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Contribution of young massive star clusters to Galactic diffuse γ-ray emission

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Young massive stellar clusters (YMSCs) have emerged as potential γ-ray sources, after the recent association of a dozen YMSCs with extended γ-ray halos. The large size of these halos, comparable to the wind-blown bubble expected around these objects, makes the detection of individual YMSCs significantly challenging. As a result, the emission from most of the galactic YMSCs could be non-resolved. If this is the case, the non-resolved emission from YMSCs could significantly contribute to the diffuse γ-ray radiation observed along the Galactic Plane.

In this study, we estimate the possible contribution to the galactic diffuse γ-ray emission from a synthetic population of YMSCs, and we compare it with the observations made available by different experiments, from 1 GeV to hundreds of TeV, in two regions of the Galactic Plane. As the population of galactic YMSCs is only known locally, we evaluate the contribution of γ-ray emission relying on the simulation of a synthetic population of YMSCs based on the observed properties of local clusters. We compute the γ-ray emission from each cluster assuming that the radiation is purely hadronic in nature and produced by cosmic rays accelerated at the collective cluster wind termination shock.

We found that the γ-ray emission from non-resolved YMSCs can significantly contribute to the observed Galactic diffuse flux. This is especially true if particle diffusion in the bubble is mediated by a Kraichnan diffusion coefficient. The predicted γ-ray spectrum should be considered as a lower limit, given that our calculation neglects the contribution by supernovae exploding in the YMSCs.

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