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Unveiling the PeVatron: Neutrinos as Probes of High Energy Cosmic Ray Origins in the Galactic Centre

A decade of gamma-ray observations from the Milky Way's centre has provided hints of the existence of a Galactic accelerator, the so-called PeVatron, capable of generating cosmic rays up to PeV energy scales. These hints are based on the observation of a gamma-ray energy spectrum from the dense gas clouds at the centre of our galaxy, which follow an energy spectrum with no detected cut-off up to 100 TeV. The gamma-ray flux generated from these clouds also suggests a cosmic ray density that decreases inversely with distance from Sgr A*, indicating that the PeVatron is likely located in its vicinity. In this talk, we will discuss how neutrinos will become a fundamental probe to complement gamma-ray observations and shed light on the origin of these PeV cosmic rays in the future. This will be made possible through a combined analysis of the neutrino telescopes coming online in the next decade, as they will have the galactic centre in their field of view and achieve angular resolutions for muon neutrinos below a tenth of a degree. We will also explore what neutrinos can reveal about the point-like gamma-ray emissions in the galactic ridge region, whose origin remains under debate.

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