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Enhanced astrometry of the rapid ASKAP continuum survey for precise localisation of fast radio bursts

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Accurate localisation of Fast Radio Bursts (FRBs) is essential for identifying their host galaxies, constraining progenitor models, and employing FRBs as precise cosmological probes. For extragalactic FRBs, particularly those at higher redshifts ($z > 1$), sub-arcsecond astrometry is required to robustly associate them with host galaxies and disentangle contributions to dispersion and scattering along the line of sight. The localisation of FRBs detected with the Australian Square Kilometre Array Pathfinder (ASKAP) relies on reference positions from the Rapid ASKAP Continuum Survey (RACS), whose astrometric fidelity has previously been limited by systematic positional errors. We present a comprehensive correction of astrometric offsets across all RACS epochs—RACS-Low, RACS-Mid, and RACS-High—using crossmatching with the Wide-field Infrared Survey Explorer (WISE) catalogue to improve positional accuracy across the entire southern sky (Dec. $< +45°$). These corrections reduce residual uncertainties to approximately 0.3 arcseconds (1-σ) or better, and are independently validated through comparisons with the Very Large Array FIRST Survey (FIRST), the Very Large Array Sky Survey (VLASS), the Radio Fundamental Catalogue (RFC), as well as the corrected RACS catalogues. The improved astrometry has been incorporated into ASKAP's FRB localisation pipeline, enabling more precise identification of host galaxies, tighter constraints on host-frame dispersion measures (DMs), and reduced uncertainties in scattering analyses. This work establishes a robust new reference standard for radio transient localisation with ASKAP and significantly enhances the utility of FRBs as astrophysical and cosmological probes.

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