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Tracking the gas distribution in the Galactic Centre using neutrinos

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The Central Molecular Zone at the Galactic Centre hosts the most massive and densest molecular clouds in our Galaxy. The mass of the clouds could be inferred from the infrared emission of the dust, or line emissions from tracers like CS and CO, but different methods having different assumptions sometimes yield inconsistent results. We propose that neutrinos can act as a new gas tracer to resolve this problem. Diffuse baryonic media will glow in neutrinos and gamma-rays when bombarded by energetic hadrons. The neutrino brightness is directly proportional to the mass of the cloud, making it an unambiguous tracer of the gas mass. Future neutrino detectors such as P-ONE, KM3NeT, and Baikal-GVD will detect neutrinos from the Galactic Centre with angular resolutions better than 0.1 deg for muon neutrinos above 10 TeV. We discuss how a future measurement of neutrino emissions from the Central Molecular Zone will help pin down the more accurate mass tracers and disentangle the leptonic and hadronic contribution when combined with gamma-ray observations.

Affiliation

Mullard Space Science Laboratory, University College London

Auteur principal: LAI, Paul Chong Wa (University College London, Mullard Space Science Laboratory)

Co-auteurs: CRUDELE, Beatrice (UCL); Dr OWEN, Ellis (Osaka University); OIKONOMOU, Foteini; Prof. WU, Kinwah (MSSL, UCL); Dr AGOSTINI, Matteo (UCL)

Orateur: LAI, Paul Chong Wa (University College London, Mullard Space Science Laboratory)

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