W. W. Webb and R. J. Warburton,[8] also at Cornell, were thus moved to try new experiments. Choosing to observe the transition in highly perfect tin whisker crystals, they found that the effect was at least as small as had been predicted by the detailed theory, but that the tiny effect of intrinsic fluctuations did seem to occur.

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Interstellar Medium Has Biological Preservative

Interstellar formaldehyde (H_2CO) has been discovered by a group working with the 140-foot radio telescope at Green Bank, W. Va. They observed the molecule in absorption against many galactic and extragalactic sources. The discovery suggests that all the known ingredients for development of life are present in interstellar space.

Five different molecules have been found in the interstellar medium: H_2O and NH_3 were both recently reported (PHYSICS TODAY, March, page 63 and February, page 67); OH, CH and CN have been known for several years.

The observers, Lewis Snyder and David Buhl of Green Bank, Benjamin Zuckerman of the University of Maryland and Patrick Palmer of the University of Chicago, say (*Phys. Rev. Letters*, 31 March) that they found H_2CO in clouds at various distances between earth and the background radio sources in 15 out of 26 positions checked. They conclude that large regions of the galaxy may be filled with clouds containing formaldehyde at densities comparable with that of OH. Its "widespread distribution indicates that processes of interstellar chemical evolution may be much more complex than previously assumed," the observers say.

It is generally believed that primitive life forms could develop in an atmosphere of methane, ammonia, hydrogen and water. Despite the inability of radio telescopes to observe methane transitions, the presence in interstellar space of water, ammonia and now formaldehyde suggests that methane and a number of other molecules are up there, too.

Giant Scintillation Counter Is Good for High Energies

An overgrown NaI(Tl) crystal makes an excellent detector of all kinds of high-energy particles (including neutrals), according to Robert Hofstadter of Stanford, who spoke at the New York meeting of the American Physical Society. He, E. Barrie Hughes, William L. Lakin and Ingo Sick tested their total-absorption detectors in a secondary beam of electrons and pions at SLAC and also at the Stanford 1-GeV linac.

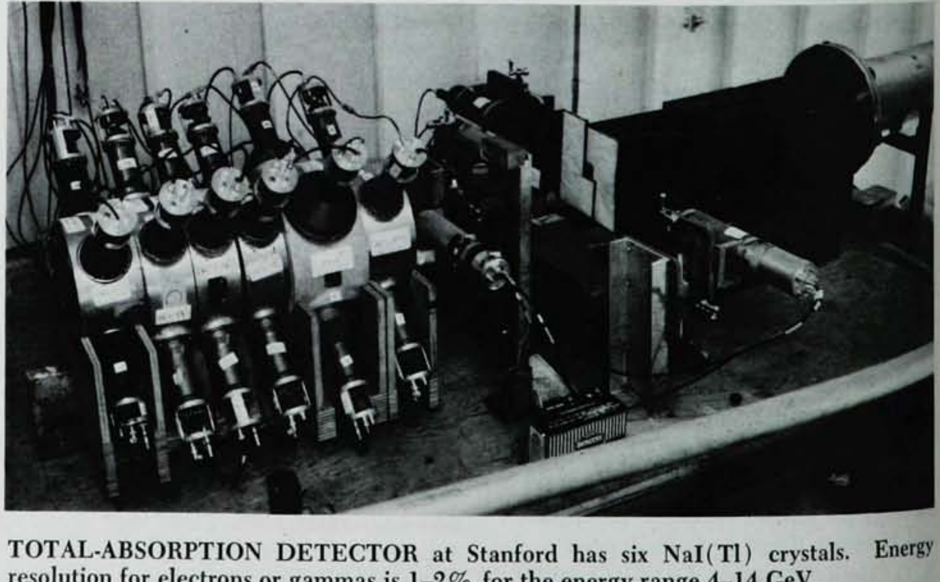
Although total absorption gamma detectors, in which a large block of scintillator produces a light pulse proportional to the gamma energy, are popular for nuclear-physics experiments, the Stanford work is the first to explore such detectors in the GeV range (*Nature* **221**, 228, 1969). Hofstadter and his collaborators used NaI(Tl) because it has an excellent scintillation yield, a high density (3.7 g/cm^3) and a correspondingly small radiation length (about 2.5 cm). However, for detection of GeV particles the crystals must be huge.

