PHYSICS

Gravity Wave Detector

A further proof of Einstein's general theory of relativity may be obtained when a new device to detect gravity waves is completed and in operation.

➤ A DEVICE to detect gravity waves, believed to be the first of its kind, will be built and operating within two years at the University of Maryland.

Dr. Joseph Weber of the University told the American Association for the Advancement of Science meeting in Washington the device is designed to measure the extremely weak effect of gravity waves when they strike an object.

The existence of gravity waves is predicted by Einstein's general theory of relativity. Any mass that is accelerated generates gravity waves. However, no one has even seen or detected them, Dr. Weber told SCIENCE SERVICE.

If a gravitational wave as strong as the earth's magnetic field hit the earth, you would be lifted from your seat and buildings from their foundations. Since this has not happened, gravity waves must be extremely weak.

Dr. Weber's report reflected a renewed interest in gravitational theory now developing after many years of neglect due to the lack of experimental guideposts and mathematical difficulties. Both remain troublesome, but much progress has been made toward better understanding of general relativity by considering approximate solutions of the very difficult equations.

One approach being thoroughly studied is the "quantization" of general relativity. This involves treating gravitational radiation as consisting of tiny packets, not as being continuous. This can be likened to the situation with light, which many years ago was thought continuous radiation but is now known to consist of tiny light packets, or photons.

The packet of gravitational energy is the graviton. Unlike light, which will interact only with charged particles, gravitons can interact with neutral particles.

Dr. Weber's device to detect gravity waves is based on the small effect they are predicted to have on a relatively large mass. When the gravity wave penetrates the mass, it is jiggled. This jiggling motion can be converted by piezoelectric crystals and low noise amplifiers into an electrical output in the radio wave range.

To eliminate unwanted effects, Dr. Weber plans to place two masses, each in its own conducting box, then combine their outputs. He said a superconductor such as lead cooled to a temperature near absolute zero, some 459 degerees below zero Fahrenheit, would give a virtually perfect electrical shield.

Whether it will take one hour, a day or a lifetime to detect gravity waves, Dr. Weber cannot predict, since this is an effect not previously studied.

Dr. Weber said that at a frequency of 100 kilocycles, he expected to be able to find any radiation having an energy of a millionth of an erg over a square centimeter per second per cycle. Today's techniques are sufficient to do this, and the detecting equipment for gravity waves would be considerably less sensitive than the radio telescopes used to pick up faint radio waves from heavenly sources.

He hopes his equipment will give a number that is the upper limit of the gravitational energy impinging on the earth.

Successful detection of gravity waves would be another proof of Einstein's general theory of relativity. So far there are only three known verifications.

