MARCH OF THE TOKAMAKS

Looking for the harmony

The music plays on while the composers try to figure out the score. The success of the Russian invention called Tokamak in confining a stable plasma of ions and electrons of the sort important to experiments looking toward controlled thermonuclear fusion occurred before theorists had a theory to fit it. Imitations of the Russian original tokamaks have been built and are being built in various parts of the world. Meanwhile theorists try to explain what is happening in them.

The first American tokamak to be completed, the ST at Princeton University, confirms "that tokamaks located at west longitudes behave like those born at east longitudes," Dr. Edward Meservey told the 4th International Conference on Plasma Physics and Controlled Nuclear Fusion Research at Madison, Wis., last week. In other words, they generally play the same song with regard to confinement and stability of the plasma. Yet, in certain respects, the Eastern and Western tokamaks are playing different notes, and both theorists and experimenters are trying to harmonize them.

An example of such dissonance is the question of energy and particle confinement times in Eastern and Western tokamaks and the related variation of electron temperature along the radius of the plasma column. (The tokamak is a toroidal or doughnut-shaped device in which a cylindrical column of plasma is bent into a circle.) The Russians find that the particles are contained much longer than the energy. They also find that the electron temperature is very much the same through a large area around the center of the plasma column. The Americans find that the confinement of energy and particles lasts about the same amount of time and that the electron temperature peaks more or less strongly at the center of the column and falls off toward the edges.

The flat electron-temperature profile the Russians have found is not in accord with the classical theory of plasmas unless one assumes an anomalous loss of heat (that is, energy) from the plasma. Dr. Lev A. Artsimovich of the Kurchatov Institute in Moscow has proposed that the electrons in the plasma have an enormously high thermoconductivity and thus dissipate the heat faster than would be expected if their thermoconductivity were normal (SN: 5/22/71, p. 357).

But American experimental results don't need the abnormal heat loss. According to Dr. Meservey they find none. The existence or nonexistence of such an energy loss is possibly a matter of difference in interpretation, he says. The energies of plasmas are measured indirectly and much depends, he says, on the numbers that are used in calculating from the raw observations. But Dr. V. S. Strelkov of the Kurchatov Institute insists that the Russian interpretation is correct. Dr. Strelkov also presented evidence that the latest Russian experiments, on a new machine called T-4, confirmed the behavior of electron temperature found in the earlier T-3 machine on which Dr. Artsimovich's suggestion of anomalous thermoconductivity was based.

Dr. Harold P. Furth of Princeton presents what he calls a simple neoclassical theory to harmonize both the Russian T-3 and T-4 and the American ST. It depends on the presence of neutral gas, some of which is always around, at the edges of the plasma. The gas enters the plasma, is ionized and carries off energy. The different temperature profiles of T-3 and ST can be explained, he says, by the different effects of the neutral gas in chambers of different size (T-3 is bigger).

Others propose other theories. One of them, Dr. A. A. Ware of the University of Texas, got into an argument with Dr. Furth. Dr. Ware proposes that a self-pinching effect of the plasma can account for the temperature profile. A tokamak plasma has an electric current running through it, around the loop of the torus. This current generates a magnetic field that tends to pinch the plasma together. Both Drs. Ware and Furth agree that there is a pinch. They dispute how seriously it affects the plasma.

Meanwhile, other instruments are tuning up, notably the Ormak at Oak Ridge National Laboratory, which is about ready to begin experiments. Others, larger ones, looking toward actual fusion reactors, are being planned. A major question for theorists is whether their explanations will scale up to make predictions for the larger machines. Dr. Furth says that his does, but he cautions not to take the predictions too seriously yet.

Whether or not the theorists can explain them, it seems that bigger, and, physicists hope, better tokamaks will be built. The Russians talk of a T-10, which would be an intermediate step toward a fusion reactor, and there are hints that an American competitor may be proposed in a year or two. □

SHADOW GOVERNMENT

Secrecy in pollution policy

The growing problem of "shadow government" — government conducted without the awareness of the people and often with the advice of highly self-interested parties—cuts across all public concerns. Last week, a Senate subcommittee chaired by Sen. Lee Metcalf (D-Mont.) began looking into the vast array of secret industrial advisory committees to Federal agencies—including the Commerce Department's National Industrial Pollution Control Council, a group of industry executives that advises the President's Environmental Quality Council, the Environmental Protection Agency and the National Oceanic and Atmospheric Administration. Meetings of the NIPCC are closed to the public, as a group of conservationists learned when they tried unsuccessfully to attend an Oct. 14, 1970, meeting.

Provisions of bills introduced by Metcalf and others would require public representation on the advisory committees and that the meetings be open to the public.

Commerce's assistant secretary for administration, Larry A. Jobe, opposed both of these goals in his testimony—using what might be fair to term doubletalk reminiscent of George Orwell's *1984*.

Said Jobe: No public representation is necessary on the committees, because "the broad public interest is inextricably and unavoidably represented by persons selected by reason of being knowledgeable or experts in particular fields." In other words, the special technical knowledge industrialists possess about the polluting they do especially qualifies them to be guardians of the public interest.

An example of NIPCC's "expertise" in pollution abatement came in an October 1970 public report by its detergent subcouncil: "Extensive human and environmental safety testing indicates . . . NTA [a proposed replacement for phosphate] is safe for people and the environment," says the report. Metcalf pointed out at the hearings that Dr. Samuel Epstein of the Children's Cancer Research Foundation in Boston had publicly raised questions about NTA's safety in May 1970—and that the U.S. Surgeon General had asked in December 1970, on the basis of tests nearly complete when the NIPCC study was published, that NTA be banned (SN: 12/26/70, p. 475).

Dr. Henry J. Steck, political scientist with the State University of New York at Cortland, summed up the case for the new legislation: "I believe the greatest danger is . . . advisory committees may permit the hegemony of one interest, one segment of society, or one set of values over all others. . . . This possibility now exists in the area of environmental policy." □