

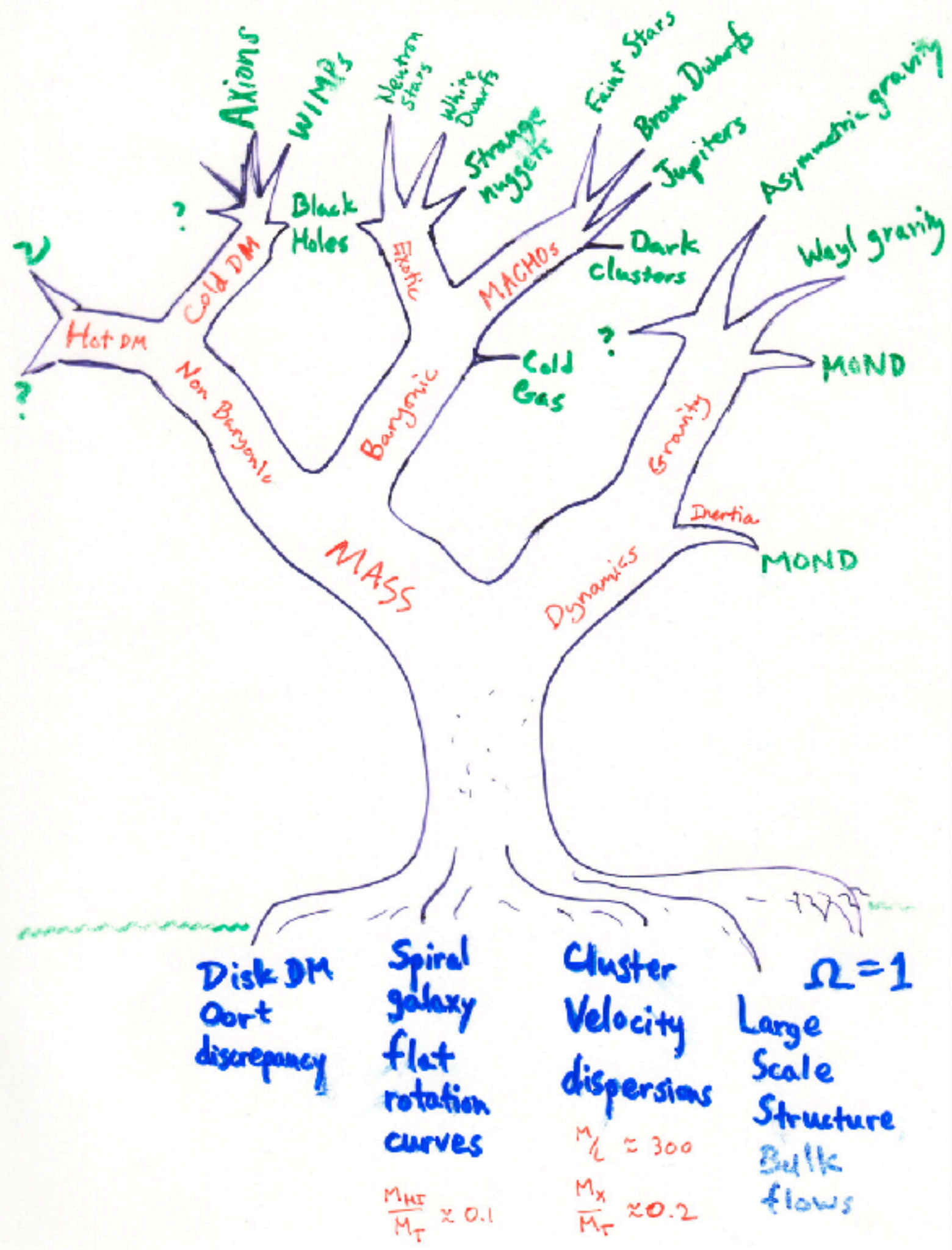
DARK MATTER

ASTR 333/433

TODAY
HALO MODELS

Homework 2 DUE

Review March 6
Midterm March 8



Halo models

pseudo-isothermal

empirically motivated

$$\rho(r) = \frac{\rho_0}{1 + (r/R_c)^2}$$

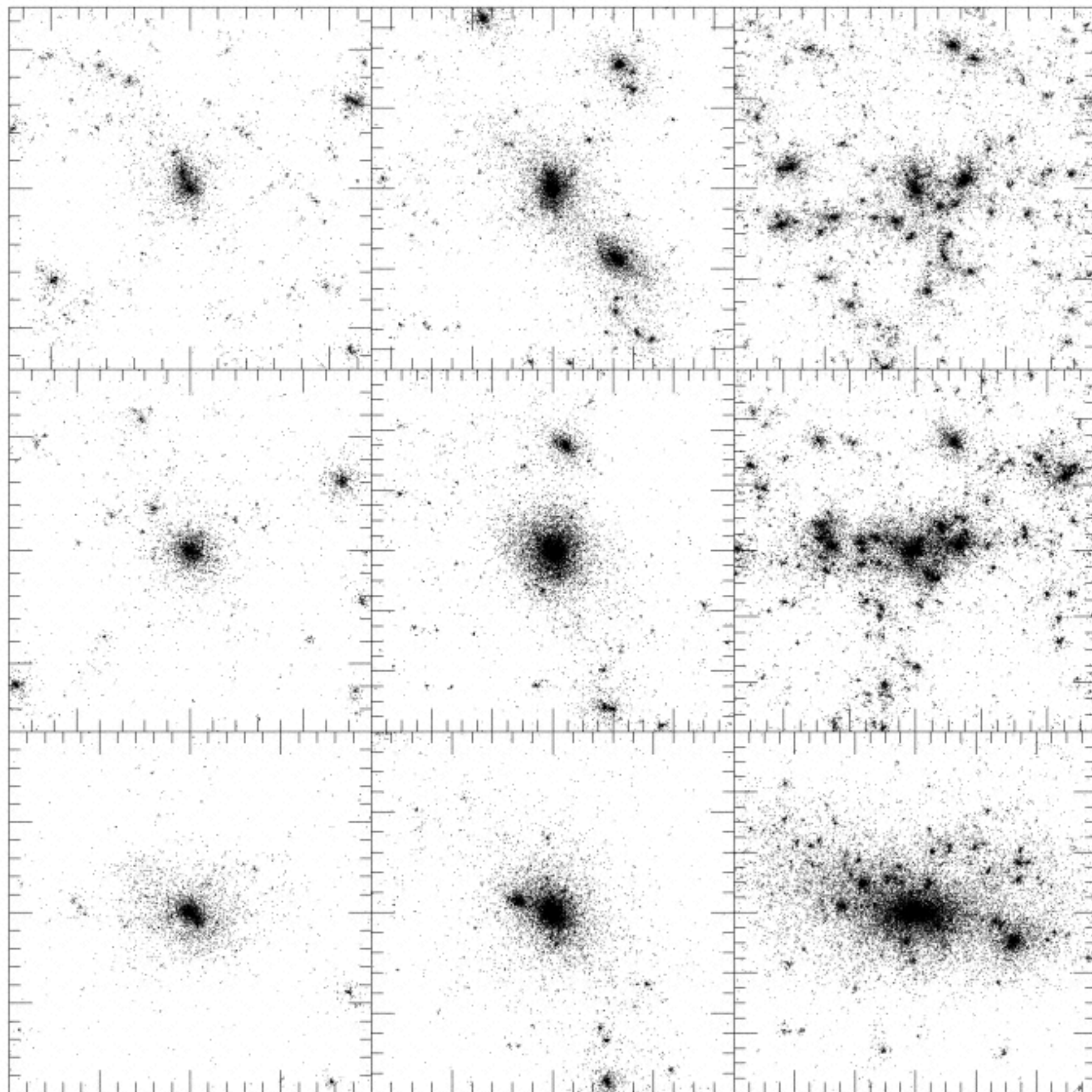
Both models have 2 parameters - a characteristic density and scale radius

