Towards a chemodynamical model of the stellar halo

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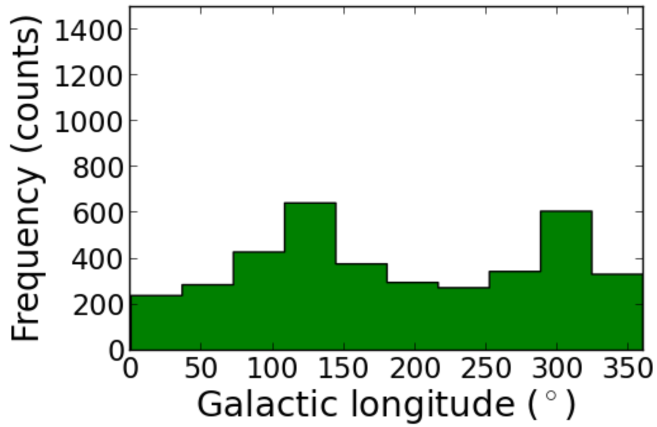
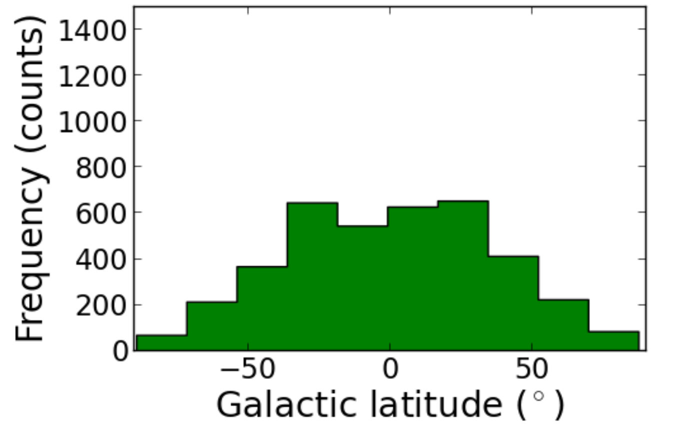
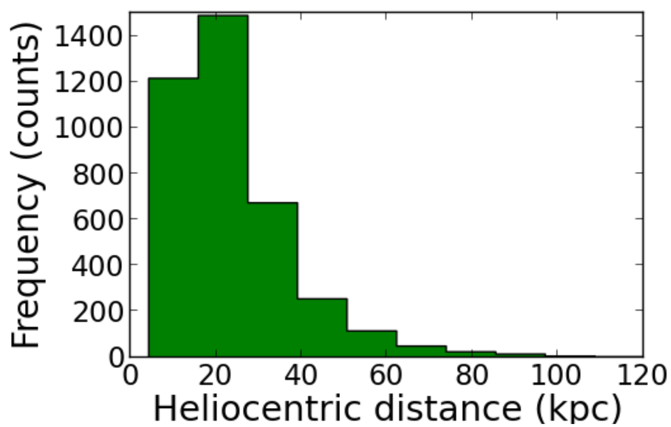
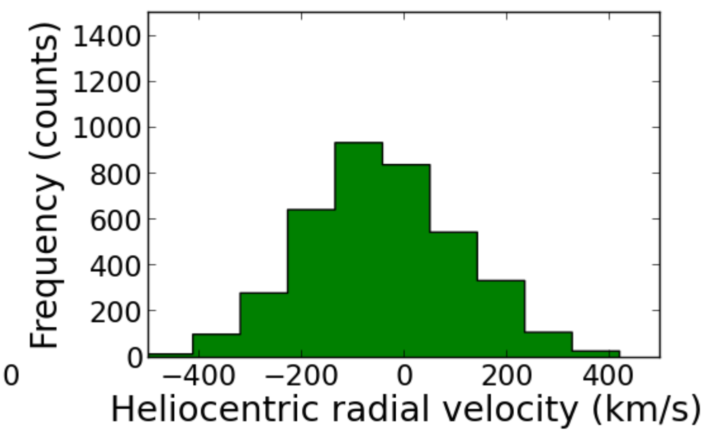
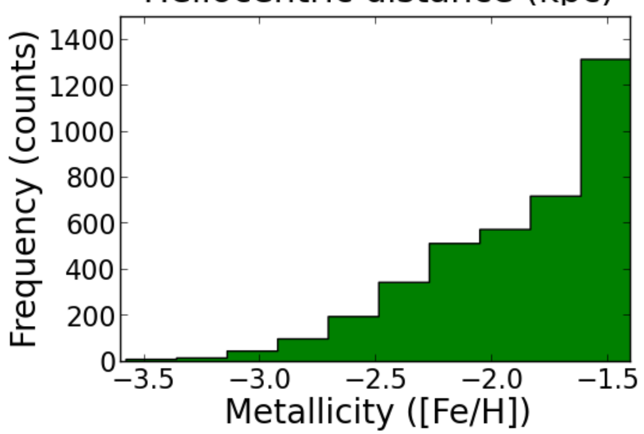
Property	Range
Galactic latitude (°)	0 < *l* < 360
Galactic longitude (°)	-90 < *b* < 90
Proper motions (mas/yr)	-11 < PM < 11
Surface gravity	Log *g* < 3.5
Colour	0.5 < $(g\text{-}r)_0$ < 1.3
Reddening	*E*(*B*-*V*) < 0.25
Apparent magnitude	*15* < *r* < 20.2
Metallicity	[Fe/H] < -1.4











