physical sciences

PULSARS

A Soviet view: subdwarf star

A pulsar includes a subdwarf star whose diameter is about a sixth or a seventh that of the sun and whose radiation is one-hundredth that of the sun.

So says Dr. I. S. Shklovskiy in a report translated from the June 21 PRAVDA. He was led to this conclusion by an optical spectrum of one pulsar obtained by observers at the Crimean Astrophysical Observatory, which indicated the object is cold for a star—less than 5,000 degrees C.

In Dr. Shklovskiy's model the visible subdwarf does not produce the radio pulses. These come rather from an unseen companion, which might be a white dwarf and which revolves around the subdwarf at a distance several times that between the earth and the sun.

Dr. Shklovskiy figures the distance of this pulsar at about 1,000 light years. In his opinion pulsars should be powerful cosmic ray sources. He figures there are about 10 million of them in the galaxy, and therefore they could be the main source of cosmic rays.

COSMOLOGY

Pair production

One of the possible ways in which energy can be converted to matter is spontaneous pair production. Given an intense force field, such as a magnetic field on the order of a million billion gauss, electron-positron pairs would appear, arising spontaneously out of the energy stored in the field.

Prof. Fred Hoyle of Cambridge University in England has suggested that there might have been a strong magnetic field present in the early history of the universe. And Prof. Kip Thorne of California Institute of Technology speculates that at magnetic field strengths greater than 4.4×10^{13} gauss most of the magnetic energy is converted into electron-positron pairs, which later annihilate to form low-wavelength radiation.

But others have argued that such pair production could not happen in a static field because the theoretically allowed energy states of electron and positron in such a field would be too far apart.

Dr. R. F. O'Connell of Louisiana State University argues—in PHYSICAL REVIEW LETTERS for Aug. 5—that this analysis does not take into account a small increment to the electron energy added by its anomalous magnetic moment—the amount by which the electron's response to magnetic forces differs from what theory originally predicted. This addition changes the energy levels so that pair production can indeed happen in high static fields, he says.

COSMOLOGY

Blackbody spectrum extended

The cosmic radio spectrum that many astrophysicists believe duplicates that of a blackbody at a temperature of 2.7 degrees Kelvin has been extended further into the millimeter wave range. Drs. P. E. Boynton, R. A. Stokes and David T. Wilkinson of Princeton University report in PHYSICAL REVIEW LETTERS for Aug. 12 that they have measured the radiation at 3.3-millimeter wavelength and found it consistent with the blackbody spectrum.

Measurement of the spectrum in this low wavelength range is especially important, because it is here that a blackbody spectrum will differ most noticeably from other possibilities and reveal itself most unambiguously. The blackbody radiation, many cosmologists believe, is left over from an explosion 10 billion years ago in which the universe we know began (SN: 6/15, p. 577).

SELENOGRAPHY

Depth of the soil

The flat lunar areas called maria have thinner coatings of soil than the mountainous regions, according to Dr. G. Leonard Tyler of Stanford University.

The conclusion is drawn from studies by bistatic radar —using a sender and receiver in different locations. The sender in this case was the lunar orbiter Explorer 35; the receiver was Stanford's 150-foot radio antenna.

Signals reflected off the surface of the moon convey information about the dielectric constant of the lunar material. The dielectric constant measures the material's resistance to polarizing efforts of electric forces—the forces' tendency to separate the positive and negative charges in the atoms of the material.

The dielectric constant is directly related to the hardness of the material that reflects the radio waves. In the moon's case the higher the dielectric constant exhibited by a reflecting spot, the nearer to the surface hard rock is likely to be. The maria come out a third higher than highland areas.

PARTICLES

Quasars may have quarks

One of the open questions in astrophysics is the distance to the quasars. If these objects are as distant as the shifts in their spectral lines lead astronomers to believe, they must radiate fantastic amounts of energy.

Light emitted by a moving body appears redder than if the body is stationary—the greater the speed the redder the light. Most cosmologists feel that the faster a body is going the farther away it is, and a distant body must radiate all the stronger to appear a given brightness to terrestrial observers.

People who find the energy requirement hard to believe are at pains to find some other way to account for the red shift.

Now two physicists from the University of Missouri, Drs. J. C. Huang and T. W. Edwards, link the quasar problem with an unsolved problem of particle physics, the quarks. According to present theory particles may be built out of objects called quarks, whose electric charge comes in fractions of an electron charge.

Drs. Huang and Edwards calculate—in the July 25 PHYSICAL REVIEW—that if for some reason quasars had quarks in some of their atomic nuclei instead of the usual protons and neutrons, the changes in atomic energy states that this would bring could account for a large part of the spectral shifts. If this were so, the quasars would be close enough to make their energy output slightly less than that of the brightest galaxies.