# physical sciences

ASTROPHYSICS

## Star formation

Scattered through the galaxy are clouds of ionized hydrogen at temperatures around 6,000 degrees K. that contain hot, young stars. Apart from these, and making up about 80 percent of interstellar matter, are clouds of cold neutral hydrogen of average temperature about 150 degrees K.

Looking in the direction of the galactic center, Dr. Kurt W. Riegel of the University of California at Los Angeles has found an extra-cold neutral hydrogen cloud —temperature 20 degrees K.—in association with a large hot ionized region.

The ultra-cold region is about 3,000 light years away, between the earth and the center of the galaxy. It cannot be seen by optical telescopes because of the obscuring clouds of dust in the way. Dr. Riegel discovered it while studying radio signals at 21 centimeter wavelength.

Dr. Riegel believes that at the interface between the cold and the hot clouds the meeting of such extremely hot and extremely cold gas may create the turbulent dynamic conditions necessary for the formation of stars.

SOLID STATE

## Gravitationally induced electric forces

Electrons are extremely light objects, but like all other matter they should feel the pull of gravity. Theory has long predicted that electrons in a metal bar placed upright in a gravitational field should shift under the influence of gravity so as to produce a perceptible electric force outside the surface of the metal.

Searches since the early 1900's have been in vain, however, because the force is apparently too small to be unambiguously determined.

Another kind of force, the centrifugal force felt by rotating objects, is dynamically and mathematically similar to gravity, and centrifugal force fields can be made very strong by spinning rotors at high speed.

Up to now attempts to find the electric force effect on spinning rotors have been confused by electrical charging caused by rubbing of bearings and friction with residual air in the vacuum chambers where the rotors were spinning.

But success in finding the effect is now reported by Prof. Jesse W. Beams of the University of Virginia in PHYSICAL REVIEW LETTERS for Oct. 7. He used a suspended cross shaped rotor spinning in a pressure of 1/100,000 torr. (Normal atmospheric pressure is 760 torr.)

COSMIC RAYS

## High energies and the primeval blackbody

According to theory, high energy cosmic rays should be cut off by the primeval blackbody radiation (SN: 8/17, p. 162). Cosmic rays are mostly protons, and at high energies they should disappear by interacting with the radio signal that represents a blackbody at three degrees K., producing a variety of mesons.

Some observers have suggested there should be no cosmic rays above an energy of $10^{11}$-billion-electron volts (GeV).

Dr. F. W. Stecker of the National Aeronautics and Space Administration presents in PHYSICAL REVIEW LETTERS for Sept. 30 a new calculation that modifies this expectation.

He bases his calculation on new data on meson production rates and the latest figures for the blackbody: temperature 2.7 degrees K., average photon energy .0006 electron volts and photon density 400 per cubic centimeter. He concludes that the life expectancy of a cosmic ray "drops sharply from $10^{12}$ years at $3x10^{10}$ GeV to $10^{10}$ years (the age of the universe) at $10^{11}$ GeV, and reaches a shallow minimum of about $5x10^{7}$ years near $10^{12}$ GeV," beyond which it rises slightly.

COSMIC RAYS

## No mystery particles at sea level

Experiments that record cosmic ray particles in the depths of mines have seemed to show the existence of previously unseen massive particles among the flux that appears. Some have thought these might be the long sought intermediate vector boson produced in cosmic ray interactions with terrestrial nuclei. Others postulate an unpredicted heavy particle, which they call U, in the cosmic rays themselves. (SN: 8/17, p. 161).

A search to see whether such particles show up in the cosmic ray flux at sea level failed to find any, report Drs. Paolo Franzini and Seth Shulman of Columbia University in PHYSICAL REVIEW LETTERS for Sept. 30.

The experiment was set up to record particles traveling at speeds between one-half and nine-tenths that of light that were capable of penetrating an aluminum absorber.

Nothing that looks like the postulated U particles was found, so if the heavy particles really exist in the underground events, they must be created below the surface.

SELENOGRAPHY

## The hot moon again

Astronomers have long debated whether the moon has a hot interior like earth's, or a cold one. In recent years the hot interior theory has lost a good deal of ground, but now, in SCIENCE for Oct. 4, three observers from the Air Force Cambridge Research Laboratories present new evidence in favor of it.

Drs. Graham R. Hunt, John W. Salisbury and Robert K. Vincent made the discovery while studying thermal anomalies on the surface of the moon. Thermal anomalies are spots whose temperature is higher than their surroundings. They become quite prominent during eclipses as the moon's surface cools when the earth's shadow cuts off its sunlight.

The explanations presented for most of these hot spots is that they represent superficial features—spots of matter that cool more slowly than their surroundings.

One such anomaly, however, runs along a line at the edge of the flat lunar area called Mare Humorum and behaves differently from the others. It appears hotter than its surroundings in the lunar afternoon as well as during eclipses. The location is a line of crustal fracture, and the Air Force observers suggest the excess heat may be due to hot gases seeping through the crack from the interior of the moon.