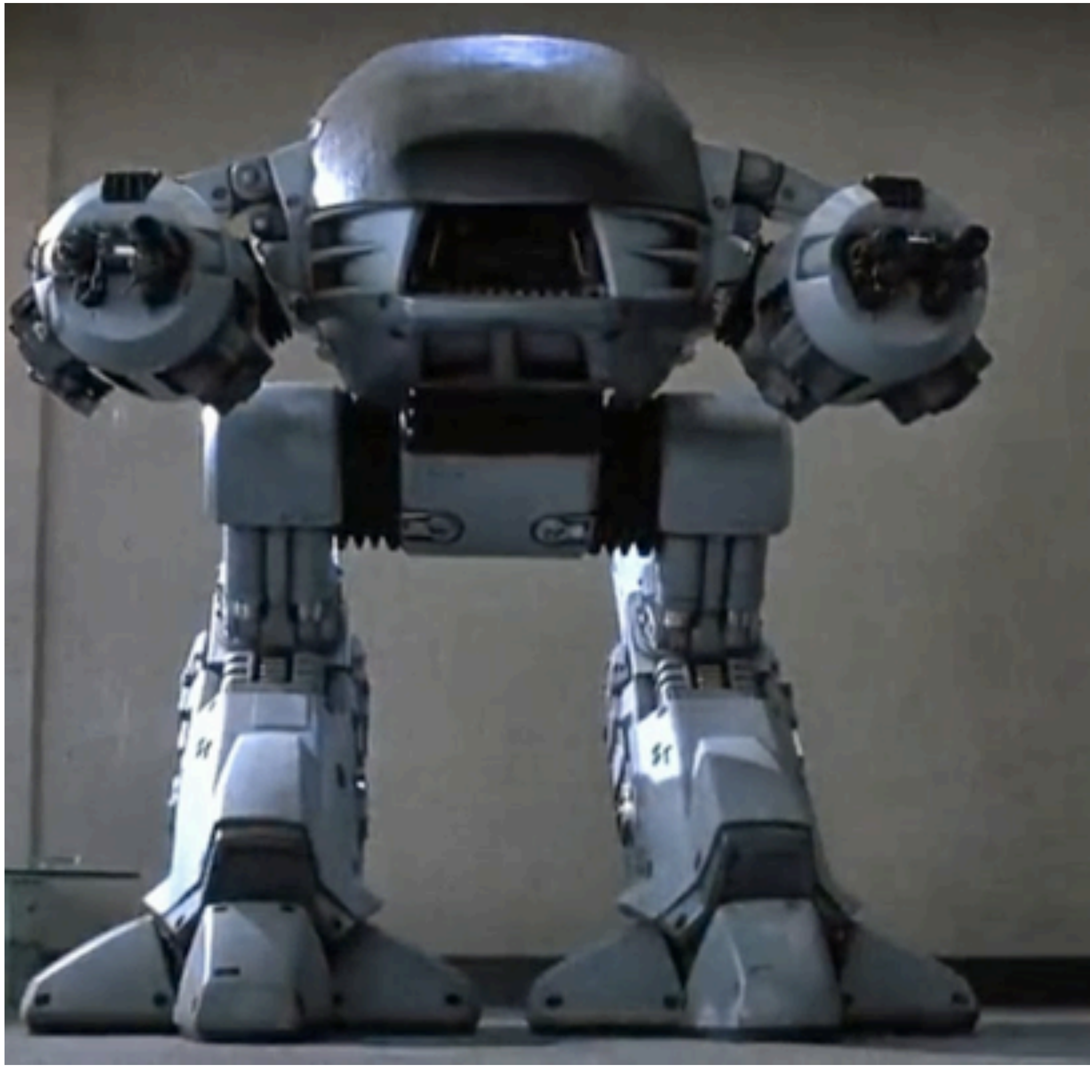
Dark Matter

ASTR 333/433

Today

Galactic Kinematic
Oort Constants
Epicycle Approximation



Homework Due

Galactic Mass distribution

Baryons

Dark Matter

Binney et al. (2013) arXiv:1309.4285

