Defending coincidences

More evidence is in for gravity waves but doubts persist

by Dietrick E. Thomsen

At Argonne National Laboratory near Chicago is a large aluminum cylinder; at the University of Maryland are two more. From time to time these cylinders are set into simultaneous vibration. Dr. Joseph Weber of the University of Maryland, to whose experiment the cylinders belong, believes that these coincidences, as he calls the simultaneous vibrations, are due to the passage of gravitational waves.

Gravitational waves are theoretically predicted waves that involve gravitational forces the same way radio or light waves involve electric and magnetic forces. Detection of gravitational waves not only is an important confirmation of modern gravitational theory, but also opens new possibilities in astronomy since the waves, like radio, carry information about the events in the universe that produce them.

Dr. Weber has been looking for gravitational waves for several years. Finally he told a June 1969 meeting in Cincinnati that he was convinced he had found them (SN: 6/21, p. 593). Some other physicists are not so convinced: Dr. Weber says his phone started to ring as soon as he got home from Cincinnati.

In the months since June he has taken steps to meet the objections of the critics and answer their questions. As he told the meeting of the American Physical Society in Chicago last month: "If it's wrong, I'm going to be the one who buries it." But he came to Chicago with new data that strengthen his conviction rather than diminish it.

One of the objections was that the coincidences might not be due to simultaneous excitation of two cylinders by a gravitational signal, but manufactured by something in the electronic circuitry that monitors the cylinders. To check this, Dr. Weber inserted into the line from one cylinder, in parallel to the instant-transmission channel he had been using, a channel that delayed transmission for two seconds. In two weeks, he said, 11 coincidences were recorded through the instant channel and none through the delayed channel. If the electronics had been manufacturing the coincidences, they should have come equally through both channels, so he feels the result is good evidence that the cylinders are in fact the source of the coincidences.

Another question, says Dr. Weber, is that "till the sources were identified, a large number of physicists wouldn't believe." So he set out to do that. The cylinders are directional antennas. If one of them is excited, it will be by a wave coming, for example, either from above or below, but not from the side.

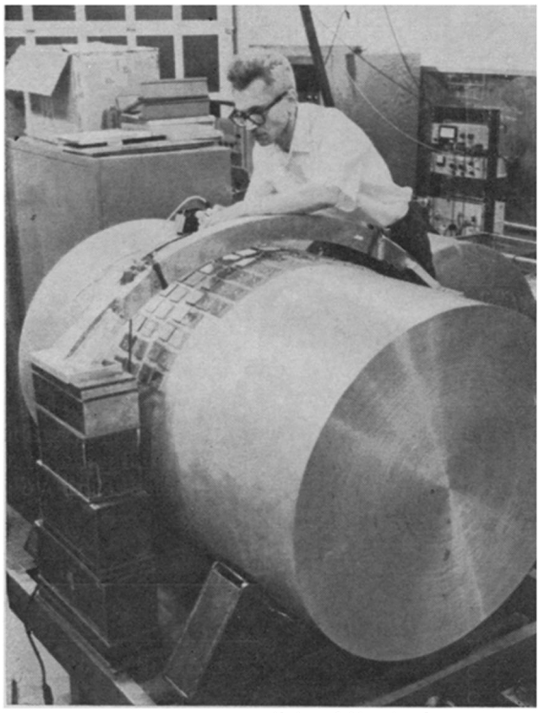
As the earth carries the cylinders around in its rotation, they sweep across the sky. Dr. Weber made records of the coincidences according to the time of the sidereal day, which clocks the earth's rotation with respect to the distant stars. Two daily peaks were found: one when the antennas were looking directly toward the center of the galaxy and one when they were looking at the center of the galaxy through the earth.

The center of the galaxy is where most of the mass is, and if gravitational waves are being produced in the galaxy, most of them should come from there. So this result fits neatly with expectations. Furthermore, seeing the signals through the earth, says Dr. Weber, is more evidence that the cylinders are responding to gravitational waves. The other most likely cause of the excitation, cosmic-ray particles, could not pass through the earth.

Serious problems still remain. As Dr. Robert H. Dicke of Princeton University puts it, "The evidence for the existence of the coincidences is strong, but I'm puzzled by what it means." The number of signals recorded and their strength is beyond any source that theory predicts, and this worries theorists.

The circumstance puzzles Dr. Weber also. The amount of energy actually recorded by the detectors is quite small, but they detect only one wavelength. If the radiation is emitted over a wide spectrum, if it is not somehow being focused, and if other reasonable assumptions are made, one can calculate that the little bit the detectors see represents the destruction of something like 1,000 stars, each with a mass equal to that of the sun, each year.

Such a figure is very disturbing, and indicates to many that something is wrong. Dr. Weber can see no reason why either theory or experiment should be wrong. Until he knows more, he says, he can only suggest that theory is right and experiment is right and, "We just have to be a lot more clever to get them together."



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Weber checks sensors on his antenna.

Further observations may bring more answers. Until now, Dr. Weber's experiment was the only one of its kind in the world, and the lack of independent confirmation has also bothered critics.

Now others are entering the field, two in England, one at the University of Reading and one at the University of Bristol. In the United States Drs. William Fairbank, William Hamilton and Steve Boughn of Stanford University are setting up shop.

The Stanford plans are to make use of an extremely good refrigerator to make a detector that can be cooled to 0.003 degree K. This would suppress the thermal vibrations in the cylinders that make signals difficult to distinguish in Dr. Weber's equipment, which runs at room temperature.

Cooling could increase the sensitivity 100,000 to a million times, and with such equipment Dr. Fairbank and his co-workers hope to see not only whatever source it is that Dr. Weber is seeing, but also the much fainter sources that theorists do predict, such as collapsing neutron stars or collapsing supernovas. Finding the things that the theorists have predicted, says Dr. Fairbank, may convince doubters both that gravitational waves are real and that some as yet unknown mechanism exists to produce the signals Dr. Weber detects. □