Bar-Driven Dynamic Structures in Local Velocity Space

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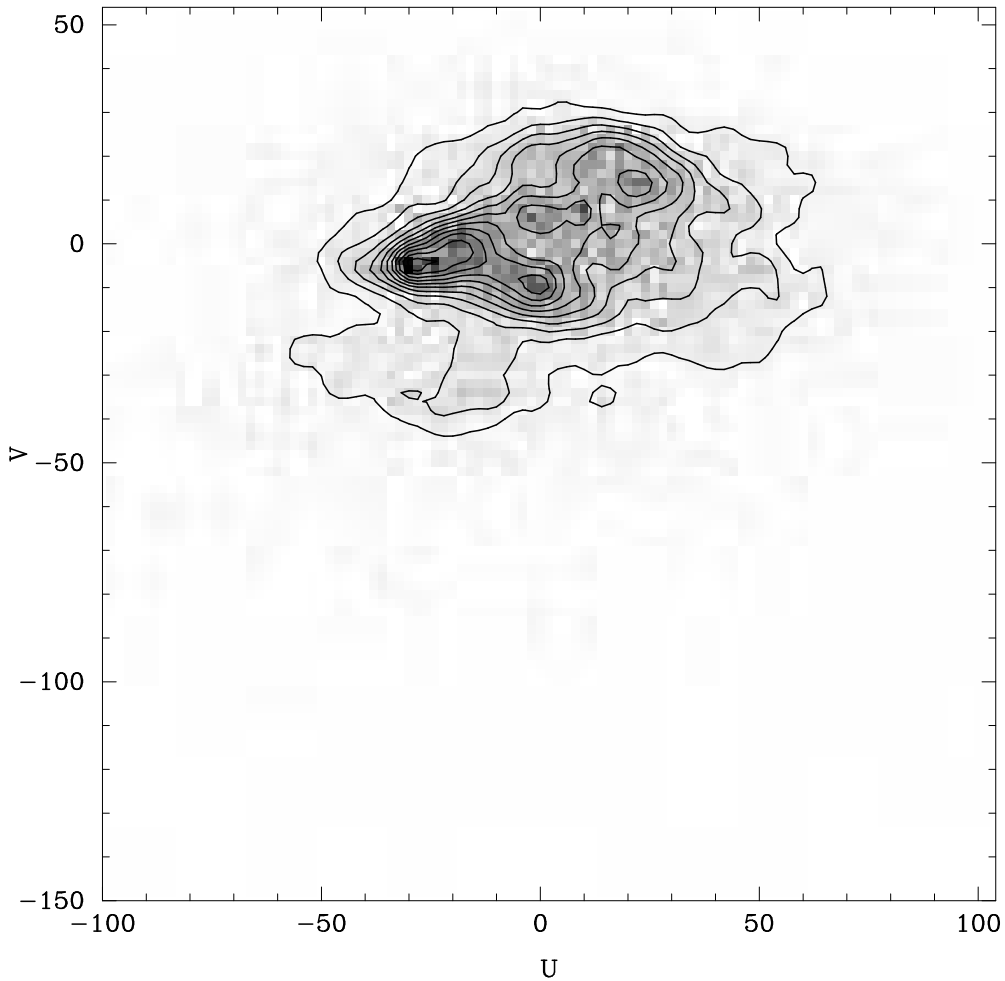
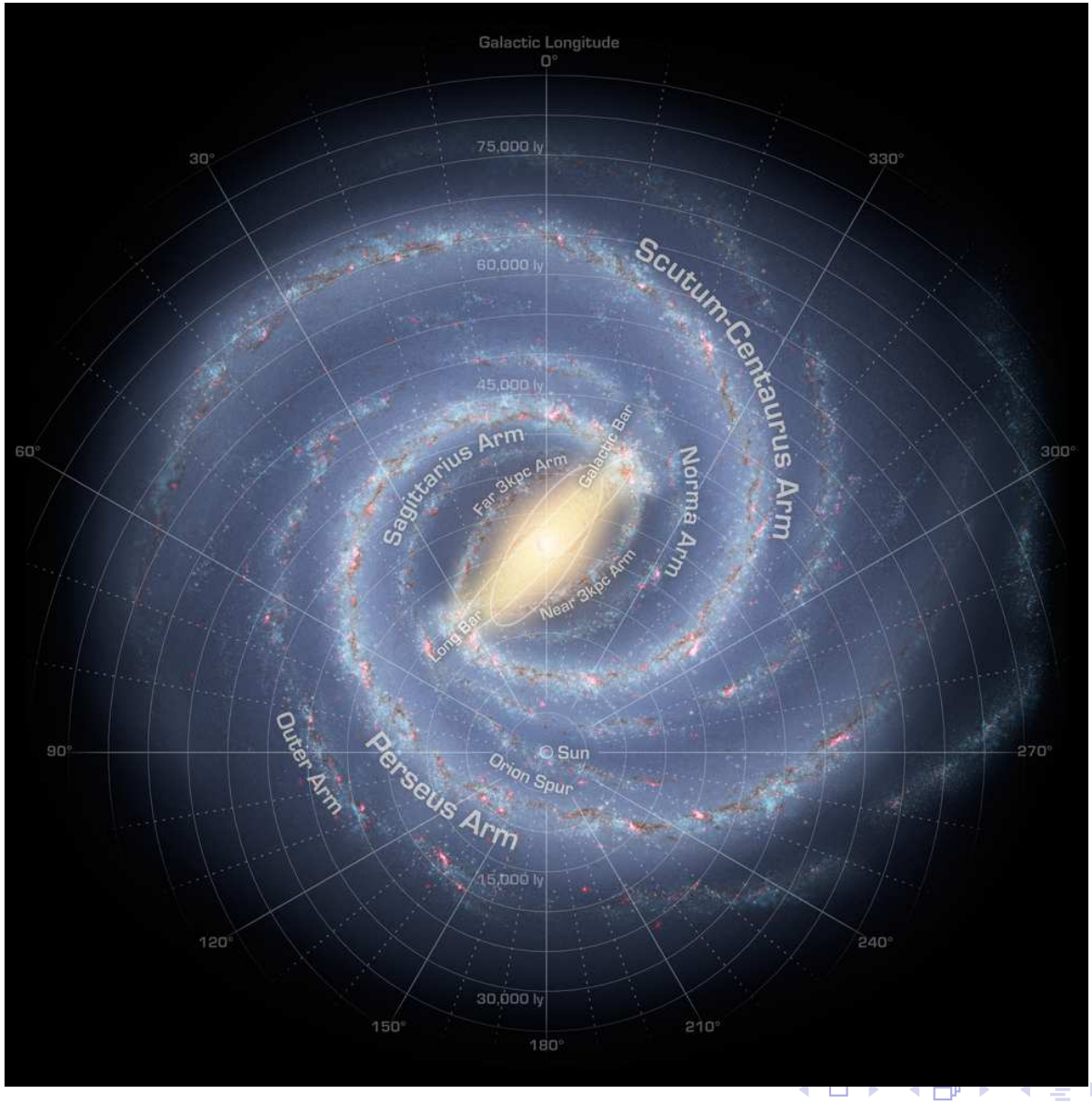
Outline