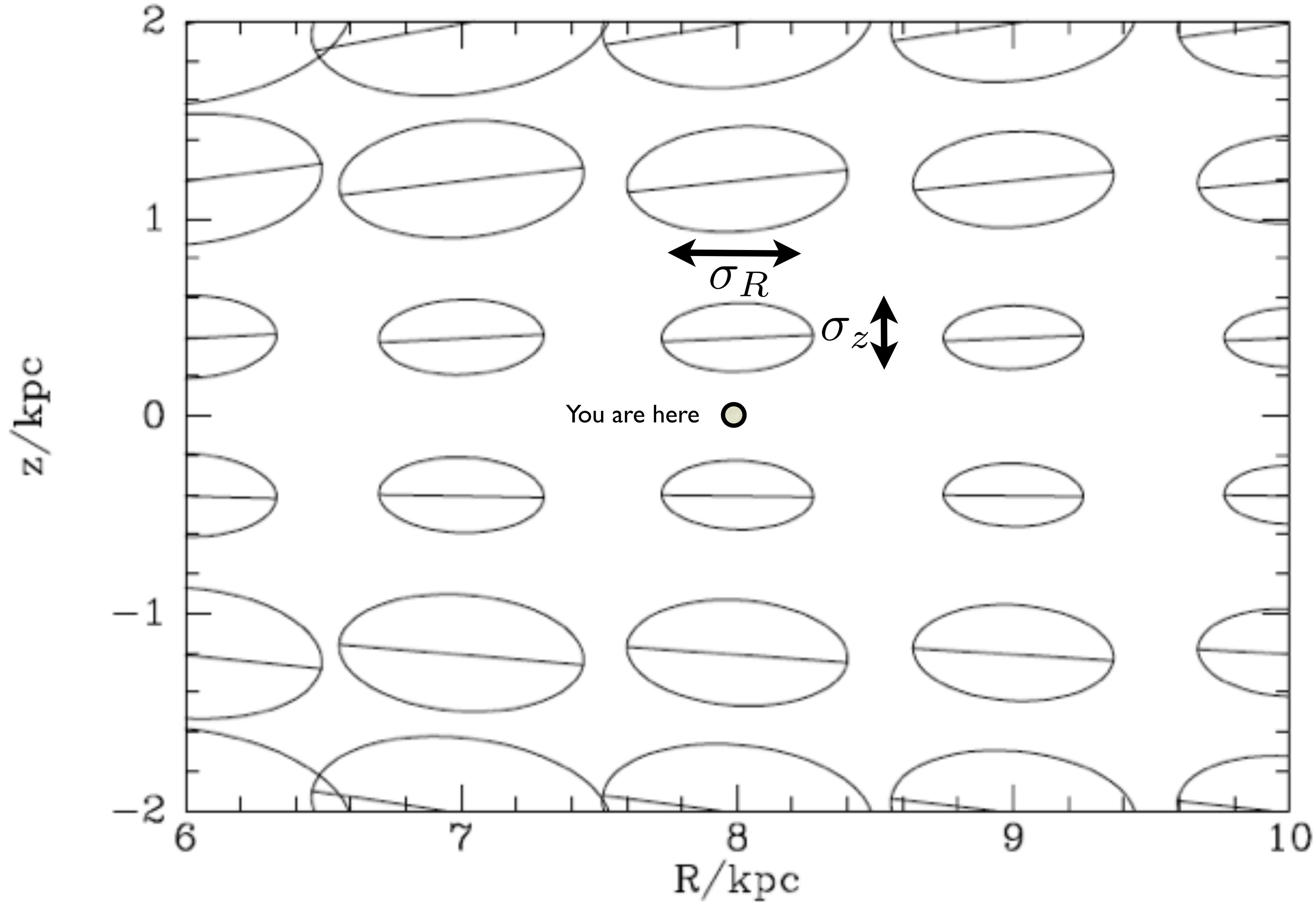


Figure 1. Representation of the velocity ellipsoids of giant stars; the lengths of the principal axes of each ellipse is proportional to the corresponding velocity dispersion at the centre of the ellipse.

