

Gravitational wave research from space
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There is a good chance that ground based gravitational wave detectors will observe the gravitational waves emitted by the coalescences of binary neutron stars within the next 3 to 4 years. These detections will open a new field of astrophysics, gravitational wave observations of the universe, which could well provide new insights into both astrophysical processes and the nature of relativistic gravitation.

The space program could contribute to this new field in several different ways:

- By observing electromagnetic counterparts to the gravitational wave events measured by ground based detectors. X and γ ray observations with quick response to the gravitational wave events would identify the astrophysical sources and help in understanding the process – a component in “multi-messenger” astronomy. (x ray mission such as lobster on the space station)
- By placing interferometric gravitational wave detectors in space. The ground based observations are restricted to gravitational wave frequencies larger than a few Hertz from perturbing local gravitational forces due to seismic and atmospheric density fluctuations. The low frequency gravitational wave spectrum observable from a space based detector includes the gravitational radiation from the collision of massive black holes now known to reside in many galaxies and the gravitational wave emission from white dwarf binary star systems in our galaxy. A space based detector has a high probability of observing the dynamics of a stellar system in the strong field limit of General Relativistic gravitation where Newton’s gravity is no longer adequate to describe the dynamics. (LISA mission or derivative)
- Observe the effect of primeval gravitational waves on the polarization of the 3K cosmic background radiation. A space based observation of the CMB could reveal the B mode (curl like) pattern in the CMB polarization due to gravitational waves at large angular scales difficult to measure from earth based and suborbital platforms. Progress is currently being made in developing the technology for this measurement with ground and balloon borne projects but a definitive measurement will require the ability to measure the polarization at many different wavelengths to separate foreground emission from the CMB and on large angular scales to avoid the effect of gravitational lensing conversion of temperature anisotropies into B modes. (CMB pol mission or derivative)