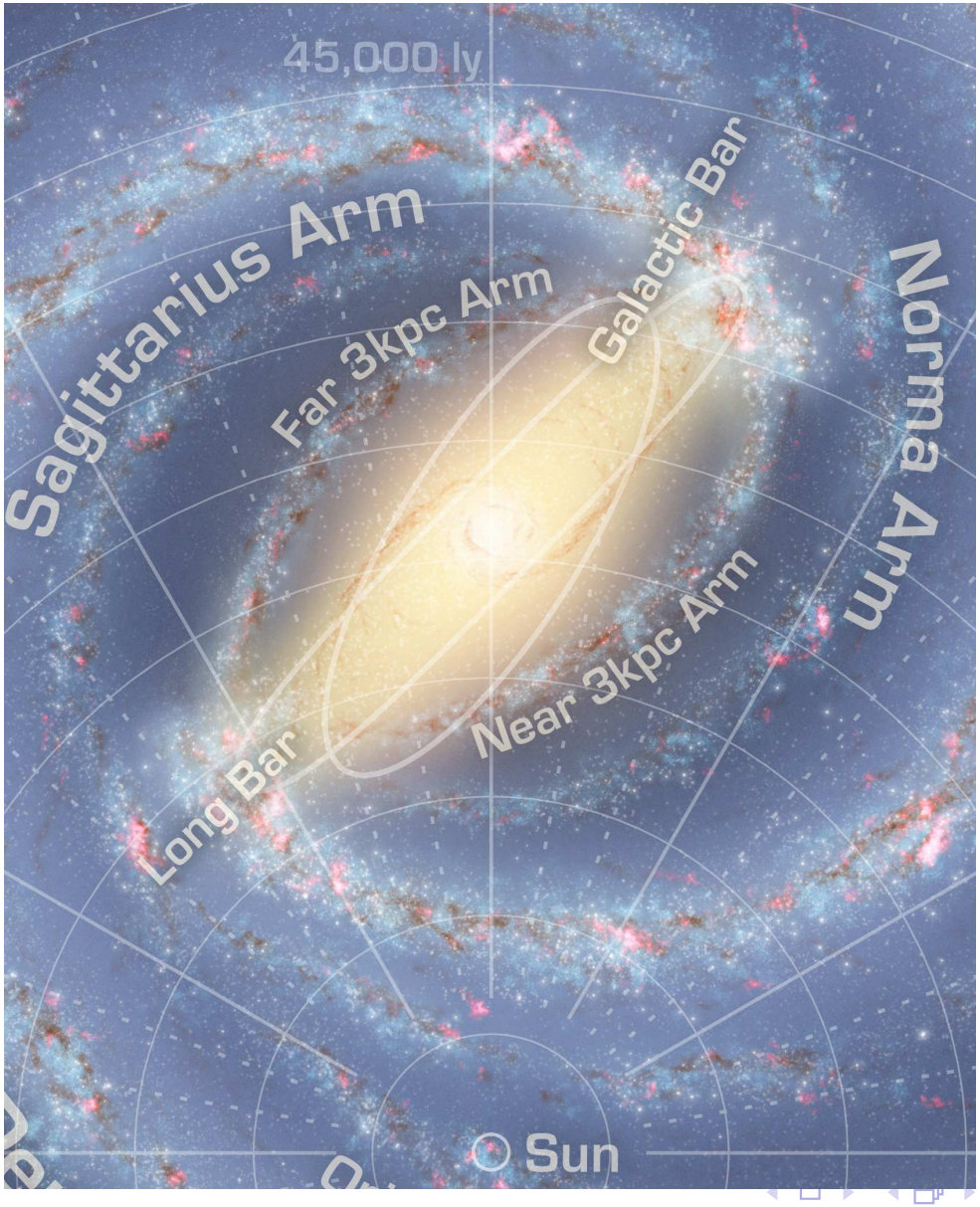
The one we're interested in



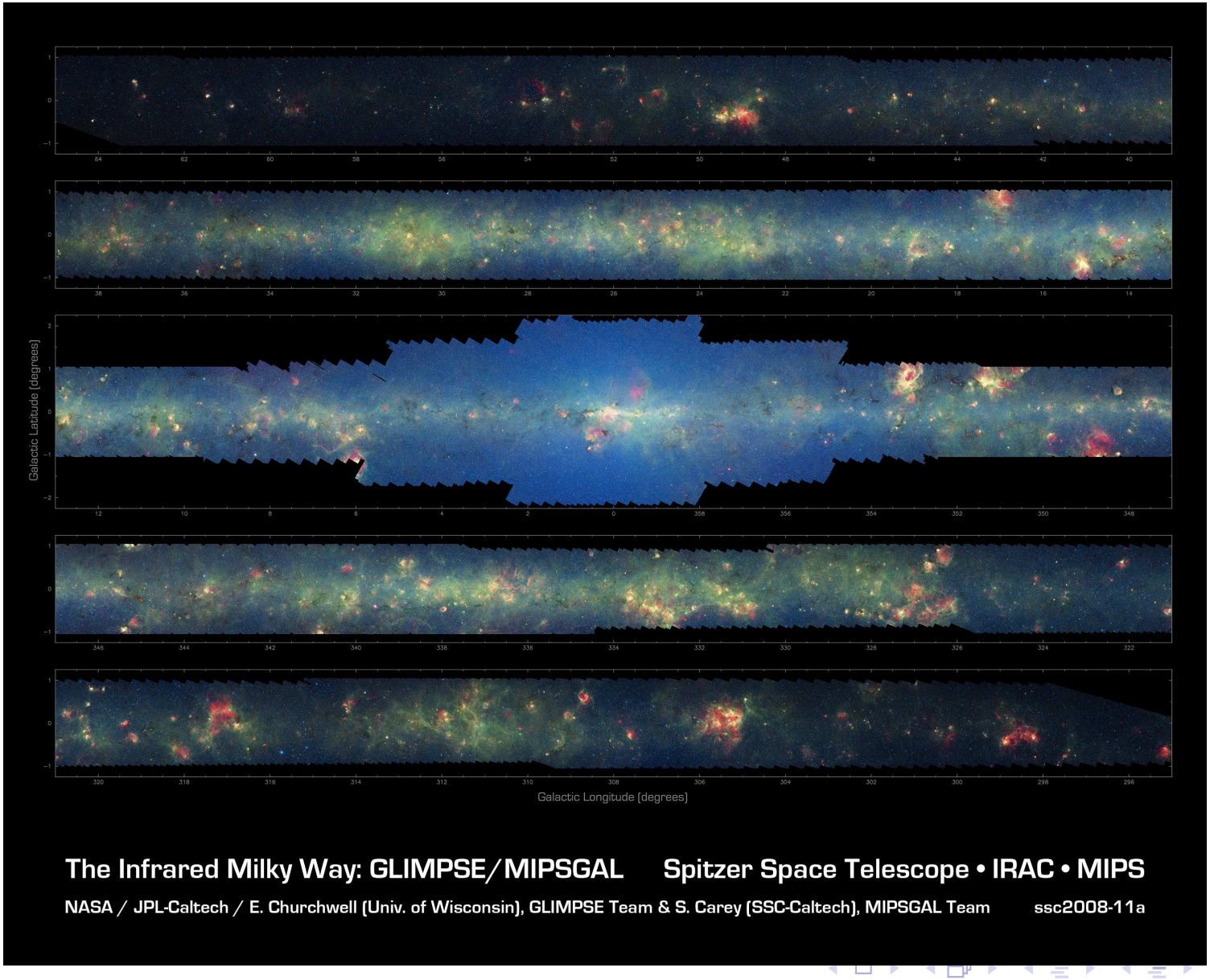
(An artist's impression of) the Galaxy



(An artist's impression of) the Galaxy (detail)



(What we actually see when looking at) the Galaxy



Pick a bar, any bar

- We know that a bar can cause dynamical structure
- The dynamical signature might be seen locally,
- The problem with the Milky Way seems to be that:
- There are two different observed large-scale (kpc) bars. (see e.g.: Benjamin et al. 2005, Bissantz & Gerhard 2002)
- So let's study the effects of two bars separately.
- And then go for two.

