Low surface brightness/dwarf Irregular galaxies

Rotationally supported, gas rich
Assumes

\[ \Upsilon_* = 1 \]

\[ V_c = \sqrt{2\sigma} \]
cusp/core problem

NGC 1560

$V_{200} = 80$
$c = 4.9$

Newtonian Stars & Gas
Cusp-Core Problem

\[ \rho(r) = \frac{\delta_c \rho_c}{(r/r_s)(1 + r/r_s)^2} \]

\[ V^2(r) = V_{200}^2 \frac{\ln(1 + cx) - cx/(1 + cx)}{\ln(1 + c) - c/(1 + c)} \]

\[ x = r/r_{200} \quad c = r_{200}/r_s \]

Rachel Kuzio de Naray
Figure 5.2: Left Column: Observed densePak velocity field of UGC 4325 plotted in raw fiber format (top) and smoothed with velocity contours at 10 km s$^{-1}$ intervals (bottom). Middle: Simulated axisymmetric NFW halo with the parameters of the NFW consturnt halo for UGC 4325. Right Column: Observed mock densePak velocity field of the simulation plotted in raw fiber format (top) and smoothed with isovelocity contours at 10 km s$^{-1}$ intervals (bottom). Bottom: Solid points are the observed densePak rotation curve of UGC 4325. The solid red line is the NFW rotation curve, and the open red circles are the rotation curve recovered from the mock densePak velocity field.

Cusps would be easily detected if present.

c = 6.9
q = 1
What if halos are not spherical?

Hayashi, Navarro, & Springel
We next consider non-axisymmetric NFW potentials with axis ratios $q < 1$ that are constant with radius. We simulate halos with axis ratios $q = 0.98, 0.96, 0.94, 0.92, 0.90, 0.88, 0.86, 0.84$. Because the test particles are no longer moving on circular orbits, the observed mock DensePak velocity field and derived rotation curve are affected not only by the value of $q$, but also by the orientation ($\phi$) of the potential's elongation with respect to the observer's line-of-sight (see Figure 5.3).

For each value of $q$, the orientation of the potential is set to $\phi = 0^\circ, 30^\circ, 45^\circ, 60^\circ, 85^\circ, 86^\circ, 87^\circ, 88^\circ, 89^\circ, 90^\circ$.

\[
\Phi(R) = -\frac{GM_{200} \ln(1 + R/R_s)}{R[\ln(1 + c) - c/(1 + c)]}
\]

\[
R = \sqrt{x^2 + (y/q)^2}
\]
Squashed halos can both enhance and suppress the observed velocity with respect to the true circular velocity.
A 2 zone $q(r)$ sort of works: prolate at small $R$; spherical at large $R$ but...
CUSP-CORE PROBLEM

- still with us
- cusps would be detected if present in all LSB galaxies and due to spherical halos
- triaxial halos appear to help, BUT require improbable halo orientations on sky