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Clustering the Interstellar Medium for Gamma-ray Modelling of Galactic Objects

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To reveal the nature of high-energy gamma-ray sources and to understand the associated emission and acceleration mechanisms, we need detailed models capable of reproducing the observed energy spectra and morphologies. Gamma rays can be produced in non-thermal radiation processes involving protons and electrons interacting with the interstellar medium (ISM). These protons and electrons originate from cosmic-ray accelerators, such as supernova remnants or pulsar wind nebulae. The model of the gamma-ray morphology is very sensitive to changes in the distance between the accelerator and ISM gas clouds. However, the estimates of these distances come with large uncertainties, which cannot determine the location of the gas clouds with the precision we require.

In this contribution, we will present preliminary results from our novel method for clustering the ISM. Our clustering determines the 3D pixels belonging to a specific ISM gas cloud, allowing us to individually move clouds and iterate over their physical distances relative to the accelerator. Using the Mopra Southern Galactic Plane Carbon Monoxide Survey, we will analyse the properties of identified interstellar gas clouds, demonstrating the importance of accurate gas locations in 3D modelling.

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