

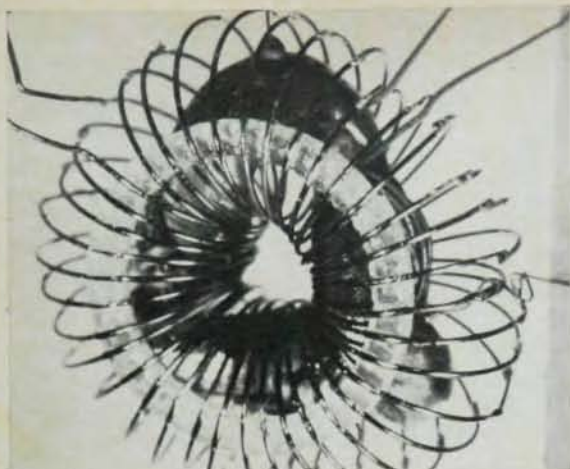


Fig. 3. Furth-Rosenbluth device with toroidal and tuning coils

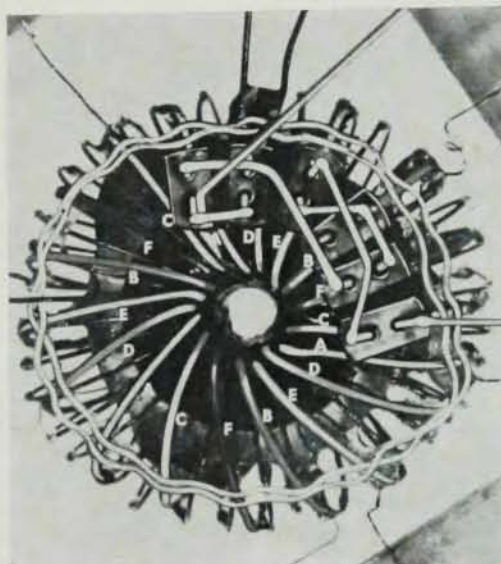


Fig. 4. Completed Furth-Rosenbluth device; a helical coil has been added to produce a magnetic field which varies as a cosine

of indium antimonide cut into the shape of a serpent swallowing its tail and fitted with a central tuning coil. In Fig. 3 a toroidal coil has been added, analogous to the axial magnetic field in open-ended systems; it serves to cut down diffusion away from the serpent's axis. Finally, Fig. 4 shows the completed machine, in which a helical coil has been added; this helical field varies as a cosine along the cross section of the plasma. Dr. Ancker-Johnson found that no combination of fields produced improvement in the lifetime of the plasma.

Considerable interest has been aroused by these thermonuclear simulation experiments and other groups are doing them now. New ideas can be tried rapidly and cheaply and in some cases might possibly provide occasional important clues, perhaps even quick tests of theory. It's true

that the plasma densities and temperatures in the solid-state devices are not at all similar to those in fusion devices. The solid-state plasmas generally have higher densities (up to about 10^{18} electrons per cm^3) and considerably lower temperatures (the exact value is not known). However, the real question is: do electron-hole plasmas develop analogous instabilities to fusion-type plasmas, and do they respond similarly to confining attempts?

NASA invites space experiments

Have you any space-flight experiments? The National Aeronautics and Space Administration is seeking proposals for its Lunar Orbiter, Surveyor, Voyager, Orbiting Solar Observatory, Advanced Orbiting Solar Observatory, Tiros, Nimbus, Explorers, and Isis, a joint US-Canadian satellite. Details

are in a 107-page publication, "Opportunities for Participation in Space Flight Investigations," available for 60 cents from the Superintendent of Documents, US Government Printing Office, Washington, D. C. 20402

ORNL transuranium program

Two new facilities at the Oak Ridge National Laboratory will soon be producing grams and milligrams of transuranium elements each year. In other words, their annual production will be tens of thousands of times the quantities that have ever been made in the past. The high flux isotope reactor, which first went critical near the end of August, will, when it reaches full power, produce a thermal-neutron flux of 5×10^{15} n/cm²/sec. This is about eight times the most intense thermal fluxes available anywhere at present. ORNL's transuranium processing facility, scheduled for completion later this year, will provide spaces and equipment for making and separating targets that are irradiated in the reactor.

Most material produced will be used in studies of nuclear structure, spontaneous fission, decay processes, chemical and biological properties of matter, and heavy-element behavior. Moreover they may hold clues to star formation. Do neutron fluxes in space form heavy elements like californium? Studying californium on earth may tell.

