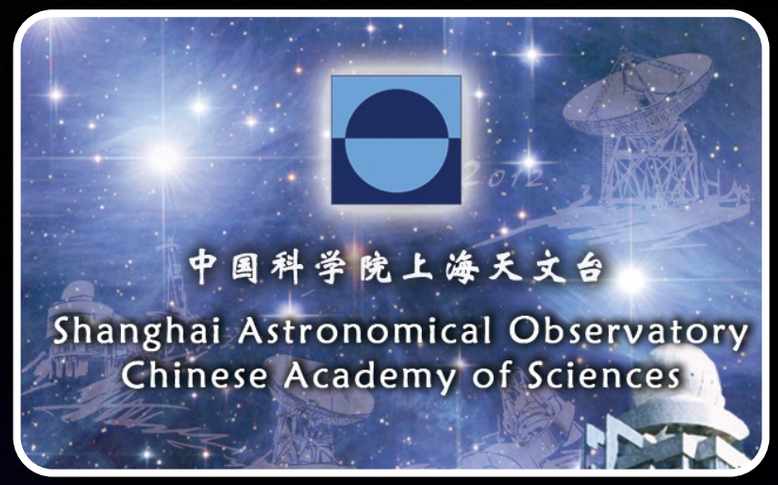

Cool Runaways: Nearby Hills stars

The Milky Way Unravelled by Gaia
December 2014
Barcelona

Work done by **John Vickers** (ARI)
& **Yanqiong Zhang** (SHAO)

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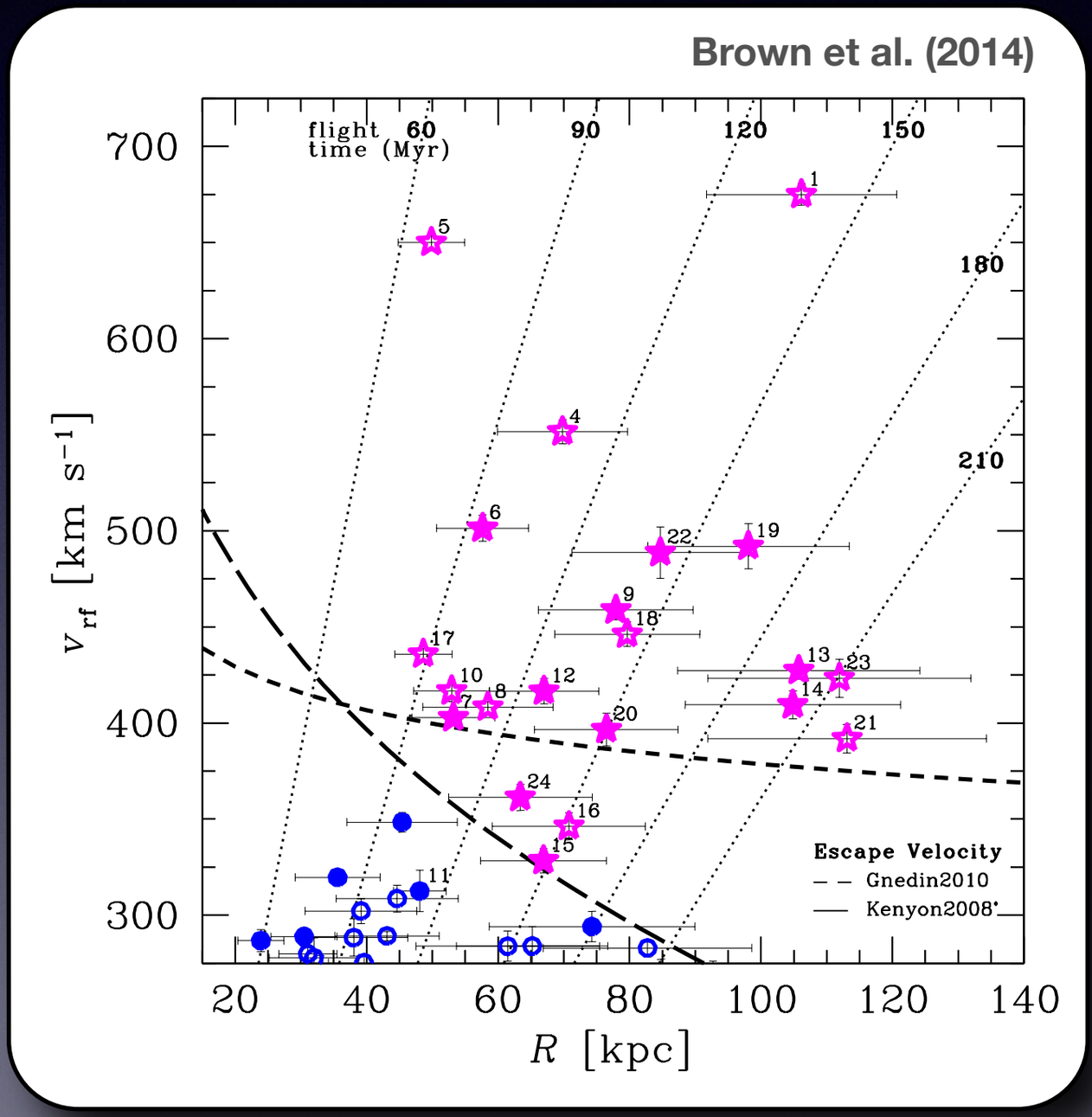
Hills ejecta as a probe of the Milky Way potential

