physical sciences

PULSARS

Explaining the speedup

A few months ago a speedup in the pulsation period of the pulsar PSR-0833-45 in the constellation Vela was recorded (SN: 4/19, p. 377). This was something of a shock, since all theorists called for pulsars to be uniformly slowing down, and such slowing had been detected for several pulsars.

In NATURE for June 28, Dr. Bernard Durney of the High Altitude Observatory at Boulder, Colo., offers an explanation of the speedup. It could have been caused, he said, by an increase in the mass of the pulsar.

The matter that increased the pulsar's mass could be a remnant of the supernova explosion that, according to theory, produced the pulsar. If such a remnant had not been thrown far enough to escape the pulsar's gravity, it would someday fall back into the pulsar.

This, suggests Dr. Durney, is what happened to PSR-0833-45. He calculates that it could have gained an amount equal to a millionth of the sun's mass in a week's time.

PARTICLES

Mass of the neutrino

Explaining beta decay, in which a nucleus gives off electrons or beta rays, requires the existence of a particle called the neutrino to carry off excess energy. The neutrino has to have zero mass at rest, since the masses of the other participants add up correctly without it.

Experiment shows that if a neutrino has mass, it is a very small amount, but a serious question is whether it can be exactly zero. Beta decay theory requires it, but it has not been clear whether the rules that govern particle interactions, or field theory, would allow a particle with the neutrino's other mathematical characteristics to have zero mass.

Now Dr. Barry Frank of Sir George Williams University in Montreal presents, in IL NUOVO CIMENTO for May 21, a new solution to the relevant field equations which, he says, allows a neutrino with zero mass.

PARTICLES

Gravity and protons

During a course of experiments to determine the effects of gravity on protons, a Russian physicist, Dr. G. E. Velyukov, reported that a proton in a magnetic field precesses between 20 and 40 hertz faster when the magnetic field is parallel or antiparallel to the gravitational field than it does when the two fields are perpendicular. He attributed this difference to the effect of gravitational forces on the protons.

But a gravity shift of this magnitude would cause serious errors in the measurement of the earth's magnetic field with proton magnetometers, since they themselves determine the field strength by the amount of precession. Measurements are often made to a precision of one gamma, but the gravity shift could introduce an error of about 730 gammas.

Dr. B. Arlen Young of Varian Associates in Palo Alto, Calif., did an experiment to check the Russian result. He reports, in PHYSICAL REVIEW LETTERS for June 30, that he did not find the effect reported by Dr. Velyukov. A proton magnetometer measuring a known magnetic field parallel and perpendicular to the gravitational field gave the same reading in both cases.

COSMIC RAYS

X-rays and infrared background

In 1968 astronomers detected an infrared background radiation in the neighborhood of the earth that is as bright as a blackbody heated to 8.3 degrees K. (SN: 11/30, p. 543).

Assuming that this infrared radiation pervaded the whole galaxy, Drs. R. Cowsik and Yash Pal of the Tata Institute in Bombay, and Dr. C. S. Shen of Purdue University, showed that collisions between it and cosmic ray electrons could produce the observed flux of cosmic gamma rays (SN: 4/5, p. 333).

But this conclusion, say Drs. R. F. O'Connell and S. D. Verma of Louisiana State University, is a "mixed blessing." They show, in PHYSICAL REVIEW LETTERS for June 30, that if this method is producing the gamma rays, it should at the same time produce X-rays of lower energy.

The mechanism, say Drs. O'Connell and Verma, could produce the total observed flux of X-rays, but they would be equally bright all over the sky. Observation shows that cosmic X-rays are a good deal brighter in some directions than others.

The Louisiana physicists conclude, therefore, that the infrared is probably a local rather than a galactic phenomenon.

PHYSICS

Special relativity and short distances

As physicists examine phenomena that take place in smaller and smaller spaces, they are continually concerned whether the laws they use to describe large-scale activities are valid for the small ones. Experience has made them wary.

One current problem is whether there is a distance below which special relativity no longer holds. One place to search for this is in the radioactive decays of elementary particles, which are accomplished over extremely short distances. If there were a violation, then the lifetimes of the daughter particles produced by the decay should be different from what they would be if special relativity were valid.

Such altered lifetimes of mu and pi mesons, for example, should be seen in the cosmic rays reaching the earth, say Drs. M. Dardo, G. Navarra and P. Penengo of the University of Torino in Italy. They calculate, in IL NUOVO CIMENTO for May 21, that such a lifetime difference could be found by examining the energy spectra of the cosmic ray pi and mu mesons. But present experimental data are not fine enough to show it, they say. Present data are enough to show, however, that there is no violation of special relativity down to about five hundred-million-billionths (5×10^{-17}) of a centimeter. The previously calculated limit was one ten-million-billionth (10^{-16}) (SN: 6/29/68, p. 621).