MW as seen by COBE

Binney et al

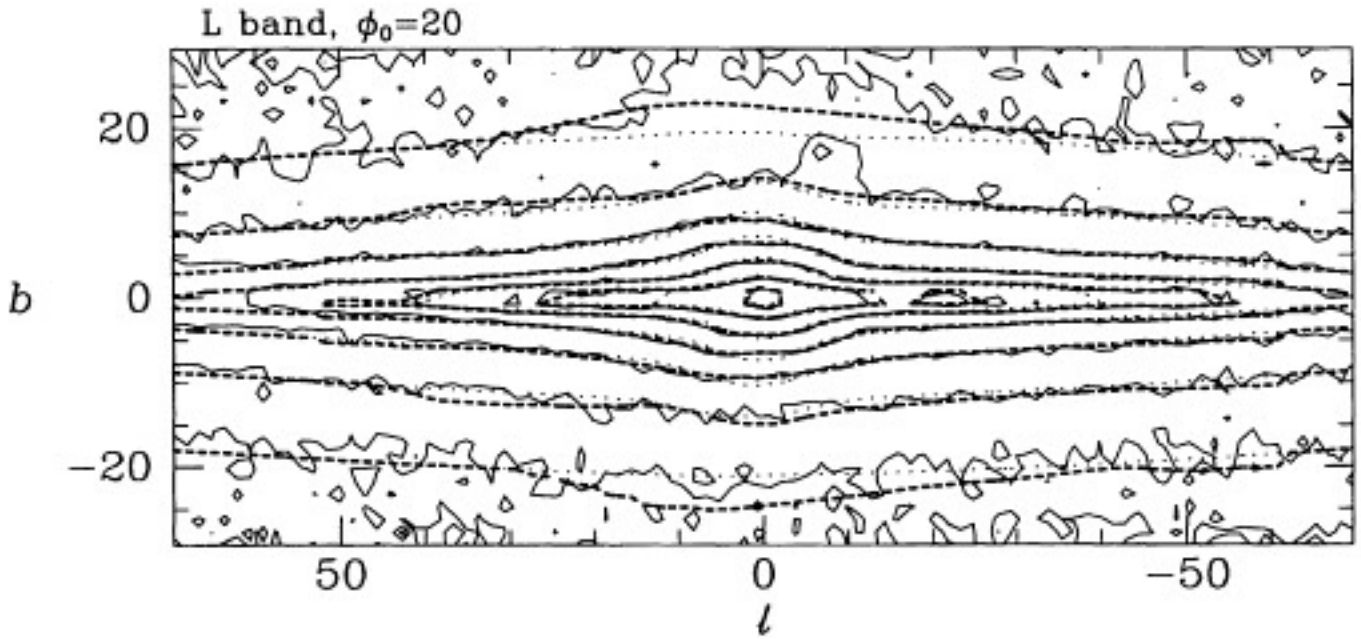
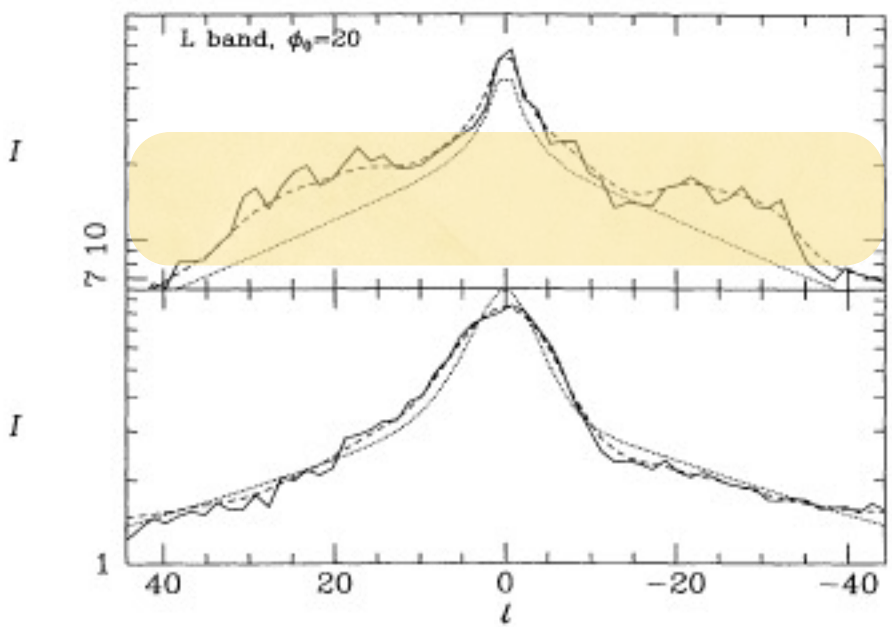


Figure 1. The fit between data (full contours) and model (thick dashed contours) that is obtained after five iterations of the Richardson–Lucy algorithm under the assumption that $\phi_0 = 20°$. The dotted contours show the initial analytic fit of equation (1). Contours are spaced by 1 mag. The Sun–centre line is assumed to lie 0.°1 above the plane.