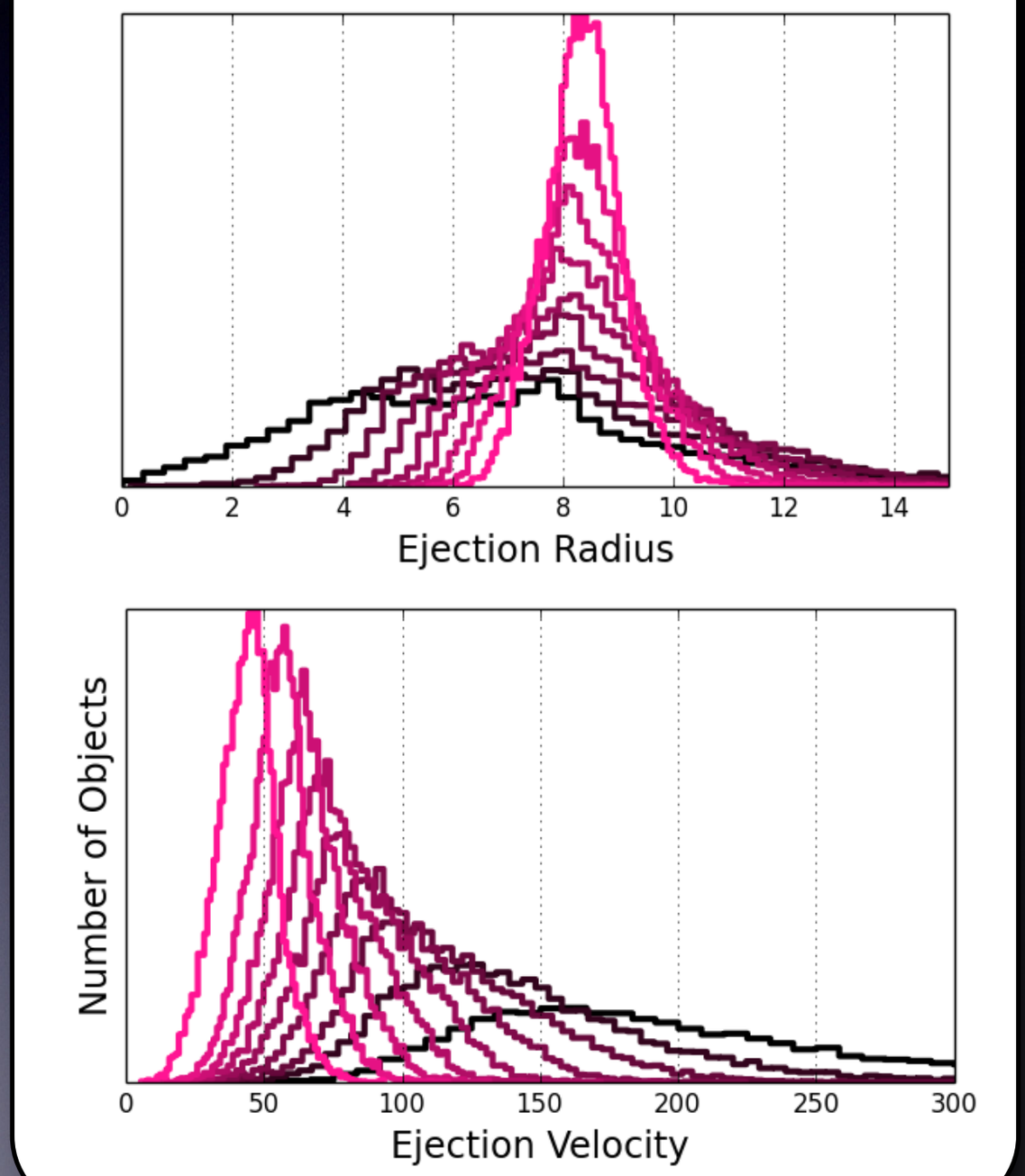
- One way to constrain the potential is through Hills stars, also known as hypervelocity stars
- All known Hills stars are all young B-type stars in the halo (Brown et al. 2014, Zheng et al. 2014)
- Since we know the orbit, we can constrain the potential (e.g. Gnedin et al. 2005)
- What we need are ***local*** Hills candidates with accurate positions and 3D velocities. Brown et al. (2014) suggest as many as 250 may lie in the solar neighbourhood