NFW

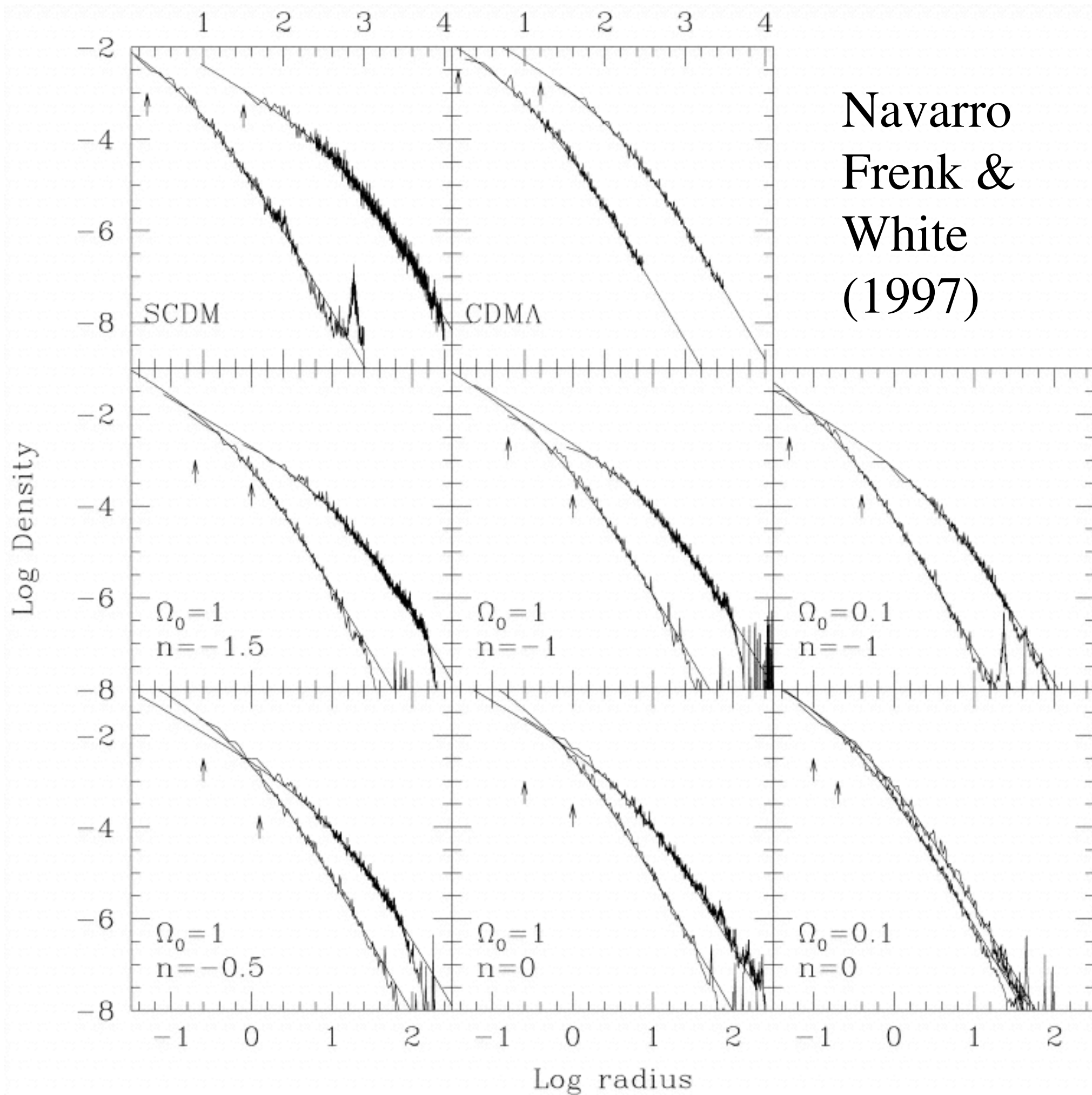
$$\rho(r) = \frac{\rho_s r_s^3}{r(r + R_s)^2}$$

