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Characterization of Neutrino Hotspots: Minimum Angular Cut and Sensitivity to Diffuse Flux

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This work evaluates the performance of a neutrino hotspot-population analysis on simulated sky maps, with the aim of quantifying the ability to distinguish injected point sources from a diffuse background and of characterizing the angular accuracy of reconstructed hotspots. First, background sky maps were compared to a Poisson distribution to justify the choice of a minimum angular separation; from this study a minimum angular cut of 1.25° is adopted for all subsequent analysis. Using this configuration, ensembles of maps were produced with injected point sources spanning a range of relative intensities (i.e., different fractions of the diffuse flux). For each ensemble, the Kolmogorov–Smirnov (KS) test was applied to compare the distributions of detection significances between injected maps and pure-background maps, thereby identifying the injection levels at which the background hypothesis becomes incompatible. In parallel, the angular separation between reconstructed hotspots and the true injected positions was analyzed for each sample, yielding the distribution of angular errors and its dependence on source brightness. The results provide operational criteria (minimum angular cut and sensitivity thresholds) to guide future correlation studies between astronomical source catalogs and the hotspots identified in neutrino sky maps.

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