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The RAVE Survey: Constraining the Local Galactic Escape Speed

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Abstract. We report new constraints on the local escape speed of our Galaxy. Our analysis is based on a sample of high velocity stars from the RAVE survey and two previously published datasets (the Geneva-Copenhagen survey and the Beers *et al.* catalogue of metal-poor stars). We use cosmological simulations of disk galaxy formation to motivate our assumptions on the shape of the velocity distribution, allowing for a significantly more precise measurement of the escape velocity compared to previous studies. We find that the escape velocity lies within the range $492\,\mathrm{km\,s^{-1}} < v_{\rm esc} < 594\,\mathrm{km\,s^{-1}}$ (90% confidence), with a median likelihood of $536\,\mathrm{km\,s^{-1}}$. The fact that $v_{\rm esc}^2$ is significantly greater than $2v_{\rm circ}^2$ implies that there must be a significant amount of mass exterior to the Solar circle, i.e. this convincingly demonstrates the presence of a dark halo in the Galaxy. For a simple isothermal halo, one can calculate that the minimum radial extent is ~ 54 kpc. We use our constraints on $v_{\rm esc}$ to determine the mass of the Milky Way halo for three halo profiles. For example, an adiabatically contracted NFW halo model results in a virial mass of $1.31^{+0.97}_{-0.49} \times 10^{12} M_\odot$ and virial radius of 297^{+60}_{-44} kpc (90% confidence). For this model the circular velocity at the virial radius is $141^{+27}_{-19}\,\mathrm{km\,s^{-1}}$. Although our halo masses are model dependent, we find that they are in good agreement with each other.

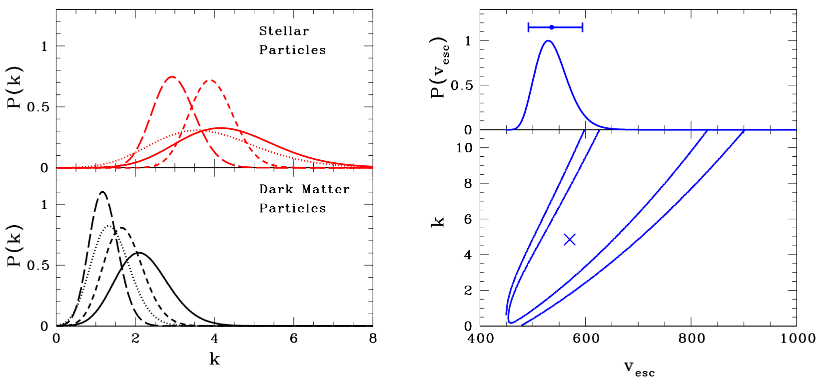

Figure 1. The left-hand panel shows the likelihood estimate for k from four simulated galaxies, where k denotes the shape of the tail of the velocity distribution. From this we deduce a uniform prior for $k \in [2.7, 4.7]$. The right-hand panel shows the final likelihood contours for our observed high velocity stars. We also show the resulting constraints on $v_{\rm esc}$ after applying our prior on k.

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