

## LISA - A Space Observatory for Low-Frequency Gravitational Waves

E. S. Phinney  
California Institute of Technology

W. M. Folkner  
Jet Propulsion Laboratory, California Institute of Technology

Gravitational waves offer a window on the universe which complements the windows provided by electromagnetic radiation and neutrinos. Just as different frequencies of the electromagnetic spectrum highlight different astrophysical phenomena, different frequency ranges of gravitational radiation will highlight different kinds of objects. The Laser Interferometer Space Antenna (LISA) will detect and measure gravitational radiation from astronomical sources at frequencies 0.1 mHz to 0.1 Hz (as compared to LIGO's 10 Hz to 1000 Hz). Sources in this frequency range have detectable lifetimes of 1 year to 100,000 year, so LISA will hear and distinguish thousands of individual sources at all times: the gravitational wave symphony of the universe. Thousands of exotic binary stars in the Milky Way will be measured, determining their masses, mass ratios, date of future coalescence, and their 3-D position within the galaxy. In some cases tidal dissipation will be measured. The merging of supermassive black holes (with masses from thousands to millions times the mass of the sun) in the nuclei of merging galaxies and proto-galaxies can be heard with high signal to noise at red-shifts from 0 to 100. Gravitational radiation from compact stars scattered into orbits plunging near supermassive black holes provides a detailed map of the space-time outside the horizon of a black hole, allowing a precision test of the no-hair theorem and detection of energy extraction from rotating black holes. We will briefly explain why low frequency gravitational wave astronomy must be done from space. We will describe the capabilities of LISA and the astronomy and the physics that could be done with it, the technology, cost and mission status.