MURA Builds Electron-Positron Storage Ring

A 200-MeV electron-position storage ring, designed to study colliding-beam and high-intensity beam phenomena, will soon begin collecting particles at the Midwestern Universities Research Association, Stoughton, Wisconsin. The ring, with radius of 145 cm, is expected to store 1 ampere of electrons and 100 milliamperes of positrons. Fred Mills, MURA director, hopes that the electrons will begin circulating by spring. A positron injection system could be in operation a year later.

The MURA 50-MeV synchrotron will inject electrons into one side of the ring three times per second; at each pulse about 0.5 ampere is expected. Eventually it is hoped to collect as much as 10 amperes in the ring, but 1 ampere is expected initially.

To produce positrons, a 45-MeV extracted beam from the synchrotron will strike a tungsten radiator; up to 25 microamperes per pulse are anticipated; at this rate it would take about 22 min to accumulate a circulating beam of 100 milliamperes.

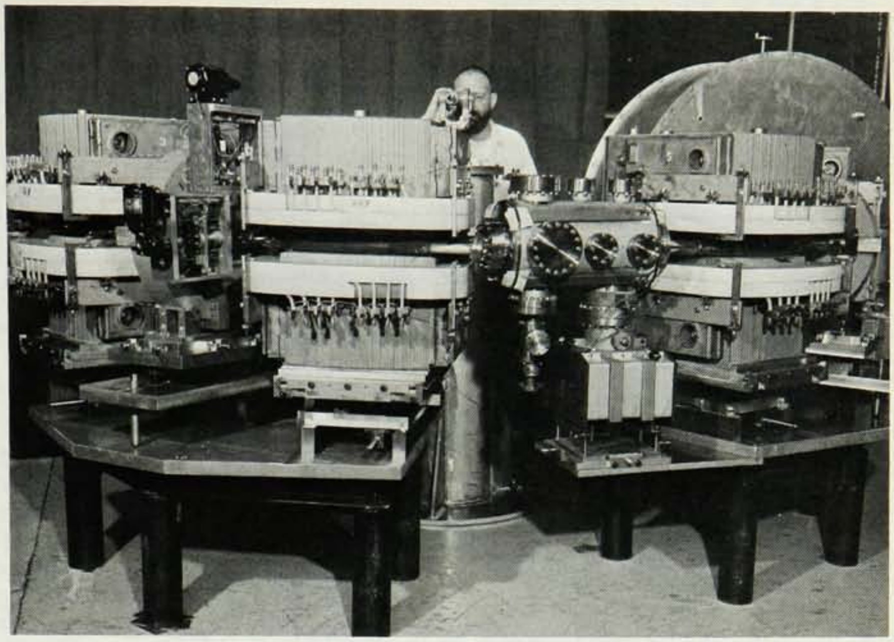
The magnet system is a separated-function alternating-gradient structure; eight bending magnets spaced around the ring produce vertical focusing at their edges, and four quadrupole magnets, also spaced around the ring, produce radial focusing.

To replace the energy radiated by the particles as they round the storage ring, 31.9-MHz rf power will be continuously supplied. Maximum power available to both cavity and beam will be 20 kW.

The magnets have been assembled and are being tested, vacuum-chamber parts are being tested and the inflector pulsing system has been built.

MURA physicists do not expect beam lifetime to be bothered much by gas scattering, since the ring will operate at 10^{-9} torr. The major trouble will probably come from the Touschek effect, in which electrostatic repulsion causes closely spaced particles to leave the ring. At 200 MeV a 1-ampere beam of 1 mm × 1 mm cross section would have a Touschek lifetime of 13 minutes. MURA physicists expect to ameliorate the Touschek effect by controlling the beam size.

Uses. Mills says that the storage ring will mainly be used to study beam instabilities and space–charge limits; these can be roughly divided into two classes: (a) those that afflict single relativistic beams, such as the resistive instabilities and the negative mass instability, and (b) those that involve two beams. As Mills remarks, "The phenomena observed so far appear to be only the beginning of what one might expect to see in intense confined relativistic beams. These experiments could have a profound effect on the design of future accelerators." The storage ring can also be used for colliding-beam experiments and for solid-state experiments, using the ring as a synchrotron radiation source in the ultraviolet (PHYSICS TODAY, September, page 76). Other uses for the device, as yet unexplored, might include the study of photonuclear reactions and the interaction of relativistic beams with plasmas.



