Threading the needle: constraining the stellar content and dynamics of the Galactic Centre with hypervelocity stars

Verberne, S.

Propositions

accompanying the thesis

Threading the needle

Constraining the stellar content and dynamics of the Galactic Centre with hypervelocity stars

1. The low-resolution Gaia BP/RP spectra can be used to measure stellar radial velocities (Chapter 2).
2. Identifying stars that appear to be on radial trajectories outward from the Galactic Centre is an efficient method to search for hypervelocity stars (Chapter 3).
3. If the S-star cluster was formed exclusively through the Hills mechanism, there must be multiple progenitor binary populations (Chapter 4).
4. The non-detection of a population of Galactic Centre ejecta in DESI DR1 constraints the ejection rate from the Galactic Centre over the past several billion years and is consistent with rate constraints on the Hills mechanism over the past ~ 100 million years (Chapter 5).
5. Upcoming large spectroscopic surveys will revolutionise our understanding of hypervelocity stars, whether these surveys discover new hypervelocity stars or not.
6. Understanding the selection function of an observational survey is vital to accurately construct forward models of that survey attempting to constrain astrophysics.
7. The field of observational hypervelocity stars would benefit more from consolidating the numerous existing hypervelocity star candidates than publishing lists of additional hypervelocity star candidates with ambiguous origins.
8. The origin of hypervelocity star candidates bound to the Galaxy will remain ambiguous as long as we lack detailed chemical abundance tracers of these stars and a better understanding of the progenitor binary populations.
9. A PhD should not be dependent on an instrument that does not work before the start of the PhD and is outside the control of the PhD candidate.
10. Better coffee in the Kaiser Lounge would improve social cohesion at Leiden Observatory.

Sill Verberne
Leiden, 9th January 2026