Red runaways

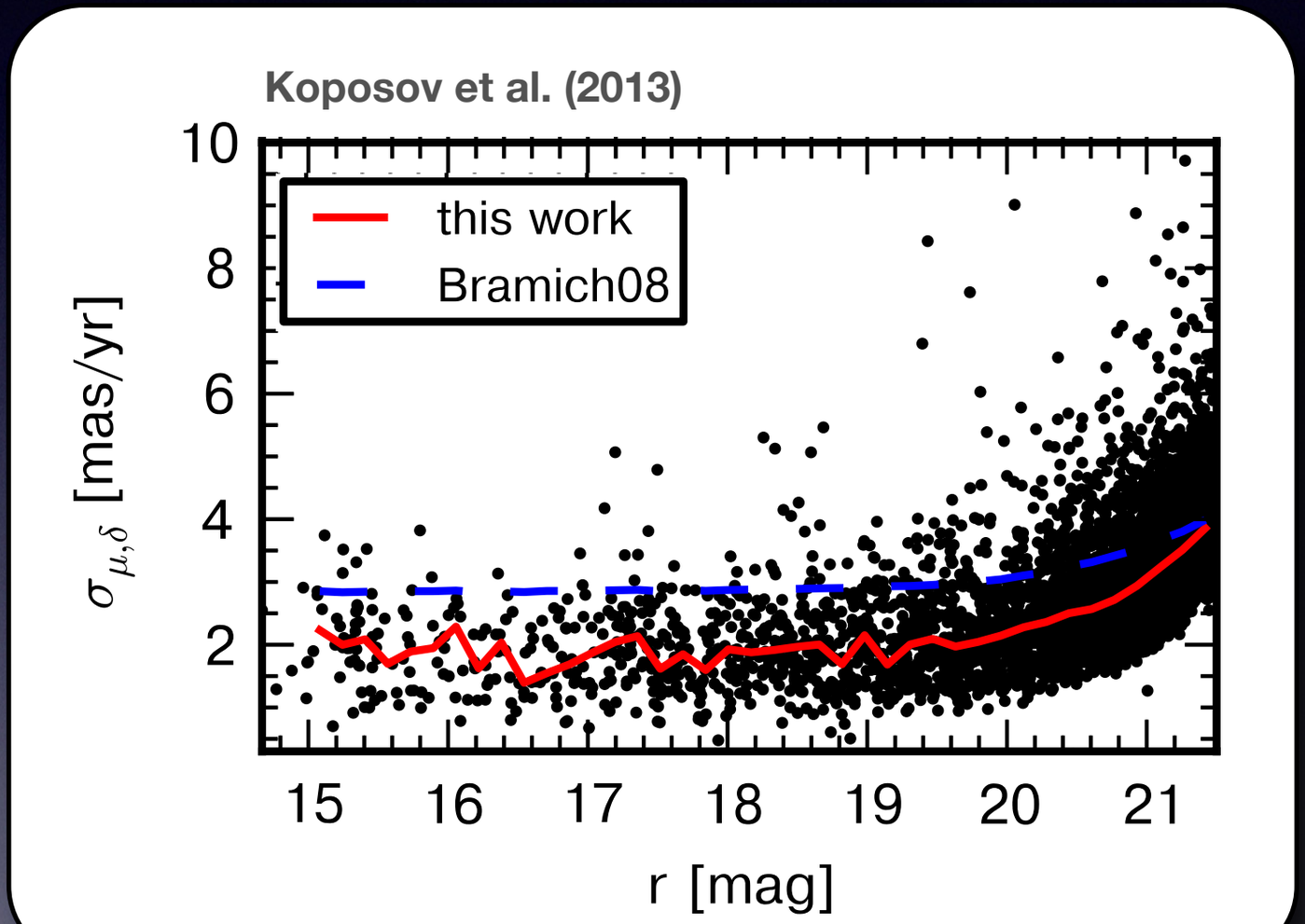
- We know of many runaway stars, i.e. stars that have been ejected from the disc
- Looking at the 3D velocities of metal-rich ([Fe/H]>-0.8) stars in SDSS, we identify outliers
- We find ~10 candidate hypervelocity stars, but these are not consistent with GC ejection (see also Palladino et al. 2014, Zhong et al. 2014)
- More importantly, we find 10-20 stars which are consistent with Galactic centre ejection

Vickers, Smith & Grebel (2014)



Stripe 82 astrometry

- The main stumbling block is the potential fallibility of proper motions
- These candidates passed a number of cuts (e.g. consistency between catalogues, stars not in crowded fields, etc)
- Ideally, we need a robust catalogue, such as from SDSS Stripe 82 (Bramich et al. 2008, Koposov et al. 2013)



