

pions, and this decay shows CP violation.

One might well ask: Does the $\Delta I \neq 1/2$ decay violate CP and not the $\Delta I = 1/2$ decay? Or do both the $\Delta I = 1/2$ and the $\Delta I > 1/2$ decays violate CP? Although some experimental data are now available, nobody knows the answer yet. Particle physicists are looking for experiments that will give the answer, but so far they appear to be too difficult.

The charge asymmetry found by Schwartz and Steinberger has another intriguing aspect. It offers a way to determine, by communication (with an exchange of dots and dashes rather than physical objects) with physicists in another galaxy, whether their galaxy is composed of the same kind of matter as ours. They will be able to make K_2^0 and observe that less negative particles are emitted, as Steinberger did. If these less-favored particles are the common constituent of their galaxy, then it, too, would consist of matter rather than antimatter.

Such a scheme for intergalactic matter identification appeared to be feasible last year (PHYSICS TODAY, Aug.

1966, page 71) when a charge asymmetry in η^0 decay was reported by Paolo Franzini and his collaborators. Subsequent experiments, however (PHYSICS TODAY, Oct. 1966, page 85), found no statistically significant asymmetry.

—CBL

Oak Ridge IMP Will Shoot Neutrals at Plasma in a Well

DCX-1, for many years a mainstay of controlled-fusion research at Oak Ridge, is now being replaced by a more broadly based experimental series, known as the "Target Plasma Program." One new experiment in the program, IMP (Injection into Microwave Plasma), is now being designed; neutral atoms will be injected into a target plasma produced by microwave heating.

In the DCX-1 experiment a beam of molecular hydrogen ions, accelerated to 600 keV, is injected into a magnetic field between two mirror coils; by dissociation in that region one obtains a collection of 300-keV atomic ions. Although the plasma is hot enough for fusion, experiments completed last year (by Julian Dunlap, Glenn Haste, Herman Postma, Larry Reber and Carl

Nielsen, *Phys. Fluids* 9, 199, 1966) showed that the hot-ion density could not be increased beyond $2 \times 10^8 \text{ cm}^{-3}$ (far from the 10^{14} cm^{-3} usually considered necessary for controlled fusion); losses from the negative mass instability were too high.

In the new approach a steady-state target plasma is generated between magnetic mirrors or in a magnetic well by microwave power applied at a frequency that gives electron cyclotron resonance at appropriate locations in the magnetic bottle. Such a plasma consists of cold ions (H^+ or D^+) and warm electrons. The cold ions cause trapping of an energetic neutral beam, and the warm electrons aid stability of the trapped ions at high densities (by Landau damping of certain critical longitudinal plasma waves).

Trapping occurs because hot (20-keV) neutral particles exchange charge with cold ions in the target. The reaction, which has a large resonant cross section, is $H^0(\text{hot}) + H^+(\text{cold}) \rightarrow H^0(\text{cold}) + H^+(\text{hot})$. This method of trapping, not previously exploited, can be 100 times as efficient as present methods (in which the injected neutral particles are ionized by Lorentz forces), according to

WORK IN PROGRESS. At Los Alamos (left) a cleared area and 0.8-km trench are the start of the meson facility now abuilding. Meanwhile at CERN (right) most of the excava-

tion is complete and concrete work has been started for the 300-meter-diameter tunnel to house intersecting proton storage rings. Beyond are CERN buildings, Geneva, the Alps.



alignability



**Ready to realign your thinking about
laser reliability . . . and realigning?**

You'll find one factor common to all our lasers . . . they are all "working models." In the lab and on-the-line, they have proven themselves rugged, reliable and versatile . . . maintaining optical alignment under every normal condition of shock and vibration . . . delivering maintenance-free operation in excess of 25,000 shots. Function selection is simple, flashlamp replacement requires no realignment of optics. Want more information? Contact: TRG Division of Control Data Corporation, Section E, 535 Broad Hollow Road, Melville (Long Island), New York 11746. Telephone (516) 531-6343