Potentials

- Standard axisymmetric stuff:
- Bulge, Halo, Dark Halo (see Flynn et al. 1996)
- Disk, scale length of 3 kpc
  (new, in comparison to Flynn et al. 1996)
- Non-standard triaxial stuff:
- Ferrers' n = 2 potential (Pfenniger 1984, Ferrers 1877)
- $\rho = \rho_0(1 - m^2)^n$
- $m = \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2}$
- $\rho = 0$, when $m \geq 1$

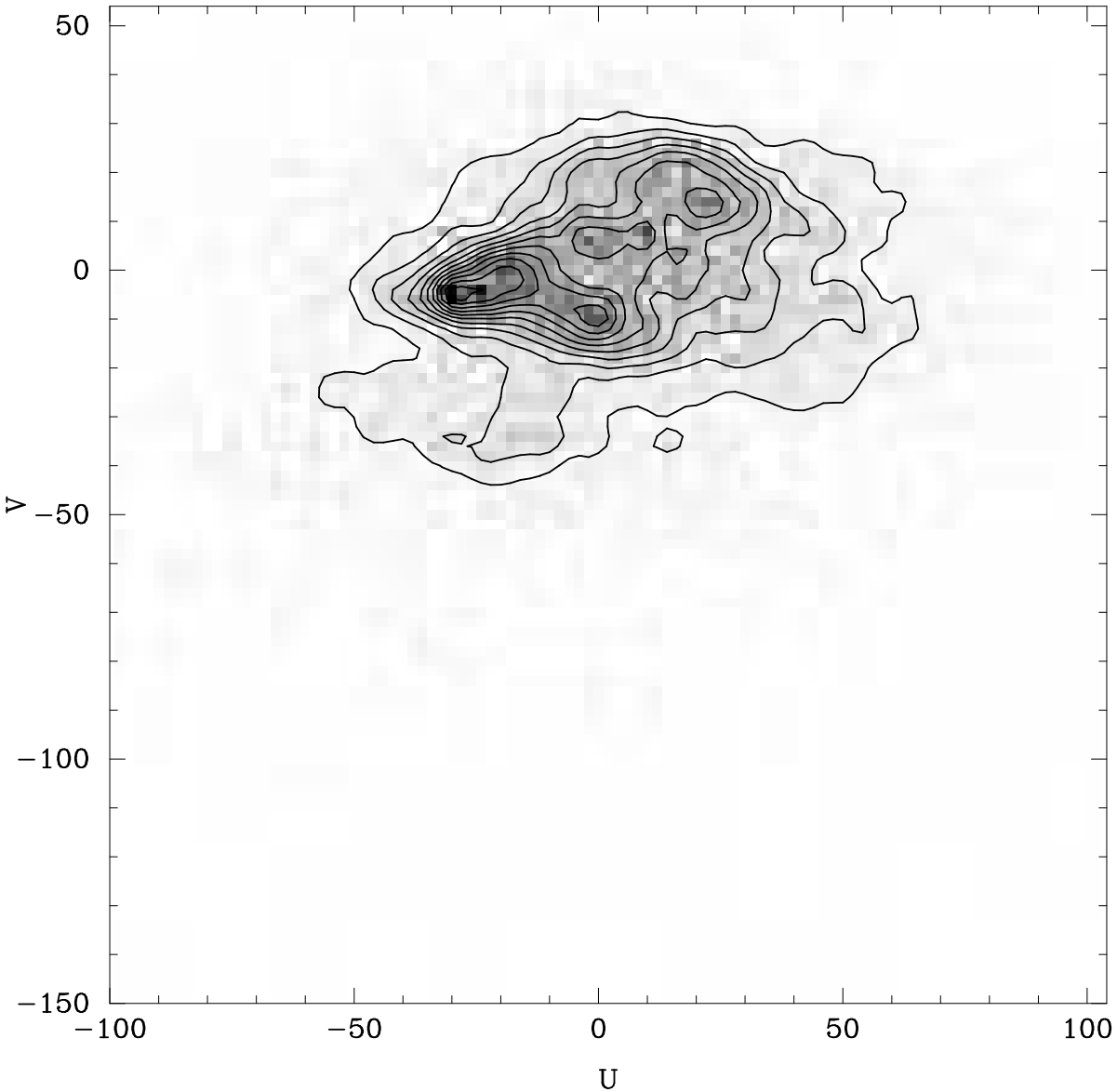
Backwards restricted method

- Dehnen (2000)
- Create a library of orbits
- Assign a weight for each point of phase-space for a certain orbit
- Compile the orbits into a table of some kind
- Interpret