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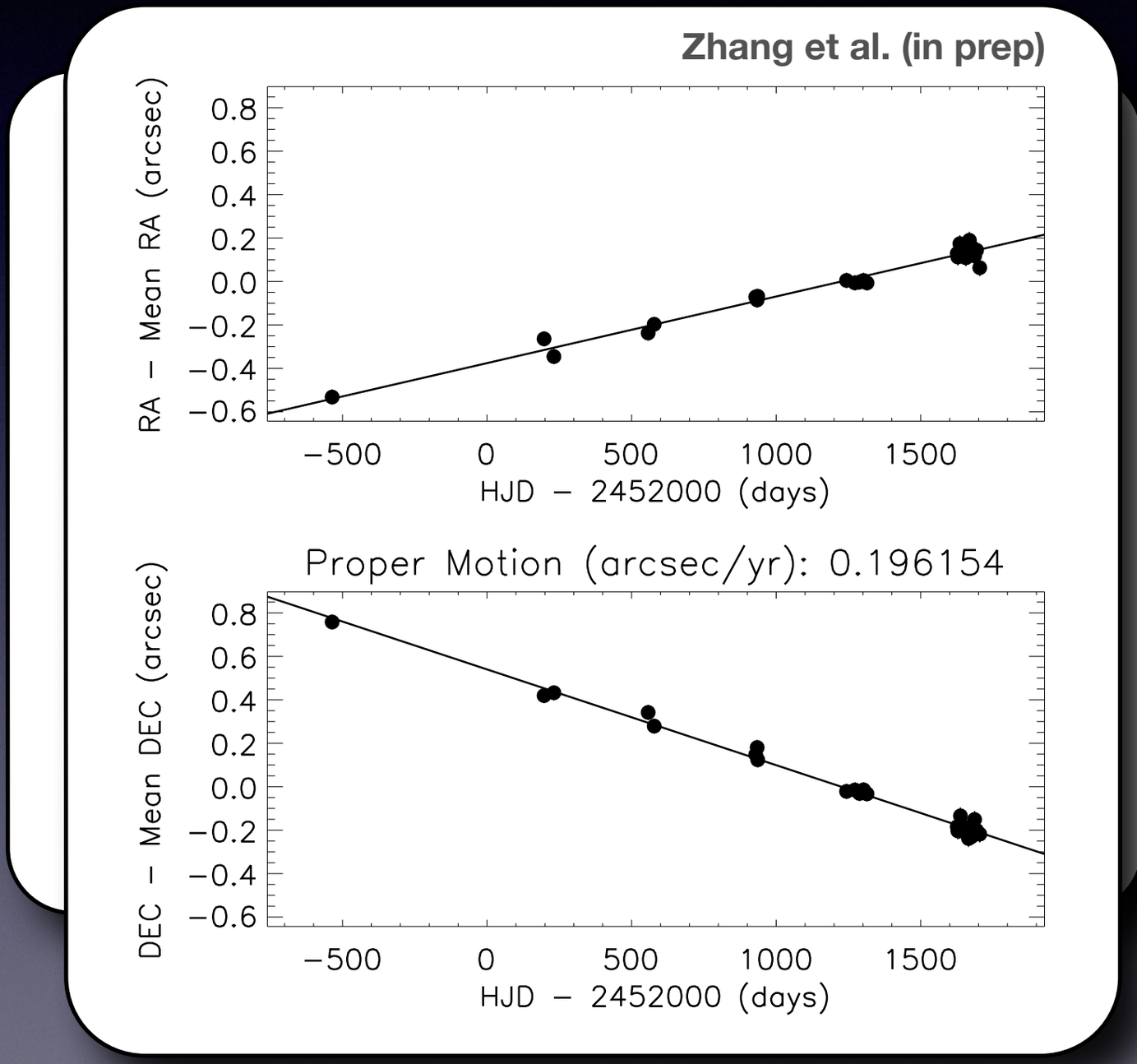
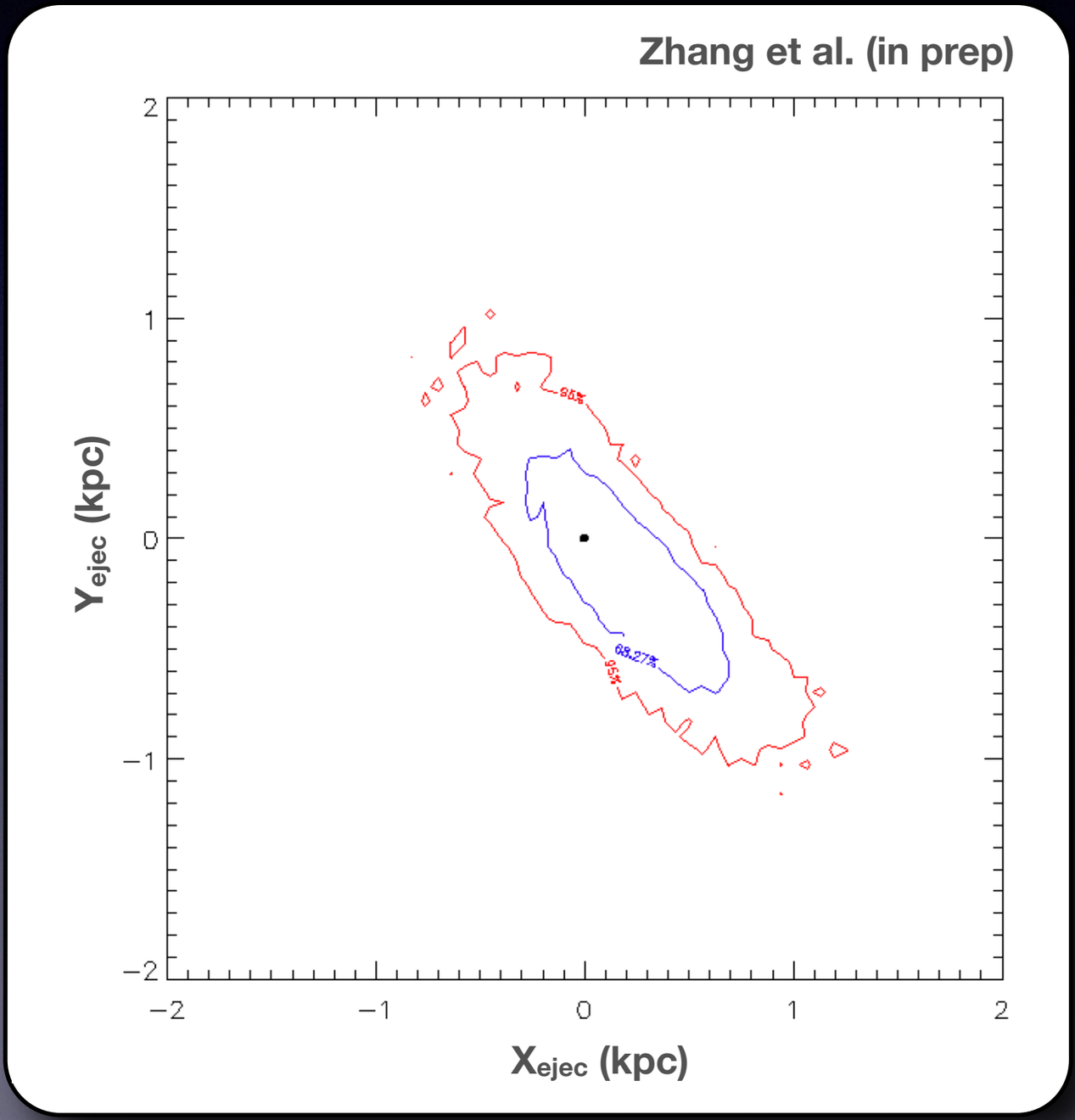


