



Hirsch says that the probability of ultimate success of the fusion program is much higher now than it has ever been before.

the senior division staff members rated all the activities in confinement according to priority. They all found the program to be generally in excellent shape, Hirsch says. Three of the programs ranked high and a couple were rated low. The Division "has taken appropriate action" on these low-ranked programs. Most of the programs were rated in the high and medium-priority range. The Standing Committee subsequently reviewed the development program, which is also a critical activity in preparation for new large feasibility experiments.

Among tokamak devices, the Princeton Large Torus (PLT) received a very high priority, and the Division looks to the feasibility of speeding up its fabrication, subject to budgetary constraints. AEC has been encouraged by the results found in the Symmetric Tokamak (ST) and Adiabatic Toroidal Compressor (ATC) devices at Princeton and Ormak at Oak Ridge, all of which are behaving according to pre-operation theory. To demonstrate the feasibility of other techniques of heating the plasma besides ohmic heating, other experiments are being pursued. ATC has already demonstrated that compressional heating works. Neutral-beam heating will soon be investigated on Ormak and ATC. At the University of Texas William Drummond is looking at turbulent heating. The possibility of rf heating is being studied on the ST at Princeton. Over the next couple of years Hirsch believes that fusion physicists should get a pretty good idea of which heating techniques are optimal.

A second machine that rated very highly was the Los Alamos Scyllac, which has now operated as a linear device and in the "arc-sector" configuration. A group of capacitor bank racks were assembled into a 120-deg arc for preliminary toroidal studies; the remainder of the capacitor banks were assembled into a linear device with magnetic mirrors on it. Just about now operations are ending on those two experiments and the system is to be converted into a full torus; the conversion is scheduled to take about a year. Like the Princeton PLT, additional money could speed up the construction. If the Division is provided more than \$40 million for FY 1974 it will be possible to speed up construction of both devices.

(At the Joint Congressional Committee on Atomic Energy hearings on controlled fusion held about a year ago, most people who testified said that the program is funding limited, not idea limited, Hirsch told us. "Our time scale will in large measure be determined by our funding levels. Our spending has to accelerate, if we're to be able to stay on a 1980 to 1982 feasibility demonstration schedule. We've asked for more money, and we've received heartening support from the Commission. The final decisions are dependent on the overall Government budgetary picture, however.")

With the Scyllac operating in the arc-sector mode, experimenters have been looking at the use of auxiliary fields to stabilize the plasma; these resemble stellarator fields. In the simple toroidal field, the plasma quickly drifts towards the walls, as theory has long predicted. With the stabilizing field the containment time rose from the theoretically expected time of a microsecond, to a time of 10 microseconds, at which time effects associated with losses out of the ends begin to become important. The containment time is also about 10 microseconds in the linear device. Both modes operate at a few kilovolts and densities of about 5×10^{16} particles/cm³. When Scyllac operates as a full torus, the Los Alamos workers will try to demonstrate, through the use of auxiliary magnetic fields, that containment times of hundreds of microseconds are possible.

To go on to feasibility in a theta pinch, Hirsch explains, one must break into two steps what is presently done in one; at present a rapidly rising magnetic field both shock heats and compresses the plasma. Because the Scyllac capacitor bank is already so huge, it is planned to use a separate shock-heating phase, employing relatively few capacitors operating very rapidly. This would be followed by a slower adiabatic compression that can be

achieved with magnetic energy storage.

The third very-high-ranking experiment, 2XII at Livermore, has been operating for about a year. It is a mirror machine that produces a peak density of about 5×10^{13} particles/cm³. Energies go as high as 8 keV. The containment times observed, which are about a millisecond, agree with a modified classical theory, which predicts the time as a function of density, temperature, magnetic field, volume, magnetic-field shape and so on. The theory is now being tested by warming up the electrons to see if the containment time will increase as predicted. In addition Livermore is installing a large neutral-beam source (the equivalent of 10 amperes) that will test an important principle for mirror systems—the injection of neutral beams to both heat and refuel the mirror plasma. Then, Hirsch told us, experimenters must demonstrate that they can sustain the plasma for a long time and continue to pump energy in with neutral beams, without disrupting the containment, both in the present version and in a still larger version of 2X. Meanwhile a modification of the Baseball II experiment is also planned, which involves both superconducting magnets and neutral beams; this modification is aimed at providing an extrapolatable technology for mirror machines.

In summary, Hirsch said, "Things are coming along very well in the CTR program, and I'm very optimistic both about our near- and long-term prospects. While ultimate success cannot be guaranteed, the probability is much higher now than it has ever been before." —GBL

MacDonald returns to Environmental Board

Gordon J. F. MacDonald, formerly a member of the President's Council on Environmental Quality, has been appointed chairman of the Environmental Studies Board of the National Academy of Sciences and the National Academy of Engineering. MacDonald is the Henry Luce Professor of Environmental Policy and director of the Environmental Studies Program at Dartmouth College. He was a member of the Environmental Studies Board from 1968 to 1970, serving briefly as its chairman before his appointment to the CEQ in 1970.

