHD stability of NBI plasma:

- When $\Delta_v \sim 0$ ($B_{V0}/B_{H0} = -0.185$) and $B_{T0}/B_{H0} < 0$, the central region is unstable with an $m = 3, n = 2$ instability at the $\epsilon = 2/3$ rational surface where the configuration has a magnetic hill. When $\Delta_v \sim 0$ and $B_{T0}/B_{H0} > 0$, the $m = 2, n = 1$

instability (at the $\tau = 1/2$ surface) does not appear for low β plasmas [$\beta(0) \leq 1.0\%$], apparently because of the magnetic well.

- When $\Delta_v \sim 2$ cm ($B_{V0}/B_{H0} = -0.192$) and $0.05 \leq B_{T0}/B_{H0} \leq 0.1$, the plasma is MHD stable, although the well is very shallow in the central region.
- The location of the instability moves outward from the $\tau = 2/3$ surface to the outer magnetic surface $\tau = 1$ as a result of pressure profile control by pellet injection. After carbon coating the wall, the location moves further outward, i.e., to the $\tau = 3/2$ rational surface.

Intensive studies of the conditions $B_{T0}/B_{H0} = 0.05$ and $B_{V0}/B_{H0} = -0.192$ are now going on, in the regime where both transport and MHD stability are favorable. In that case, density clamping of the ECH plasma is overcome, and moreover a plasma with $T_e = 350$ eV and with a density $\bar{n}_e = 3.7 \times 10^{19} \text{ m}^{-3}$, which is higher than the RF cutoff density, can be produced in steady state without radiation collapse.

In the next phase of experiments starting in October, the investigation of the properties of higher- β plasmas will be emphasized.

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Meeting Reports

THIRD WORKSHOP ON WENDELSTEIN VII-X

Schloss Ringberg, 26–29 June 1989

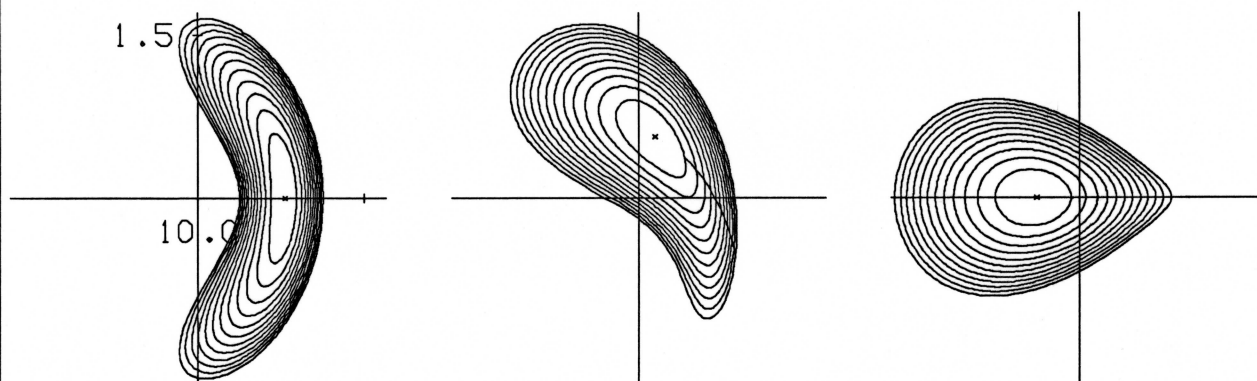
The third workshop on Wendelstein VII-X was held at Schloss Ringberg near Tegernsee, Bavaria (FRG), from 26 to 29 June 1989.

It started with an overview on the Wendelstein VII-X project by H. Wobig, who described various critical issues of 5-period Helias configurations. Presently, the main dimensions of the Wendelstein VII-X device are major radius 6.5 m, average plasma radius 0.6 m, and magnetic field 3 T.

Optimization of Helias configurations was discussed by J. Nührenberg, who found a plasma equilibrium with average beta of approximately 5% to be stable against ideal ballooning modes. The topology is shown in the figure in the three characteristic planes.

Stability of nonlocal MHD modes was analyzed numerically by C. Schwab, showing roughly the same beta limits as the ballooning modes. Resistivity, however, leads to slowly growing modes below the threshold of ideal MHD theory (H. Wobig, J. Geiger, H. P. Zehrfeld).

