A two-dimensional computer-program for end losses from a theta-pinch*

F. HERTWECK and W. SCHNEIDER
Institut für Plasmaphysik, Garching bei München
Federal Republic of Germany

THE axial losses of mass and energy at the end of a theta-pinch are investigated.

The plasma is described by a one-fluid model with the following assumptions: infinite electrical conductivity ($\sigma = \infty$), electron temperature equal to ion temperature, isotropic pressure and radial equilibrium.

As boundary conditions for the magnetic field **B** it is assumed that the current in the coil is constant in time and that **B** is continued periodically at the end-plane. For the dynamic quantities ρ, **v** and the heat flow **q** boundary conditions are used, which allow free outflow at the end-plane. The initial condition corresponds to an already compressed plasma in radial equilibrium.

The resulting system of partial differential equations for the quantities ρ, **v**, p and **B** as function of r, z and t is solved numerically in magnetic field line co-ordinates. The main advantage of this co-ordinate system is the more accurate computation of effects parallel to the magnetic field lines, because there is no numerical diffusion.

It is investigated how the disturbance due to mass and energy losses at the end of the theta-pinch propagates into the inner part of the vessel. The relative importance of kinetic energy, heat conduction and convection for the endlosses is calculated.

This program is intended as a first step towards a more sophisticated program with a two-fluid model including anisotropic pressure.

* This work was performed as part of the joint research program of the Institut für Plasmaphysik. Garching and Euratom. Presented by W. SCHNEIDER.

Electron line density measurements in a magnetic rotating field pinch*

A. HEYM
Laboratoire de Recherches sur la Physique des Plasmas, Lausanne, Switzerland

Two high power generators deliver r.f. pulses each of which consists of 8 periods at a frequency of 2 Mc. They generate a plasma in a tube of 5 cm diameter and 50 cm length. One generator produces an axial current of 18 kA peak amplitude while the other, which feeds a 3 turn coil, induces an azimuthal current of 56 kA peak amplitude in the plasma. When the two currents are 90° out of phase, the plasma experiences a rotating magnetic field of 1·8 kG.

We have measured the temporal and spatial evolution of the electron line density in such a discharge with a Mach Zehnder interferometer. This apparatus is equipped with a photomultiplier detection system which allows the electron line density to be measured without ambiguity.

These measurements were made in 25 mtorr He which was preionized by an axial current pulse of 13 kA amplitude and 15 μsec duration.

The formation of a pinch is demonstrated. The electron density on the axis of the discharge tube grows during the first two microseconds until the value of $1{\cdot}6 \times 10^{16}$ electrons cm^{-3} is reached. At this time the density within 4 mm of the wall is zero and the integral of the electron density over the cross section indicates complete ionization. After about 2·5 μsec, evolution of gases from the wall causes the current to switch back to the wall bringing about the formation of a 'hang-up' pinch which lasts for the remainder of the discharge.

* Presented by the author.

Theoretical and experimental results on the electrostatic plugging of a cusp containment system*

J. L. HILTON, C. K. HINRICHS and A. A. WARE
Aerojet-General Corporation, San Ramon, California, U.S.A.

IT HAS been generally assumed that the use of electrostatic fields to suppress cusp losses, due originally to LAVRENTEV [1] is limited to low densities such that the Debye length is not less than ρ_i, the ion

* Presented by A. A. WARE. Work sponsored by Air Force Aero Propulsion Laboratory, Research and Technology Division, Air Force Systems Command, United States Air force.