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Searching dark matter in galaxy clusters with high energy gamma-rays

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Currently, the scientific community widely acknowledges that the primary component of the matter density in the Universe is an enigmatic entity known as *dark matter*.(DM). It is hypothesized to consist of neutral, stable, and non-baryonic elementary particles. In regions of high matter density, such as the Universe's galaxy clusters, DM has the potential to undergo self-annihilation or decay, generating a significant gamma-ray (γ-ray) signal. Galaxy clusters are the largest gravitationally bound structures observed in the Universe, with DM accounting for approximately 80% of their total mass, while the remaining 15% and 5% are attributed to intracluster gas and galaxies, respectively. (1) Consequently, galaxy clusters represent promising candidates for hosting substantial high-energy γ-ray emissions resulting from DM interactions. The objective of this study is to investigate the differential γ-ray flux and a parameter known as the J-factor, which characterizes the distribution of DM in galactic halos. Based on the theory applied to our own Milky Way galaxy, we've extended it to encompass galaxy clusters. (2) The presence of substructures within the main halo of such targets, in the form of self-contained regions of enhanced DM density, can amplify the annihilation/decay signal, yielding a catalog of the largest J-factors. (3) This analysis also facilitates a comparison between the differential γ-ray flux and the sensitivity of current gamma-ray detectors, such as Fermi-LAT, as well as future observatories like the Cherenkov Telescope Array (CTA). Consequently, ground-based telescopes, which are still in the developmental stage, are being considered for their observation capabilities regarding these galaxy clusters with the most significant visible J-factors. The detectability of these observatories is an ongoing area of study, playing a crucial role in our future projects.

Palavras-chave: Dark matter. J-factor. Galaxy clusters.

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