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Distinguishing cores from cusps in the dark matter density profile using the proper motions measurements

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We have shown the potential of next-generation astrometric satellites for distinguishing between a cusp and a core in the dark matter density profile. This goal can be achieved with the measure of the proper motions of at least 6000 stars within a nearby dwarf galaxy with an accuracy of 1 km˜s^{-1} at most. We have built mock star catalogues similar to those expected in future astrometric missions like Theia. Our mocks include celestial coordinates, radial velocity, and proper motion of the stars, while density and velocity fields of the stars are sampled from an extended Navarro-Frank-White (eNWF) spherical model. Employing a Monte Carlo Markov Chain algorithm, we have shown that the eNFW parameters with a relative uncertainty of 20\%, on average can be recovered, and thus we can distinguish between a core and a cusp at 3σ. Our result shows that the measure of the proper motions of stars can provide a fundamental contribution to understanding the nature and the properties of dark matter particles.

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