PHYSICAL SCIENCES

From our reporter at the meeting of the American Physical Society in Washington

Solar mysteries

One of the observational criteria that might distinguish between rival theories of gravitation is the oblateness of the sun. If the sun is oblate, the motions of the solar system would not fit Einstein's calculations thus making an opening for the theory of Brans and Dicke.

For the last few years Henry A. Hill of the University of Arizona and co-workers have operated a program of observations to check on solar oblateness. Earlier they reported finding no oblateness. Now Hill reports some other things they have found.

The sun oscillates with periods of a few minutes to an hour. The oscillation does not appear in the shape of the sun but in the distribution of brightness across its disk. The sun also appears to be quite transparent; one can see down to the core.

These factors could yield an explanation for the puzzling lack of a flux of neutrinos from the sun, as shown in other observations. For the sun's atmosphere to maintain itself requires a temperature that should lead to copius neutrino production, and it seemed either the sun collapses or the neutrinos should be there. But acoustic waves connected with the brightness pulses could hold the atmosphere up at a lower temperature, and neutrinos are not necessary.

For a mutable gravity

Another point on which rival theories of gravitation differ is whether the strength of gravitational forces varies with time. This would mean that what Newton called "the universal gravitational constant" is not constant but varies over time. In this sense the viable rivals to Einstein, who insisted on no variation, are Brans and Dicke, Hoyle and Narlikar and Dirac.

For some time now Thomas C. Van Flandern of the U.S. Naval Observatory has been insisting that observations do in fact indicate such a variation, and he continues to pursue new observations and to introduce new numbers. A variation of gravity will show up in the motions of bodies in the solar system. Van Flandern started out studying lunar occultations of stars over the last 20 years. Later he added changes in the earth's rotation. His latest figures include records of ancient eclipses.

Van Flandern's determinations indicate a decrease in gravitational strength. Expressed as a ratio of the rate of change of the gravitational constant to the value of the constant, it now comes to 6 ± 2 parts in a hundred billion, a change and a refinement of the error limits over the figure he quoted last August. 8 ± 5 parts in a hundred billion. Recent figures from the LURE program of laser ranging to the moon give 3 ± 3 parts in a hundred billion, consistent both with Van Flandern's 6 and with zero, which is what Einstein would have expected.

New cosmic ray detector

A newly discovered electromagnetic process called transition radiation has been used in the design of a new lightweight cosmic-ray detector by Dietrich Müller and co-workers of the University of Chicago. Transition radiation occurs when a fast particle crosses the boundary between two different materials. Part of the particle's energy is shaken off and may appear as X-rays, the intensity of which is related to the particle's energy, one of the prime facts that observers want to know about a cosmic ray. The detector uses repetition, a series of sandwiches for the particle to traverse, to enhance the gain of information.