Hills ejecta in SDSS Stripe 82

- Use Stripe 82 proper motions and SDSS spectroscopy to hunt for Hills candidates
- We estimate distances photometrically and integrate their orbits to find the last disc crossing, incorporating all uncertainties
- From a total of 13k stars we find a few interesting candidates
- If this is a Hills star, then it was ejected at 490 km/s

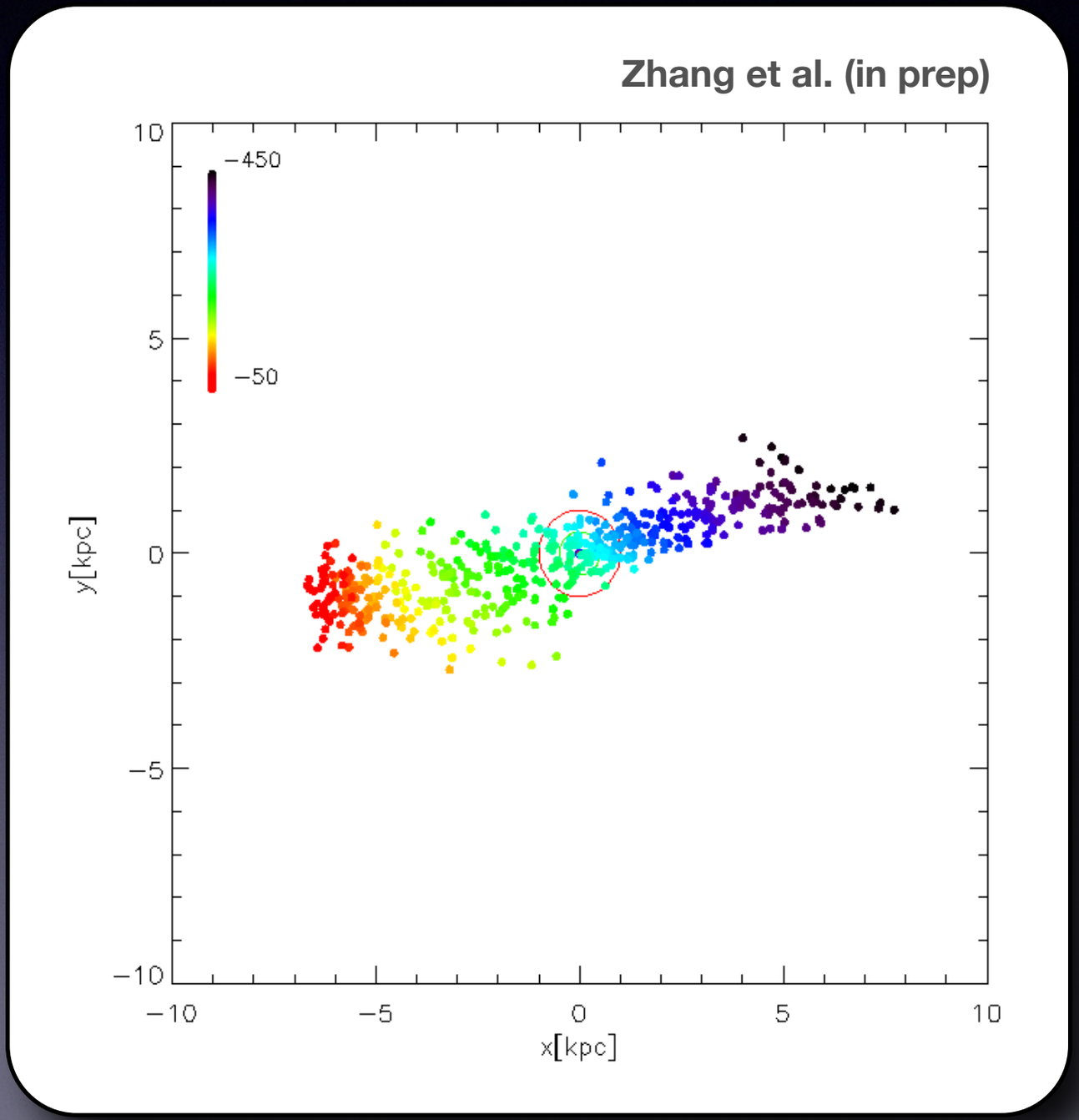


What if we have no spectra?