The new reactor has a wastebasket-size core, fully enriched uranium fuel in aluminum cermet plates, 100 MW maximal power, and light-water cooling and moderation. A 5-in-diameter center hole permits irradiation of targets where flux is at a maximum.

The processing facility is a two-story building containing nine process cells, eight laboratories and lots of remote handling and processing equipment. In it irradiated pellets for the reactor will be put together and taken apart again. The first ones that go in will contain plutonium-242 made at Savannah River. After 12 to 18 months irradiation the pellets will be processed for removal of curium (atomic number 96), which will be made into new pellets for the next irradiation cycle. After many cycles

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and attainment of equilibrium, annual recoveries are expected to be about a hundred grams of curium, milligrams of berkelium (97), grams of californium (98), tens of milligrams of einsteinium (99), and about a milligram of fermium (100).

NRL electron ring

The Naval Research Laboratory has constructed a small electron storage ring, the Sozotron, to study intense electron beams. Its designers plan to investigate normal modes of oscillation, loss and instability mechanisms, and other significant behavior of strictly space-charge-limited beams.

The "strict" space-charge limit permits a much denser beam than the "usual" space-charge limit of conventional circular-accelerator theory. The strict space-charge limit is set by a balance between focusing forces exerted by magnets and disruptive Coulomb forces between the particles. In this case thermal pressure gradients play a negligible role in the radial outward force. (The term "thermal pressure gradients" is used to denote the effect of random transverse motions of the electrons because of the analogy with the behavior of gases.) The usual space-charge limit in conventional machines is set by the space charge necessary to cause the single-particle oscillation frequency to resonate destruc-

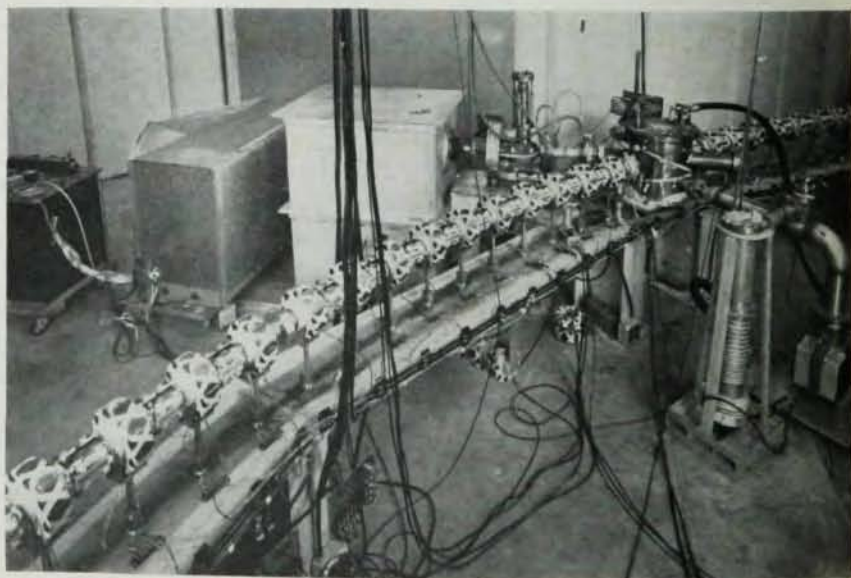
tively at some multiple of the revolution frequency. Here the thermal pressure gradients play a dominant role.

The Sozotron beam comes from a klystron at an energy of 100 keV and has an intensity of about 4 A. It is injected into a single turn by means of a fast-turn-off deflector having a constancy of deflection field over the deflection time interval better than one percent. If the beam can be shown to be stable or made stable for about 1 msec under (strictly) space-charge-limited conditions, the possibility of increasing the beam energy to about 100 MeV by betatron acceleration will be considered.

Further plans call for an increase of injection energy to 1 MeV. If the storage problems connected with the original 4-A beam can be satisfactorily solved, an increase in the contained current by a factor of a hundred should be possible when the 1-MeV injector is used.

So far, containment time is about 2 microsec, and the current is about 1 A at the end of this time. Much time has been spent in developing diagnostic equipment to provide a complete accounting for the fate of the beam; efforts to extend the containment time are expected to resume shortly.

The principal scientists involved are D. G. de Packh and J. B. Ehrman.



A view of Sozotron, the electron storage ring at the US Naval Research Laboratory, in the neighborhood of the machine's injector