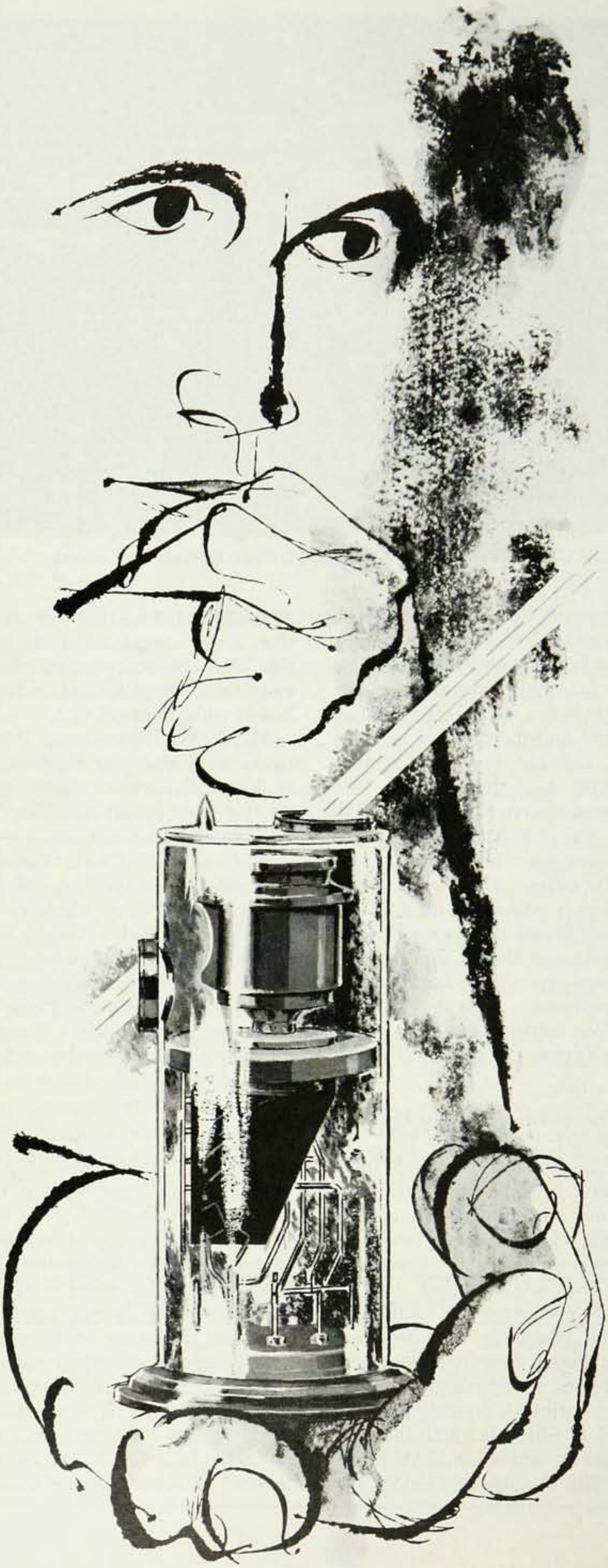
MURA ELECTRON-POSITRON STORAGE RING: Preliminary assembly.

The MURA device is one of several new storage rings: At Stanford a pair of 500-MeV electron-electron rings is running, at Frascati a 1.5-GeV electron-positron ring is being tested, at Orsay a 500-MeV electron-positron ring will soon be running, and at Novosibirsk a set of 130-MeV electron-electron rings and a 700-MeV electron-positron ring are running, and a ring that can either store 4 or 5 GeV electrons and positrons or 25-GeV protons and antiprotons is being built (PHYSICS TODAY, November, page 72).