*motivated by
simulations*

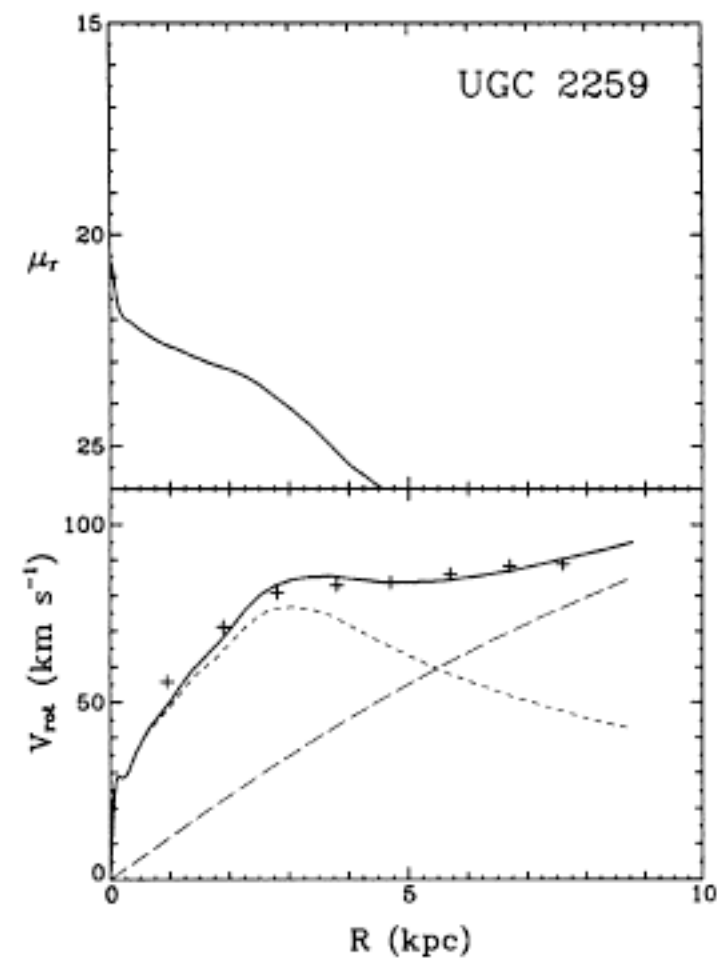
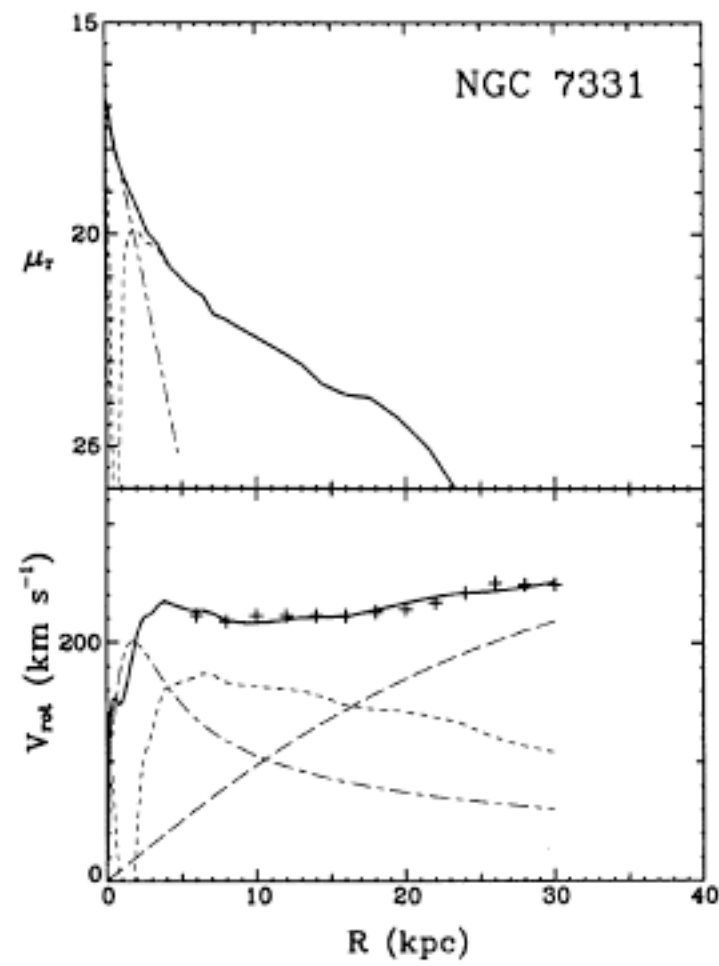
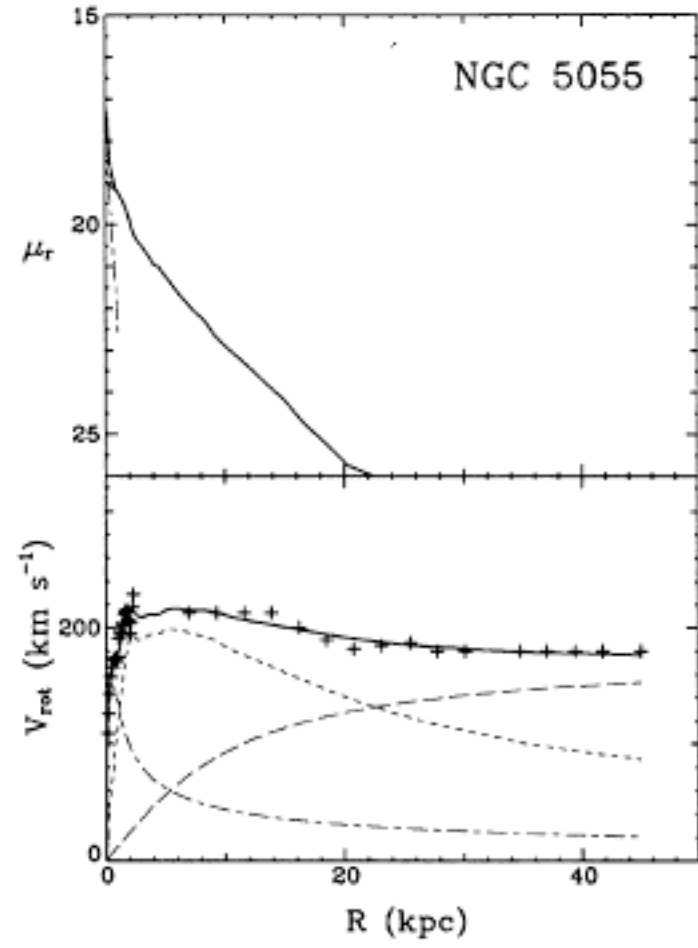
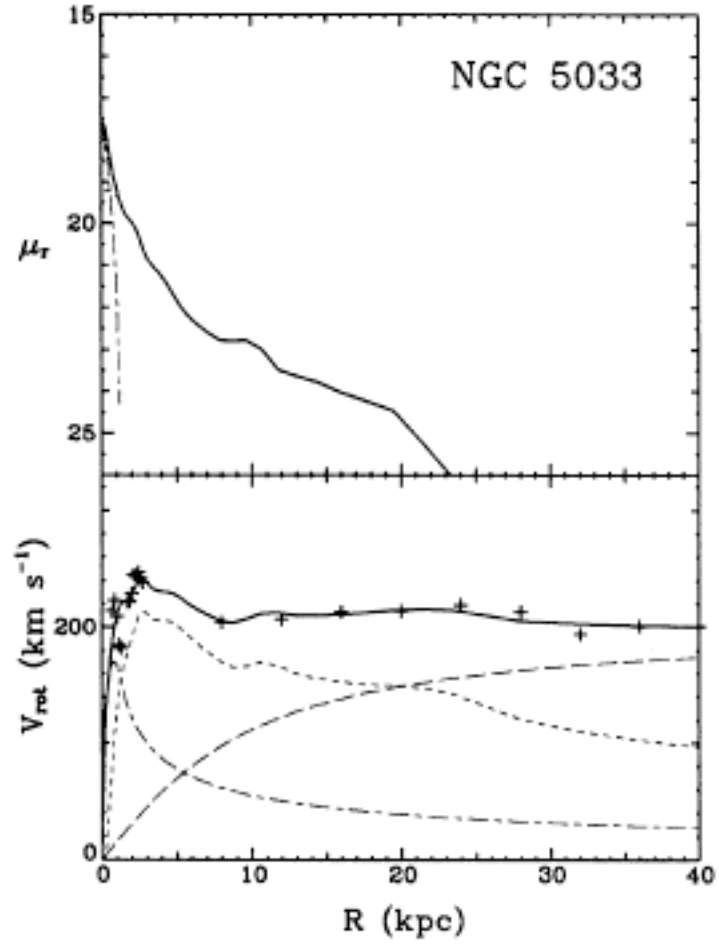
see “NFW halos” on review literature page

