Pearls on a String: Numerous Stellar Clusters Strung along the Same Orbit

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Background

Young stars are clustered across a wide range of scales, from compact bound objects to 'streams' that extend over several hundred parsecs. Using the revolutionary 6D data provided by *Gaia*, we performed a systematic study of the orbit space clustering of stars in the extended solar neighbourhood (< 800 pc).

Pearls on a string

We have looked for ensembles of stars clustered in both action and angle coordinates, algorithmically identifying a set of 55 prominent clumps in orbit and orbital phase space (see also: Coronado et al. 2020, **Fig. 1**). Some of these groups are established clusters, some unrecognised streams.

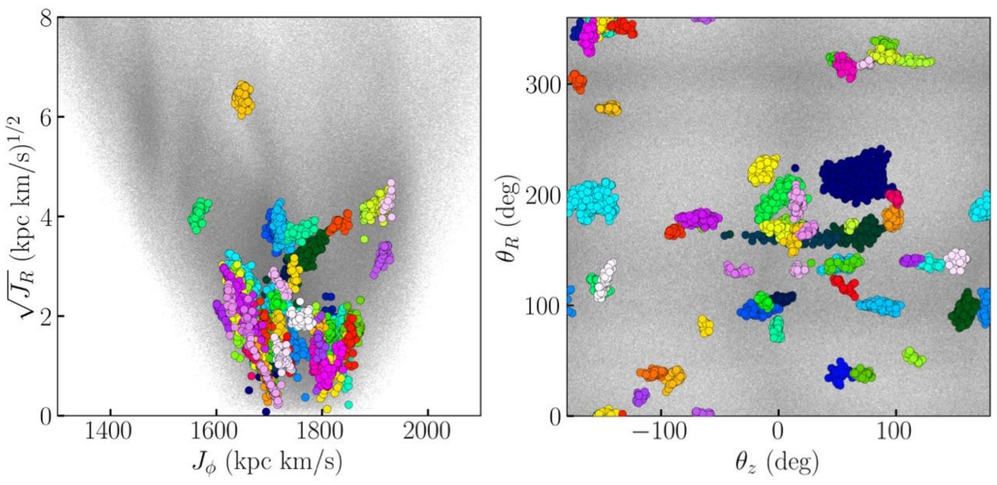

Fig. 1 Member stars of the 55 action-angle groups in the action plane (left) and the angle plane (right).

We then explored the orbital phase distribution of all sample stars in the same orbit patch (**Fig. 2**) as any of the 55 groups. Remarkably, orbits that contain one such clump, commonly contain many other distinct clumps with other orbital phases, like *pearls on a string* (**Fig. 3**).

We compare our result to an offset and a smooth orbit patch and find that orbits in the Galactic disk that contain at least one group contain significantly more pearls than any comparison field (**Fig. 4**).

Implications

Our results imply that recent star-formation in the Galactic disk is strongly clustered towards a modest subset of particular orbits, presumably the orbits on which the cold ISM was moving when giving birth to these stars.

