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Dark matter searches through correlations of the gamma-ray sky with neutral hydrogen, cosmic voids and galaxies surveys

Dark matter in cosmic structures is expected to produce signals that originate from its particle-like nature, among which the electromagnetic emission represents a relevant opportunity. However, this emission is very faint and contribute only to the unresolved background radiation. This background emission is isotropic at first order, but exhibits a degree of anisotropy since it originates from clustered dark matter haloes. This fact implies that the anisotropies in the radiation field will be correlated to the matter distribution in the Universe.

In this work we propose to exploit this correlation by using neutral hydrogen intensity mapping via the 21cm emission line as a tracer of the matter distribution, and gamma rays as the tracer of dark matter annihilation. Intensity mapping (IM) offers excellent redshift information since it measures a line emission. Also, IM has the advantage of not being flux limited in the measurement of the matter distribution, as opposed to galaxy surveys, since it does not need to resolve individual galaxies. We show the expected signal from this cross-correlation channel and we forecast constraints through the combination of Fermi-LAT gamma-ray data and the next-generation radio telescope Square Kilometre Array. We extended this powerful technique by including the complementary information offered by cosmic voids. Finally, we present the preliminary results of the cross-correlation between galaxy surveys and the gamma-ray flux from the upcoming gamma-ray detector CTA.

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