Z_2 Z_1 Z_0  $M < M_*$ $M \sim M_*$ $M > M_*$

Navarro
Frenk &
White
(1997)

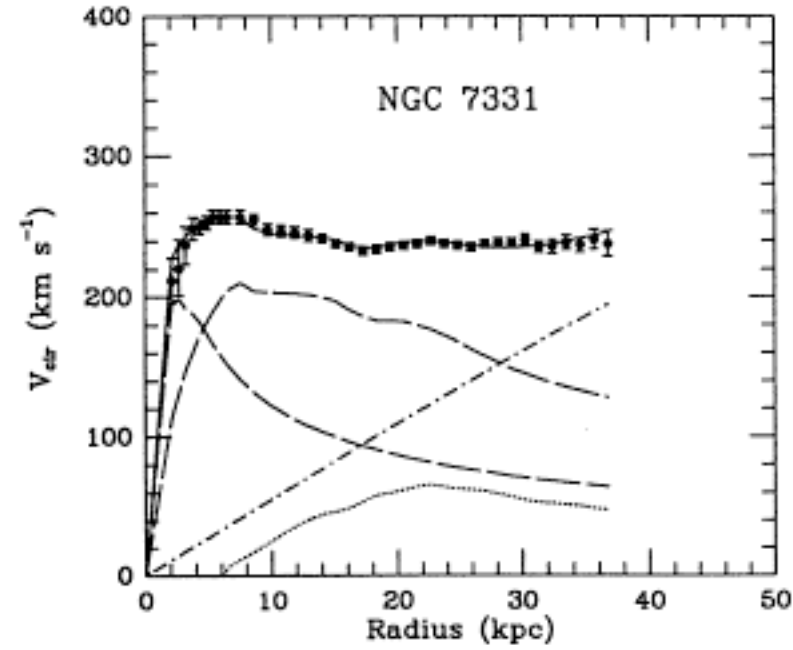
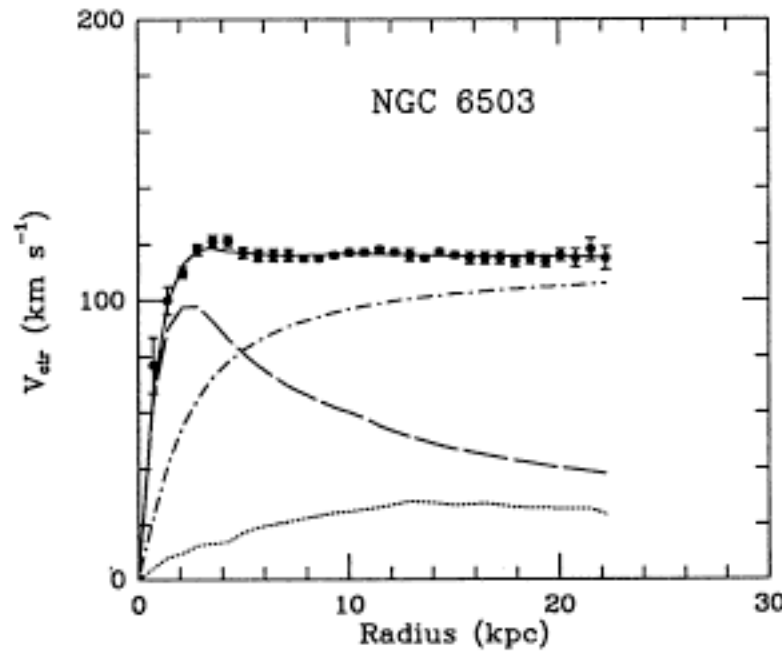
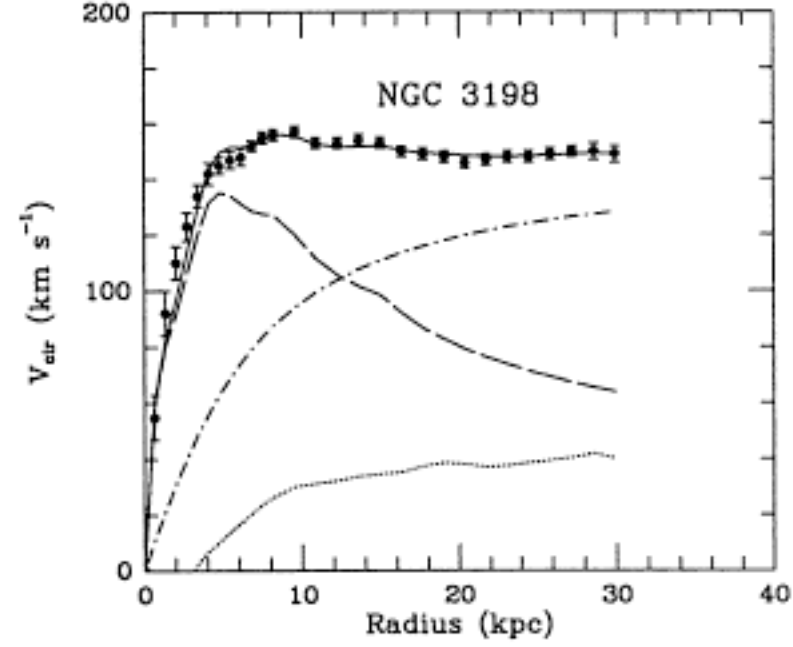