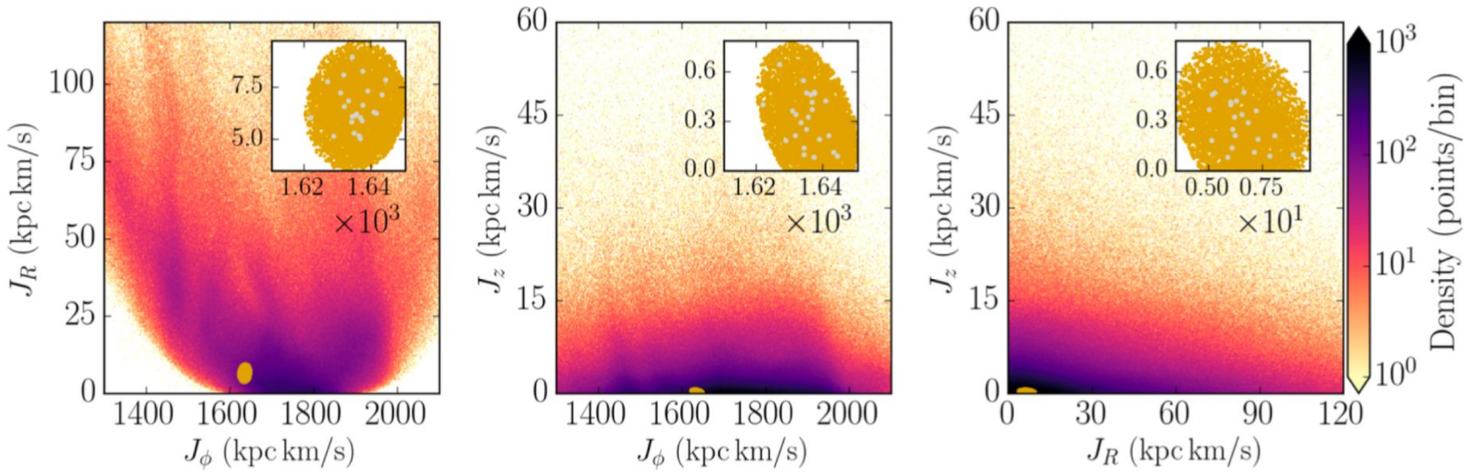

Fig. 2 The three projections of the orbital action distribution of the 6D *Gaia* data within 800 pc. In the top right, the actions of one example group are shown in grey, and the orbit patch is illustrated as a golden ellipse.