US-Soviet atomic-energy cooperation continues

The fifth in a series of memoranda of cooperation between the US Atomic Energy Commission and the USSR State Committee for the Utilization of

Atomic Energy, initiated in 1959 to further technical cooperation in the peaceful uses of atomic energy, is presently being negotiated. The new memorandum calls for increased scientific and technical cooperation in low-, medium- and high-energy physics and accelerators; controlled thermonuclear reactions and plasma physics; nuclear reactors and atomic power stations, including breeder reactors; radiation chemistry; thermionic reactors and energy conversion, and the disposal of radioactive wastes. Visiting delegations will investigate these topics at various scientific establishments in the two countries, with smaller groups of scientists concentrating on research in specialized areas.

in brief

The Massachusetts College of Optometry announces a program of accelerated study toward the Doctor of Optometry degree (a two-year course). The program is open to candidates or holders of the PhD in fields related to optometry. Write to Joseph Jefferson, Division of Special Studies, Massachusetts College of Optometry, 424 Beacon St, Boston, Mass. 02115.

For information about the Computer Physics Communications Program Library, which is housed at the Queen's University of Belfast, write

to The Program Librarian, CPC Program Library, Department of Applied Mathematics, Queen's University of Belfast, Belfast BT7 1NN, Northern Ireland. The library has been operating for three years and now contains a file of over 100 programs.

The papers of Ernest O. Lawrence have been given to the Bancroft Library at the University of California at Berkeley.

DePauw University's new \$7.5 million Science and Mathematics Center was dedicated recently.

the physics community

Bell Labs seeks staff from minority groups

Bell Laboratories has started a program intended to find, develop and hire more candidates from minority groups for its professional research staff. The program, called Bell Labs Cooperative Research Fellowships, offers outstanding minority-group graduates tuition, living-expense stipends and summer employment in a research lab while they study for advanced degrees.

Once accepted into the program, each candidate works closely with a member of the technical staff at Bell Labs. The adviser will supervise the participant's work at Bell Labs during the summer and will help him plan his graduate studies.

When the participant has completed the requirements for an MS, his work will be reviewed and it will be decided if he shows enough promise to continue in the program. Those who complete the program and earn a PhD will be reviewed for appointment as members of the Bell Labs technical staff.

For further information, write to Sidney Millman, Bell Laboratories, Mountain Avenue, Murray Hill, New Jersey 07974.

\$20 article charge for six AIP journals

The American Institute of Physics is re-establishing an article charge on six AIP-published journals to help support the cost of wide dissemination of research results through publication of journal pages and production of a data base of articles. The publications affected by the \$20.00 charge for each article in addition to page charges are

The Journal of Chemical Physics, *Journal of Applied Physics*, *Applied Physics Letters*, *The Physics of Fluids*, *Journal of Mathematical Physics* and *The Review of Scientific Instruments*.

The publication charge for these journals used to consist of two parts, a page charge and an article charge, until about three years ago when the article charge was suspended. The article charge is now reinstated to pay the input processing costs of micropublishing and data-base production required to improve dissemination to the technological community as a whole, which needs and uses research results of physics. The American Physical Society never discontinued its abstract charge comparable to AIP's article charge, and presently collects \$15.00 per article in the *Physical Review* in addition to the page charge.

All publication charges are still voluntary; once an article is accepted by an editor, it is assured publication, although non-payment of publication charges may result in a delay in publication.

Francombe becomes AVS president

Maurice H. Francombe, manager of device and materials research at the Westinghouse Research Laboratories in Pittsburgh, is the new president of the American Vacuum Society. He succeeds Daniel G. Bills, who vacated the office on 1 January. The president-elect of the society for 1973 is Dorothy Hoffman, a member of the technical staff of RCA Laboratories in Princeton, New Jersey.

Francombe, who received his PhD in physics at the University of London,

has done research in ferroelectricity, magnetism, sputtering of thin films, epitaxial growth and surface physics. His responsibilities at Westinghouse include supervision of research on dielectric films, magnetic and surface-wave devices and ion implantation. In 1963 he assisted in founding the thin-film division of AVS, and in 1968 he became its chairman.

Hoffman will become president of AVS in 1974. After receiving her MS in chemical engineering from Bucknell University, she worked as a research engineer and eventually became head of process development at the International Resistance Company in Philadelphia. While there she played a major role in the development of the evaporated metal film resistor. Formerly a member of the board of directors and secretary of AVS, Hoffman is presently in charge of the thin-film technology service group at RCA Laboratories.

Institute of Physics forms two new groups

The council of the Institute of Physics has approved the formation of a Quantum Electronics Group. The chairman of the steering committee for the new group is S. A. Ramsden, head of the Department of Applied Physics at the University of Hull, UK. In conjunction with The Chemical Society, IOP has formed a Neutron Scattering Group. B. T. M. Willis of the Atomic Energy Research Establishment in Harwell is chairman of the steering committee. Nonmembers desiring to join the groups should write to the Registrar, IOP, 47 Belgrave Square, London SW1X 8QX, UK. □