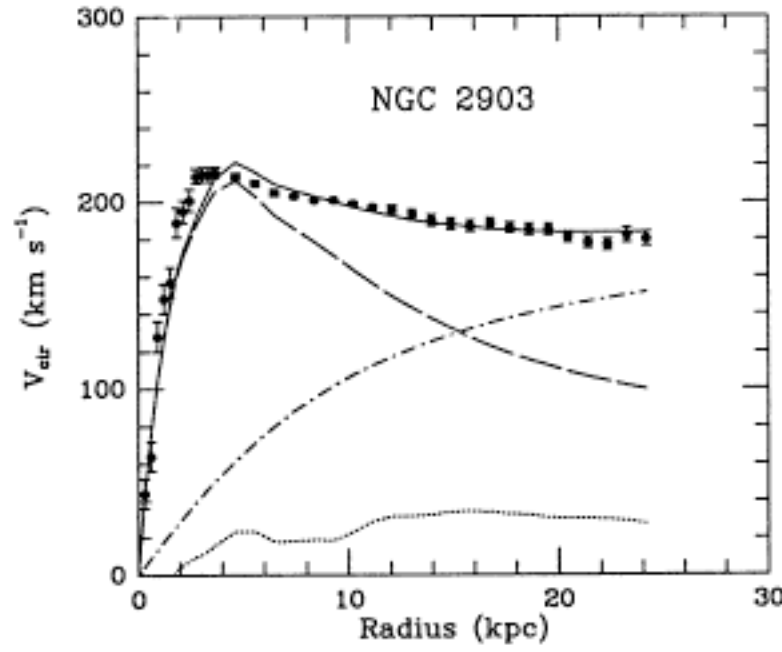
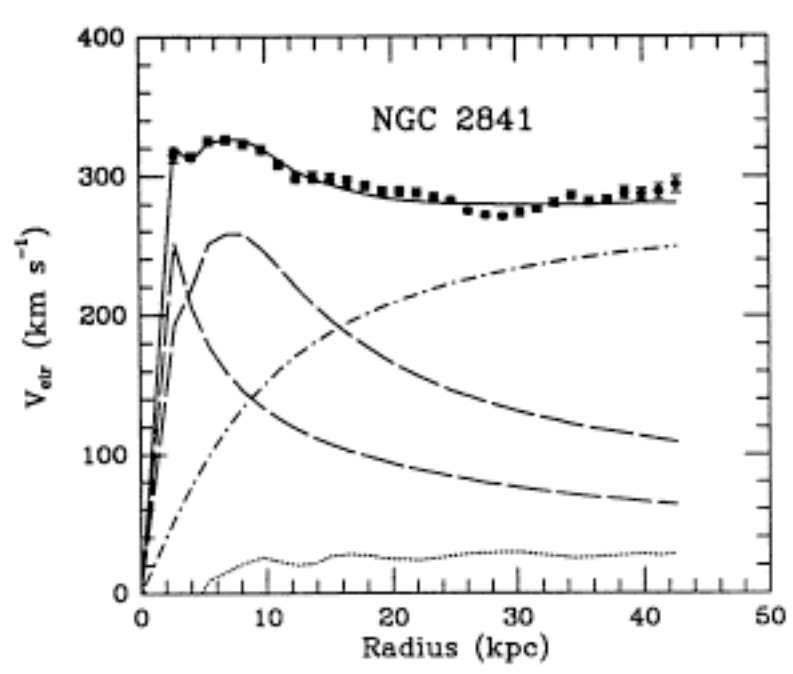
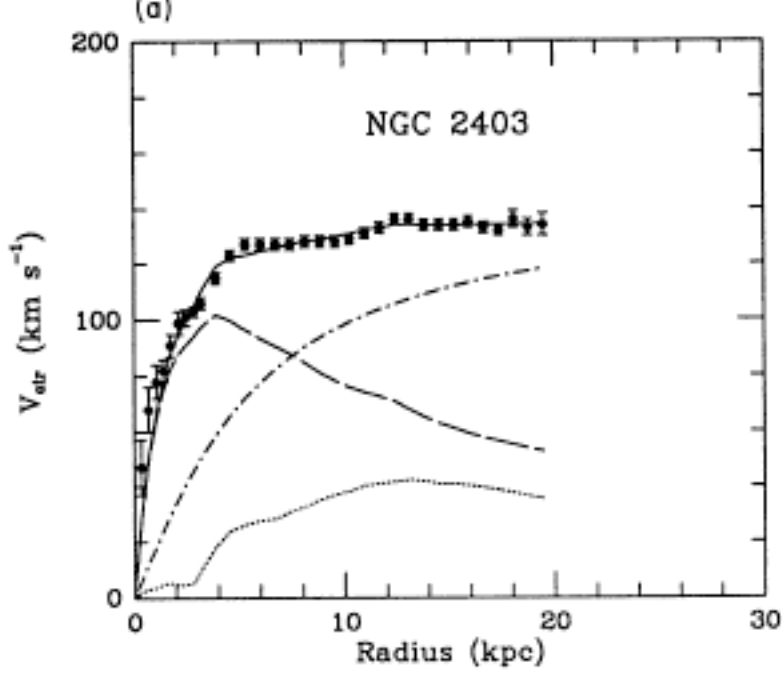


pseudo-isothermal
fits



Kent (1987)

pseudo-isothermal
fits



Begeman, Broeils, &
Sanders (1991)

