Definitions of the LSR

There are 2 commonly used definitions:

1. Kinematic LSR
2. Dynamical LSR

Kinematic LSR (KLSR)

Choose a sample of N local stars. Average their radial (u), angular (v) and axial (ω) motions.

$$\bar{u} = \frac{1}{N}\sum_{i=1}^{N} u_i$$

$$\bar{v} = \frac{1}{N}\sum_{i=1}^{N} v_i$$

$$\bar{\omega} = \frac{1}{N}\sum_{i=1}^{N} \omega_i$$

The velocity vector of the KLSR is set to these averages:

$$(u, v, \omega)_{LSR} = (\bar{u}, \bar{v}, \bar{\omega})$$

Dynamical LSR (DLSR)

This is based on a point moving in a circular orbit around the galactic centre so that the centrifugal force exactly balances gravity.

$$(u, v, \omega)_{LSR} = (0, v_c, 0)\big|_R$$

$$\frac{{v_c}^2}{R} = -\frac{\partial\Phi}{\partial R}$$

The KLSR and DLSR don't exactly coincide. The KSLR is better for local effects, the DLSR for the whole galaxy.

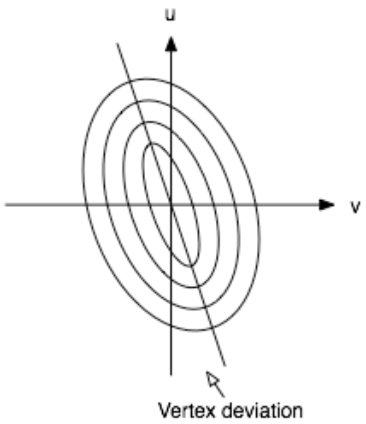
Solar motion in the Oort section is based on:

$$(u_0, v_0, \omega_0) = -(\bar{u}, \bar{v}, \bar{\omega})$$

Extrapolate to $\sigma_v = 0$ (stellar velocity dispersion) for a value with respect to the DLSR.

Star Streaming

Plot u against v relative to the LSR: contours of number of stars.



- Expect circular contours if the motions are random.
- Actually find an ellipsoidal distribution.
- Origin corresponds to LSR
- Split stars into classes by spectral type. Vertex deviation $\sim 20°$ for young F-stars, smaller for older S, K, M.
- Local stars are not quite in a steady state.
- Younger stars are especially perturbed.

Possible reasons:

1. Young stars still have component of motion from formation process?
2. Nearby Orion spiral arm breaks axial symmetry?