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The contribution to the diffuse γ-ray emission from young massive stellar clusters

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In the last decades, several young massive star clusters (YMSC) have been associated with extended γ-ray sources, suggesting that some acceleration process, able to produce particles at least up to hundreds of TeV, is at work. The number of YMSCs exhibiting γ-ray emission is around ten, while the possible sources amount to a significantly higher number, potentially reaching several hundred. It is plausible that many of such objects have not been observed yet because of their low surface brightness. However, the collective emission of such unresolved sources may contribute to the diffuse Galactic γ-ray background. In this work, we aim to estimate the total contribution of unresolved YMSCs to the diffuse γ-ray flux, considering a synthetic population created from observed properties of nearby clusters located within 2 kpc from the Sun. We simulate the Galactic population of YMSCs using a Montecarlo approach. For every cluster, we build the stellar population so as to estimate the collective wind luminosity and mass loss rate. The γ-ray emission of each object is then calculated assuming a pure hadronic scenario, where protons are accelerated at the wind termination shock of the stellar cluster and subsequently interact with the material embedded inside the wind-blown bubble. We also account for different scenarios for the particle diffusion inside the system, which determines both the maximum energy and the escape time from the bubble, thus affecting the final gamma-ray spectrum. The results are then compared with measurements of the diffuse gamma-ray flux in different regions of the Galactic plane provided by several telescopes, such as EGRET, Fermi-LAT, ARGO, Tibet-ASγ, and LHAASO. Preliminary results indicate that the diffuse emission from the unresolved cluster population could be nonnegligible between 1-10 TeV.

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