A LISTENER'S DIGEST OF IAU SYMPOSIUM No. 64 ON GRAVITATIONAL RADIATION AND GRAVITATIONAL COLLAPSE

WILLIAM A. FOWLER
California Institute of Technology, Pasadena, Calif., U.S.A.

IAU Symposium No. 64 was primarily concerned with observations and theory concerning gravitational waves and black holes. An excellent introduction to the theory was given by Misner (Maryland). It was, however, disappointing to learn from him that the prospects of enhanced gravitational radiation from beaming effects in relativistic orbits were no longer considered to be very great, contrary to original expectations. In the relativistic orbit of a mass about a black hole the gravitational radiation is indeed beamed tangential to the orbit path but since the orbiting mass spirals in toward the black hole the radiation is also beamed toward the hole and is largely captured by it.

Weber (Maryland) reported that he continues to observe pulses of gravitational radiation at the rate of 7 coincidences per day between Argonne and Maryland at 20% detection efficiency so that the overall rate is 10^4 events per year with each event involving 10^{8-9} erg cm^{-2}. This exceeds by many orders of magnitude the maximum radiation possible from the galactic center if reasonable restrictions on mass loss are taken into account. Weber also reported that he had found coincidences between his observations at Maryland and records on tapes sent to him by Douglas (Rochester).

Tyson (Bell Labs) reported that his observations of frequency versus pulse size at 710 Hz were consistent with expected amplifier noise (40 K) and indicated no gravitational wave pulses. Drever (Glasgow) reported 5 ± 11 events in six months of operation. Kafka (Munich-Frascati) reported no evidence for gravitational pulses in his own observations but did report that he found a small effect on tapes sent to him by Weber using the Munich algorithm for what constitutes a gravitational pulse. It was agreed that the exchange of tapes between observers was of the greatest importance in making further progress in this field.

Braginski (USSR) reported only on his future plans which involve the reduction of noise by the use of high Q, single crystals of sapphire. Progress in the production of these crystals was reported. Braginski also discussed the use of Doppler ranging between two drag-free Earth satellites to detect the long wave-length gravitational waves expected from non-relativistic collisions of globular clusters as suggested by Zel'dovich (USSR). Braginski pointed out Doppler ranging techniques can now measure velocity differences of $\sim 10^{-5}$ cm s^{-1} and that this number need only be reduced to 2.5×10^{-7} cm s^{-1} in order to make the technique useful.

Fairbank (Stanford) and Hamilton (LSU) discussed their ambitious plans for low temperature gravitational wave detectors where they hope to gain a reduction in

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noise relative to signal by a factor of 10^5 by operating at 0.003 K! Beautiful slides of the current status of their equipment lent support to their hope that they would be in operation within one year.

Giacconi (Harvard) discussed the continuing observations on binary X-ray sources and the growing evidence for accretion on the compact member of the binary as the source of the X-rays. In terms of implications that the compact member is a black hole he indicated that Cyg X-1 and SMC X-1 were the best candidates in this regard. He was followed by Kraft (Lick) who reported on the recent measurements of his group on Cyg X-1 which is a single line spectroscopic binary. By observations of reddening they conclude that the object is more than 2.5 kpc distant from the Earth. In this way the absolute magnitude of the primary is determined indicating that its mass is $\geqslant 30\, M_\odot$. In turn then the compact secondary must have $\geqslant 6\, M_\odot$ which is rather high for a neutron star on present theories and thus Cyg X-1 may well include a black hole, the first observed.

There was also much ado about gravitational collapse (Penrose), the stability of general relativistic systems (Chandrasekhar), white holes (Zel'dovich, who was elected the most active participant), gravitational induced electromagnetic radiation (Ruffini), observable effects of black holes (Bardeen, Press, *et al.*) and accretion on black holes (Rees *et al.*). All in all, it was a very exciting and stimulating symposium and this listener did not get his normal amount of sleep throughout.

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