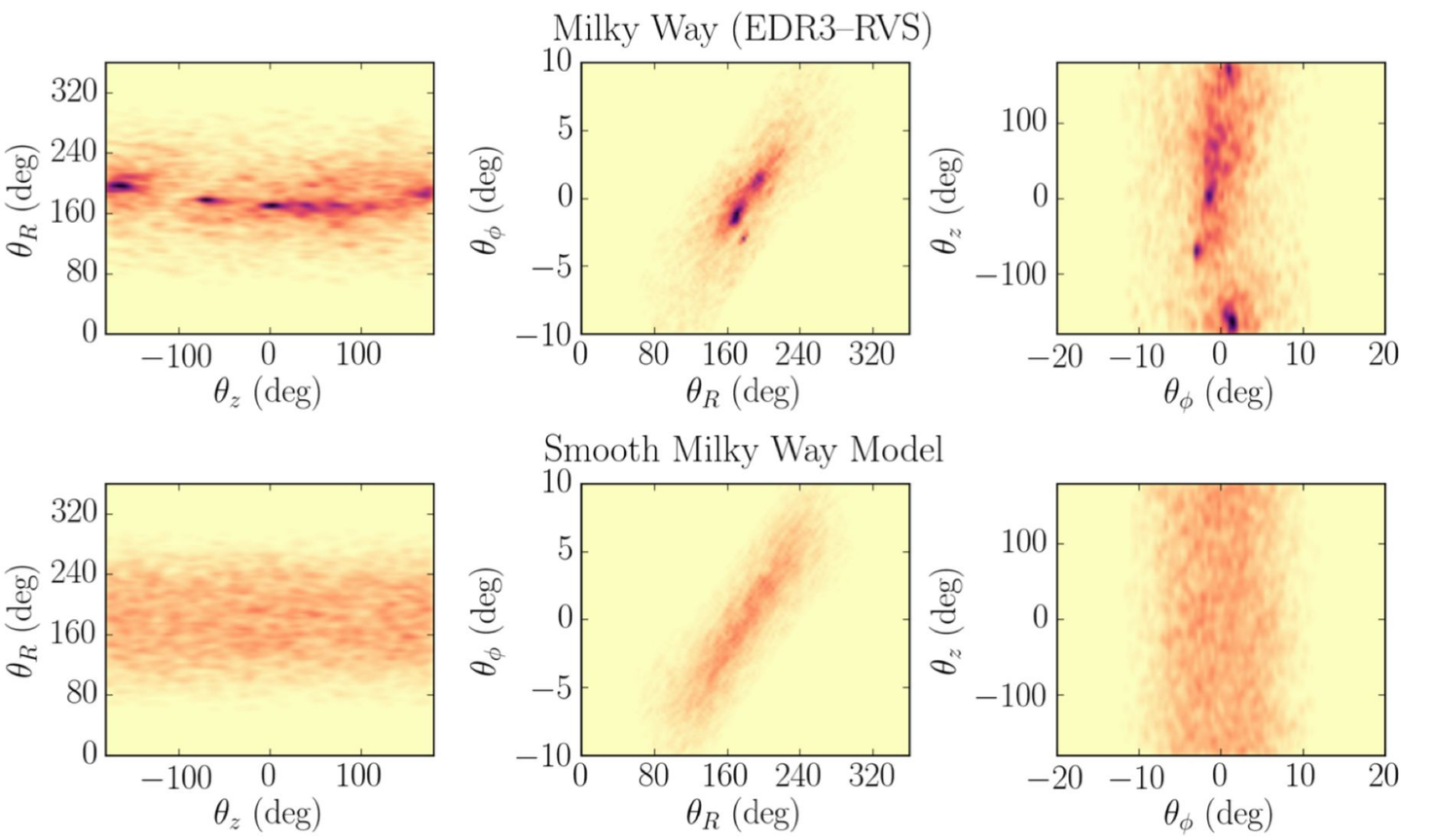

Fig. 3 Top row: Kernel density map of the orbital phase distribution for all stars in the orbit patch around the example group. Remarkably, the orbit patch contains many other distinct clumps (*pearls*) with other orbital phases. Bottom row: The analogous distribution in the same orbit patch, but with points drawn from a smooth mock catalog (Rybizki et al. 2020).

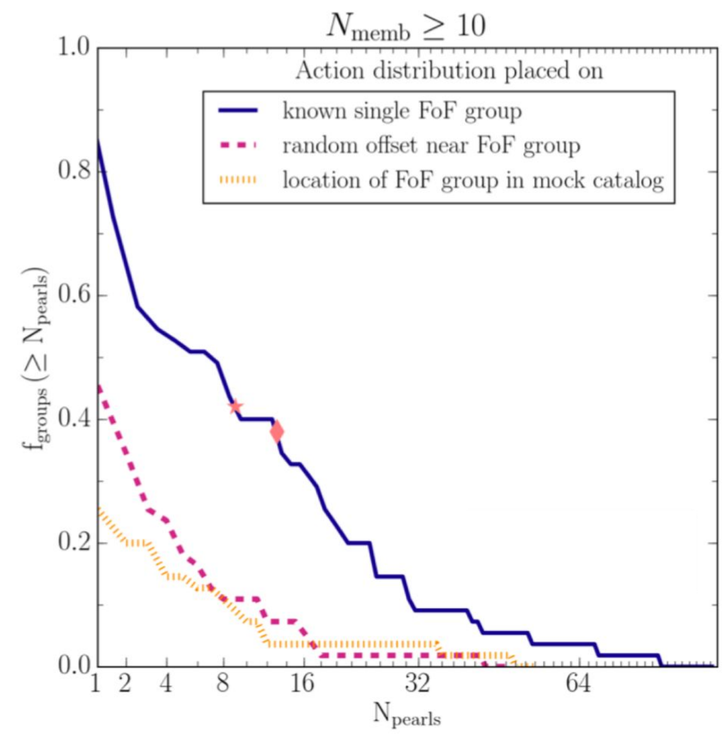

Fig. 4 The fraction of groups as a function of the number of pearls for the orbit patches in the 55 groups. Each pearl has a minimum number of 10 member stars. The orbit patch selection is shown with a blue solid line, the smooth mock catalog with a purple dashed line, and the offset orbit patch with an orange dotted line.

As **Fig. 4** shows, we find significantly more pearls in the orbit patch around the groups than in any of the two comparison fields.

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& check out our subm. paper on arXiv:2107.00036: https://arxiv.org/abs/2107.00036

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