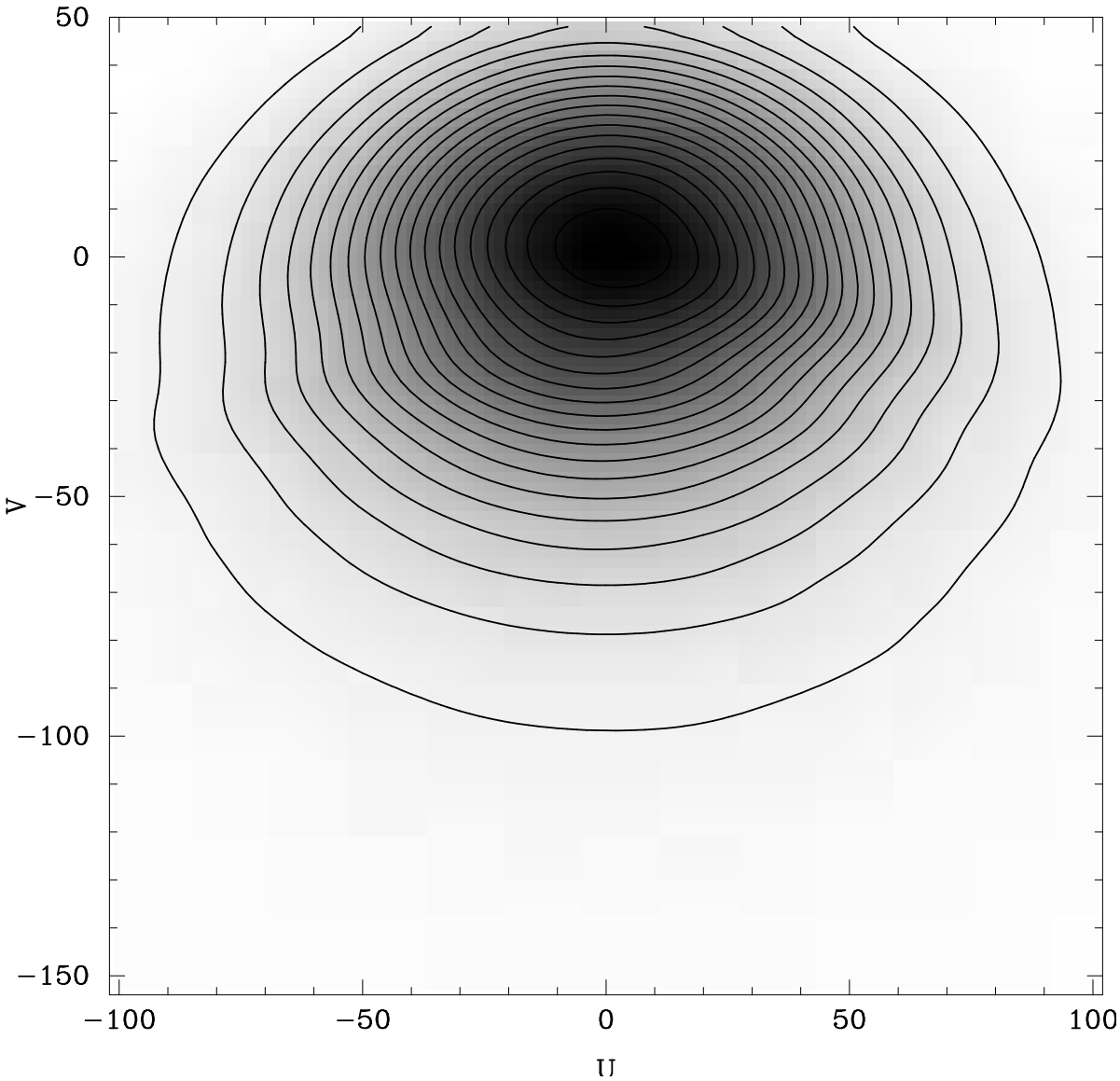
Quick words on simulations

- Uniform 100 x 100 grid of velocity points, starting at our local position.
- Velocities U:[-50,50], V: [-150:50], 2 kms^{-1} steps
- Full orbital history for each velocity point over 1 Gyr
- Weighted values for each point in velocity-space;
- Corrected for the local circular velocity, and asymmetric drift. See Lewis and Freeman (1989).

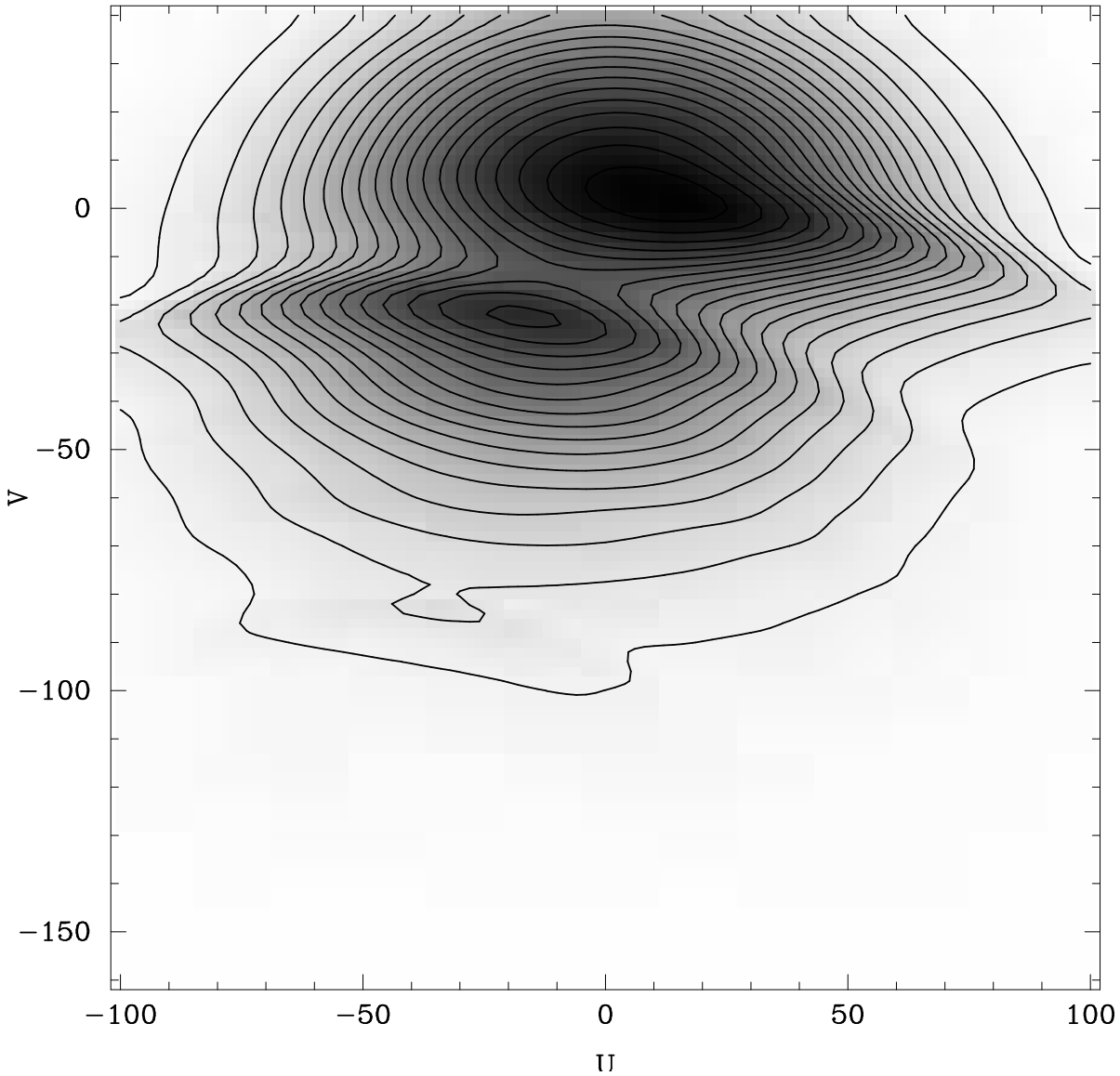
Reruns!



