physical sciences notes

MATHEMATICS

Advanced courses attract math students

Undergraduate mathematics programs in U. S. colleges and universities have had significant changes during this decade, including an increase in the proportion of students taking advanced courses.

Undergraduate mathematical science enrollments in four-year colleges in 1965 increased 44 percent over those in 1960, which is about the same rate as general undergraduate enrollments for these periods.

The survey was made by the Conference Board of the Mathematical Sciences, a consortium of seven national organizations and three affiliated societies, in cooperation with a National Academy of Sciences Committee.

It showed that two opposing trends are apparently balancing each other—a proportionate decline in elementary courses and a proportionate increase in the more advanced courses. Nevertheless, nearly half of the enrollments in 1965-66 were in courses below the level of calculus.

CELESTIAL MECHANICS

Mass of asteroid Vesta

Asteroid 197, Arete, approaches asteroid Vesta within a distance of four million miles once every 18 years. Perturbations of Arete's motion by Vesta during these close approaches could be used to figure out Vesta's mass fairly precisely, says Dr. Hans G. Hertz of Goddard Space Flight Center, who gives the results of some calculations in the April 19 SCIENCE.

Since Arete was discovered in 1879, it has made five close approaches to Vesta—in 1885, 1903, 1921, 1939 and 1957. Altogether 72 different observations were made at these times. From these Dr. Hertz calculates Vesta's mass at 1.17343 ten-billionths of a solar mass—about 200 million billion metric tons.

A precise knowledge of Vesta's mass could yield more precise calculations of the masses of the asteroids that Vesta comes near. At present masses of most asteroids are only estimated.

ACCELERATORS

Precise measurement of ionizing radiation

A solution to the problem of making precise measurements of the ionizing radiations in particle accelerators is offered by the hydrogen pressure dosimeter developed at the Britain's Rutherford High Energy Laboratory.

Dosimeters normally used for dose measurement of living tissue generally have an upper dose limit of approximately 1,000 rads. (1 rad corresponds to the absorption of 100 ergs by 1 gram of material.) The dose level that can damage materials is 1 million to 1,000 million rads. These high radiation doses collected over long exposure periods of months or even years coupled with the varied quality of the ionizing radiations have rendered most previous dosimetry systems ineffective.

The new instrument is based on the fact that the major gaseous product from some irradiated hydrocarbons is hydrogen. In the case of polyethylene the gas produced is 97 to 98 percent hydrogen. The quantity of hydrogen generated can be related by prior calibration to the radiation dose absorbed.

The Rutherford dosimeter measures the hydrogen pressure build-up inside a sealed capsule containing the polyethylene and relates this to the absorbed radiation dose. Under test, it has shown little variation with changes of dose rate, the maximum dose rate used being 1 million rads per minute. With suitable calibration the dosimeter will detect all types of damaging high energy radiation including protons and neutrons.

A development of the system is under way to extend the useful range to lower dose regions.

PARTICLES

Proton radiography

Energetic protons from an accelerator may be used to produce radiographs similar to X-ray pictures, Dr. A. M. Koehler of the Harvard University Cyclotron Laboratory reports in the April 19 SCIENCE.

The pictures show very good contrast but poor spatial resolution, according to Dr. Koehler. A proton radiograph of a stack of aluminum absorbers showed by contrast the presence of a piece of aluminum foil that represented only 0.2 percent of the thickness of the stack, but the outlines of the shapes were quite fuzzy.

To make the radiographs protons from the external beam of the Harvard cyclotron were passed through a lead scatterer that reduced their energy from 160 million to 137 million electron volts and spread the beam from a diameter of two centimeters, where it struck the scatterer, to 10 cm at the point three meters downstream where the radiographs were made.

Dr. Koehler thinks the technique may be useful in detecting flaws in technical materials as well as in medical radiography.

RADIATION

Low energy solar protons

The flux of low-energy protons from solar flares has been measured by a 16-pound Environmental Research Satellite designed by the Air Force Cambridge Research Laboratories and TRW Inc.

The satellite got data on the proton spectrum between 0.5 and 40 million electron volts; few direct measurements had previously been made at these energies. Fewer protons were found than some scientists believe should have been there. The data are being processed to yield flux and energy spectra.

The satellite, which has an apogee of 60,000 nautical miles and a perigee of 4,630, spends about 90 percent of its time outside the earth's trapped radiation zones, an ideal orbit for measuring solar flare radiation.

Data on solar flare particles, besides its theoretical interest, is necessary for calculations of probable damage to astronautical equipment and personnel.