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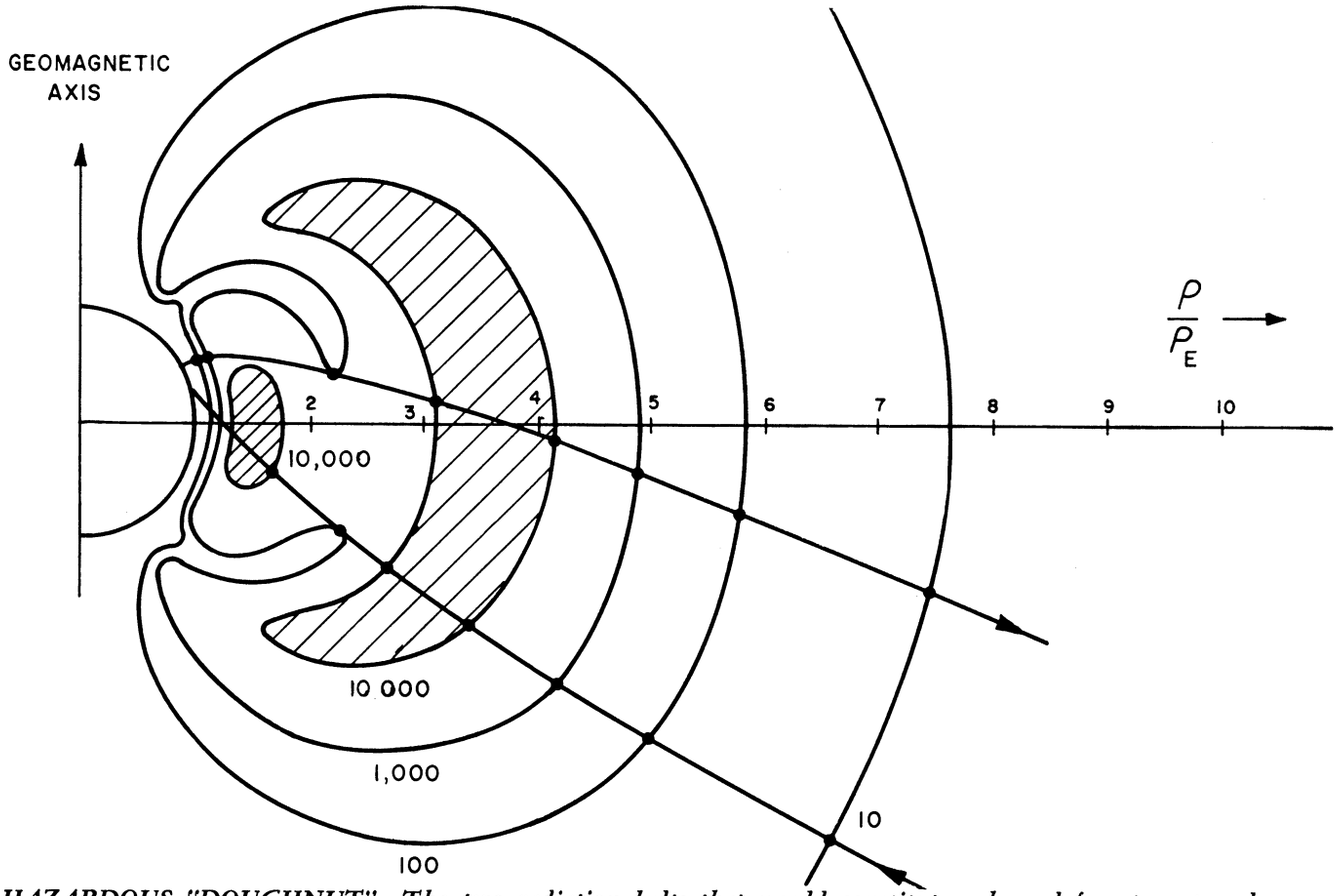

HAZARDOUS "DOUGHNUT"—The two radiation belts that would constitute a hazard for space travelers are shown. *(See. p. 21)*

ASTRONAUTICS

Assemble Space Lab

See Front Cover

➤ A 400-TON manned space laboratory shaped like a giant five-spoked wheel and assembled by small but powerful "astro-tug" vehicles was proposed at the meeting of the American Association for the Advancement of Science.

The lab would carry a crew of ten men for six months without additional supplies having to be brought from earth. According to its developers, Saunders B. Kramer and Richard A. Byers of Lockheed Missile Systems Division, the space station would be built, and made to orbit, 500 miles above the earth. The proposal was a non-solicited one submitted to the National Aeronautics and Space Administration.

The space station would consist of 15 cylindrical units to make up the rim of the "wheel," five spokes, and three hubs. All would be prefabricated, launched from earth separately and guided into a cluster in the same orbit. Assembling of the components would be done by small "astro-tugs," also sent up by missiles. These tugs would round up the units and hook them together through the use of mechanical arms similar to those used to handle radioactive material through a protective shielding.

The major advantage of the space station would be that three men could operate within the pressurized sealed cabin of each "astro-tug" without the encumbrance of space suits while the assembly work was being carried out. Other manned space station proposals have necessitated the use of lone men in space suits, floating free in space while doing the actual construction.

The photograph on the cover of this week's SCIENCE NEWS LETTER is an artist's conception of the projected manned space research laboratory that could be orbiting the earth at a 500-mile altitude in ten years. It is powered by a nuclear source shielded at the end of a boom and pressurized and sealed to maintain its own micro-atmosphere.

The space lab would take from 12 to 30 days to assemble from time of launching to operation. Actual work in space would take less than a week. If the go-ahead for the project were given right away, said the scientists, the station could be in operation well within ten years.

Materials and supplies would be delivered to the station periodically through air locks by earth-launched re-entry vehicles, which would also serve to carry crew members back to earth.

The space base would be equipped with chemistry, physics, electronics, photography, medical and hydroponic laboratories. Furthermore, it could be used as an assembly site for exploratory rocket ships, either manned or unmanned, which could be launched to circle the moon, Mars, Venus or other planets and return to the station.