Four papers by W. Lotz, C. Beidler, H. Maassberg and U. Gasparino, and by H. J. Gardner and A. H. Boozer



Topology of a 5% beta WVII-X configuration

were concerned with neoclassical transport and bootstrap current, utilizing Monte Carlo computations and solutions of the drift-kinetic equation. Localized particles trapped in the modular ripples cause additional neoclassical losses. However, C. Beidler showed that with 12 modular coils per field period these losses are small.

A large part of the workshop was technology-oriented. In contrast to the two preceding workshops on Wendelstein VII-X, a number of representatives of INTERATOM participated for one day. They presented the results of a feasibility study dealing with the superconductor, the winding technique, cooling system, support system, time schedule of construction, and rough cost estimates. The result of the study is positive; solutions to the main problems could be found, and it was concluded that the superconducting coils envisaged for Wendelstein VII-X are feasible.

Methods to derive modular coils from the finite-beta fields were discussed by P. Merkel. The contribution by J. Kisslinger was concerned with further smoothing of the coil shapes, according to criteria not yet incorporated into the numerical procedures, and with ensuring a certain parameter range in the vacuum fields by use of additional external coil sets.

In papers by E. Harmeyer, J. Sapper, and J. Simon-Weidner, results of the electromechanical behavior of nonplanar modular coil systems and the resulting forces and stresses were presented, for both superconducting and water-cooled coil systems. Superconducting coils are preferred by the Wendelstein VII-X team. Tests of short conductor samples in large background fields and considerations of the investigation of a small superconducting test coil and a full-size prototype coil were discussed in a contribution by W. Maurer from the Karlsruhe Institute.

Edge fields and limiter-wall loads were studied for vacuum fields for a particular coil system, at three values of the rotational transform, by F. Rau. These studies were complemented by the investigation of the neutral gas behavior at the edge, contributed by R. Scardovelli and F. Sardei.

A different topic was the study of magnetic islands presented by H. Wobig, F. Herrnegger, and F. Rau. The "natural" islands and their residues were investigated for one of the various coil topologies. Another contribution compared different modular Helias systems and showed the effect of external perturbations.

The last day of the workshop concentrated on experiments in Wendelstein VII-AS and projections to Wendelstein VII-X given by H. Renner, estimates of plasma parameters for this experiment by H. Wobig,

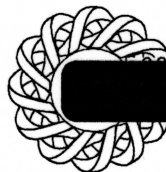
and papers by V. Erckmann, F. Wesner, F. P. Penningfeld, and E. Speth on the three main heating schemes, ECRH, ICRH and NBI. Anomalous transport in tokamaks and stellarators was discussed in a contribution by A. Boozer.

G. Grieger summarized the highlights of the workshop.

Thus, the workshop was a critical survey of the present state of the work performed on Wendelstein VII-X so far, in order to arrive at a "reference configuration" for this experiment. Regarding the estimated time schedule and cost estimates, a reduction of the main geometrical parameters of Wendelstein VII-X has been discussed. The implications of such a reduction will be investigated in the future.

A total of 37 papers was given at the workshop. The *Proceedings* will be published as an IPP Garching Laboratory Report.

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People

G. Hutch Neilson to join CIT Team

Hutch Neilson will be leaving the ATF Group in November to take a new ORNL assignment as Deputy Head of Physics for the Compact Ignition Tokamak (CIT) project at Princeton Plasma Physics Laboratory.

Hutch joined the stellarator community in 1984. He worked on facility preparations for ATF after the ISX-B program ended and became interested in magnetic diagnostics, equilibrium control, and operation of stellarators. He led the team that carried out the commissioning and initial operations of ATF in 1987-1988 and became head of the Confinement Project Section of ORNL's Fusion Energy Division in 1988. In the past year, he has worked to strengthen research ties between tokamaks and stellarators as a member of the U.S. Transport Task Force. As a member of the national CIT project team, Hutch will work toward a machine design that will fulfill the mission to study the physics of burning plasmas. Hutch hopes that continued cooperation between the tokamak and stellarator communities will keep him in touch with the many friends he has made in the stellarator world.



