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Type : **Poster**

Mapping the Faint Frontier: Improved Local Group Kinematics with JWST + Gaia + HST Astrometry

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Stellar proper motions (PMs) are fundamental for reconstructing the Local Group dynamics, understanding the Milky Way accretion history, and constraining the nature of dark matter. While Gaia is powerful for measuring PMs, its performance is limited for faint sources ($G > 20$ mag). Previous studies on Gaia + Hubble Space Telescope (HST) astrometry have shown that combining telescopes achieved more precise PM measurements than Gaia alone.

Motivated by GaiaHub, a previous Gaia + HST tool, we have developed GaiaWebb, which combines Gaia and James Webb Space Telescope (JWST) observations. GaiaWebb retrieves JWST images, extracts stellar positions and magnitudes, cross-matches JWST sources with Gaia stars, aligns JWST images to the Gaia reference frame, and then measures the improved PMs using large JWST-to-Gaia time baselines. We have also expanded another Gaia + HST tool, BP3M (Bayesian Positions, Parallaxes, and Proper Motions), to simultaneously combine JWST + Gaia + HST measurements. The enhanced BP3M differs from GaiaWebb in that it uses Gaia data as priors while jointly aligning images and making measurements. We tested our new tools on the Large Magellanic Cloud and Draco dwarf galaxy, and the resulting PMs are consistent with the literature measurements. GaiaWebb and BP3M improve PM precision by factors of 5-20 compared to Gaia DR3 alone, with faint stars ($G > 19$ mag) seeing the largest improvement.

Our future work will include producing publicly available catalogues of improved PMs, calibrating those catalogues through comparisons with the literature, and measuring new bulk motions of Local Group structures.

Did you give a contributed talk at CASCA 2026?

No

If you are selected for a poster, would you be interested in giving a short flash talk on your work?

Yes

What is your career level?

Undergraduate

Which keyword describes the area of focus of this talk?

Astrostatistics

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Session Classification : Galaxies