PHYSICS

Red Shift Confirmed

➤ THE RED SHIFT predicted by Einstein's general theory of relativity has been confirmed directly on the sun for the first time.

Two French scientists used a very accurate method to observe the red shift of the sun's radiation caused by the effects of gravitation on strontium atoms. The gravitational red shift predicted by Einstein was a source of controversy for many years because it could not be measured on the sun and measurements on stars such as the companion to Sirius had a large margin of error.

Within the past two years, the gravitational red shift has been confirmed in experiments using the so-called Mossbauer effect, for discovery of which Dr. Rudolph L. Mossbauer, now at the California Institute of Technology, won the 1961 Nobel Prize in Physics. The confirming experiments took advantage of the variation in the earth's gravitational field over a distance of several feet vertically.

Now Drs. J. E. Blamont and F. Roddier of the Meudon Observatory, France, have used a very precise instrument to measure directly the solar red shift caused by the sun's mass. Previous measurements have not been sufficiently precise to separate this shift from other effects, such as those caused by changes in temperature or pressure.

Einstein's theory of general relativity predicts that the lines of the spectrum (light) of a star are displaced to the red by an amount that is proportional to the star's gravitational potential. In the case of the sun, the effects are small and heretofore difficult to separate from others.

The report by Drs. Blamont and Roddier appears in the current Physical Review Letters, 7:437, 1961.

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PHYSICS

Measure Time by Atoms

➤ ALTHOUGH man has heretofore measured time by watching the apparent motions of the stars and planets, during the next decade the world will base time upon the "dance" vibration or frequency of an atom instead, Dr. John M. Richardson, chief of the National Bureau of Standards radio standards laboratory, Boulder, Colo., told the American Association for the Advancement of Science in Denver, Colo.

The reasons for this change, Dr. Richardson explained, are that the instruments of modern science can measure the "vibration" of an atom more accurately than they can measure the motions of stars and planets, that all of the forces affecting atoms are better understood, and that the atom's vibration appears to be more stable than planetary motions.

Four thousand years before the birth of Christ the Egyptians knew that the years were 365 days long by watching the movement of the dog star, Sirius. Modern science has refined astronomical observations to a tremendous precision, and such observations will always be an excellent way to measure long periods of time such as years and centuries. It is difficult, however, to use these observations to measure a second, or a fraction of a second, for the movement of the stars and planets is slightly irregular and the reasons for these variations are not thoroughly understood. The full complexity of astronomical measurements is illustrated by the fact that the most accurate formula for determining astronomical time includes about 900 elements and considers the gravitational effect of most planets in the solar system. Currently astronomical time can be measured to a few parts in a billion (10 to the 9th power or 1,000,000,000) but it takes five or ten years to do it, and astronomers agree that there is no way they know of today to ever measure astronomical time to better than a few parts in ten billion (10 to the 10th power).

Modern technology demands higher precision. When a satellite is moving at orbital speed an error of a small fraction of a second between tracking stations can create a noticeable error in the measured position of the satellite. The same problem applies to missiles. A more precise measurement of time will also contribute to our basic knowledge by leading to a better understanding of planetary motions, and by making some of the predicted consequences of the theory of relativity accessible to new experimental tests.

In contrast to astronomical measurements, atomic devices have been developed by various laboratories which agree to parts in ten billion (10 to the 10th power). This has been accomplished in spite of the problems of making comparisons to this precision when the devices are separated by thousands of miles. Two instruments in the same laboratory—the U.S. National Bureau of Standards—have agreed to better than two parts in 100 billion (10 to the 11th power) for the past year. Some scientists estimate that atomic instruments will be made during the next few years which will agree to parts in 10,000 billion (10 to the 13th power, and even 1,000,000 billion (10 to the 15th power). Achievement of the last figure would be one hundred thousand times better than astronomical measurements. Atomic measurements can be made in a matter of minutes.

The atom which has been most thoroughly tested to date is cesium, a metal which looks something like mercury when heated to a temperature of about 100 degrees Fahrenheit.

The International Committee on Weights and Measures plans to consider the question of atomic-versus-astronomical time at the 1966 General Conference on Weights and Measures, the international conference at which the different nations agree on standards of scientific measurement.

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Empiricism Attacked

➤ SCIENTIFIC progress is endangered by those who misuse scientific experiments to bolster preconceived theories, the American Association for the Advancement of Science was told in Denver, Colo., by Dr. Paul K. Feyerabend, professor of philosophy of the University of California at Berkeley.

These "philosophers of science" or "logical empiricists," as he dubbed them, are even more dangerous than the anti-scientific priests and "school philosophers" of a few decades ago, he warned, because they work from within the halls of science.

"These groups work against scientific progress, proceed under the flag of progressivism and empiricism and thereby deceive a good many of their followers," Dr. Feyerabend said. "Although their presence is noticeable enough they may almost be compared to a fifth column, the aim of which must be exposed in order that its detrimental effect be fully appreciated."

Modern empiricism was introduced, he explained, with the intention to rid physics of all metaphysical ingredients. It was inspired by the hope that such a procedure will free the minds of scientists from prejudice and will thereby lead to valuable discoveries and precipitate a tremendous progress of knowledge. This hope has not been realized. Now as ever scientific progress is impeded by dogmatic adherence to metaphysical positions, Dr. Feyerabend feels.

These positions are now defended by giving them the appearance of well confirmed theories and this is achieved with the help of a theory of confirmation that either misuses experimental results for their defense, or excludes such results as irrelevant where they might endanger the position adopted.

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PUBLIC HEALTH

Tiny Balloons Track Industrial Odors

➤ TINY BALLOONS are being used by city inspectors to track down unpleasant odors in a heavily industrialized city.

The fact that odor travels downwind is helping Cincinnati Air Pollution Control inspectors locate both unknown and suspected sources of unpleasant industrial fumes, such as the by-product of a manufacturing process.

Low-flying balloons inflated with enough helium to make them rise slowly are released, and their paths watched with a compass. When enough readings are obtained, the culprit industry can be pinpointed.

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