Towards understanding neutron stars with continuous gravitational waves

LIGO Virgo KAGRA Webinar
Thursday 24 March 2022
1400 UTC (10AM US Eastern)

Abstract

Neutron stars are compact stellar remnants that exist at the extremes of matter and gravity. They provide an environment for studying physics at the limits of our understanding, under conditions inaccessible to Earth-based laboratories. The detection of gravitational waves offers a unique probe for studying the physics of neutron stars. In 2017 the first detection of gravitational waves from two colliding neutron stars was observed as a transient flash or "chirp" of gravitational radiation. In future we hope to detect a different type of gravitational waves from neutron stars: the long-lived "hum" of continuous gravitational waves from a neutron star which is very slightly deformed from perfect symmetry. Continuous gravitational waves are much quieter than the transient gravitational waves from neutron star collisions, and are therefore much more difficult to detect. In this talk we will describe recent efforts to detect continuous gravitational waves using LIGO and Virgo data from the third observing run, and motivate prospects for detection in future observing runs. We will focus on searches targeting known astrophysical objects which are highly likely to be associated with neutron stars. Pulsars are neutron stars which emit electromagnetic radiation observed through radio, X-ray, and gamma-ray telescopes. Supernova remnants are the exploded remnants of massive stars which may contain newborn neutron stars at their centre. Low-mass X-ray binaries are neutron stars orbiting a low-mass companion star; the extreme gravity of the neutron star strips matter from its companion, which could lead to the formation of mountains on the neutron star surface.

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