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Perspectives of observing prompt very-high-energy gamma emission from binary neutron star mergers

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The prompt emission in Gamma-ray bursts is usually observed 10 keV-10 MeV range. However, to date, at higher energies, it has not been detected yet. Although the current generation very-high-energy (VHE; E > 30 GeV) gamma-ray detectors (MAGIC and H.E.S.S.) have successfully demonstrated the capability of detection of the afterglow of GRB, the prompt phase of detection has remained unexplored. Here, we investigate the perspectives of multi-messenger observations to detect the prompt emission of short GRBs at very-high-energies. Considering binary neutron star merger as progenitor of short GRBs, we evaluate the joint detection efficiency of the Cherenkov Telescope Array observing in synergy with the third generation of gravitational wave detectors, such as the Einstein Telescope and Cosmic Explorer. We evaluate taking the expected capabilities to detect and localize gravitational wave events in the inspiral phase and to provide an early warning alert able to drive the VHE detection. We demonstrate that the sensitivities of CTA make it possible the detection of the VHE emission even if it is several orders fainter than the one observed at 10 keV–10 MeV. We discuss the results in terms of possible scenarios of prompt VHE counterparts of binary neutron star mergers, such as the synchrotron self Compton components in the leptonic GRB model, high energy tail of the hadronic GRB model, and external Inverse Compton emission.

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