ions) are investigating the electron-ring accelerator or smokatron (PHYSICS TODAY, April, page 63) a group at Avco-Everett Research Laboratory is trying to use an electron cloud to make a source of highly stripped heavy ions for nuclear-physics experiments. Like the electron-ring accelerator, the Avco device uses external magnetic fields to control the motions of an electron cloud and then uses the electrostatic fields generated by these electrons to trap the ions and then strip them.

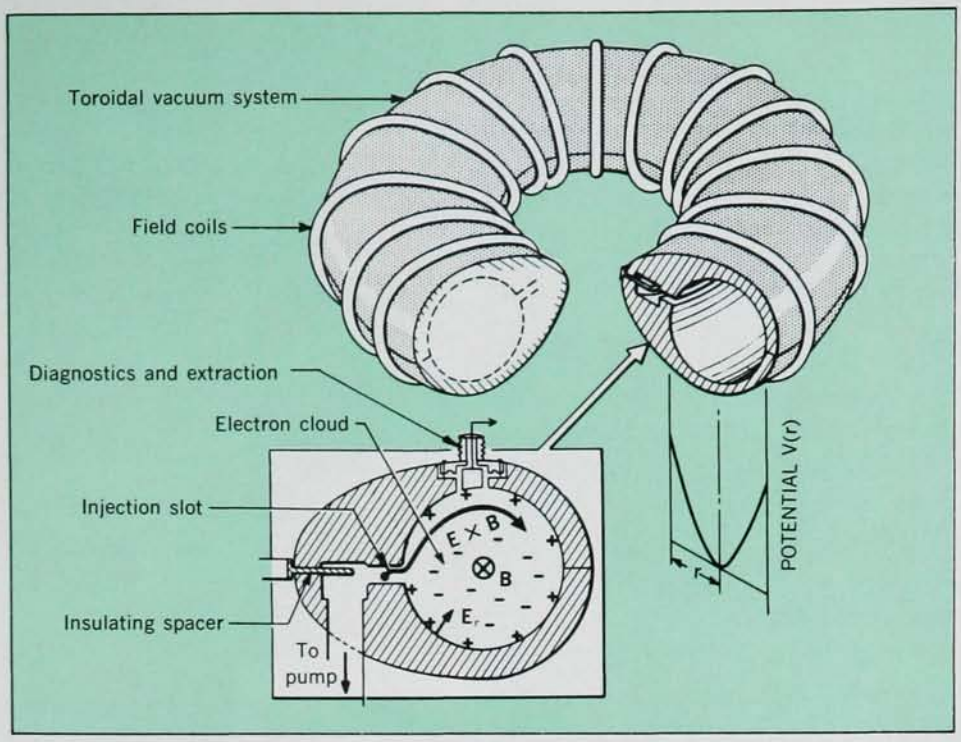
Because of the great interest in making superheavy elements (PHYSICS TODAY, February, page 63) many experimenters would like a beam of uranium ions. But, as Richard H. Levy of Avco explains, one needs a substantial current of highly stripped ions to make a relatively small accelerator (because the required dimensions are at best proportional to the mass-to-charge ratio).

Available ion sources can produce useful currents of U^{11+} or U^{12+} at best, Levy explains. If the Avco device works, Levy expects it can make 10^{11} ions of U^{60+} per second (from a source about 40 cm in diameter), which could then be accelerated in a 2-meter-diameter cyclotron to an energy that would exceed the Coulomb barrier of a uranium target. In the hoped-for reaction a gigantic compound nucleus would then fission asymmetrically and produce a new superheavy element.

At first the Avco group (consisting of Jack Daugherty, Jan Eninger, Sargent Janes, Levy, and consultants Hans A. Bethe of Cornell and Bernard T. Feld of MIT) thought of building a complete accelerator, called the heavy-ion plasma accelerator (HIPAC) (*Phys. Rev.* **145**, 925, 1966). As work progressed, the idea seemed promising as a heavy-ion source for other accelerators, too (*Phys. Rev. Letters* **20**, 369, 1968).

