

RESEARCH FACILITIES AND PROGRAMS

Yes, there are antideuterons

Antideuterons exist. Perhaps antiatoms and anti-Brookhavens too.

To observe an antideuteron, bombard beryllium with 30-BeV protons from the Brookhaven alternating-gradient synchrotron. Use an analyzer made of bending magnets, Cerenkov counters, coincidence and anti-coincidence circuits to eliminate from the debris whatever has the wrong charge, velocity, and momentum (hence mass). What remains is antideuterons, and there are some, report Leon Lederman and his Columbia colleagues Dorfman, Eades, Lee and Ting in the June 14 *Physical Review Letters*.

Not that it's easy. The problem is to accept particles with β ($= v/c$) between 0.81 and 0.96 after strongly rejecting particles with $\beta = 1$, such as pions, which are 500 million times more plentiful in the beam. Calibration was accomplished by tuning the system to positive deuterons. With a change of polarity antideuterons appeared at the same values of velocity and momentum.

The analyzing telescope, designed to search for possible metastable particles suggested by the SU_3 symmetry scheme, consists of six bending magnets, ten beam-defining scintillation counters, two Cerenkov counters (one gas, one liquid), and three guard counters. When it is tuned for antideuterons, a particle, to be counted, must have the correct momentum to pass through the magnets, must be separated from any $\beta = 1$ particle by at least 35 nanosec, must not trigger any of five $\beta = 1$ coincidence circuits, must not trigger a pion-sensitive gas Cerenkov counter, must have β between 0.81 and 0.96 as determined by both a water-glycerine Cerenkov counter and delayed coincidences, and must have the same velocity over three different portions of its path as determined by coincidences. Moreover, any event that triggers guard counters surrounding the path is rejected because it might be caused by

nuclear reactions along the beam. As an additional check, it was verified that the counting peak in the multichannel analyzer shifts appropriately with a small shift in the accepted momentum; thus change in velocity with change in momentum is what it ought to be.

One can not rule out a new particle with the charge, mass and momentum of an antideuteron, but observed lifetime and absorption cross section argue against this hypothesis.

The team may have seen antitritons too at about 1% of the antideuteron concentration, but evidence gathered in the available time was not conclusive.

Molecular-beam accelerator

The University of Chicago has received a grant of \$193 275 from the Air Force Office of Scientific Research for the construction of a molecular-beam accelerator. The project will be directed by Lennard Wharton, assistant professor in Chicago's Chemistry Department and Institute for the Study of Metals. The accelerator is intended for use in studying energy transfer in certain chemical reactions.

The feasibility of the device depends on the fact that certain molecules possess permanent electric dipole moments and that dipole moments can be induced in others. The dipole moments interact with external electric field gradients causing the molecules to be attracted to the location of highest field strength. The direction of the external field does not affect the interaction.

Acceleration will be accomplished in the manner of a traveling-wave tube by electric fields whose orientation will be transverse to the direction of the beam's motion. The fields will be produced by pairs of hemispherically headed electrodes on opposite sides of the beam axis. The electrodes will be connected to an rf power supply so regulated that the

fields will be shut off as the molecules reach their strongest points. This feature will allow the pulses of molecules to retain the acceleration provided by each pair of electrodes and move on to the next accelerating stage. If the fields were kept on steadily, the molecules would be decelerated after passing the axis of the field and eventually would be attracted backwards. About one thousand accelerating stages will be used.

Since the moving molecules will be attracted away from the beam axis toward the heads of the electrodes, the orientation of successive pairs of electrodes will alternate between the vertical and horizontal directions perpendicular to the beam. This alternation, combined with proper spacing of electrode pairs, will establish a condition somewhat analogous to alternate-gradient focusing in particle accelerators. Special focusing electrodes will be provided for fine adjustments. The machine will be about ten meters long, and its experimental area will be three meters on a side.

The accelerator will yield beams with energies in the range 0.5 eV to 4 eV. Since the strength of the chemical bonds is some ten million times smaller than that of nuclear bonds, it is expected that these energies will result in data on chemical bonds which will be comparable in the fineness of their definition to the data for nuclear bonds secured in current nuclear-structure experiments.

The purpose of the research is to study both the dissociation of diatomic molecules by collision with an inert target and the three-body reactions in which such molecules dissociate and one of their elements associates with a third fragment to form a new molecule. It is known that such reactions depend on increasing the rotational and vibrational energy of the molecule by inelastic collisions until its constituent atoms come apart. Professor Wharton's research aims to determine the "structure" of such interactions (e. g., how much energy is gained in a collision, whether the energy necessary for the interaction is gained stepwise in a number of collisions or all at a blow, how much of each type of energy is