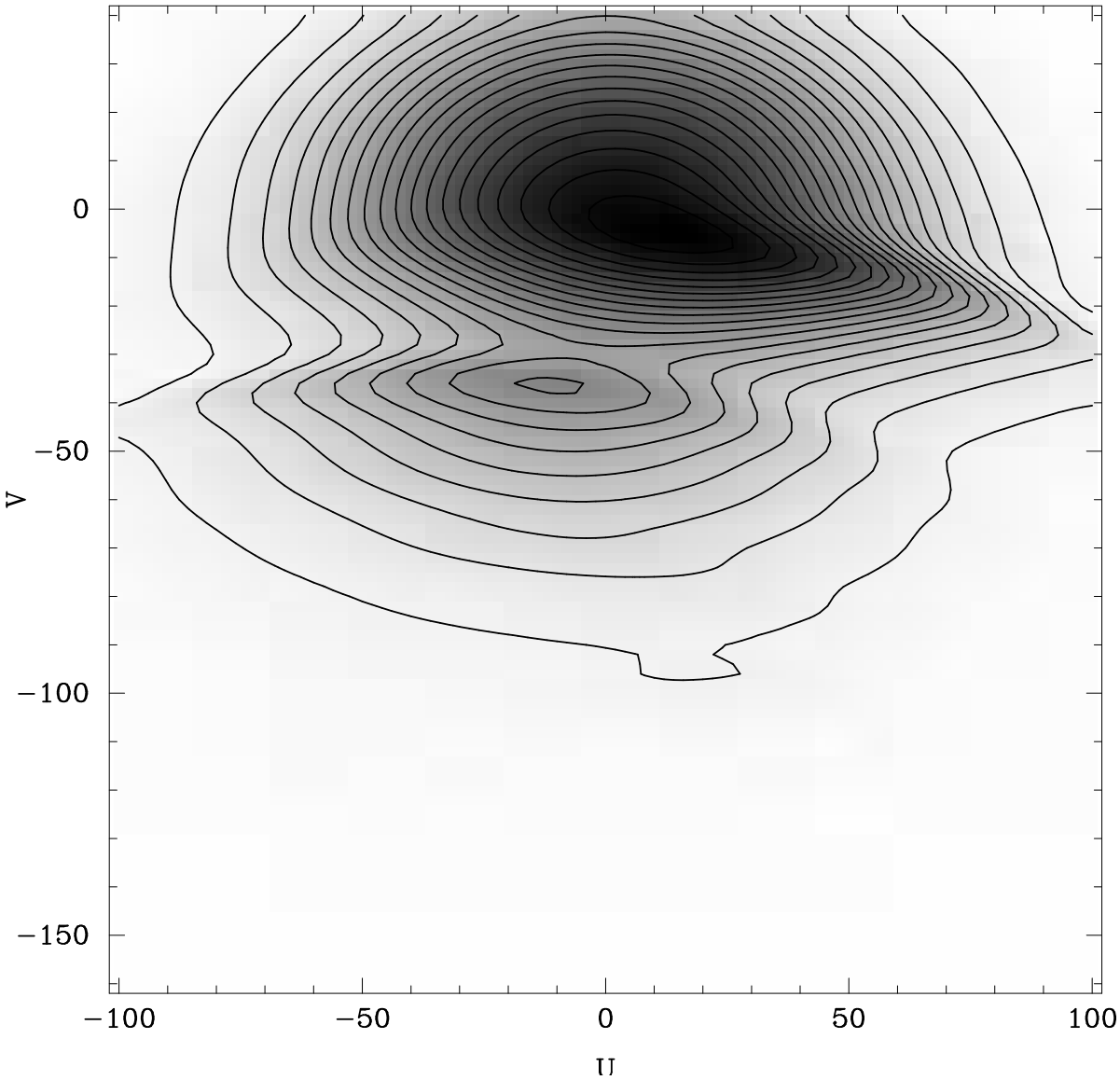
What does it do? - Mass



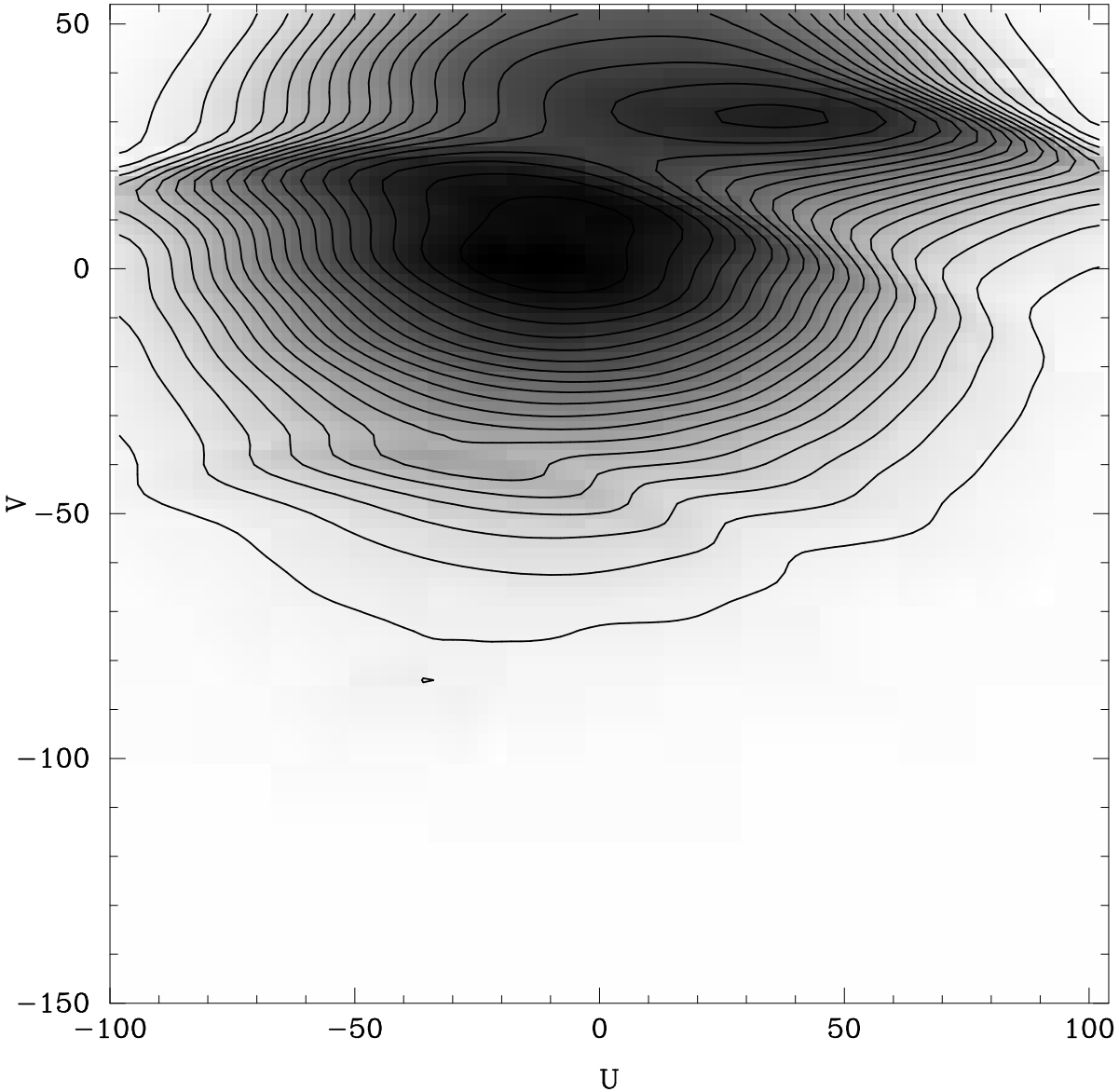
OLR variations - Long Bar