The Stanford detector consists of six separate crystals, whose sizes ranged from 29 to 33 cm in diameter and 9.5–18 cm in thickness. Each crystal is sealed in a thin aluminum case and viewed radially by four photomultipliers. The six crystals are mounted coaxially to simulate one large crystal 69 cm thick along the beam axis.

Energy resolution for an incident electron or gamma ray is 1–2% for the energy range 4–14 GeV. Unlike some other devices this resolution improves as energy increases. Hofstadter says that the theoretical resolution of the detector is 0.02%, but a more realistic figure is 0.1%.

The NaI(Tl) crystals can also be used to detect strongly interacting particles, but they must have larger diameters and greater lengths. The Stanford experimenters constructed a total-absorption nuclear-cascade counter by stacking crystals in a 1.5-meter row. Using a tin simulator they studied containment of particle energy as a function of detector radius and length. Results, allowing for equipment limitations, suggest that a TANC counter made with crystals of sufficient size (about 80-cm diameter) should give very useful resolution.

Hofstadter says that there is "virtually no limit to the highest energy detectable by the detector."



TOTAL-ABSORPTION DETECTOR at Stanford has six NaI(Tl) crystals. Energy resolution for electrons or gammas is 1–2% for the energy range 4–14 GeV.

Electron Cloud to Produce Highly Stripped Heavy Ions

Positive ions trapped in electron clouds are exciting interest among high-energy and low-energy physicists alike. While those interested in making high-energy protons (and perhaps heavy 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.

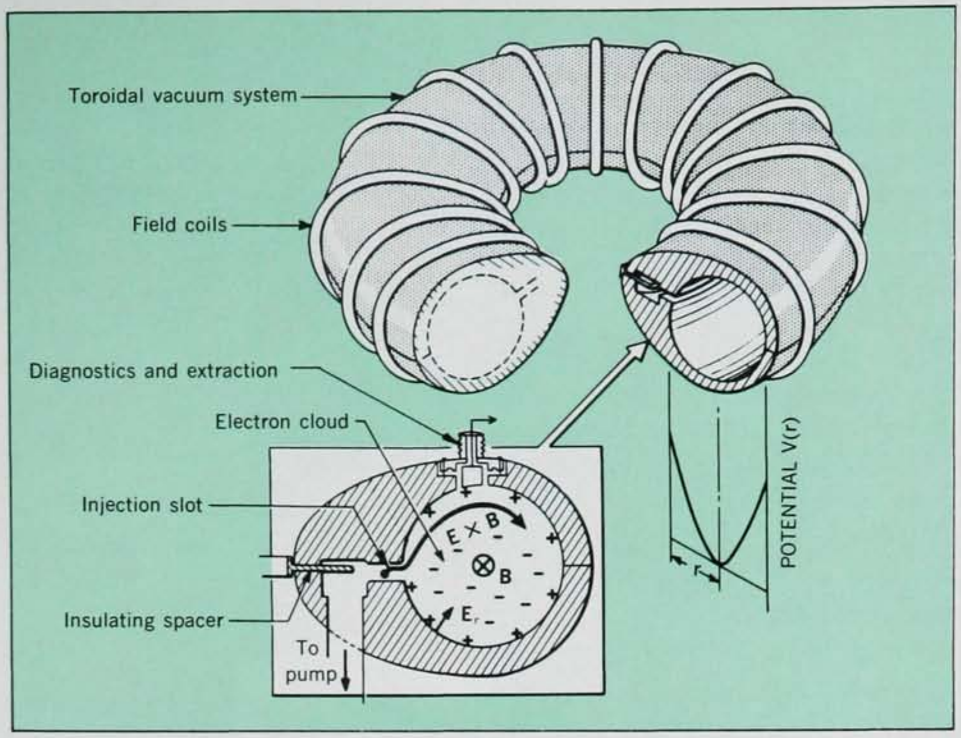
Because of the great interest in making superheavy elements (PHYSICS TODAY, February, page 63) many experimenters would like a beam of uranium ions. But, as Richard H. Levy of Avco explains, one needs a substantial current of highly stripped ions to make a relatively small accelerator (because the required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