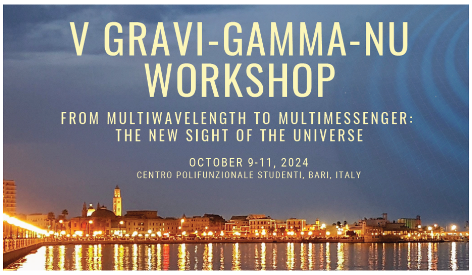

Contribution ID: **15** Type: **Contributed talk**

Estimation of joint detection probabilities of Gamma-Ray Burst and Gravitational Waves produced by NSBH binary mergers

Wednesday, 9 October 2024 15:45 (15 minutes)

Black hole-neutron star (NSBH) coalescence events are regarded as highly significant phenomena within the current multimessenger framework of gravitational waves, and they are poised to assume an increasingly prominent role in the foreseeable future. To date, only a handful of such events have been observed, with GW200105 and GW200115 being the most noteworthy among them. However, with the forthcoming upgrades to the LIGO-Virgo-Kagra (LVK) interferometers, and particularly with the prospective implementation of next-generation instruments such as the Einstein Telescope (ET), we anticipate a substantial increase in the detection rate of these events, potentially by orders of magnitude.

The study of NSBH coalescences, alongside neutron star binary (BNS) mergers, is pivotal due to their status as prime multimessenger candidates capable of producing a wide range of electromagnetic counterparts, including Gamma-ray Bursts (GRBs) and Kilonovae. By conducting joint analyses of both the gravitational and electromagnetic signals, it becomes feasible to derive more precise insights into the properties of the involved celestial objects and the myriad processes occurring during and subsequent to the merger, including the neutron star's stiffness and the mechanisms underlying GRB generation and beam structure.

This work provides an estimation of the combined detection capability for gravitational signals and GRBs originating from NSBH events, considering the anticipated upgrades to existing instruments and the deployment of next-generation facilities. In assessing the gravitational wave detectors, we compare the LVK interferometers with ET employing the GWFish software, while for evaluating the detectability of GRBs, particularly focusing on the afterglow component, we primarily reference Fermi and the prospective CTA array telescope. By utilizing state-of-the-art models for beam formation and propagation, we investigate how the goodness of information derived from these events is contingent upon the instruments utilized and the inherent characteristics of the coalescence itself.

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Session Classification: Day 1: Latest results