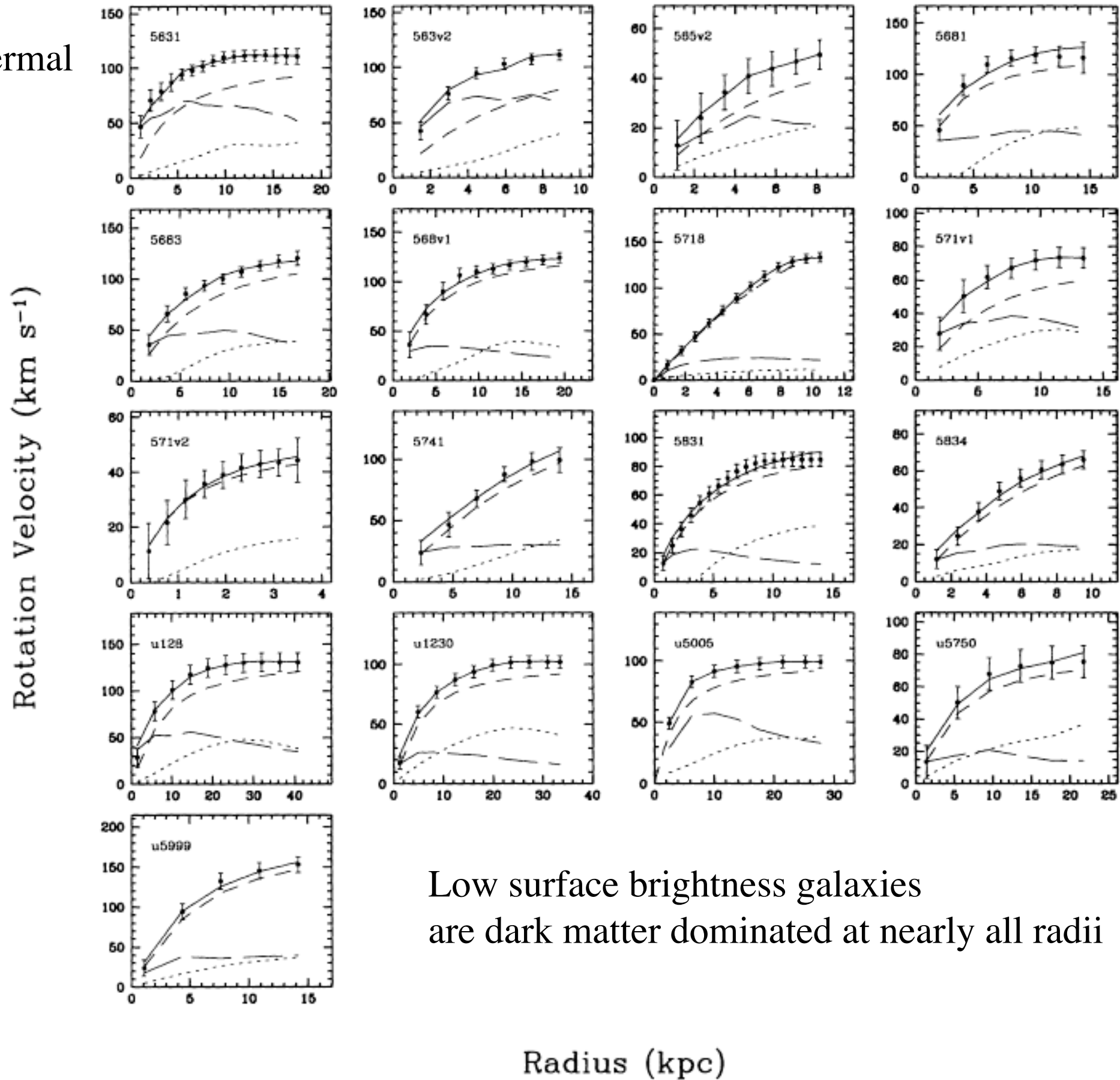
pseudo-isothermal
fits

Figure 5. Maximum disc rotation curve decompositions of the final sample of LSB galaxies. The dotted lines represent the rotation curves of the gas; the long-dashed line those of the scaled stellar disc; the short-dashed lines the rotation curves of the halo. The full line represents the total model rotation curve. Error bars are based on a combination of profile width in the position-velocity diagrams (BMH96) and the asymmetries between the rotation curves of both sides of the