In HIPAC (see figure) an electron cloud is contained in a toroidal vacuum chamber by an azimuthally symmetric magnetic field. The electron space charge creates a topologically closed potential well in which ions can be trapped. Because the electron kinetic energy in HIPAC is about 10 keV, the ions will become highly stripped.

After sufficient stripping occurs, the magnetic field is lowered, allowing electrons to move toward the wall; this movement reduces the potential-well depth. The ions can leave the device through a negatively biased aperture.



SOURCE OF HIGHLY STRIPPED HEAVY IONS contains electron cloud. Electron space charge traps ions, which become highly stripped and are extracted.

In Avco's first HIPAC experiment, a 1-m-diameter toroid with a 4-kG magnetic field that lasted for a millisecond, experimenters showed containment of 7×10^9 electrons/cm^3 for the same time interval. Levy says that at such densities, any strong plasma instability could be expected to put in an appearance in microseconds. In a new experiment, the vacuum is being improved to about 10^{-9} torr and magnetic-field duration increased. This experiment should be capable of making stripped ions. How good the beam quality will turn out to be is still uncertain. —GBL

Mars Mariners to Study Surface and Atmosphere

Mariner VI is already well on its way to Mars, and its twin, Mariner VII, was sent on its path in late March. They will arrive on 30 July and early August, respectively, and will start televising pictures of the Martian surface as they pass approximately 10 000–3000 km from the planet.

The trajectories have been designed so that Mariner VI will photograph the equatorial region and Mariner VII the south polar region of the planet. Two cameras on each spacecraft will operate alternately to show small and large areas of Mars at high and low resolution; filters on the cameras may show color differences of surface details.

An infrared spectrometer on each Mariner will look in the lower atmosphere for evidence of molecules important in biochemical processes, and an ultraviolet spectrometer will identify the constituents of the upper atmosphere. Surface-temperature measurements (by infrared radiometer) and S-band occultation (refraction of radio signals from the spacecraft as they pass behind Mars) complete the experiments on these Mariners, and tracking data will be used to determine the mass of Mars, the Earth–Moon mass ratio and the Earth–Mars distance.

The Soviet spacecraft Venus 5 and 6, launched in January, are expected to arrive at their destination on 16 and 17 May. By late March no announcement had been made of Soviet Mars flights, but the opportunity for a launch extends to early April.

IN BRIEF

Chicago Pile 5, a research reactor that went critical in Feb. 1954, is presently enjoying a ten-month rest-and-rehabilitation vacation. During the shutdown the reactor, which was