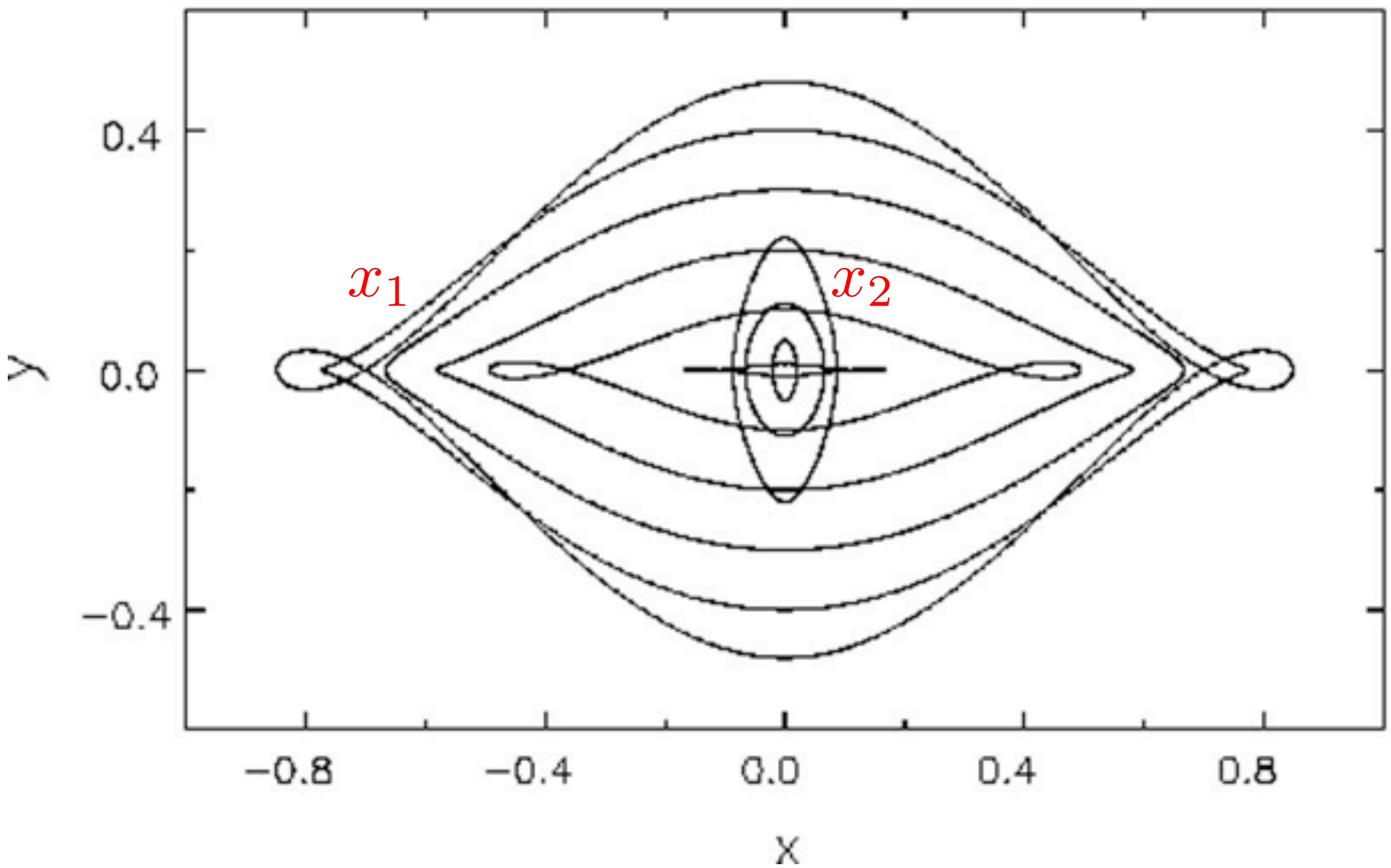
asymmetry in star counts indicates bulge is a bar



inferred by Kent et al. (1991) from Infrared Telescope data. At higher latitudes the iterations make smaller changes, but these include successfully modelling significant asymmetry in latitude at $|l| \lesssim 10°$. In fact, this figure shows that the final model fits the data nearly as well as any smooth model could, and that the remaining residuals are associated with small-scale structure which it is not appropriate to model at this stage.

The fit plotted in Figs 1 and 2 was obtained under the assumption that the Sun–centre line lies 0.°1 above the assumed symmetry plane of the Galaxy. That is, the Sun has been assumed to lie 14 pc above the plane. Fig. 3 compares the residuals (model − data) that one obtains for this case with those that one obtains when the Sun is located within the plane (bottom panel) or 28 pc above the plane (top panel). Whereas in the bottom panel positive residuals tend to occur at $b > 0$, in the top panel they occur at $b < 0$. From the fact that in the middle panel positive and negative residuals show no