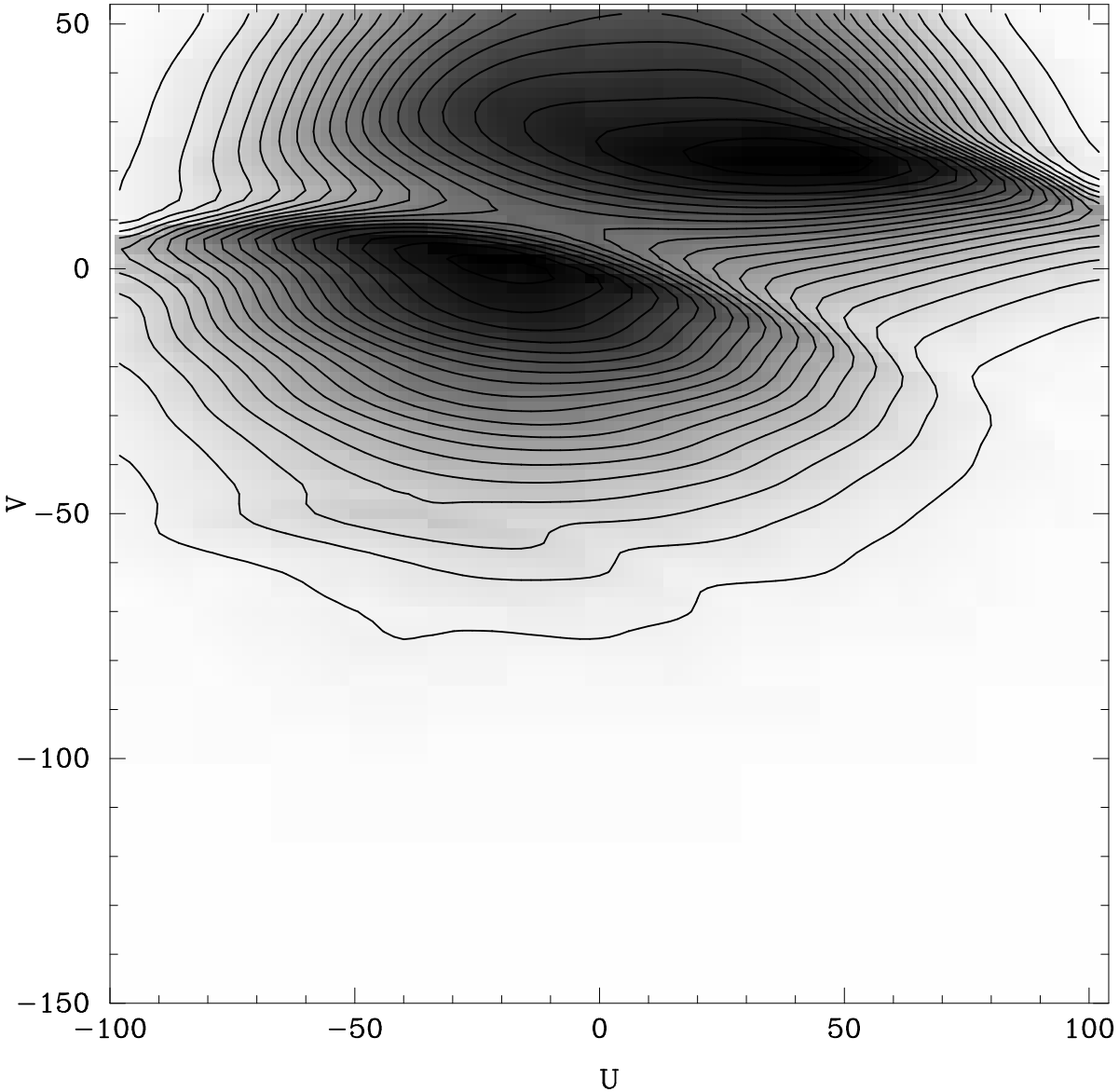
Angle variations - Long Bar



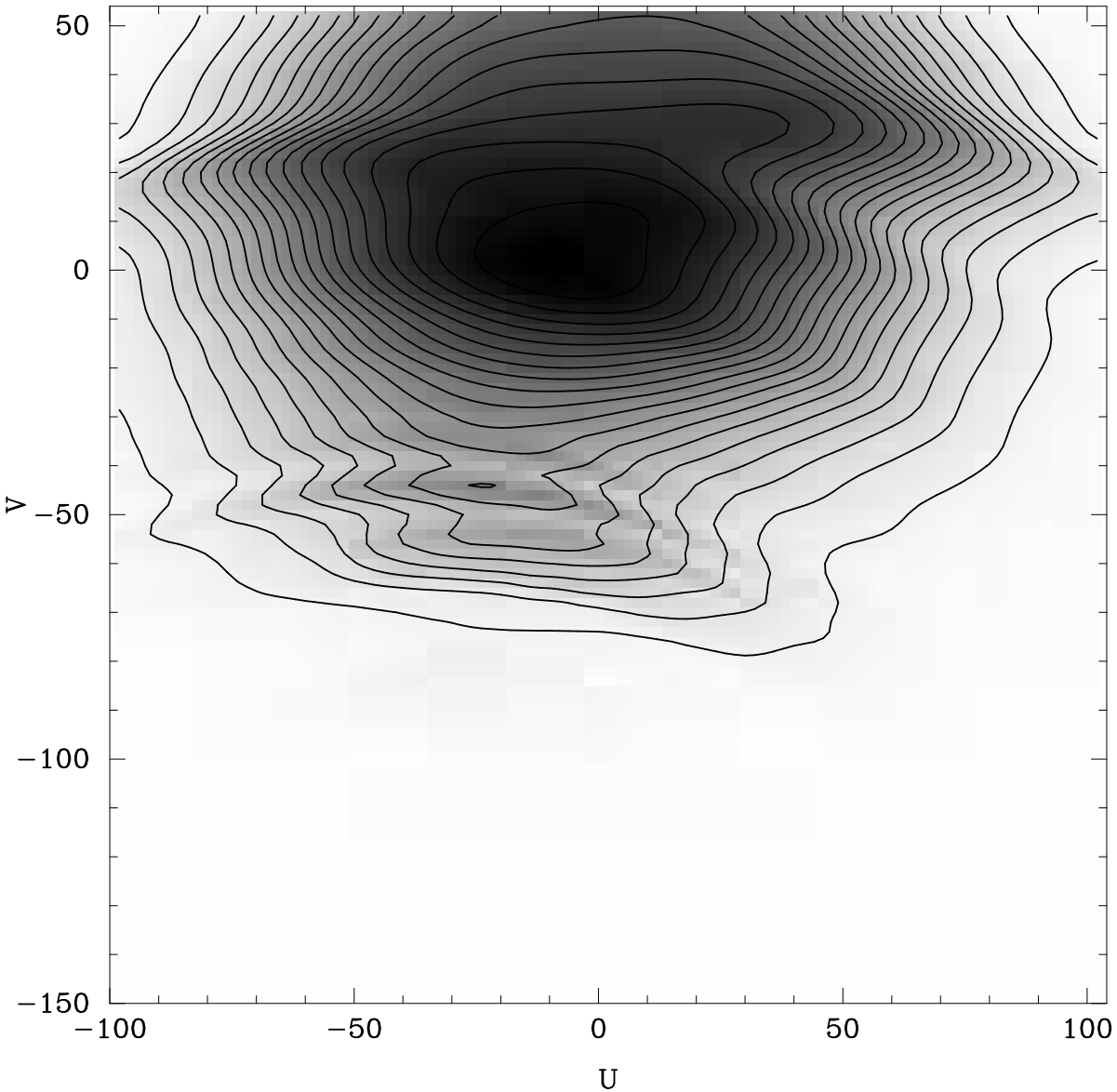
Two bars! Phase locked at 1.87.



