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Gravitational waves from close binary relativistic objects

Coalescence of close pairs of relativistic objects like black holes and neutron stars provides extremely valuable information on the evolution of stars, galaxies and the Universe as a whole. These events are observed in the gravitational-wave and (less frequently) in the electromagnetic ranges. Electromagnetic events (gamma-ray bursts and kilonovae) are explained in the literature in two different scenarios: the fusion of two neutron stars, or the stripping of a neutron star by its more massive companion. A stellar-mass black hole may also be such a companion. The report will briefly describe the achievements and problems in explaining signals from pairs of relativistic objects in different scenarios. The LIGO, VIRGO, and KAGRA detectors are already routinely detecting gravitational waves from black hole mergers. There are much fewer signals from binary neutron stars. To detect them against the noisy background, the task of quickly calculating patterns (templates) for gravitational waves from coalescing objects is very relevant. In different scenarios (merging vs stripping), different gravitational wave forms are predicted. We show that the authors who did the "fully analytical" template calculations in various orders of post-Newtonian decomposition, have actually solved numerically the differential equations arising in the problem . In our work with I.Klopova-Saporovskaya and A.Mishakina, we explore the limits to which truly fully analytical solutions can be obtained, which is useful for quickly detecting a signal in gravitational waves using the matched filtering method at the earliest stages.

Primary author(s) : Prof. BLINNIKOV, Sergei

Presenter(s) : Prof. BLINNIKOV, Sergei

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