- However, only around 5% of stars in Stripe 82 have spectra, so how can we identify the Hills stars hidden in this sample?

- We calculate the last disc crossing as a function of the unknown radial velocity

- Follow up the good candidates with spectroscopy, identifying a number of good candidates, e.g. this star with [Fe/H] = -0.4 & ejection velocity of 560 km/s



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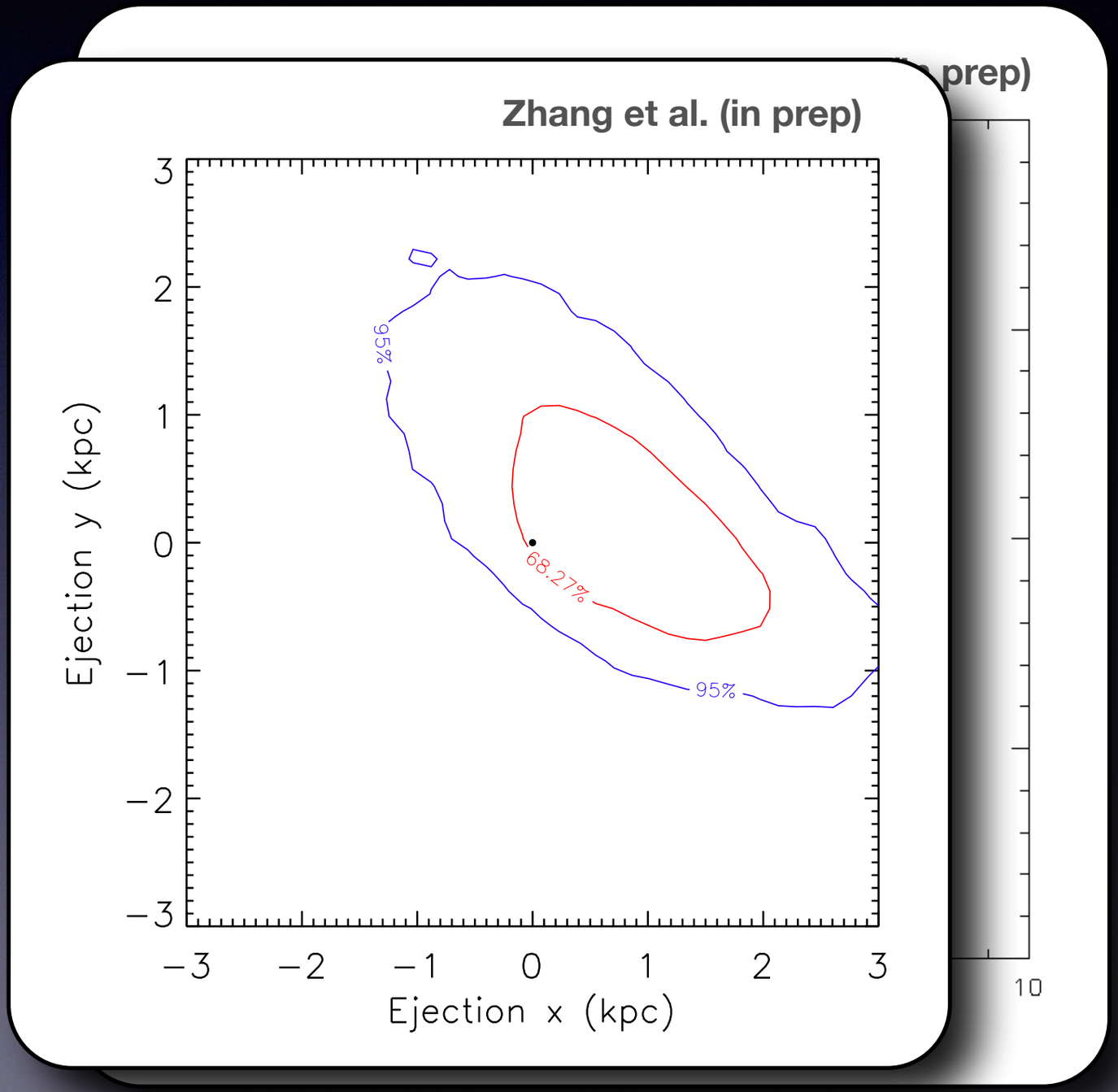

