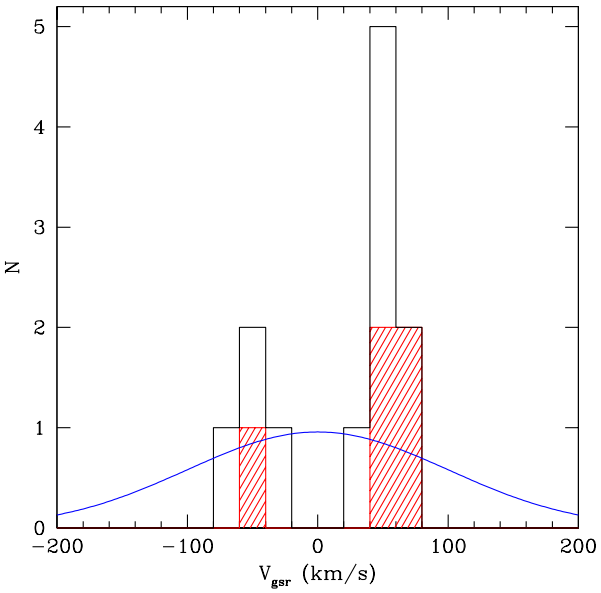

Fig. 1. Histogram of $V_{\rm gsr}$ of RR Lyrae stars in the Pisces overdensity. The shaded histogram corresponds to the stars measured in this work. The Gaussian curve represents a smooth halo normalized to the number of RRLS in the sample.

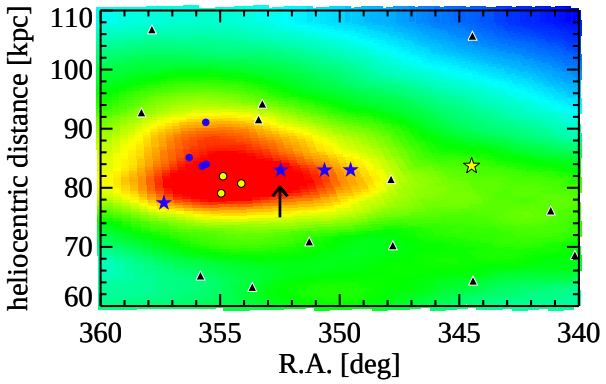

Fig. 2. Density contours of RR Lyrae stars in the Pisces region, from Sesar et al. (2010a). Symbols on top show the location of the RR Lyrae stars. Circles and star symbols represent the samples observed spectroscopically by Kollmeier et al. (2009) and this work, respectively. The arrow denotes the star in common between the two datasets.

is clear that the velocities of the RR Lyrae stars do not behave as a normal distribution. Indeed, normality is rejected, with $> 95\%$ confidence level, by using a Shapiro-Wilk statistical test. The distribution of radial velocities shown in Figure 1 is bimodal. One peak, the largest, contains 8 stars and $\langle V_{\rm gsr}\rangle = 50$ km s^{-1} ($\sigma = 10$ km s^{-1}). On the other hand, the second peak contains the remaining 4 stars and $\langle V_{\rm gsr}\rangle = -52$ km s^{-1} ($\sigma = 23$ km s^{-1}).

Both groups have large extensions in the sky (Figure 2), which is hard to reconcile with the groups being bound systems. Thus, most likely these are tidal debris from a destroyed galaxy or galaxies. The positive velocity group extends $\sim 8^\circ$ in right ascension, which corresponds to $\sim$9 kpc at the distance of the Pisces overdensity (blue symbols in the online-only color version of Figure 2). The second group (yellow symbols) has a slightly larger angular extension. In declination, both groups may extend beyond the limits of the narrow Stripe 82 ($\pm 1.^\circ 27$).

The positive velocity group has a metallicity of [Fe/H] $= -1.4$, while the smaller group has [Fe/H] $= -1.7$. However, given the errors of our measurements, the dispersion observed in each group, and the low number statistics, we cannot say that the groups have different metallicities. The important point, however, is that the progenitor(s) must have been a system(s) with a metal-poor population. Recently, there has been indication that a group of M-giants (which trace a intermediate age population) may be related with the Pisces overdensity (Sharma et al. 2010). If confirmed, the progenitor may then be a system with multiple stellar populations, like many of the dwarf satellite galaxies of the Milky Way.

We conclude that the Pisces overdensity is composed of two different kinematic groups occupying about the same volume of the halo. The two groups may come from the same disrupting galaxy as tidal tails stripped at different epochs may overlap on the sky (e.g. Sagittarius). On the other hand, it is possible that these are two overlapping streams from two different merger events. Available data do not allow us to discriminate between those two scenarios.

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