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## High-energy gamma rays from cosmic rays escaping from microquasars

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HAWC and LHAASO reported very high energy (VHE) gamma rays with energies exceeding 100 TeV from five Galactic black hole binaries. The spatial extent of the VHE gamma rays is several tens of pc, which is much larger than the size of a black hole binary system. Some black hole binaries have different gamma-ray spectra, some of which are steeper than predicted by the standard shock acceleration model. Although individual interpretations of the VHE gamma rays from the SS 433 and V4641 Sgr were discussed, a unified explanation for the five microquasars that emit VHE gamma rays has not yet been attempted. In this work, we try to understand the origin of the VHE gamma rays from microquasars in a unified way by considering CRs escaping from microquasars. To understand the distribution of escaping CRs around a microquasar, we solve the diffusion equation taking into account the finite size of the CR source and the continuous CR injection. We show that the energy spectrum in the emission region is described by a broken power law spectrum with one or two spectral breaks even though the total spectrum of escaping CRs is a single power law spectrum. We then show that the VHE gamma-ray spectra of five microquasars can be explained in a unified way, in which all five microquasars have the same energy spectrum of the escaping CRs without the high energy cutoff,  $dN/dE \propto E^{-2}$ , the same diffusion coefficient, and the same emission region.

### Collaboration(s)

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