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Cygnus OB2 as testing ground for particle acceleration at the wind termination shock of massive star clusters

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In the last decade, the detection by diverse experiments of diffuse gamma-ray emissions toward several galactic massive star clusters has renewed the attention to these objects as potential galactic cosmic ray accelerators. Indeed, the conversion of a few percent of the power supplied by the strong winds from the massive stars into accelerated particles is enough to explain the observed gamma-ray luminosities in a pure hadronic scenario. Cygnus OB2 is one of the massive star clusters found in coincidence with diffuse gamma-ray emission detected in a broad range of energies, from a few GeV up to 1.4 PeV.
In this work, we aim to compare the morphological and spectral features of the observed gamma emission with those predicted from a theoretical model where particles are accelerated at the termination shock of the cluster wind. Both the expected gamma-ray morphology and spectrum depend on the properties of the distribution of accelerated cosmic rays, which are directly affected by the physics of acceleration at the termination shock and by the propagation in the hot expanding bubble created by the cluster wind.
We found our model to be in good agreement with the observed spectral energy distribution. The expected radial gamma-ray profile reproduces fairly well HAWC observations but is not totally in accord with Fermi results. According to the best fit model, Cygnus OB2 should be able to accelerate cosmic rays up to 1 PeV, hence resulting in a likely cosmic ray PeVatron.

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