

XV. GRAVITATION RESEARCH

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Our research objective is to make an experimental study of the post-Newtonian effects of relativistic gravitation. At present, the major emphasis is placed on a feasibility study of gravitational radiation detectors based on the principle of the interaction between free masses and gravitational waves. Gravitational wave antennas of this type, when used with large baselines and sensed interferometrically, give some promise of being able to detect the gravitational radiation from stellar binaries. Preliminary calculations with a 1-km baseline system using 1-ton masses in space indicate that the dominant noise for periods longer than 100 s may be stochastic force attributable to high-energy protons. The antenna employing a 1-W laser would be able to detect the gravitational radiation from several short-period binary systems in several months of integration time. Because of laser amplitude noise, the limiting strain sensitivity for periods shorter than 100 s corresponds to $(\Delta\ell/\ell)^2 \sim 10^{-42}/\text{Hz}$.

A prototype interferometric antenna with a 1-m baseline is being constructed in the laboratory. The sensitivity at frequencies higher than 100 Hz is limited by laser amplitude noise and corresponds to $(\Delta\ell/\ell)^2 \sim 10^{-36}/\text{Hz}$. In the present design, at frequencies lower than 100 Hz, the noise is dominated by seismic and acoustic noise. With this antenna we should be able to set significantly lower limits on the gravitational radiation spectrum but not on a level where any reasonable astrophysical process could be measured.

