EXCERPT from BIENNIAL REVIEW REPORT 1997-1998

Agris J. Kalnajs

June 17, 1999

1 Research conducted and proposed

1.1 Star Streaming

The Hipparcos data was released in 1997. The top panel of Figure 1 shows a plot of the tangential velocity components along the Galactic plane in the direction pointed to by the Galactic longitude l. These stars, with distance errors less than 10%, are within 100 parsecs of the Sun and have a $B - V < 0.8$. For those marked with the blue dots $B - V < 0.32$.

A group of stars all moving with the same space velocity would map into a sinusoidal curve. One can see two distinct sinusoids which correspond to the two streams that Kapteyn saw in 1904, and which could also be seen (with some effort!) in the stars with the best determined velocities found in Gliese's and Woolley's catalogues.

This plot demonstrates that we do not live in an axisymmetric galaxy which is in equilibrium. In the latter case the velocity dispersion should have minima in the directions $l = 90°, 180°$, and maxima in the directions $l = 0°, 180°$. The ratio of the two dispersions should be $sqrt(2)$.

Such streaming will occur naturally in a barred galaxy. In the vicinity of an Outer Lindblad Resonance the orientation of the periodic orbits changes by 90°. The lower panel of Figure 1 shows the orbits around OLR produced by a bar. In this co-rotating frame the stars move in a retrograde sense. If we assume that the bar rotates in a clockwise sense, then an observer in the first (or fourth) quadrant could see two (or three) periodic orbits at suitably chosen points. The stars on the red orbits, which move outward, correspond to the Hyades Stream, while those on the blue orbits, which have a small inward motion, belong to the Sirius Stream.

If the star streaming is caused by a rotating bar, then there is no reason to expect that all the stars in a stream have similar ages or abundances.

The intersecting orbits also insure the presence of spiral shocks in the gas and new-born stars which add a wealth of detail to the observed velocities. Some of that detail is accidental, however the streams are a part of the grand design of a barred Milky Way.

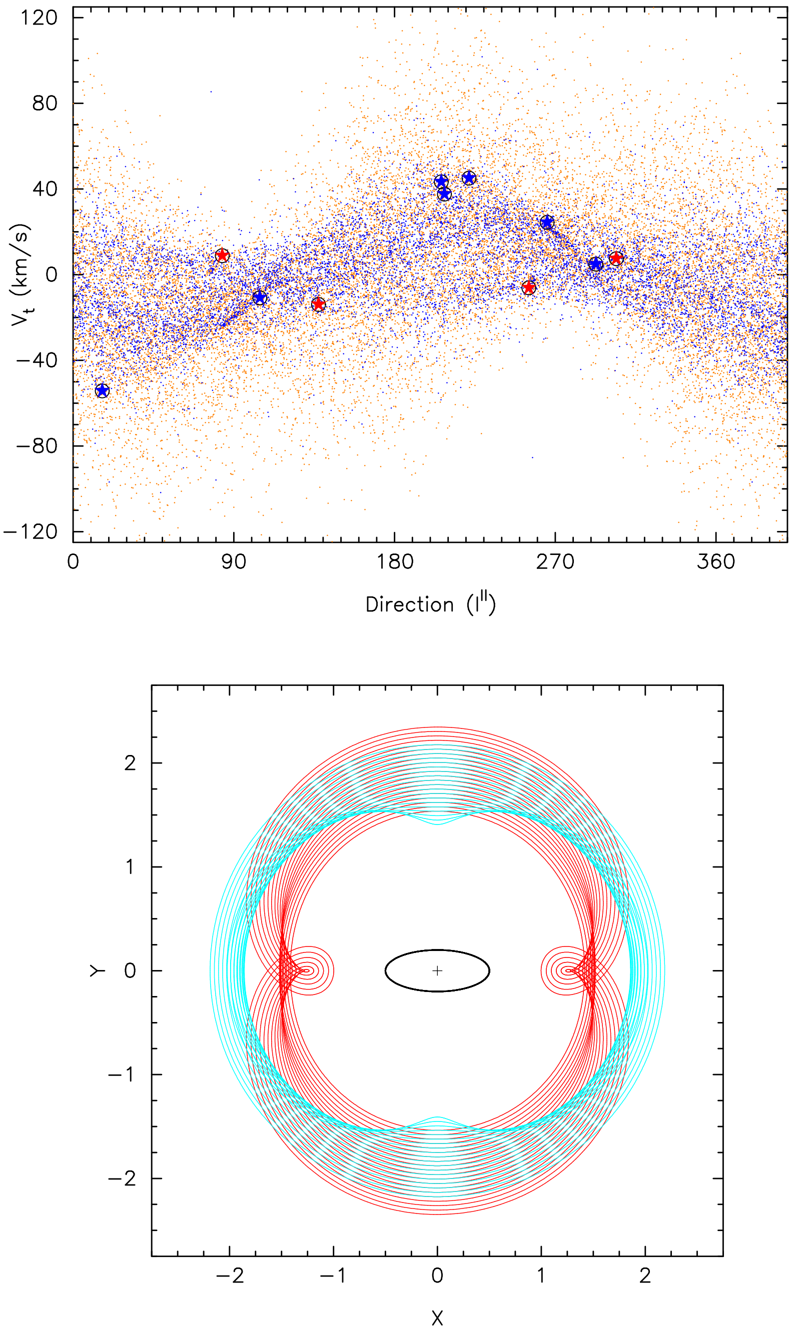

Figure 1: The velocities of Hipparcos stars seen in various directions (top), and periodic orbits around OLR produced by a weak bar (bottom).