Constructing a DF for the extended solar neighbourhood based on approximations of the third integral

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Study of the extended solar neighbourhood

- Angle-Action variables as starting point
- Epicycle approximation (nearly circular orbits):

$$\begin{cases} J_R = E_R/k \\ J_\phi = L_z \\ J_z = E_z/\nu \end{cases}$$

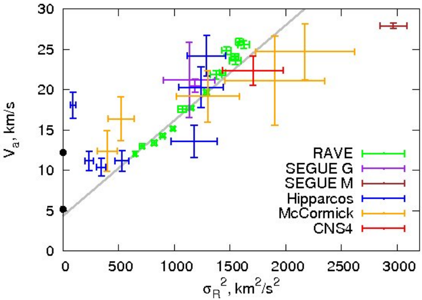
- Modeling approach: flexible
- Radial gradients in the disk
- Changes in E_z must be compensated in changes in E_R
- Approximation for third integral of motion (I_3 Ansatz)
- Phase-space distribution function $f(r, v)$ comparable with observations
- Apply to subpopulations with different α-enhancement and metallicity

- Jeans theorem: f(integrals) solve the collisionless Botzmann equation
- Strong Jeans theorem: $f(I_1, I_2, I_3)$ for regular orbits

$$\begin{cases} I_1 = E_{tot} \\ I_2 = L_z \\ I_3 = [\frac{1}{2}W^2 + \Phi(R,z) - \Phi(R,0)]/\sqrt{\rho(R,0)} \end{cases} \qquad \text{(Klement, 2009)}$$

- I_3 valid only locally
- Vertical structure of solar neighbourhood is well known (Just & Jahreiss, 2010)
- DF of the disk (2D): $f(E, L) \propto L^{2n} g_n(E)$ (Khoperskov et al., 2007)
- From 2D to 3D
- Distribution function $f(I_1, I_2, I_3)$ for the extended solar neighbourhood

- Asymmetric drift (Plot of Oleksiy Golubov)



- $V_\odot = 4.47 \pm 0.92$ km/s
- Orientation and tilt of the velocity ellipsoid
- Self-consistent problem: make a guess for the dependence of the DF on the isolating integrals and calculate the density, potential, motions and velocity distributions.