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Decomposing the origins of gamma-rays from the Galactic Centre with neutrino imaging and implication on the millisecond pulsar population

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Molecular clouds in the Galactic Centre will glow in neutrinos and gamma-rays when bombarded by energetic hadrons. Gamma-ray imaging of the Galactic Centre has therefore been employed to study the cosmic-ray energy spectrum and density distribution around Sgr A*. While part of the gamma-rays may be contributed by leptons, leading to uncertainty that is challenging to estimate, neutrinos serve as clean messengers of hadronic interactions and are thus better tracers of cosmic rays in the Galactic Centre. IceCube's recent announcement of the Milky Way's first neutrino map highlights our advanced capability to discern Galactic emissions. Future neutrino observations will achieve an angular resolution below 0.1 degrees, enabling us to resolve the central region of our galaxy. We explore the potential role of millisecond pulsars as cosmic-ray accelerators, and use neutrino imaging to constrain their population. Their population bears significant implications for the gamma-ray excess problem and the formation of extreme mass ratio inspirals in galaxies similar to Milky Way.

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