Pushing the Limits of Astrometry: Technological Advances and Scientific Prospects

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Abstract

Astrometry is one of the oldest branches of astronomy. It measures the position, proper motion, and parallax of celestial objects. Following the Hipparcos and Gaia missions, which measured several billion of these objects using global astrometry, several space missions are considering increasing the precision of astrometry on pointed objects using large-field differential astrometry. These missions are aimed at detecting rocky planets in the habitable zones of stars in the solar neighborhood and at understanding the nature of dark matter in galactic environments. I will give an introduction and a historical perspective of relative astrometry, with an emphasis on recent developments that will allow us to explore the capabilities of future space missions. Indeed, during the last ESA Prospective Survey, the Senior Committee recognized that after Gaia "*the next steps in space astrometry could be to improve the relative astrometric accuracy by an order of magnitude*" (Section 3.1.7). Several proposed space missions using a diffraction-limited telescope with a large field of view are capable of reaching sub-microarcsecond precision. Beyond the exoplanet and dark matter cases, the expected science is much broader. While the instrumental challenges are significant, they appear to be close to being solved.

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