6th INTERNATIONAL CONFERENCE, BERCHTESGADEN,
FEDERAL REPUBLIC OF GERMANY, 6–13 OCTOBER 1976
The conference was attended by 434 scientists from 30 countries and four international organizations.

Plasma Physics and Controlled Nuclear Fusion Research

Progress in fusion research which has been made since the last conference held in Tokyo in 1974 was reported at this conference. One hundred and fifty papers were presented on magnetic and inertial confinement systems, plasma theory and fusion reactor concepts.

Perhaps of greatest interest to the participants were the first experimental results from the two large tokamaks, the T-10 in the USSR, and the PLT in the USA. Preliminary results show that, as expected, substantial increases in plasma parameters and energy confinement times (40 to 60 msec) have been achieved by increasing the size of the devices. These results are in general agreement with the theoretical scaling laws. Substantial agreement is found in the operation of these two experiments, with T-10 having a smaller impurity concentration.

A second major achievement in tokamak research is the successful operation at relatively high densities reported by the Alcator (USA) and Pulsator (FRG) groups. Raising the density has produced an increase of the $n\tau$, which has now reached the record value of $10^{13}cm^{-3}s$.

The successful use of neutral injection heating to tokamaks was reported by several groups (particularly the TFR(F)group). These results affirm the earlier hopes for this heating method.

The most notable feature of this conference, however, was the high plasma conditions reported in magnetic confinement devices other than tokamaks. In the 2XII B mirror machine at Livermore (USA), densities up to $10^{13}cm^{-3}$ have been reached using powerful (5MW) neutral injection systems. The future of stellarators appears to be much brighter than in the past. Stellarators have now passed the Bohm diffusion limit found earlier. Results reported from CLEO (UK), Wendelstein VII-A (FRG) and L2 (USSR) show confinement times at least 10 times Bohm times. With temperatures by ohmic heating now up to 900 eV, it will be most interesting to see the operation when non-ohmic heating methods are applied to these traps.

The optimistic picture from the experimentalists was supported by the theoretical papers. No new unpleasant theoretical surprises, such as a new type of instability, have been found during the past two years. On the contrary a number of proposals to control instabilities, raise the beta values, control the influx of impurities, and so forth, were made at the conference. It was pointed out that computers will play an increasingly important role in plasma theory to include non-linear effects not tractible by analytic methods.

The relatively small number of papers on inertial confinement systems, laser fusion and electron-beam fusion, was probably due to the fact that large installations now under construction in the USA, USSR and Japan will not be completed until 1977–78. The most important problems that were discussed included the interaction of laser radiation with plasma, compressional experiments, relativistic electron beam production, and transport and interaction with targets. Resonant absorption, parametric heating, and the production of energetic ions and electrons may be due primarily to hydromagnetic turbulence, according to a number of papers on the energy transfer from laser beams to plasmas. Volume compressions of hollow pellets of more than 1,000 were reported by a number of laboratories. Important new results are expected when the very large experiments as Shiva (10 kJ) at Livermore, Delfin (10 kJ) at Lebedev, the 100 kJ CO_2 laser at Los Alamos and Gekko XII and Lekko III in Osaka are completed.

In electron-beam fusion the most difficult problems are the transport and focussing of the electron beam onto the target together with those of beam plasma interaction and energy transfer. The group at Kurchatov (USSR) reported on experiments where a volume compression of 1,000 has been reached. Similar results have been obtained at Sandia (USA).

A limited number of papers dealt with technological problems and reactor concepts. In the tokamak concept, it appears that there is a tendency to reduce the physical size of the reactor. and therefore the cost of the design, by increasing both the first wall loading and the power density in the thermonuclear plasma. Two non-tokamak reactor concepts were presented, a mirror reactor by Livermore and a pulsed-linear high-beta reactor by Los Alamos.

In summary one can say that steady progress has been achieved in fusion research with no new formidable obstacles reported. There is an increasing sense of confidence that at least one of the approaches being investigated will lead to controlled fusion.