physical sciences

Gathered at the meeting of the American Physical Society last week in Seattle

Muonium in free radicals

Muonium is a short-lived substance formed when a muon or mu meson plays the part of an atomic nucleus and captures an electron. The two form a system in which the electron revolves around the muon. Muonium does not last long because muons are radioactively unstable and eventually decay. Muonium is of great interest to physicists since it is one of the simplest systems in which a particle not normally part of an atom plays a quasi-atomic role.

Muonium can form compounds as a normal atom would, and it now appears, Dr. J. H. Brewer of the Lawrence Radiation Laboratory at Berkeley told the meeting, that in some cases it will also form free radicals. Free radicals are highly reactive combinations of atoms that in ordinary chemistry proceed to form further compounds.

Muonium compounds are formed by introducing muons into solutions of different chemicals. Contrary to expectation, Dr. Brewer found that muons in solutions of bromium and iodine formed free radicals instead of chemically stable compounds.

Superconducting LINAC for heavy ions

For several years physicists at Stanford University have been building a linear accelerator for protons that is designed to use superconducting waveguides for the radiowaves that accelerate the protons. The use of superconducting metals in the waveguides is expected to lead to large savings in the power and time lost to heating caused by electrical resistance in ordinary metals.

Because of metallurgical difficulties, the Stanford physicists have so far achieved only half the amount of acceleration per foot of waveguide that their original plan calls for. Nevertheless their experience convinces them that a superconducting accelerator for heavy ions is feasible and they have begun to design one.

The properties of superconducting waveguides, says Dr. L. R. Suelze, would make such an instrument particularly versatile in accelerating particles with a wide variety of ratios of charge to mass. Such a "universal particle accelerator" could range from uranium ions with energies of 10 million electron-volts per nucleon to protons of 100 or 200 million electron-volts or even to electrons, he says.

A star orbiting a black hole

Black holes (SN: 12/26/70, p. 480) are supposed to be invisible, but cosmologists have been busy postulating various situations in which a black hole might betray its presence by its effects on nearby objects. One such possible case is if a visible star is in orbit around a black hole.

Drs. C. Cunningham, J. M. Bardeen and J. D. Cushman of the University of Washington at Seattle have calculated what such a star might look like. They postulate a fairly ordinary kind of star, one which, to an observer traveling with it, appears to emit light equally in all directions and with a constant luminosity. They place this star in an equatorial orbit very close to a hypothetical black hole and calculate how it would appear to observers far from the black hole.

They find that the black hole's extremely strong gravitational field focuses the starlight, particularly for an observer who is not very far from the equatorial plane of the black hole. For him the star's light will appear to fluctuate with strong peaks of light from time to time. The University of Washington group finds that generally most of the energy received from the star at great distances comes out in directions relatively close to the equatorial plane.

High-energy X-ray sources in the south

In recent months X-ray astronomers have made a good deal of news by the discovery of sources with rapid and large variations in their brightness. So far such objects have been found in the northern portions of the sky. From Australia now comes a report of two new ones in southern skies.

Drs. J. E. McClintock, W. H. G. Lewin and G. R. Ricker of the Massachusetts Institute of Technology report that a balloon flight from Australia last Oct. 15-16, found a source at galactic longitude 300.7 degrees and galactic latitude minus 2.2 degrees showing several flares that rose and decayed within a few minutes. The object's flux increased five times in about two and a half minutes. Another source, at galactic longitude 1.4 degrees and latitude 1.2 degrees, also showed a considerable rapid variability.

Cosmic-ray antiprotons calculated

Cosmic rays are mostly protons, but when some of them strike nuclei of interstellar hydrogen (also protons) in their travels, these proton-proton collisions may produce antiprotons. Dr. M. C. Chen of the University of Nevada at Las Vegas has calculated an energy spectrum for these cosmic-ray antiprotons and numerical ratios of antiprotons to protons. He finds that the number of antiprotons with different energies varies according to what is called a power law with an exponent of about 2.6, a spectrum similar to that of the cosmic rays generally. The ratio of cosmic-ray antiprotons to protons ranges from one to 3,800 at a 1,012 electron-volts energy to one to 1,000 at 1,018 electron-volts.

Superconducting lead in accelerators

Most persons who attempt to build superconducting particle accelerators choose niobium as the metal from which to make superconducting waveguides. Now tests by a group from the California Institute of Technology indicate that the more common and more easily fabricated metal lead may also be useful for waveguides.

Drs. G. J. Dick, K. W. Shepard, M. L. Yu and F. W. Wright report that studies demonstrate "that superconducting lead can be used to build a prototype proton accelerator with an energy gain of 1.5 million electron-volts per meter of waveguide." This is somewhat less than can be done with niobium. The Stanford group, which is working with niobium, reports energy gains of slightly more than 6 million electron-volts per meter.