

Magdalena Sieniawska - Rotating neutron stars: dense-matter interiors and gravitational-wave searches using the time-domain F-statistic method

Wednesday, 12 June 2019 10:50 (20 minutes)

Gravitational waves astronomy is one of the youngest and dynamically progressing field in modern astronomy. Existence of gravitational waves was predicted by Einstein, more than hundred years ago, but was confirmed observationally only in 2015. Until then we could observe astrophysical bodies and events only by telescopes that register electromagnetic waves (like radio waves, gamma waves, X-rays etc.), and neutrinos, hence a lot of fascinating phenomena, like the mergers of black holes, were practically invisible. So far, several signals from the compact objects coalescences were detected in LIGO and Virgo detectors. As the interferometers improve their sensitivity, we expect other, more subtle, types of signals to be registered. One of the promising scenario is the detection of continuously-emitted, periodic and almost-monochromatic gravitational waves, originating inside rotating neutron stars (NS). Discovery and research on such types of signals can provide interesting information about the properties of neutron stars, their structure and environment around them.

The reason why gravitational signatures from NS are so thoroughly and eagerly wanted, is that the interior of a NS is still a mystery today. The extremely large densities and pressures present inside NS can not be reproduced in terrestrial laboratories. We also do not have a credible theoretical description of how matter behaves above the nuclear saturation density. By measurements of the NS masses and radii one can, in principle, determine the properties of matter inside NS. Since the measurements of NS parameters from the electromagnetic emission are in most cases charged with large observational errors, an analysis based on gravitational waves emission can be an alternative to determining the NS properties and their equation of state.

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