TRG
DIVISION

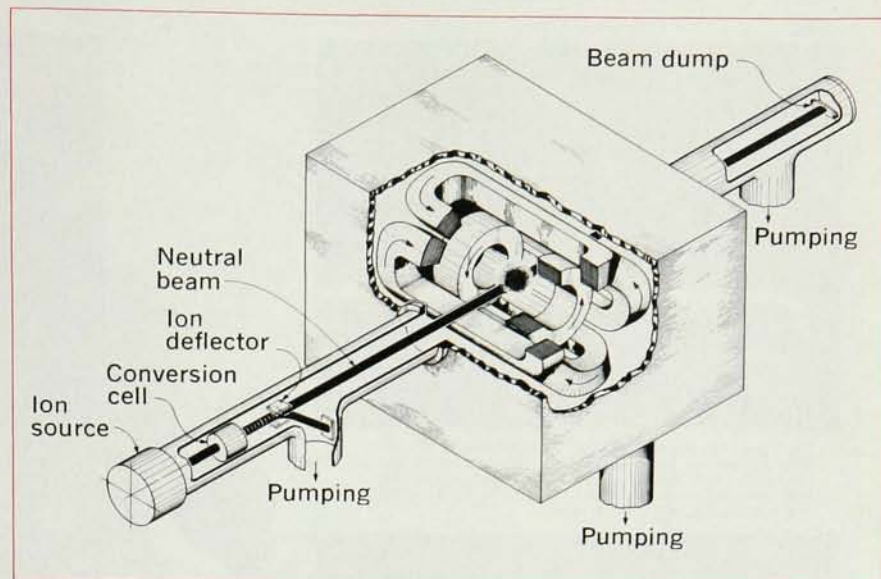
CONTROL DATA
CORPORATION

Arthur H. Snell, assistant director of Oak Ridge.

The electron-cyclotron heated target plasmas have been under development at Oak Ridge for some time. In the simple mirror configurations used earlier a surrounding gas pressure of 10^{-5} torr was required to provide a continuous supply of cold electrons for gross stability. Snell expects that a magnetic-well configuration will yield gross stability of the target plasma without the cold electrons. Then the pressure can be reduced to 10^{-6} torr or lower, low enough for hot-ion build-up (due to high trapping efficiency) to interesting densities.

IMP will use a magnetic-well configuration, which incidentally will also suppress the negative-mass instability. It will be smaller than DCX-1 (and its successor, DCX-2) in physical size but larger in terms of Larmor orbits. It will use superconducting coils in a flexible mirror-quadrupole arrangement. (Copper windings would require 23 MW of dc power.) Some parameters for IMP are given in the table.

In a parallel experiment at Oak Ridge (INTEREM), which uses a simple mirror configuration so that ambient pressure must be relatively high, 0.1 amperes of 20-keV H^0 particles are injected into a microwave plasma produced in a 2.5-kG magnetic field. Experimenters have found a hot-ion density of $3 \times 10^8 \text{ cm}^{-3}$ with no indication of ion cyclotron radiation signaling the instabilities previously encountered.



OAK RIDGE IMP experiment now being designed will inject neutral atoms into a target plasma produced by microwave heating.

Getting a Charge Out Of a Solar Power System

A solar power system capable of converting sunlight into all the electricity needed to operate a large manned orbiting space station for a year or more can be built with existing technology and equipment, RCA Astro-Electronics scientists announced at the Inter-Society Energy Conversion Engineering Conference in Miami, Fla. Functioning as part of a space station in a 200-nautical-mile orbit, the system would generate 5 to 8 kW of usable power.

During daylight, the system would produce 8 kW for the station's on-board systems while simultaneously charging the batteries so that 5 kW

would be available when the earth obstructed the sunlight. To make this possible, the solar array would have a capability of 15.5 kW.

The most distinguishing feature of the system proposed in this NASA-sponsored study would be four paddles each 5.2 by 8.5 meters. Blanketed by solar cells that convert sunlight into electricity, the panels would be arranged in an H configuration around the manned space station. The system could be assembled, tested and ready for operation by the early part of the next decade.

... also of Interest: Albany, Michigan State, Germanium

The State University of New York, Albany expects to install a 4-MeV Dynamitron in the academic year 1968-69 that will produce intense beams of positive ions for the study of low-yield neutron and proton capture reactions. The research program, directed by Jagdish Garg, will include nucleon polarization studies and high-resolution neutron and gamma spectroscopy . . . Michigan State University will soon have a TRIGA Mark 1 reactor that will operate at 250 thermal kW . . . J. C. McGroddy and M.I. Nathan of IBM find that bulk germanium in a high electric field can modulate a direct current with high-frequency oscillations in the gigahertz range. □

Parameters for Oak Ridge IMP

Steady state magnetic field	20 kG at center
Longitudinal mirror ratio	2:1
Radial mirror ratio	1.3:1
Maximum field	70 kG, near quadrupole coil
Mirror coils	15-cm diameter throats, coils spaced about 30 cm apart, conductor to conductor
Effective plasma volume	1.5 liters
Microwave power	2 kW at 55 GHz (5.5 mm) cw, from specially developed traveling-wave amplifiers
Neutral beams	One or two, estimated 0.2 A each of H^0 at 20 keV, with 50% energy spread built in