width, the new data confirm theoretical expectations. —GBL

References

1. J. V. Allaby, Yu. B. Bushnin, S. P. Denisov, A. N. Diddens, R. W. Dobinson, S. V. Donskov, G. Giacomelli, Yu. P. Gorin, A. Klovning, A. I. Petruhkhin, Yu. D. Prokoshkin, R. S. Shuvalov, C. A. Stahlbrandt, D. A. Stoyanova, International Conference on Elementary Particles, Lund, Sweden, 1969.
2. S. J. Lindenbaum, International Symposium on Contemporary Physics, Trieste, June 1968.
3. V. Barger, M. Olsson, D. D. Reeder, Nuclear Physics **B5**, 411 (1968).
4. G. G. Beznogikh, A. Buyak, K. I. Iovchev, L. F. Kirillova, P. K. Markov, B. A. Morozov, V. A. Nikitin, P. V. Nomokonov, M. G. Shafronova, V. A. Sviridov, T. Dien, V. I. Zayachki, N. K. Zhidkov, L. S. Zolin, S. B. Nuruchev, V. L. Solovianov, International Conference on Elementary Particles, Lund, Sweden, 1969.

PPA Proposes Heavy-Ion Improvement Program to AEC

Modifications to the Princeton-Pennsylvania Accelerator will give nuclear structure a unique new tool. Monochromatic proton beams, intense primary beams of 2.4-GeV deuterons and 4.8-GeV alpha particles are all expected by late this year. PPA has submitted to AEC a four-phase proposal to add a high-energy, heavy-ion capability.

In the initial improvement program the key modification is an all-solid-state power supply that will produce a 50-millisec flat top, constant to 0.01% at a pulse rate of 10 per second. With the new power supply, the 3-GeV proton beam is expected to be monochromatic within about ±300 keV or better. An external proton beam of about 4×10^{11} protons/sec is already available. The deuteron intensity is expected to be about the same as the proton intensity; because the alphas are more difficult to make, their intensity is expected to be between 0.1 and 0.5 as much.

Development work is expected to produce, by 1970–71, modest beams of relatively heavy ions with 10–100 MeV/nucleon, according to Milton G. White, PPA director.

The present PPA injector is 3 MeV. A 75-MeV high-current booster injector synchrotron is being designed. It would yield 20–30 times more proton current and would allow injection of polarized protons (which are not available with other high-energy accelerators because they automatically depolarize their protons). The same injector synchrotron could also be adapted to produce intense beams of very heavy ions with energies up to 1.2 GeV/nucleon (up to nickel) and 0.8 GeV/nucleon for uranium.

In the four-phase program, Phase 1 (costing $500 000) provides a ceramic vacuum chamber capable of reaching the 3×10^{-9} torr required for acceleration of the heaviest ions, such as xenon (though light ions could be accelerated at 10^{-7} torr). Xe^{8+} could be accelerated to 28 MeV/nucleon with a current of 5×10^{10} particles/sec, White estimates.

Phase 2 adds a small booster synchrotron and a Cockcroft–Walton accelerator ($2.25 million), thus permitting much wider choice of ion sources, higher heavy-ion currents and a proton current of 2×10^{13}/sec.

Phase 3 ($800 000) adds equipment to permit full stripping of the heaviest ions and subsequent acceleration to 800–1200 MeV/nucleon.

Phase 4 adds a second 4-MV injector, a polarized-proton ion source and a heavy-ion development program.

Experiments. Just before the Brookhaven Cosmotron was shut down at the end of 1967, Harry Palevsky and his collaborators (PHYSICS TODAY, October 1967, page 75) ran a series of experiments with 1-GeV protons that probed the distribution of matter in light nuclei. Energy resolution was about 3 MeV, and the beam retained a long-term stability of about 1.5 MeV.

PPA will be able to do similar studies but at a much faster rate; although the Cosmotron had ten times the intensity, it only pulsed once every 2 sec. (PPA pulses 10 times per second.) White explained that PPA experiments can look for deuterons or alphas inside the nucleus. With the small wavelengths associated with 3-GeV particles, one can probe fine details. Because so few nuclear-structure studies have been done in the 1–3 GeV range, White feels that interesting results are bound to show up.

Palevsky plans to do alpha–alpha reactions at PPA. Because the isospin and spin are both zero, one can see whether or not the constituent parts of the alpha particles behave independently.

With polarized protons, White noted, one could look at any spin-dependent process. Using the deuteron beam, they could make a highly collimated 1.4-GeV neutron beam; by polarizing the deuterons, a polarized neutron beam could be produced.

Besides the sharp increase in nuclear studies, PPA expects a steady increase in its current heavy backlog of elementary-particles experiments. At present, 14 experiments are on the experimental floor and taking data more or less simultaneously. (The average number of users taking data simultaneously is about 4.5.)

Program is Proposed for Outer-Planet Trips in 70's

A "grand tour" of several of the outer planets, possible in the late 1970's because of their unusual relative positions, has been recommended by a committee of the National Academy of Sciences. In a report called *The Outer Solar System: A Program for Exploration,* the group, headed by James A. Van Allen and Gordon J. F. MacDonald, notes that a similar juxtaposition will not recur for 200 years and that taking advantage of it would substantially reduce the time and money spent in exploring the outer solar system. A series of specific missions would start with a trip to Jupiter in 1974.

Prime objective of outer solar-system studies include experiments to:

- investigate the appearance, size, mass, magnetic properties and dynamics of the outer planets and their major satellites
- characterize the planetary atmospheres (chemical and isotopic composition, existence of biologically significant substances and conditions, description of their motions and temperature-density-composition structure)
- study in detail the external magnetic field and respective particle population of each planet
- study the solar wind (properties at great distances from the sun, mode of interaction with the planets, outer boundary of its flow)
- determine the composition, energy spectra and cosmic-ray fluxes in interstellar space.

IN BRIEF

Explorer 41, the seventh in the International Monitoring Platform series, was launched on 21 June. The satellite carries 12 experiments to study solar plasma, magnetic fields and cosmic rays. □