Cooperation

This new section will give reports on inter-laboratory exchanges and cooperative efforts.

VISITING SCIENTISTS

At CHS, Nagoya, Japan

Dr. L. Perranich (General Atomics, USA) stayed at Nagoya for three weeks in April to plan an experimental study of the effects of field errors on confinement.

Dr. J. Harris (ORNL, USA) stayed for three weeks in May to participate in the CHS experiment and to discuss the CHS-ATF collaboration.

Dr. S. Sobhanian (Tabriz University, Iran) returned home on August 30 after a 10-month stay in Japan. He contributed to the calibration of a metal bolometer and radiation loss measurements.

At IPP-Garching, FRG

During July 1989, two scientists from the Institute of Physics and Technology of the Ukrainian Academy of Sciences, Kharkov, USSR, Dr. V. V. Pljusnin and Dr. A. A. Shishkin, visited the Wendelstein Team at IPP Garching. This visit was made possible under the terms of the Agreement of the FRG and the USSR on Scientific and Technical Cooperation, dated 22 July 1986.

Both guests presented information about their work at Kharkov in the seminars "Experiments on Uragan 3," given by V. V. Pljusnin, and "Theoretical Activities on Plasma Confinement at Kharkov," given by A. A. Shishkin.

This talk initiated some discussions regarding the Kharkov experiment Uragan-2M, and we agreed to look into some of the details of its vacuum fields. Uragan-2M is an $l = 2$, $M = 4$ torsatron, utilizing a modulated winding law. In addition to axisymmetric compensation and correction windings, a set of 16 toroidal field (TF) coils is foreseen. They produce the major part of the toroidal field and thus reduce the effects of the helical ripple. The design value of the magnetic field is $B_0 = 2$ T, the major radius of the system is $R_0 = 1.7$ m, and the plasma aspect ratio is about 10.

These four coil systems provide a certain range of vacuum field parameters. We concentrated on the

Uragan-2M standard case. The vacuum field shows a number of "natural" magnetic islands at rational ι values. The largest islands are situated near the edge at $\iota = 2/3$. In a new result, it was found that the size of these islands can be reduced considerably by changing a small parameter in the winding law. Simultaneously, the size of the last useful flux surface is increased. These results are also valid at other ι values, when the $2/3$ islands have been shifted by a small amount, while keeping the axis position approximately constant. Details are given in our common Laboratory Report, IPP 2/301, *On Vacuum Field Properties of the Uragan-2M Standard Configuration*.

Further collaborative studies are under way to assess the neoclassical transport level may be expected in Uragan-2M. The presence of the 16 TF coils leads to a relatively small value of the helical ripple. This should have a beneficial effect on plasma confinement in the long-mean-free-path regime. On the negative side, the TF coils produce a significant ripple of their own, which can be expected to increase the transport rate. Also, the winding law envisioned for Uragan-2M tends to localize the helical ripple on the low-field side of the torus; this also leads to degraded confinement. The goal of the current transport study is therefore to account for these competing effects and to compare Uragan-2M with the "classical" torsatron configuration. Results will be available at a later date in a common laboratory report.

At ORNL, Oak Ridge, TN, USA

Dr. S. E. Grebenshchikov of the Institute of General Physics, Moscow, and Dr. V. I. Tereshin of the Institute of Physics and Technology in Kharkov visited ORNL in August-September as part of the US-Soviet fusion research exchange program. They contributed to the optimization of neutral-beam-heated discharges that led to the achievement of new record parameters for 2-T operation in ATF. In addition, Dr. Grebenshchikov participated in discussions on ongoing collaborative modeling of ECH absorption in L-2 and in further planning for the proposal by the Institute of General Physics to develop a 2-mm microwave scattering system to be used to study drift-wave turbulence in low-collisionality ECH plasmas in ATF. Dr. Tereshin worked with ORNL staff on modeling of finite-pressure equilibria and NBI for the modified magnetic configuration of the Uragan-3M torsatron.

During the visit, Dr. Grebenshchikov gave a seminar on ECH plasma experiments in L-2, and Dr. Tereshin gave a seminar on the first results from short-pulse neutral beam heating in Uragan-3M.