pseudo-isothermal
parameters

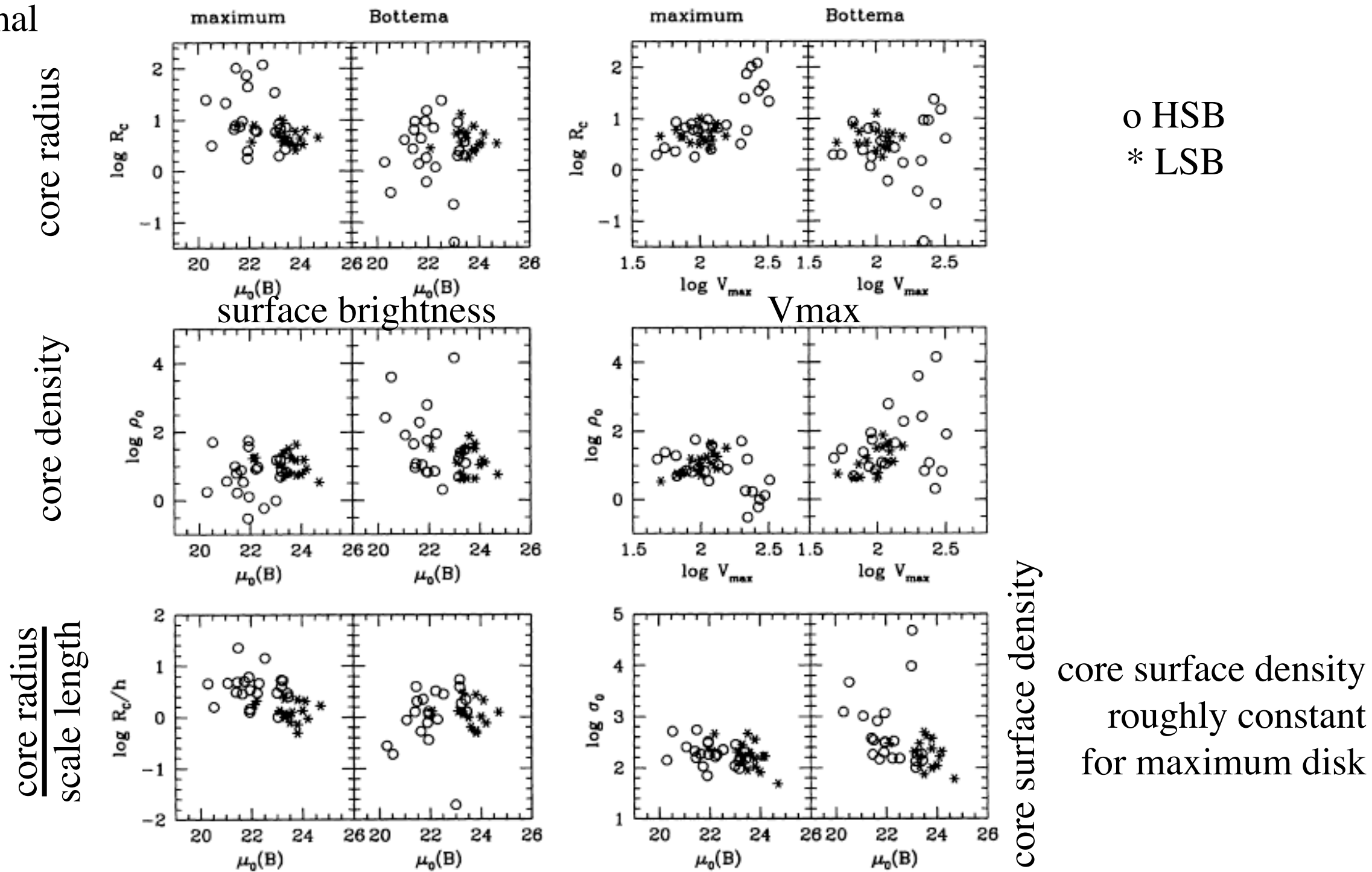


Figure 9. Isothermal halo fitting parameters for maximum disc fits (left panels) and Bottema disc fits (right panels). The open circles represent the HSB sample, the asterisks the LSB sample. ρ_0 is expressed in units of $10^{-3} M_{\odot} \text{pc}^{-3}$; R_c in kpc; σ_0 in $10^{-3} M_{\odot} \text{pc}^{-2}$; V_{\max} in km s^{-1} ; and $\mu_0(B)$ in mag arcsec^{-2} .

5.4 Minimum disc

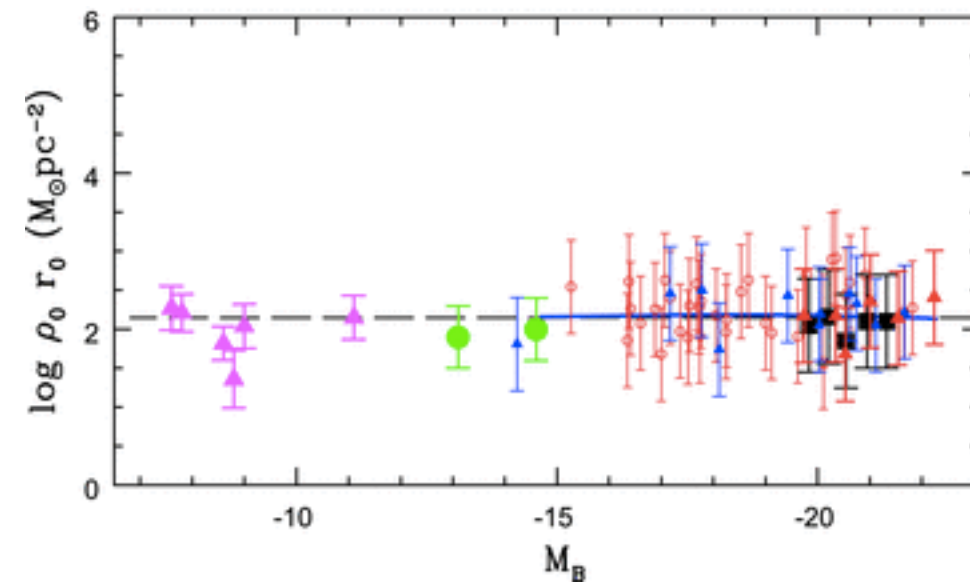
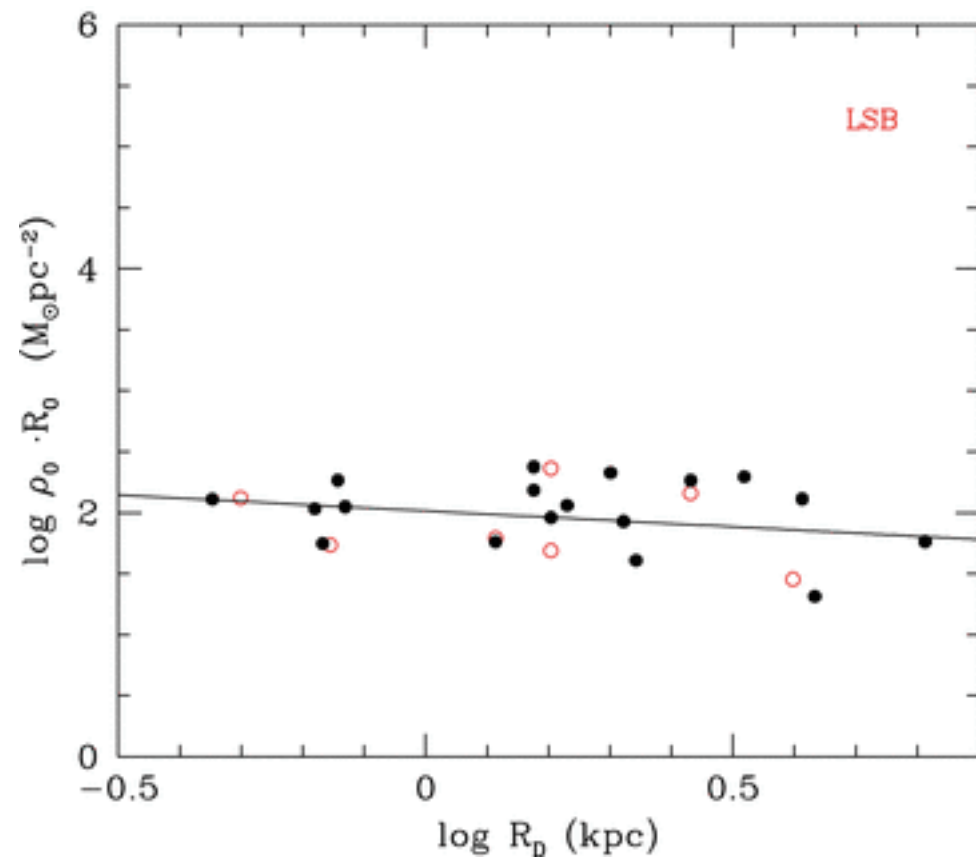
We can illustrate that the halo parameters derived for the LSB galaxies are robust values by comparing the values derived for maximum disc and minimum disc. This is done in Fig. 10, where the core radii and central densities as derived using these two extreme hypotheses are compared. The difference in maximum and minimum disc-halo parameters is clearly a strong function of surface

