

Title: Gravitational Wave Astronomy with the Next Generation of GW Observatories

Author: B.S. Sathyaprakash for the 3G Science Case Team and 3G-GWIC Committee

Advanced LIGO and Virgo have begun the field of gravitational astronomy even before reaching their design sensitivity; when they do the advanced detector network will have addressed a number of problems in physics and astronomy. With an increase in strain sensitivity by an order of magnitude compared to advanced detectors, Einstein Telescope and Cosmic Explorer will be able to probe binary black holes at the edge of the Universe, binary neutron stars at the dawn of star formation, and supernovae up to several million light years. The 3G detectors will join LISA and EM/particle detectors to enable rich and broad multi-messenger astrophysics. Science potential of such a network of gravitational-wave antennas could help us:

- Explore New Physics in Gravity and in the Fundamental Properties of Compact Objects
- Determine the Properties of the Hottest and Densest Matter in the Universe
- Understand the Physical Processes and Mechanisms that Underlie the most Powerful Astrophysical Phenomena
- Reveal the Population of Merging Black Holes throughout the Universe and Search for Seeds of Supermassive Black Holes
- Investigate the Particle Physics of the Primeval Universe and Probe its Dark Sectors