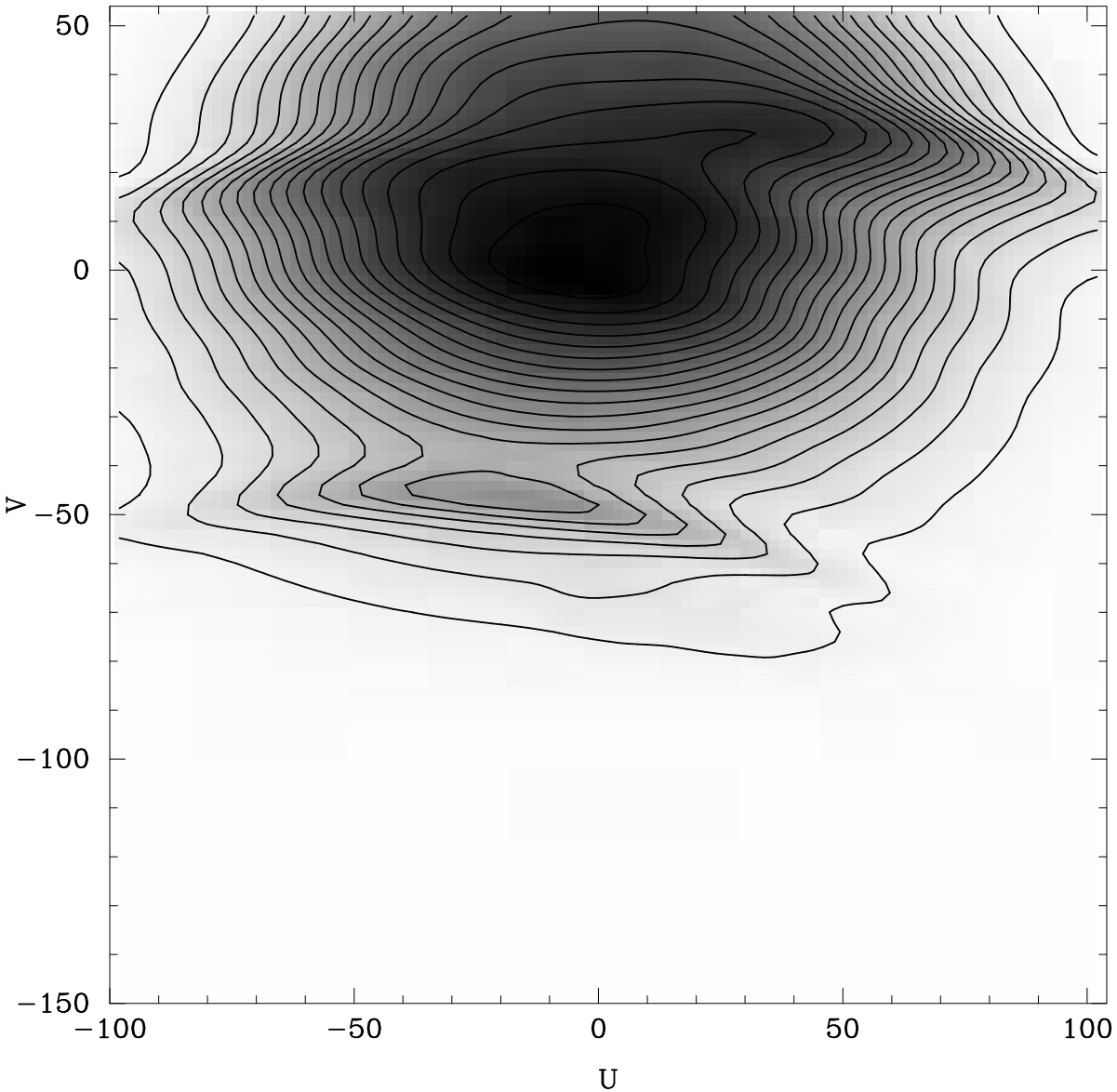
Two bars! Phase locked at 1.95.



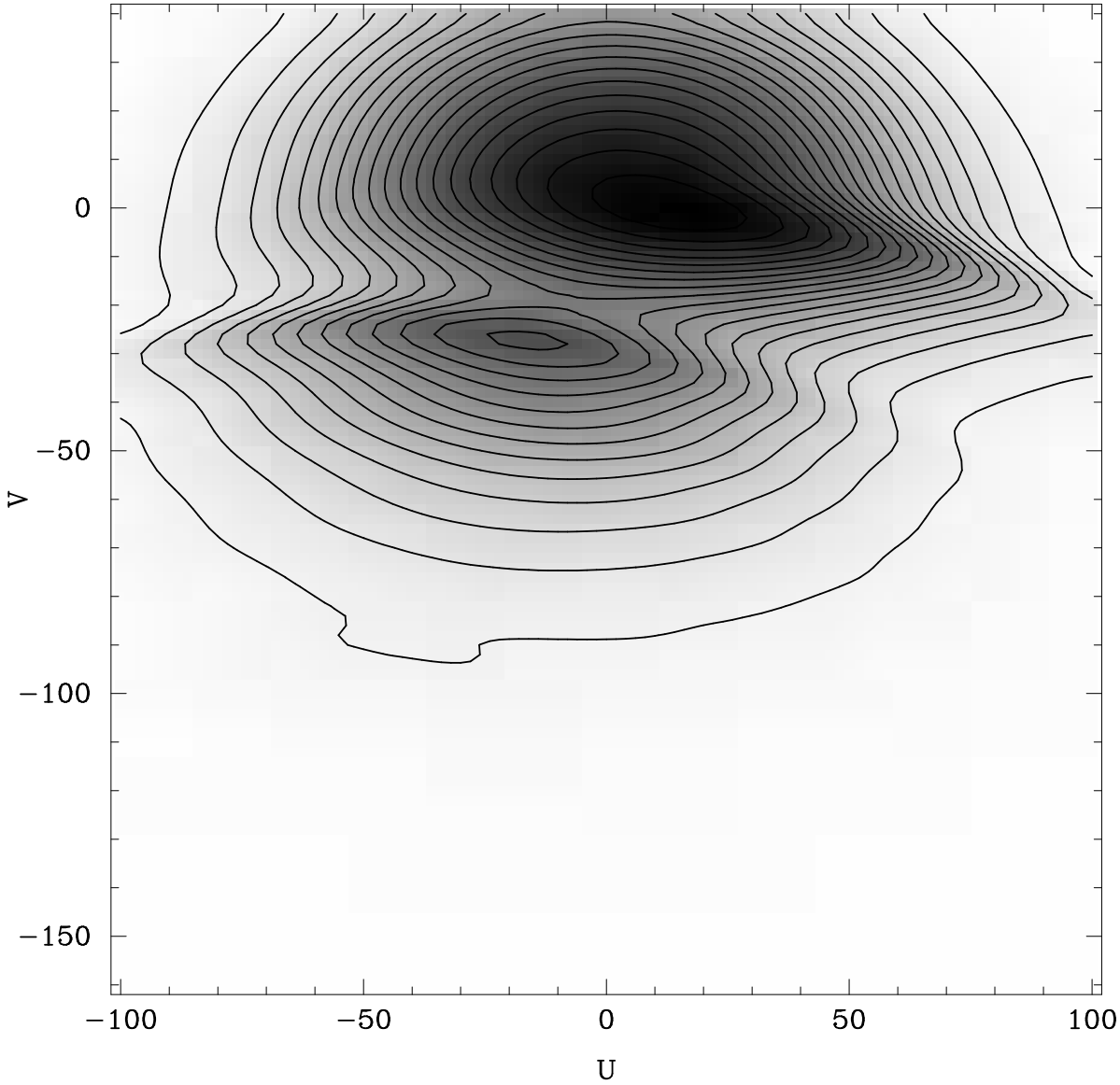
Two bars! Phase unlocked, long at 1.87, Galactic at 1.50



