Trying to fit gravity waves into the galaxy

The gravitational waves that Joseph Weber of the University of Maryland has been recording for the last few years (SN: 6/21/69, p. 593; SN: 5/27/68, p. 408) are giving cosmologists and theoretical physicists serious problems. If Weber's data are correct, something serious may be wrong with our galaxy or the laws of physics or both.

Basically the problem is the intensity of the radiation that Weber records. Weber records pulses from the direction of the center of the galaxy at one frequency, 1,660 hertz. When his results are extrapolated over the 100-to-1,000-hertz range that experiment suggests the spectrum is likely to cover, the result is that the center of the galaxy appears to be converting mass to gravitational waves at a rate of about 10,000 times the mass of the sun per year.

According to the best astronomical data the total present mass of the galaxy is 10^{11} solar masses, and about 10^{10} of these are in the central area. The rate of mass dissipation suggested by Weber's results would remove all the matter in the center in something between a million and 100 million years. The galaxy is supposed to be about 10 billion years old, and the center is still there. Something has to give.

One necessary procedure is experimental checks on Weber's results. Beside Weber himself, who continues to refine his equipment, Vladimir Braginsky of Moscow State University and J. A. Tyson of Bell Telephone Laboratories in Murray Hill, N.J., now have experiments in operation.

Tyson has been particularly concerned with improving the sensitivity of the antennas used to detect the waves. Weber's original set-up has a low signal-to-noise ratio, and there is a suspicion it may miss things: The flux of gravitational radiation may be higher than has so far been determined. There is also need for measurement at various frequencies to see whether the actual spectrum of the radiation is what was inferred from Weber's results.

After completing a study of how the sensitivity of gravity-wave antennas might be optimized, which he did with G. L. Miller, Tyson put two antennas on the air to record at 4,300 hertz. One of these is at Murray Hill, the other at the University of Rochester. About six months of data have been taken and only about half of that so far analyzed. The statistics are not yet good enough to say for sure that gravitational radiation is being recorded or that the flux approximates Weber's, but Tyson has several months more data to analyze, and when that is done (in a month or two), he believes he will either be able to corroborate Weber or announce a different significant result.

Prospects seem even better for a further experiment of Tyson's. "I am most excited about a new antenna which I am constructing at Bell Labs," he says. This will be an aluminum bar 140 inches long weighing 8,000 pounds. It will operate at two frequencies on either side of Weber's and will have about 50 times the sensitivity of Weber's. It will operate in conjunction

Luna 20 returns highland samples

Luna 20 returned to the Soviet Union last week with soil and stones drilled from the Apollonius Mountains that form an isthmus between Mare Crisium and Mare Fecunditatis. The region is located between the lunar equator and 10 degrees north on the right side of the moon's disk as viewed from earth (the eastern limb). It is about 120 kilometers north of where Luna 16 landed (SN: 9/26/70, p. 269), the only other Soviet craft to return samples from the moon. Luna 18 was probably going to land in the same area, but it crashed near Mare Fecunditatis (SN: 9/18/71, p. 188).

Moscow accounts of the Soviet triumph, were glowing. They described the materials as the "first" from the lunar continents (continents are the same as highlands or terrae). "We shall probably receive samples of genuinely continental matter and the results of this study will make it possible to judge which of the existing hypotheses is correct," said Kirill P. Florenskiy of the Academy of Sciences of the U.S.S.R.

U.S. lunar scientists agree. The theory goes something like this: The moon's high areas, such as the Apollonius site, are what is exposed of the "original" outer crust (believed to be anorthositic in composition). Most of the maria were formed later by impact and then subsequently flooded or filled with upwelling of material from below. Apollo 11 and 12 and Luna 16 returned material representative of maria. But the Apollo 11 soil samples contained hints of what was to come: The soil was found to be "contaminated" by material different in composition, lighter in color and lower in density from the mare's soil. The fragments were chemically similar to anorthosites on earth (and also similar to Surveyor 7's findings in the moon's Southern Highlands). At the time, John A. Wood of the Smithsonian Astrophysical Observatory speculated that the fragments were from the highlands. The Apollo 15 Genesis Rock was an anorthosite, reinforcing the theory.

The Luna 20 site has all the markings of a true terrae region. The Apollo 15 orbital data revealed that the area has the highest aluminum-to-silicon ratios of any area of the near side (although not quite as high as the ratios on the far side). The ratios are what one would expect from anorthositic gabbros. Thus the material could be the oldest yet returned from the moon, and U.S. scientists are eagerly awaiting a sample of it. In January, the Soviets received Apollo 14 and Apollo 15 material as part of the sample exchange agreement (SN: 5/1/71, p. 303). Last year Luna 16 material was exchanged for Apollo 11 and 12 samples. The total return of Luna 16 was three and one-half ounces, and it is expected that Luna 20 returned as much or more. To date Apollo astronauts have returned 385 pounds from the moon.

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Luna 20's snowy return with samples from the highlands.