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Probing cosmic-ray distribution around Cygnus OB2

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Recently, massive star clusters have received renewed attention as possible cosmic-ray (CR) factories. In the neighborhood of a massive star cluster, assuming a steady-state injection lasting a few million years, the density of escaping, freshly accelerated CRs is expected to decrease following a 1/r profile. As CRs diffuse away from the cluster, the hadronic component interacts with molecular clouds (MCs) in its vicinity, causing a distinct observed morphology in the gamma-ray band, which results from the convolution of the spatial distribution of CRs and MCs. Cygnus OB2 is one of the most massive star clusters in the Milky Way, located near the Cygnus X star-forming complex. Fermi observations of the region revealed an extended gamma-ray emission (Cygnus Cocoon) possibly coming from CRs accelerated by Cygnus OB2. Recent studies claim that this extended emission is compatible with a CR distribution of freshly accelerated escaping particles. In this work, we aim to infer the shape of the distribution of CRs around Cygnus OB2 by studying the 3D Cocoon morphology. For this purpose, we implemented a 3D model of MCs distribution around Cygnus OB2, where their distance is obtained using maser parallaxes and dust reddening information.

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