Proper-Motion Based Kinematics Study of Galactic RR Lyraes

Andrei K. Dambis[1], Leonid N. Berdnikov[1,2], Alexei S. Rastorguev[1] and Marina V. Zabolotskikh[1]

[1]Sternberg Astronomical Institute, M.V.Lomonosov Moscow State University, Universitetskii pr. 13, Moscow, 119992 Russia
email: dambis@yandex.ru

[2]Astronomy and Astrophysics Research division, Entoto Observatory and Research Center, P.O. Box 8412, Addis Ababa, Ethiopia

Abstract. We use the UCAC4 and SDSS proper motions of about 7500 RR Lyrae type variables located within ~ 10 kpc from the Sun to study the dependence of their velocity ellipsoid on Galactocentric distance in the R_G = 3-17 kpc interval. The radial velocity dispersion, σ_{VR}, decreases from ~ 190 km/s at R_G=3.5–5.5 kpc down to ~ 100 km/s at R_G=13–15 kpc, and the σ_{VT}/σ_{VR} ratio remains virtually constant ($\sigma_{VT}/\sigma_{VR} \sim 0.54$–0.64) in the Galactocentric distance interval from R_G=4.5 kpc to R_G=10.5 kpc increasing to ~ 0.9 both toward the Galactic center and beyond R_G=11 kpc.

Keywords. stars: kinematics, stars: RR Lyrae, Galaxy: kinematics and dynamics

Our kinematic tracer sample consists of 7464 RR Lyrae type variables located within ~ 10 kpc from the Sun drawn from the lists of Szczygiel *et al.* (2009) (based on ASAS survey data), Torrealba *et al.* (2015), and Drake *et al.* (2013) (based on the Catalina Sky Survey data) with the proper motions adopted from the UCAC4 (Zacharias *et al.* 2013) and SDSS DR12 (Alam *et al.* 2015) catalogs. We compute the photometric distances to these RR Lyraes using mid-IR WISE W1-band intensity-mean magnitudes determined from ALLWISE data (Wright *et al.* 2010) and our W1-band period-metallicity-luminosity relation

$$< M_{W1} >= -0.814 + 0.106[\text{Fe/H}] - 2.381 \log P$$

(Dambis *et al.* 2014).

We use the maximum-likelihood method to determine the average kinematical parameters of the entire sample – the bulk-motion components (U_0, V_0, W_0) = (-16 ± 5, -212 ± 4, +3 ± 5) km/s and the velocity-ellipsoid parameters σ_{VR} = 178 ± 4 km/s and σ_{VT}/σ_{VR} =0.66± 0.02 – from proper-motion data exclusively. We also determine the velocity-ellipsoid parameters within 1 kpc-thick Galactocentric distance bins (Figs. 1–2). The radial velocity dispersion decreases steadily from ~ 190 km/s near the Galactic center to ~ 100 km/s beyond $R_G \sim 13$ kpc, whereas the σ_{VT}/σ_{VR} velocity dispersion ratio remains almost constant between R_G=4.5 kpc and R_G=10.5 kpc and increases both toward the Galactic center and beyond $R_G \sim 13$ kpc. The results become highly uncertain beyond $R_G \sim 12$ kpc.
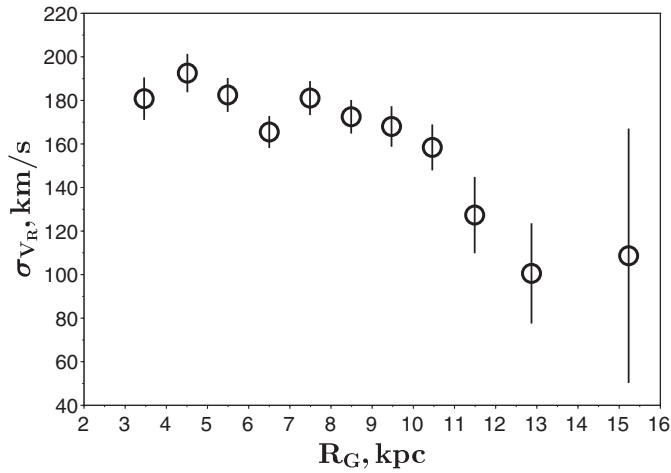
Acknowledgments

Figure 1. Radial velocity dispersion for halo RR Lyraes as a function of Galactocentric distance.
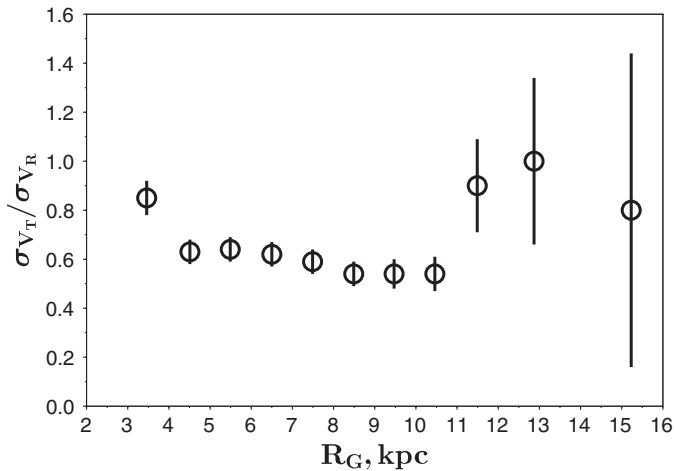

Figure 2. Transversal-to-radial velocity dispersion ratio for halo RR Lyraes as a function of Galactocentric distance.

References

Alam, S. *et al.* 2015, *arXiv1501.00963*
Dambis, A. K., Rastorguev, A. S., & Zabolotskikh, M. V. 2014, *MNRAS*, 439, 3765
Drake, A. J. *et al.* 2013, *ApJ*, 763, 32
Szczygiel, D. M., Pojmanski, G., & Pilecki, B. 2009, *AcA*, 59, 137
Torrealba, G. *et al.* 2015, *MNRAS*, 446, 2251
Wright, E. L. *et al.* 2010, *AJ*, 140, 1868
Zacharias, N. *et al.* 2013, *AJ*, 145, 44