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ASTRONAUTICS

Find Space "Doughnuts"

➤ MAN COULD orbit earth without radiation anxieties—if his passenger satellite kept well out of two hazard-filled "doughnuts" in space.

A space traveler rocketing toward the moon or a neighbor planet should plan his cruise to avoid two distinct and dangerous zones, Dr. James Van Allen, head of the State University of Iowa department of physics, said. (See p. 19.)

The Iowa space scientist and discoverer of the radiation belt—now *belts*—which bears his name revealed findings from the Pioneer III space probe at the annual meeting of the American Astronautical Society in Washington. The radiation experiment was originated and planned at the State University of Iowa May 1958, with Dr. Van Allen and his associates working in cooperation with Director W. H. Pickering and Dr. Eberhardt Rechtin, both of the Jet Propulsion Laboratory, at California Institute of Technology.

During its 38-hour flight from Cape Canaveral to a peak height of some 63,000 miles, Pioneer III's instruments "provided good signals almost all the way going and coming," Dr. Van Allen reported.

Major tracking stations at Goldstone Lake, Calif., in Puerto Rico, and at Cape Canaveral followed the 13-pound probe to "within 1,000 miles of its most distant point" and on its way back to approximately 2,000 miles above the eastern edge of Africa's Sahara desert, to whose sands it may have added a little metallic dust after it disintegrated in earth's atmosphere.

Pioneer III's transmission of information reflected "a magnificent job of telemetry on the part of the Jet Propulsion Laboratory," Dr. Van Allen said.

"Working perfectly, the radiation instruments and the probe's radio transmitter provided continuous data all the way through the hearts of two distinct zones," Dr. Van Allen continued.

Each belt was found to have about the same maximum intensity of particles (electrically charged electrons or protons). The peak count for each belt—the first at 2,400 miles out and the second at 10,000 miles out—was measured at 25,600 counts per second.

These high counts were the equivalent of about 10 roentgens per hour, if electrons, and of about 100 r. per h. if protons. This would mean that an unprotected man could not, on the average, survive long after having received more than 45 hours exposure within either belt.

The apparatus, consisting basically of two tiny geiger counters, one 2½ inches long and the other 1½ inches long, was not designed to distinguish among the types of particles encountered. But providing the greastest dynamic range of any space probe to date, the counters were designed in accordance with experience with Iowa instruments aboard satellite Explorer IV. Still under study at the Iowa data reduction center, information from the satellite launched July 26, 1958, may yet reveal whether the particles are electrons or protons, he said.

Dr. Van Allen placed the 2,000-mile-thick "first doughnut" at roughly between 1,400 and 3,400 miles from earth's surface and the 4,000-mile-thick "second doughnut" at between 8,000 and 12,000 miles distant.

The data interpretation in the Iowa Physics Building showed that the radiation particle counts dropped to as low as three-tenths of a roentgen per hour at a distance midway between the two hazardous zones —approximately 6,000 miles out. Thus a man might circle the earth at that distance safely for a considerable period of time, as far as radiation dangers are concerned, he said.

Dr. Van Allen summarized major results of the Pioneer III space probe as 1. penetration all the way through earth's surrounding radiation region and determination of its structure and extent, 2. the discovery of two distinct radiation zones concentric to earth's core and with similar peaks about 7,600 miles apart, 3. measurement of the cosmic ray intensity remote from earth in interplanetary space, and 4. new knowledge of the effective limits of earth's magnetic field.

On this last point, he explained it was found that the ability of earth's magnetic field to trap articles emanating from the sun or from other sources diminishes rapidly beyond a distance of 18,500 miles from the surface of the earth.

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GENERAL SCIENCE

Pentagon Names Dr. York To Head Defense Research

➤ THE DEPARTMENT of Defense has announced the appointment of Dr. Herbert F. York to the newly created position of director of Defense and Engineering.

Dr. York said it was still too early to describe in any detail the relationship his office would have to the Advanced Research Project Agency of the Pentagon. ARPA is a permanent agency within the Department, he said, and will continue.

Dr. York's new office will supervise all research and engineering in the Defense Department. This means that ARPA will continue to operate on its own research and development problems, but under the general supervision of Dr. York's office.

Dr. York is a native of Rochester, N. Y., and received his Ph.D. in physics from the University of California. Since March, 1958 he has been director of research, Advanced Research Projects Division of the Institute for Defense Analyses and chief scientist of ARPA. He is presently a member of the President's Science Advisory Committee.

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