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Abstract

As the Galaxy evolves it is subjected to a plethora of various dynamical processes that leave their mark upon it. We can view a snapshot of the ongoing processes and connect it to past events. To do this, we require an accurate picture of the stellar motions and positions which are predicted by numerical models. This is the two-pronged approach of Galactic dynamics which connects both theory and observations.

This thesis summarizes three papers where I use this approach to gain new insights into both the current structure of the local Galaxy and one of the processes responsible for it.

In Paper I, I seek to determine the relationship between the vertical extent of stellar orbits and their participation in radial migration across the disc. By numerically simulating different types of discs I am able to determine that radial migration primarily affects stars with small vertical excursions in halo dominated galaxies and affects all stars more equally in disc dominated ones.

In Paper II, I utilize the proper-motion limited catalogue of Gaia EDR3 to determine the most accurate velocity distribution of white dwarfs to date using a penalized likelihood estimate. This provides kinematics for the stars on the two sides of the bifurcation visible in the white dwarf cooling sequence. The paper is able to find known and some novel structure in the velocity distribution and finds that the bifurcation is related to two separate kinematic populations of white dwarfs.

In Paper III, I further apply the methods of Paper II to two new samples of stars: the local stellar halo and the Solar neighbourhood. With the updated Gaia DR3 I am able to show accurate velocity distributions for both samples and reveal new velocity substructures in the local halo which are part of the *accreted* stellar halo.

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