PANEL DISCUSSION ON ELECTRON-RING ACCELERATORS

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Summary of Discussion

This panel discussion was intended to complement the status reports presented in the morning (Session VIII), and to concentrate on current problems at laboratories actively constructing electron-ring accelerators. In addition, a few related theoretical topics were covered. Papers giving more details on all these matters, follow after this summary.

An interesting phenomenon has been discovered at Dubna. The emission of a cathode in a high-pressure environment (10^{-3} torr) increases from about 20-30 A to over 10 000 A after some 100 ns. Due to ion-focusing the beam is well confined over distances of 1 m. No theoretical explanation has yet been given.

Negative-mass instability is presently the problem of highest importance at Berkeley, and extensive measurements and calculations of wall-induced instabilities are being made. It has been shown that eddy-current induced instabilities can be damped by proper choice of coil shapes and material (see paper by Avery and Laslett). The injected beam has a strong azimuthal structure, due to the injection of $1\frac{1}{2}$ turns, which can be cured by shorter bunches from the injector. The compressor wall's surface impedance required for avoiding instabilities has been calculated for various models. Stabilization of electron rings by an azimuthal magnetic field is described in a paper by Laslett and Schumacher.

At Garching, two different methods to increase the brightness of electron guns are being studied: the use of a window-less electron gun or laser-induced emission in a Febetron.

Ion loading of an electron ring by a molecular beam is being investigated at Karlsruhe. A very dense supersonic beam is shot axially into the compressor, and very short loading times can be achieved. The ion loading can be done in a clean high vacuum and can be accurately adjusted by timing with a rotating slit. The charge state can be influenced by the density of the beam. A discussion on the loading times in various schemes followed. (The development of a fast resonant single-core compressor is described in a paper by Steinbock.)

A novel approach is being pursued at the University of Maryland. A hollow electron beam is emitted from a modified Febetron and injected into a magnetic cusp. Due to the field reversal, part of the forward motion is converted into rotation. By decelerating, the electron bunch is considerably compressed in the axial direction such that it can be loaded with a sufficient number of ions. The cusp additionally acts as a momentum selector to reduce the energy spread of the beam coming from the Febetron.

A transverse ERA is being studied at the Universities of Bari and Lecce, where two models are being constructed.

Earlier calculations of radiation loss of short bunches in a periodic structure have been extended (Berezhnoj, et al.) and have been verified experimentally at SLAC. No γ-dependence has been found over a wide range of energies. The influence of bunch shape and length was the subject of some discussion.

A theoretical paper of considerable interest was presented by Koshkarev. Due to the coupling of various modes of electron and ion oscillations, a number of overlapping unstable regions limit the maximum number of ions and the rate of acceleration in an electron ring. It appears that neither Landau damping nor image focusing can cure this effect, and the influence of B_γ fields is doubtful. The large ion loss in the acceleration experiment at Dubna could possibly be due to this effect. Whether it presents an ultimate limitation in electron-ring accelerators is, however, not yet established.