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Spiral-like features in the disc revealed by Gaia DR3 radial actions

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The so-called action variables are specific functions of the positions and velocities that remain constant along the stellar orbit. The astrometry provided by Gaia Early Data Release 3 (EDR3), combined with the velocities inferred from the Radial Velocity Spectrograph (RVS) spectra of Gaia DR3, allows for the estimation of the actions and orbital parameters for the largest volume of stars to date (33.6 million sources). In Palicio et al. (2023, published in A&A), we computed these quantities and explored them with the aim of locating structures in the Galactic disc. Using Gaia DR3 photometric data, we selected a subset of giant stars with better astrometry as a control sample.
We found that the maps of the percentiles of the radial action J_R reveal arc-like segments. In particular, we found three arc-shape regions dominated by circular orbits at inner radii, whose location and shape suggest a connection with the spiral arms. The spatial distribution of the control sample, moreover, shows overdensities similar to those interpreted as spiral arms using upper main sequence stars (Poggio et al. 2021). For Galactic coordinates (X, Y, Z), we found good agreement with the literature in the innermost region for the Scutum-Sagittarius spiral arms. At larger radii, a low J_R structure tracks the Local arm at negative X, while for the Perseus arm, the agreement is restricted to the X<2 kpc region, with a displacement with respect to the literature at more negative longitudes. We detected a high J_R area at a Galactocentric radii of 10.5 kpc, consistent with some estimations of the outer Lindblad resonance location. We conclude that the pattern in the dynamics of the old stars is consistent in several places with the spatial distribution of the spiral arms traced by young populations, with small potential contributions from the moving groups.

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