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Perspectives for kilonovae multi-messenger detections

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The detection of the gravitational wave (GW) signal GW170817 and the electromagnetic (EM) signal AT2017gfo confirmed the association between binary neutron star (BNS) mergers and kilonovae (KNe) and showed the potential of joint detection to unveil the nature of neutron stars and the nucleosynthesis of heavy elements in the Universe. The next-generation GW interferometers, such as the Einstein Telescope (ET), are unprecedented resources to enhance the chances of detecting EM counterparts significantly enlarging the horizon of detectable BNS mergers, and dramatically improving the source parameter estimation. Starting from BNS merger populations based on population synthesis codes, we compute the number of detected mergers and estimate the source parameters within a Fisher-matrix approach for different configurations of ET operating alone or in a network of present or next-generation GW detectors. We compute the KN emission associated with the BNS merger population using numerical-relativity-informed fits for two different nuclear equations of state, and considering the influence of black hole prompt collapse on the kilonova signal. Furthermore, we include the emission from the afterglows of short gamma-ray bursts. In the talk, I will discuss the perspectives for ET observing in synergy with the Vera Rubin Observatory taking into account the present uncertainties on the rate of BNS mergers, neutron star mass distribution, and nuclear equation of state.

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