Government Studies Night Light Satellite

The National Aeronautics and Space Administration has let contracts to several firms (Boeing, Westinghouse, Schjeldahl, Goodyear, Grumman) to study the possibility of constructing a satellite that would reflect sunlight onto night portions of the earth's surface. The project is classified, and NASA, although it confirmed existence of the studies, would not give any details. Unconfirmed reports, however, speak of a mirror brighter than the natural moon, which would illuminate an area half the size of Florida. The idea of such satellites has been linked to problems of night fighting, especially in Viet Nam.

Astronomers are upset by the prospect of such sky illumination. Earth-bound lights (for example, of cities) are bad enough; the presence of an illuminator in the sky could render all kinds of optical astronomy impossible. One of the alarmed astronomers is Edgar Everhart, a physics professor at the University of Connecticut. (Comets and other faint nebulosities are his interests.) Everhart learned about the



study through news items in the Hartford *Courant* (one of the few newspapers that have apparently carried the story) and sought to spread word among other astronomers both by conversation and by letter to *Sky and Telescope*.

One of those to whom Everhart talked, Leo Goldberg of Harvard, is less alarmed, being less convinced that the government is likely to launch satellites. But Goldberg did say that anything that added to background light in the sky could be a source of trouble. Goldberg, who is a member of a NASA advisory committee chaired by C. H. Townes of MIT, informed PHYSICS TODAY that NASA had referred the reflecting-satellite question to the committee for advice. Goldberg expressed the opinion that NASA was proceeding carefully and would take account of scientific advice as the study proceeded.

Another astronomer who is actively watching the project is John W. Findlay of the National Radio Astronomy Observatory. Findlay is chairman of a committee of the Space Sciences Board of the National Academy of Sciences that is charged with a study of the reflecting-satellite project. This committee is the same one that studied the West Ford (space needles) project for the Academy. When PHYSICS TODAY spoke with him, Findley had preliminary information that his committee members were studying. He was sure that the government would coöperate and would consider the opinions of interested scientists and the possible dangers to astronomy before proceeding. Findlay did not expect that his committee would meet before the first of this month and did not feel that the government was rushing the project.

Meanwhile, representatives of NASA at Huntsville, Ala., while confirming existence of the studies, said that they expected preliminary reports from their contractors by the end of November. But at the time of this writing nothing has yet been made public.

Gas and Solid-State Lasers Operate in the Ultraviolet

Continuing attempts to discover laser action in short-wavelength regions have succeeded with both gas and solid-state lasers. Roy Paananen of the Raytheon Research Division, Waltham, recently reported that continuously operating uv ionized-gas lasing had been demonstrated over four transitions in three of the noble gases [*Appl. Phys. Letters* **9**, 34, (1966)]. Solid-state semiconductor lasers emitting in the ultraviolet use zinc sulfide and zinc oxide. The zinc-sulfide model made by Charles Hurwitz of the MIT Lincoln Laboratory, has a peak output power of 1.7 W and a power efficiency of 6.5% [*Appl. Phys. Letters* **9**, 116, (1966)]. The zinc-oxide laser reported by Frederick Nicoll of RCA Laboratories, Princeton, although less efficient, is the first solid-state laser to emit in the uv region [*Appl. Phys. Letters* **9**, 13, (1966)].

Gas laser. Uv emission produced by the continuously operating gas laser occurs at 332.4 and 337.8 nm for singly ionized neon and 350.7 and 351.1 nm for doubly ionized krypton and argon, respectively. The laser consists of 26 2.54-cm-long ceramic tubes pressed into aluminum spools to provide mechanical support and cooling. Effective length was approximately 55.9 cm; the end ceramic tubes were tapered to a straight-line approximation of an exponential to avoid violent plasma oscillations at the higher operating current levels.

Before any uv attempts were made, evidence of singly ionized saturation in krypton and argon was examined. With this in hand doubly ionized uv lasing in both these gases was obtained without difficulty.

Singly ionized neon at 0.6 torr provided lasing at 332.4 nm. However, the discharge was accompanied by serious overheating and consequent outgassing of the cathode. Paananen did not find this effect with the heavier noble gases; he plans further investigation.

Zinc-oxide laser. Last May, Nicoll reported uv emission in pulsed operation of an electron-beam pumped zinc-oxide laser at temperatures near that of liquid nitrogen. The zinc-oxide crystals were grown from vapor as plate-