Looking ahead

- Gaia will drive a revolution in this field, allowing us to constrain the potential

- However, we still need radial velocities
  - LAMOST survey now in its 3rd year, obtaining 1M spectra per year
  - First international data release due in January, with vR & parameters for 1M stars

- There are many other exciting future projects…

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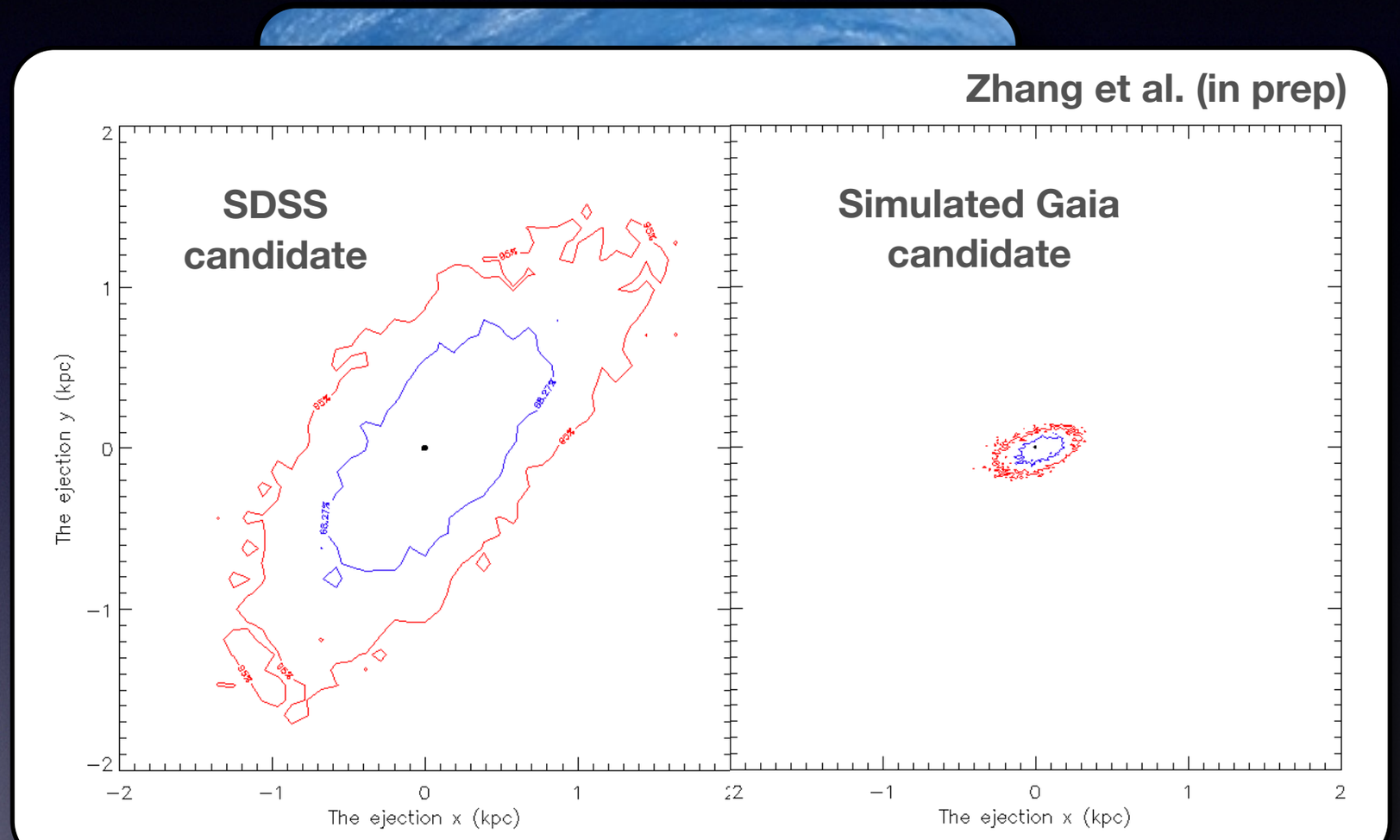

