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Discovering early high- and very-high-energy gamma-rays from compact binary mergers in the era of 3G GW detectors

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The origin of the prompt emission in gamma-ray bursts (GRBs) remains debated. Our understanding is primarily derived from wide-field telescopes that operate within the 10 keV-10 MeV range. However, capturing early emissions at higher energies (above 100 GeV) is challenging because of the time required for slewing of the telescopes. I will discuss multi-messenger observational strategies aimed at detecting early VHE emissions from compact binary mergers, particularly in the context of third-generation gravitational wave detectors such as the Einstein Telescope (ET) and Cosmic Explorer (CE). With the proposed exceptional low-frequency sensitivity, it becomes feasible to detect and pinpoint gravitational wave events during the inspiral phase, providing an early warning alert for electromagnetic facilities. I will further discuss the physical mechanisms responsible for generating VHE counterparts via the synchrotron self-Compton model in the leptonic scenario, as well as external inverse Compton emission, as potential candidates in the 10 GeV - 10 TeV energy band (very-high-energy gamma-rays; VHE). Additionally, I will briefly discuss the recent discovery of the GeV component from a compact binary merger, GRB 211211A, and its implications for the possibility of GeV to sub-TeV emissions from these sources. Furthermore, I will highlight the detection of the second component of GRB 221009A and its potential impact on our understanding of VHE prompt emissions.

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