Probe the stellar halo with RR Lyrae stars: I The catalogue of RR Lyrae stars with metallicity and systemic radial velocity

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- Background
- The sample of RR Lyrae
- The metallicity and systemic radial velocity of RR Lyrae
- Preliminary Results

Background

- The stellar halo is arguably the component that contains the most useful information about the evolutionary history of the Galaxy.
- Despite its crucial importance, our knowledge of the stellar halo is fragmentary. This is at least partly driven by the paucity of halo stars.
- number density, metallicity (inner halo, outer halo?)
- Tidal stream, substructure?



Why we select using RR Lyrae

- RR Lyrae are valuable tracers of old stellar population to map the Galactic halo structure.
- Precisely measuring systemic velocities may help to identify halo substructures using kinematics, discern the nature of progenitors of halo substructures and constrain orbits of halo substructures.
- Up to now, there is no large spectroscopy catalogue about RR Lyrae

The advantage of RR Lyrae

- standard candle, easy to decide the 3D structure of halo
- Old stellar population, include much early stage information of Galaxy
- Short period and large amplitude of light curve, easy to identification



II.Sample

Large-scale RRLs Surveys

Survey	Filters	Area (\deg^2)	Range of V magnitude	Sources	Reference
Catalina	V	~ 33,000	12 - 20 13 5 - 19 7	23,306	Drake et al. 2013,2014 Mateu et al. 2012, Vivas et al. 2004, Zinn et al. 2014
NSVS	ROTSE-NT	~ 31,000	V < 14	1,304	Kinemuchi et al. 2006, Hoffman et al.2009
LINEAR LONEOS	no spectra filter LONEOS-NT	8,000 1,430	14-17 V < 18	5,684 838	Sesar et al.2013 Miceli et al. 2008
SEKBO	$B_M R_M$	1,675	V < 19.5	1,992	Keller et al. 2008, Prior et al. 2009
SDSS Str82 GCVS	ugriz	249	15-21	601 7,954	Watkins et al. 2009, Suveges et al. 2012, Sesar et al. 2010 Samus et al. 2009

Table 1. Characteristics of recent large-scale RRLs surveys

- Not include: Bulge and South Sky
- Total uniq source: 43,536



The spectra sample

- SDSS dr12 + LAMOST (2016.6): 7,299,478
- Match with photometry sample
- Uniq source: 6,268 (SDSS: 3,684, LAMOST:2,584)
- All source: 9,594 (SDSS: 4,768, LAMOST: 4,826)



Reference star

- Match with the Globular cluster catalogue and High resolution spectroscopy observation.
- Total: 68 (sdss/30, lamost/38)
- Uniq: 48 (sdss/24,lamost/24)

Calculation about metallicity

- High resolution spectroscopy measurement
- Delt S method (through comparison of the Call K line with the hydrogen lines H δ , H γ and H β)
- Caby photometry
- Fourier- decomposition method of light curve
- Our method: Treat each single exposure spectrum as a normal spectrum of a star, match Kurucz model, minimization the Chi square.

The reliability of our measurement

1.comparison with reference star



2.Comparison of multiple observation



Calculation of systemic radial velocity

• Method: gaussian fitting + template fitting

 $v_{\rm obs}(\Phi_{\rm obs}) = A_{\rm rv}T(\Phi_{\rm obs}) + v_{\gamma},$



compare Rv with the reference star

III.Preliminary Results



Carollo et al. Nature, 2007, 450, 1020



our work



Thanks