

Cool run-aways

Nearby Hills ejecta as a probe of gravitation potential of the Milky Way

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Hills Stars

When a stellar binary interacts with the Black Hole at the Galactic centre, one of the stars can be ejected with very high velocity (Hills 1988).

So far, confirmed Hyper-velocity stars are O/B/A stars !

Nobody has confirmed any low-mass Hills.

There are some HVS candidates in LAMOST.(Li et al. 2012, Zhong et al. 2014, Zheng et al. 2014)

Predicted number of ejected F/G stars ~ 30 * number of ejected O/B stars (Kenyon 2008)



To find low-mass Hills candidates — Data

Sloan Digital Sky Survey (SDSS) Stripe 82 data:

- 250 sq deg $(50^{\circ} < RA < -50^{\circ}, -1.25^{\circ} < Dec < 1.25^{\circ})$
- ~80 epochs over 7 years, u g r i z photometry
- Small systematics and random errors of proper motion (Koposov et al.2013)



249,901 low-mass stars13,170 with SDSS spectroscopy

Zhang et.al accepted by APJ http://arxiv.org/abs/1608.04053

To find Hills star — Method

If we trace the orbit of a star back in time, a Hills star will come from the Galactic centre

Calculate the last disc crossing by integrating the orbit back through time



To find low-mass Hills candidates — Identify





• $p(r_cr < 1 \text{ kpc}) > 25\%$

226

The possible Crossing positions of a star with measured errors by Monte Carlo technique

9 Hills Candidates with [Fe/H] > -0.58

The GC is within 3*σ of the Crossing position.

v_cr > 400 km/s



Observe 76 'good' Hills F/G targets with [Fe/ H] > -0.6 by Palomar telescope

- For one of the targets, the GC is within 3*σ of the crossing position.
- The proper motion selected sample has an efficiency of around 1/76 ~ 1.3%
- while the SDSS sample has an efficiency of 10/13170 ~ 0.08%



Constrain the Galactic potential by Hills Stars

All Galactic Potential are adopted from Dehnen & Binney(1998)



Constrain the Galactic potential by Hills Stars with Gaia error

If we have 50 nearby low-mass Hills stars:



Summary

- There may be several low mass Hills star in Stripe 82 data.
- Nearby Hills stars can constrain the Galactic potential, but accurate data is needed.