Closed orbits in the frame of a bar rotating with pattern speed Ω_B



Linblad resonances occur when

$$m(\Omega - \Omega_B) = \kappa$$

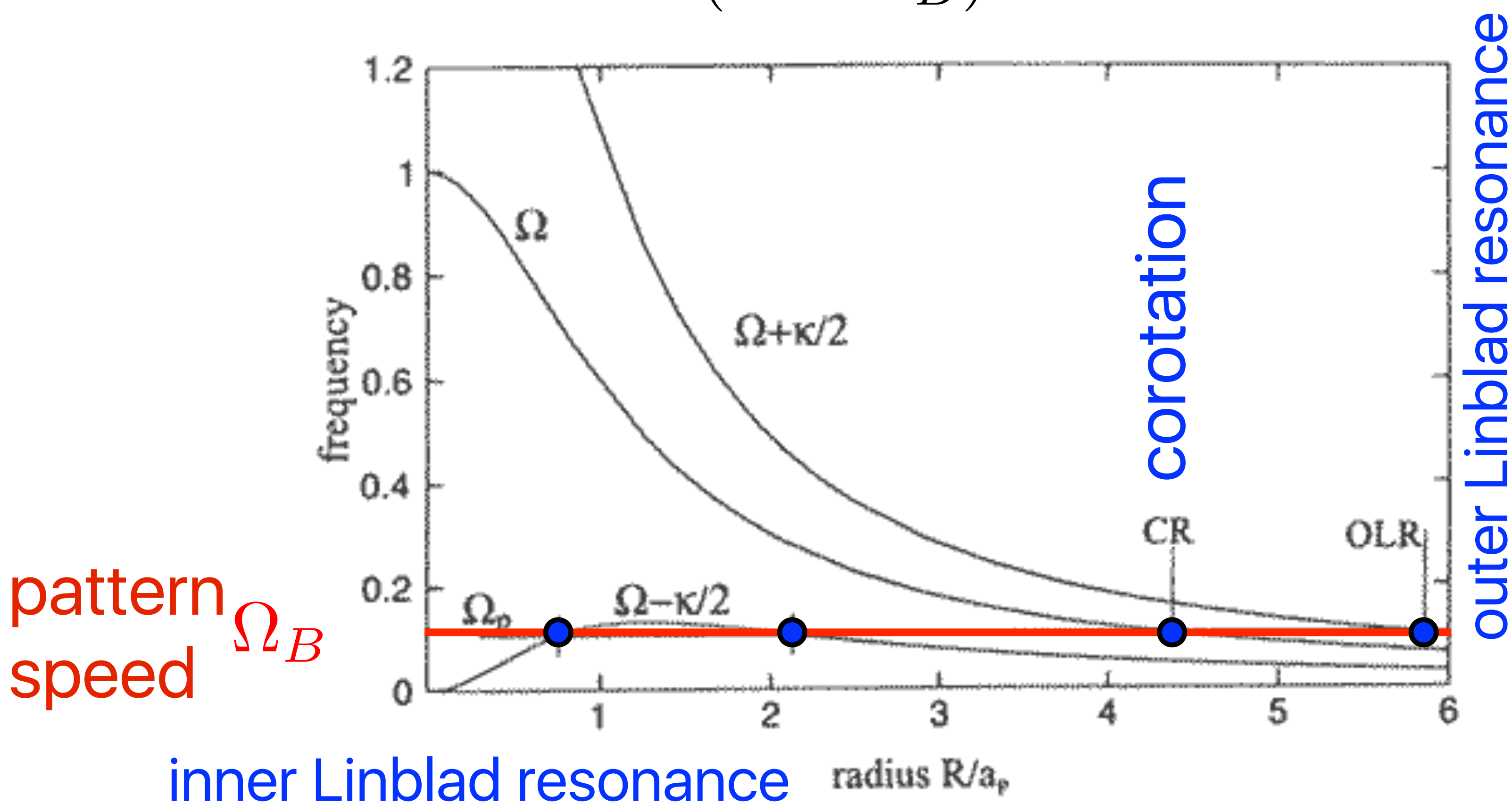


Figure 5.29 Frequencies $\Omega(R)$ and $\Omega \pm \kappa/2$ in the Plummer potential of Equation 3.11. For pattern speed Ω_p, the $m = 2$ inner Lindblad resonances are marked by vertical ticks, the corotation radius is labelled 'CR', and the outer Lindblad resonance 'OLR'. If the pattern speed had been twice as large, the inner Lindblad resonances would be absent.

Linblad resonances thought to confine spiral structure

http://cosmo.nyu.edu/~jb2777/resonance.html

Bars

- Non-axis-symmetric potential
  - provides perturbing torque to orbits
- Transfer angular momentum
  - stars get outward kick
  - gas sinks toward center
- Interact with dark matter halo
  - live halos may encourage bar growth, but
  - dynamical friction slows bars