Characterising a population of metal-poor stars with disc kinematics in the Milky Way with the Pristine-Gaia synthetic metallicity catalogue

To deepen our knowledge of the early Milky Way, it is of particular interest to investigate the orbital and chemical properties of the most metal-poor stars, associated with the oldest stars in our Universe.
Up to recently, it was widely accepted that the most MP stars would be found on pressure-supported orbits, either within the Galactic halo or the bulge, in the context of a hierarchical assembly of galaxies. The rise of photometric (Pristine) and spectroscopic (SEGUE, LAMOST,...) surveys led to the uncovering of large samples of UMP, VMP and EMP stars. As seen with the publication of the Pristine-Gaia synthetic (PGS) catalogue, mimicking Pristine photometry using Gaia DR3 BP/RP spectro-photometry enables to go all-sky, a key feature to disentangle disc formation, a process that remains until this day quite puzzling.
In a paper that is being submitted, after validating and curating the PGS sample for our use with the help of spectroscopic surveys, we identify an asymmetric angular momentum distribution within our sample, down to the lowest metallicities ([Fe/H] < -1.7), in favour of a prograde component. We then investigate whether the population could be due to the tail of a zero-rotation or a prograde halo. After probing spatial distributions, as well as Vφ and action space distributions and comparing them with a mock model, we conclude that:

- this population cannot be the tail of distribution of a stationary halo
- from a view of the Vφ distribution alone, this population could be the tail of a slightly prograde halo (Vφ ~ 30-40 km/s); however, this does not erase the signature of the population in the action space
- the [Fe/H] lower limit of this population with a 2σ confidence interval is located at ~ -3 dex, about twice as low as the classical limit

Finally, we discuss the potential origins of this population (in/ex-situ) in light of recent papers.