Observational constraints consist of sky positions, heliocentric distance, heliocentric radial velocity, and metallicity for a sample of 6036 K-Giants from the SEGUE survey (Xue et al. 2014). Upper metallicity limit of -1.4 is imposed (Schönrich et al. 2012) to minimize contamination from disc stars, resulting in 3686 stars.

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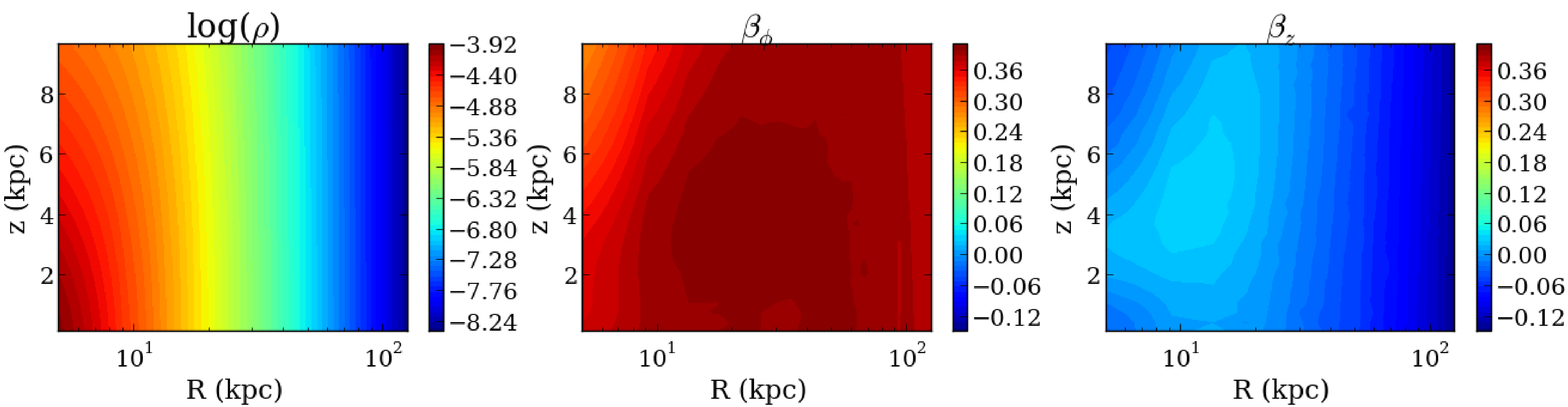
$$f(\mathbf{J}) = \frac{f_0}{h(\mathbf{J})^{\alpha}(h_0 + h(\mathbf{J}))^{\beta-\alpha}} \exp\left[-\left(\frac{h(\mathbf{J})}{h_{\max}}\right)^4\right], \; h(\mathbf{J}) = J_R + \gamma_1 |L_z| + \gamma_2 Jz + J_{\mathrm{core}}$$

$$\mathcal{L} = \frac{p(S|D)p(D|M)}{p(S|M)}$$

Use Neader-Mead 'amoeba' algorithm to maximise the likelihood of the observations given the stars are in the survey and an action-based distribution function (Posti et al, 2015, Williams et al. 2015).



The best-fit parameters are $[\alpha\ \beta,\ h_0, \gamma_1, \gamma_2]$ = [2.1,5.0,8400,0.94,0.68], describing a density profile that falls off as -2.1 in the inner regions and -5.0 further out. The halo is radially anisotropic with regards to the azimuthal velocity dispersions but isotropic with regards to the *z* velocity dispersions, as expected in an axisymmetric potential. The more metal-poor stars show a weaker transition in their density profile between the inner and outer stellar halo and a slightly stronger degree of anisotropy in their azimuthal velocity dispersions.