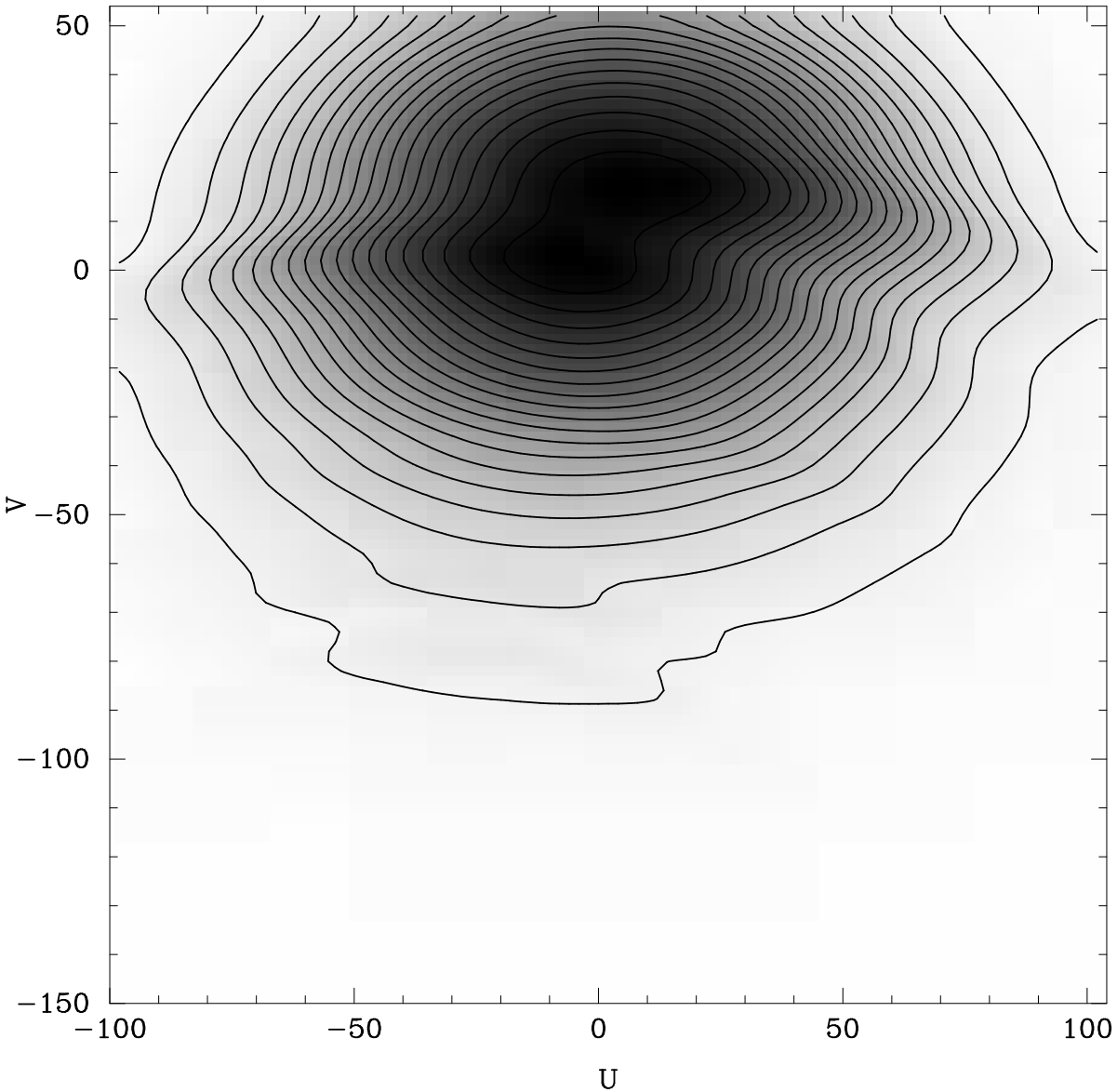
Two bars! Phase unlocked, long at 1.50, Galactic at 1.87



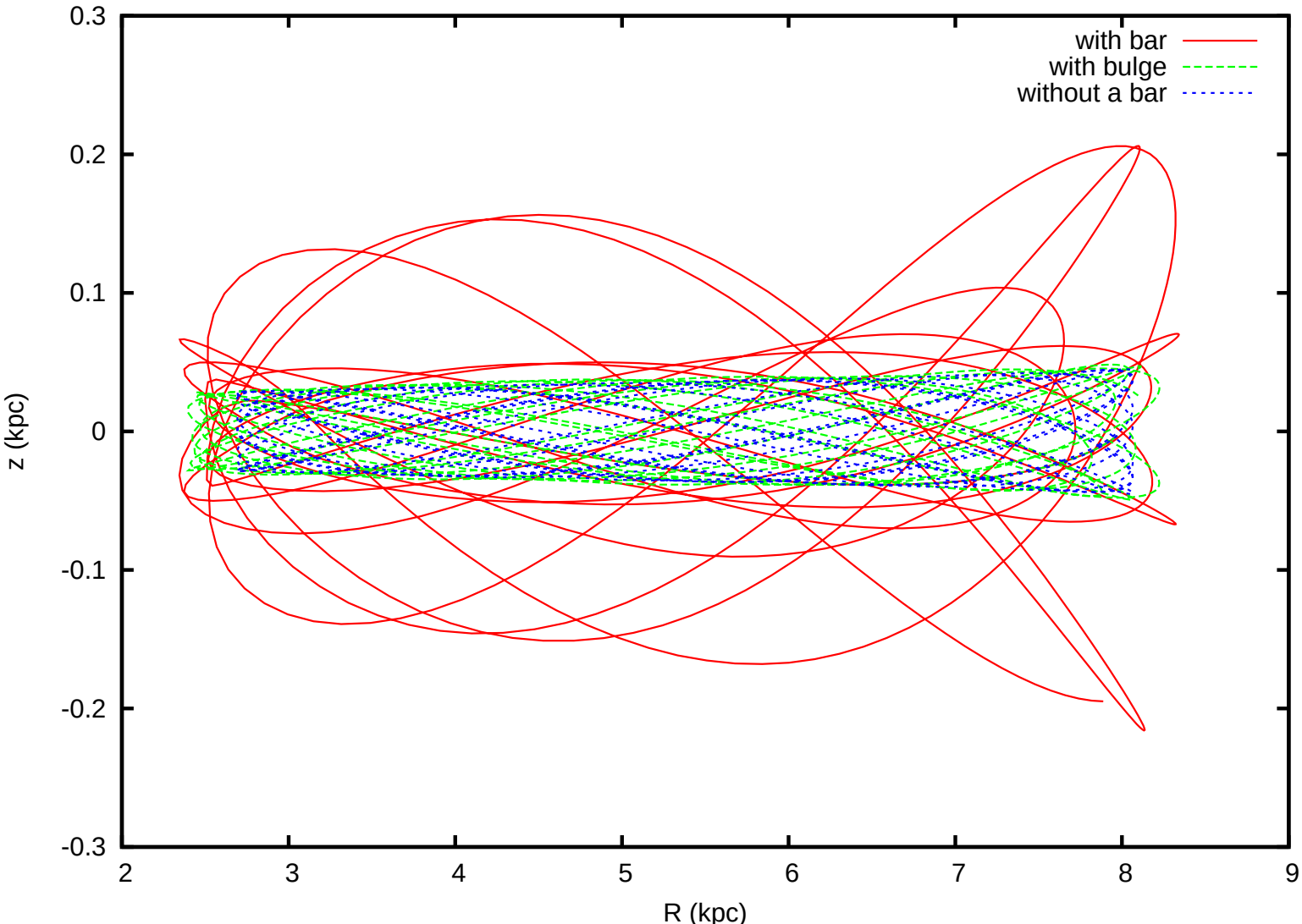
Two bars! Phase locked at 1.87, half-mass.



Two bars! long at 1.87, Galactic at 1.50, half-mass.



Potentially something very interesting



The End

- A bar will create structure(s) in velocity space.
- The angle, mass, and speed of the bar will affect it's position and shape in velocity space.
- Two large, massive bars will wreck havok on velocity structure.
- Direct interaction with bars can cause also cause structure in velocity space.
- More details in Gardner & Flynn 2010 (MNRAS 405, p. 545 or arXiv:1002.0551)