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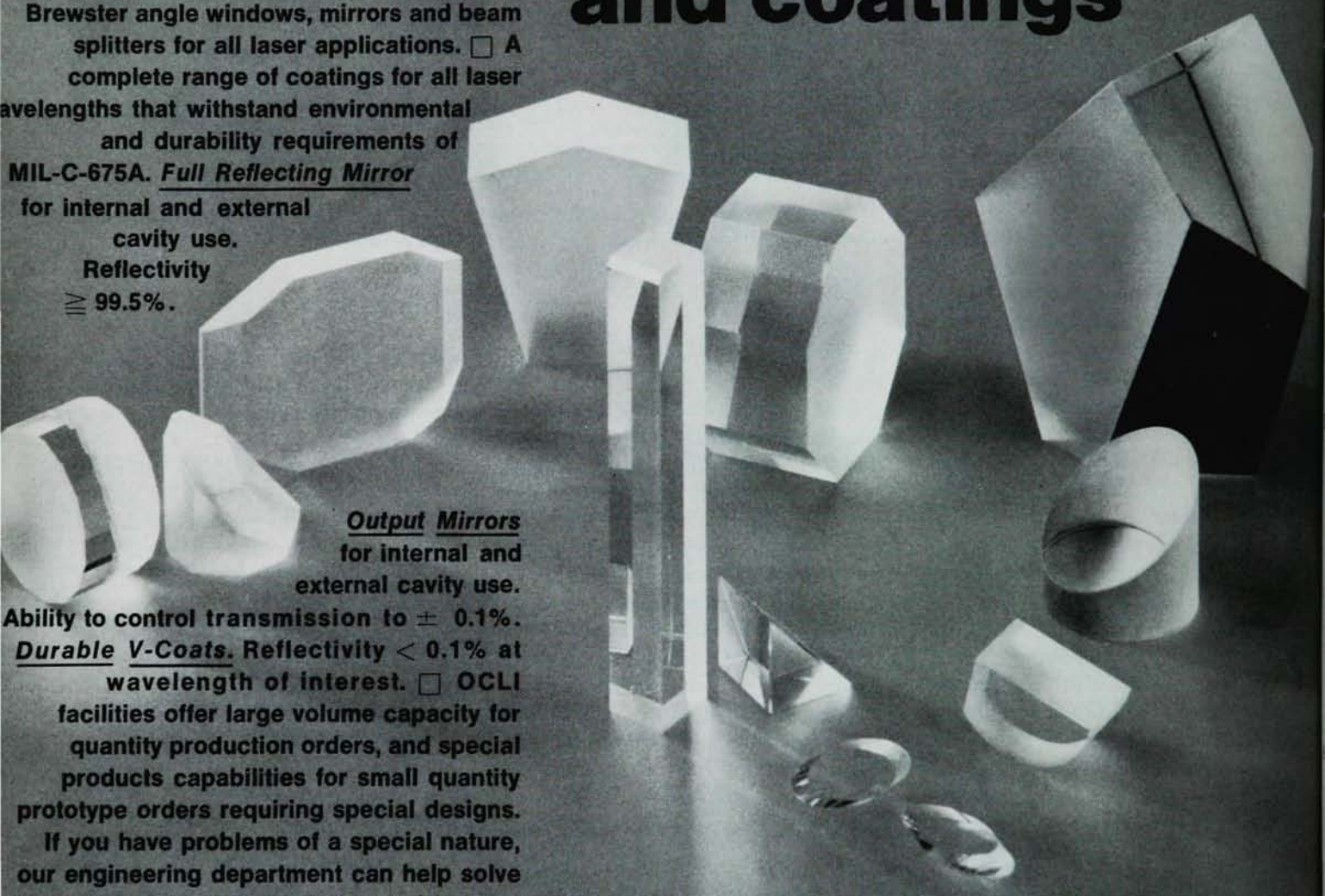

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recently operated at 4.5 megawatts, will undergo replacements and improvements costing an estimated $1.9 million.

Yerkes Observatory (of the University of Chicago) has a new 41-inch (1-meter) reflecting telescope with a Cer-Vit mirror. This is the first major telescope to have a mirror of this material, which has an essentially zero temperature coefficient of expansion. Cer-Vit is made by Owens-Illinois, Inc.

The Smithsonian Astrophysical Observatory is to get a new 60-inch (1.5-meter) telescope at its Mount Hopkins Observatory, near Tucson, Ariz. The instrument will be used to investigate planetary atmospheres and the energy distribution in stellar radiation.

An intensive study of the Martian atmosphere is planned for Jet Propulsion Laboratory's Table Mountain Observatory this year; it will coincide with the Mariner VI and VII fly-by missions. The observatory's 40-foot (12-meter) Coudé spectrograph will be used to determine atmospheric constituents.

ISIS-A, the third coöperative Canadian–US ionospheric satellite, was launched at the end of January and is currently taking data on ten experiments for the Defense Research Telecommunications Establishment (Ottawa), NASA, the National Research Council of Canada, US Air Force Cambridge Research Laboratories, the University of Western Ontario and the US Southwest Center for Advanced Studies.

A three-way coöperation involving Sweden, the UK and the US is responsible for current studies of sudden upper-atmosphere warming conditions. Sounding rockets (Nike-Cajuns) are being launched from the European Space Research Organization's range at Kiruna, Sweden.

36 research rockets will be launched in a 36-hour period this summer to investigate radio propagation in the Arctic. Launches will be timed to occur during "polar-cap absorption events," or radio blackouts caused by irregular solar activity. The program is jointly organized by Air Force Cambridge Research Laboratories, the US Army Ballistic Research Laboratory and the Defense Atomic Support Agency. □