chlorides and so obtained glasses with virtually zero expansion coefficients between 0° and 400° C.

COMPUTATIONAL PHYSICS

Collisions and Tides

from a Correspondent

MANY of the techniques and difficulties of computational physics are shared by people working on topics as diverse as plasma physics, atomic structure, lattice statistics, hydrodynamics and semiconduction transport theory. This was clearly illustrated by the conference on computational physics held by the Computational Physics Group of the Institute of Physics and the Physical Society which took place in London from September 7 to 9.

One theme was the theoretical determination of important physical parameters, and vital contributions came from Professors P. G. Burke (Queen's University, Belfast) and M. J. Seaton (University College, London). Burke's group at Belfast has developed a general set of codes to describe atomic collisions and scattering cross-sections. For a given atom, five procedures are followed on the computer: the determination of relevant atomic wave functions; the calculation of oscillator strengths and hence the determination of the polarizability of the atom; the effect of long range atom–atom interaction, and the calculation of electron–atom scattering cross-sections. Machine independent self-contained modulae have been developed, which it is hoped other workers may usefully employ. Seaton illustrated the importance of this work in the interpretation of solar and astrophysical data.

Mr C. L. Pekeris (Weizmann Institute, Israel) described the results of a two dimensional programme to describe the tides in the oceans of the world. A massive calculation using 180,000 mesh points had been used to obtain quantitative agreement with the known motion of the tides. Hence the frictional drag of the tides on the Earth's rotation was empirically determined and correspondingly the acceleration of the Moon's revolution about the Earth could be obtained. Several previously undetermined features of the Earth's tides were found, in particular the existence of a null point in the South Atlantic.

Several contributions were concerned with plasma physics and magnetohydrodynamics. Dr D. E. Potter (Imperial College, London) illustrated results of two dimensional time dependent magnetohydrodynamic phenomena, results in quantitative agreement with experimental plasmas. He said that in the next few years it could be possible to describe the structure of the magnetosphere, of the Earth's dynamo problem and of toroidally contained fusion plasmas. In a series of contributions, Drs R. Peckover, K. V. Roberts (UKAEA, Culham), M. Petravic, and G. Kuo-Petravic (Oxford) illustrated how the programming and structure of such very large complex computer codes could be greatly simplified by symbolic methods. Symbolic languages have been developed so that the simple and clear notation of vector calculus can be used almost directly in programming the computer, and with very little loss of computer execution time.

There was a consensus of opinion that while many of the equations of classical and quantum physics are well known, the limitations of analytic mathematics prohibit an understanding of many significant phenomena. The development of models on the computer, and the observation of their evolution in time, will clearly make a significant contribution to the development of all branches of physics in the future.

GAS DISCHARGES

Breakdowns and Thrusters

from a Correspondent

GAS discharges were the topic for discussion at an international conference held in London from September 15 to 18, under the auspices of the Institution of Electrical Engineers, the Institute of Physics and the Physical Society, and the Institute of Electrical and Electronics Engineers.

A session on pre-breakdown phenomena again revealed that the magnitude of breakdown voltages in uniform or near-uniform field configurations cannot usefully indicate either the relative importance of different secondary processes in Townsend growth or the nature of the transition to a streamer process. Discussing the divergent field gaps which are important in engineering, Dr T. E. Allibone (formerly of Central Electricity Generating Board) pointed out that experimenters remain indispensable in the absence of any quantitative model of flashover. Professor V. Popkov (Krzhizanovsky Power Institute, USSR) emphasized that the flattening of the breakdown voltage versus gap clearance characteristic made prospects of power transmission at levels above 1,200 kV extremely remote. Even at two-thirds of this level, the problems associated with corona noise and power loss are formidable.

The even more contentious subject of electrode phenomena aroused lively discussion of cathode-spot emission mechanisms and retrograde arc motion. A useful contribution to the physics of cold cathodes was made by Dr A. E. Guile (University of Leeds). Professor T. J. Lewis and Mr P. E. Secker (University College of Bangor) when they discussed the role of surface oxide layers at the cathode. The very large current density observed at cathode spots (up to 10^{12} A m^{-2}) was accounted for in terms of a tunnel (autoelectronic) emission of electrons through the oxide coating, this emission being caused by an electric field of about 10^9 V m^{-1} created by positive ion deposition on the oxide. They also claimed that electron velocity components parallel to the cathode surface could account for retrograde motion in a transverse magnetic field. It would seem difficult, however, to omit column effects entirely from any account of retrograde motion.

Another cathode spot mechanism, first proposed by von Engel and Robson, has been investigated by Mr A. J. T. Holmes and Dr J. R. Cozens (Imperial College, London). The release of electrons by the action of metastable atoms at the cathode was found to be observed best by measurement of the glow-to-arc transition voltage. A useful by-product of this work is that gas density increased at the cathode which served to increase the transition voltage—a possible new approach to arc inhibition.

The SERT II mercury ion thruster for space propulsion was described by Mr H. J. King (Hughes Aircraft). A Penning discharge produced a 20 A electron current, from which a 4 A ion beam was extracted. Subsequent acceleration and neutralization of the beam provided 0·028 N thrust, at an exhaust velocity of 30 km s^{-1} and