GRAVITATIONAL RADIATION

Waving Goodbye to Weber's Waves

by our Cosmology Correspondent

WEBER'S gravitational wave detectors may well be detecting something—but it is almost certain that they are not detecting pulses of gravitational radiation. This was the clear consensus that emerged from the Oxford–Cambridge–London Relativity Seminar, held at All Souls College, Oxford, on April 27. Theoretical discussions formed an important part of the seminar, particularly those concerned with the possibility of detecting black holes and the implications of the discovery of Cyg X-1, a binary system which contains the best candidate yet for such a completely collapsed object. But the proceedings were dominated by the experimentalists and their reports of the present status of the search for gravitational radiation—a remarkable turnabout from the situation a couple of years ago, when it would have been laughable to suggest that such a relativity seminar could be so concerned with experiments.

Dr R. W. P. Drever (University of Glasgow) summarized the present situation in the experimental field. All the present crop of experiments were, of course, inspired by Weber's claims that pulses of gravitational radiation were being detected by his equipment. Others have found it very difficult to duplicate Weber's results, and questions regarding the sensitivity of his equipment, and the possibility of unconscious human bias, have inevitably arisen. A team from the Soviet Union were the first to follow Weber, using a detection system which had the advantage that it could be accurately calibrated.

Basically, all the gravitational wave detectors consist of massive aluminium cylinders, cooled to reduce thermal effects and suspended in a vibration-free environment. Weber's equipment has never been calibrated directly; he estimates its sensitivity as better than 1 kT, but others have estimated the response of this apparatus as only sensitive to 10 kT pulses. The Soviet instrument is calibrated as sensitive at the 9 kT level, so some doubt remains as to whether that instrument's negative result should be directly compared with Weber's positive results.

What of more sensitive detectors? Basically, there are two approaches now being employed: bigger detectors and/or more sophisticated signal processing. Neither approach has met with success in the form of a definite detection of even one pulse of gravitational radiation. At the University of Bristol, what is essentially a second generation experiment, in terms of sensitivity, is still being constructed. There, the attitude is that enough people around the world are already producing negative results at the few kT level, and that it is worth waiting a little longer to produce a machine more sensitive by five orders of magnitude. In Glasgow, a detector rather smaller than Weber's but with about the same sensitivity is one of the many producing negative results, and, perhaps most interesting of all at present, a joint Munich/Frascati system, designed to be as similar to Weber's as possible, is also failing to produce any positive results.

The conclusion, from these and other experiments, seems inescapable. Weber has not found pulses of gravitational waves. Dr Drever speculated that perhaps Weber's pulses are associated with disturbances in the Earth's magnetic field, because his apparatus is unique in containing large amounts of ferrous material, although the detector cylinder itself is non-magnetic. It is also still just possible that Weber has been fortunate in building a detector which operates at a favoured frequency for gravitational radiation, but this faint prospect did not stir any enthusiasm in Oxford.

The theoreticians were far from displeased to learn of these negative results, because according to general relativity sensible disturbances, such as supernovae explosions, should produce gravitational radiation detectable on Earth only with equipment much more sensitive than Weber's. Professor M. Rees (University of Sussex) estimated that an improvement by a factor of 10^8 is needed before positive results can be expected, because this would extend the range of the detector to the Virgo cluster and offer hope of detecting one supernova a year. Professor D. Lynden-Bell (University of Cambridge) turned the question around to ask at what level of sensitivity relativists would be distressed to learn of the continued failure of the experiments to find gravitational waves. It seems that the pundits will only begin to worry when negative results are obtained by experiments 10^{12} times more sensitive than those of today.

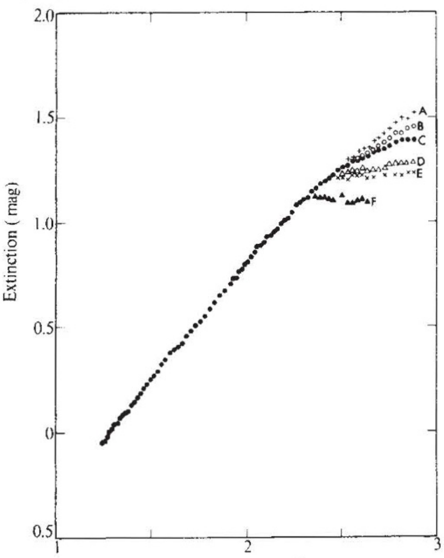
That might have seemed to have brought the young science of gravitational wave experimentation to an untimely demise; but Dr Drever promptly returned to the fray to suggest that at the present rate of improvement in techniques the first quantum of improvement, by Professor Rees's factor of 10^6, could be achieved within a few years. As well as the ultimate refinement of the Weber approach, a 5 to 6 ton cylinder levitated by superconducting magnetic coils and maintained at 1/30 K, with tiny oscillations detected by Josephson junction effects (with instru-

Reddening of Stars near the Galactic Centre

IN next Monday's *Nature Physical Science* (May 14) Whittet, van Breda and Nandy describe interstellar extinction curves which they have derived from photoelectric scanner observations of twenty-two early type stars in a region of the southern Milky Way which includes the galactic centre. There are considerable variations in the data, which are not correlated with position of the stars in the plane of the Galaxy, suggesting that the extinction law in these regions is strongly influenced by the physical conditions which prevail in local dust clouds.

The scanner observations were made with the 36-inch telescope at Cerro Tololo during May 1972. They covered 3480 to 5240 Å with a bandwidth of 40 Å in the second order, and 5160 to 8040 Å with a bandwidth of 80 Å in the first order. The area surveyed was from $l^{\rm II}=260°$ to $l^{\rm II}=30°$, passing through the galactic centre.

The twenty-two reddened stars examined seem to fall into six chief groups, as far as the extinction curves are concerned (see figure). But the stars in each group are not spatially related—for example, stars which contribute to extinction curve D include one at $l^{\rm II}=343°$, one at 15°, one at 263° and three others. Even this distinction is somewhat artificial, however, and Whittet *et al.* point out that there seems to be a continuous family of curves, at least between curves A and D in this figure. Of the nine stars observed in the galactic centre region "six show a reddening law close to curve C; the other three follow curves A, B, and D".



Characteristic extinction curves for reddened stars observed at Cerro Tololo.