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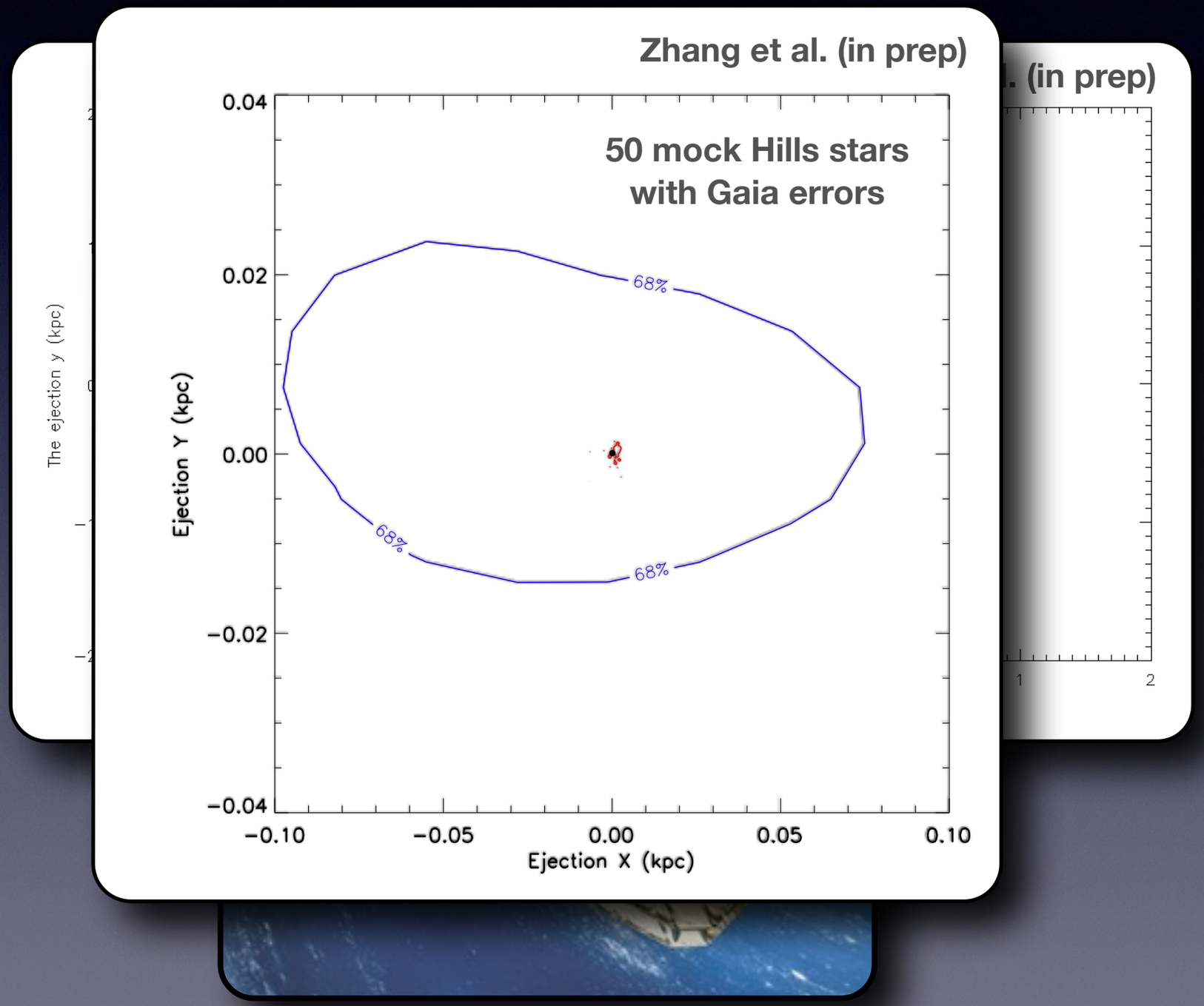

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