physical sciences

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COSMIC RAYS

Primordial composition traced

The composition of cosmic rays is different, by the time they reach the earth, than it is when they are still near their distant points of origin. The difference is the result of en route collisions with interstellar atomic nuclei which break heavier cosmic rays into lighter ones. By working backward from a knowledge of cosmic ray composition at the top of earth's atmosphere, three Naval Research Laboratory scientists have deduced the relative composition of cosmic rays at their so-called primordial source regions.

C. H. Tsao, M. M. Shapiro and R. Silberberg of NRL first needed to know how much interstellar hydrogen gas a cosmic ray passes through before reaching the solar system, and the nature of the composition changes due to nuclear break-up in the gas. Using prior research for that data, they deduce that: Carbon and oxygen are almost equally abundant at the source; neon, magnesium, silicon and iron are each about 20 percent as abundant as carbon, with nitrogen about 10 percent as abundant; chromium, sulfur, argon, calcium, sodium and aluminum ase still less common, and all other elements—except for hydrogen and helium, which are by far the most common elements both near earth and at the source—are less than three percent as plentiful as cosmic ray carbon.

NUCLEAR PHYSICS

New map of the nucleus

A new view of the atom's nucleus may help scientists working with nuclear fission to tell how big a target they have to shoot at.

The nucleus apparently has a skin of neutrons surrounding its charged core, and about one-tenth as thick as the core, reports Dr. Clyde Wiegand of the University of California's Lawrence Radiation Laboratory in Berkeley. This observation results from Dr. Wiegand's development of a way of observing continuously exotic atoms made up of a nucleus and a single, closely orbiting, negatively charged K meson, or kaon.

The scientist's technique indicates that the kaons collide with the nuclear surface about six fermis, or about 25 hundred trillionths of an inch, out from the center. This is a greater distance from the nucleus than was predicted using measurements derived from the area occupied by nuclear protons, which indicates that the protons must be inside the all-neutron shell.

SPECTROSCOPY

Measuring energy differences

A relatively new technique called level-crossing spectroscopy, developed to study details of the excited states of atoms, has been successfully applied to studying the excited energy state of a molecule.

Most precise work in measuring details of molecular structure has been confined to ground states, according to Drs. R. L. deZafra, Alan Marshall and Harold Metcalf of the State University of New York at Stony Brook, L.I., and excited-state measurements have been limited by the technical problems of optical spectroscopy.

Using the new technique, however, the researchers have been able to measure energy differences in the OH free radical, whose existence in vast interstellar clouds has caused speculation that some sort of maser action may be going on in space.

The technique is based on the fact that when a molecule is placed in a magnetic field, some of its energy levels are raised and some are lowered; when the levels cross, there are observable changes in the molecule's light scattering. "We can," the scientists report, "detect energy differences less than a millionth of a billionth of that expended by a flea in jumping over a matchbox."

ELECTRON MICROSCOPY

Look but don't touch

A variety of limitations may stymie scientists trying to study individual biological molecules with a microscope, even though instruments can be made to discriminate among objects that small.

On the molecular level, report J. R. Breedlove Jr. and G. T. Trammell of Rice University in Houston, X-ray microscopy is impossible because an X-ray of the necessary energy is likely to ionize the atoms in the molecule. Electron microscopy is limited by increasing ionization probability to molecules no larger than about three atoms.

Even the field ion microscope, which has been used to image atoms in certain tightly bound metals, is unusable because its large electric fields would tear ions from a soft biological molecule.

GEOPHYSICS

Lunar clue to cosmic rays on earth

The possibility has been suggested by some scientists that the evolution of organisms on earth was suddenly and appreciably altered at some point by intense bombardment of cosmic rays from nearby exploding stars. This question, an Atomic Energy Commission physicist suggests, could be answered by study of mineral samples from the moon.

Radiation tracks left in the lunar rocks could be broadened by a suitable etching technique, and then observed through an optical or electron microscope, says Dr. Raymond Gold of the AEC Argonne National Laboratory in Argonne, Ill. This would make it possible to study cosmic radiation in the vicinity of the earth without the influence of the earth's atmosphere, he says, making it possible to get a better ratio between tracks of cosmic rays and those resulting from natural decay of uranium.

By studying the tracks, physicists can determine the nature and magnitude of the bombarding radiation, the approximate direction of the source and the approximate time at which it took place.