5.5 Bottema disc mass-to-light ratios

The most important property that distinguishes the Bottema disc from the maximum disc is its small range of $(M/L_B)_*$. This is immediately apparent in Fig. 8. The Bottema disc typically implies values of $(M/L_B)_*$ between 1 and 2. In general the reddest galaxies have the highest mass-to-light ratios.

The striking systematic offset in $(M/L)_*$ at fixed V_{\max} between

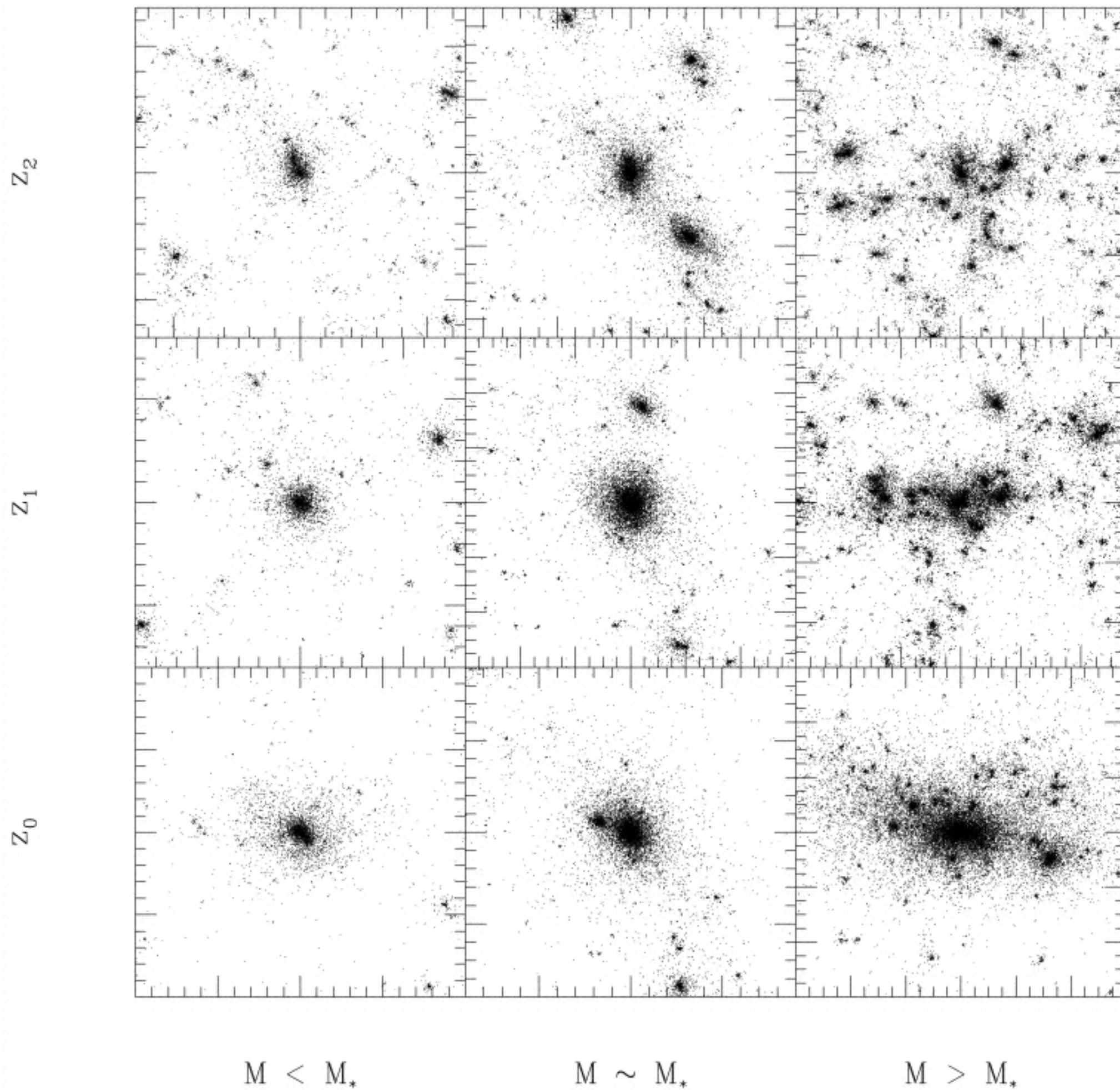
Halo core surface density (product of core density and core radius)
is nearly constant (Donato et al 2009)



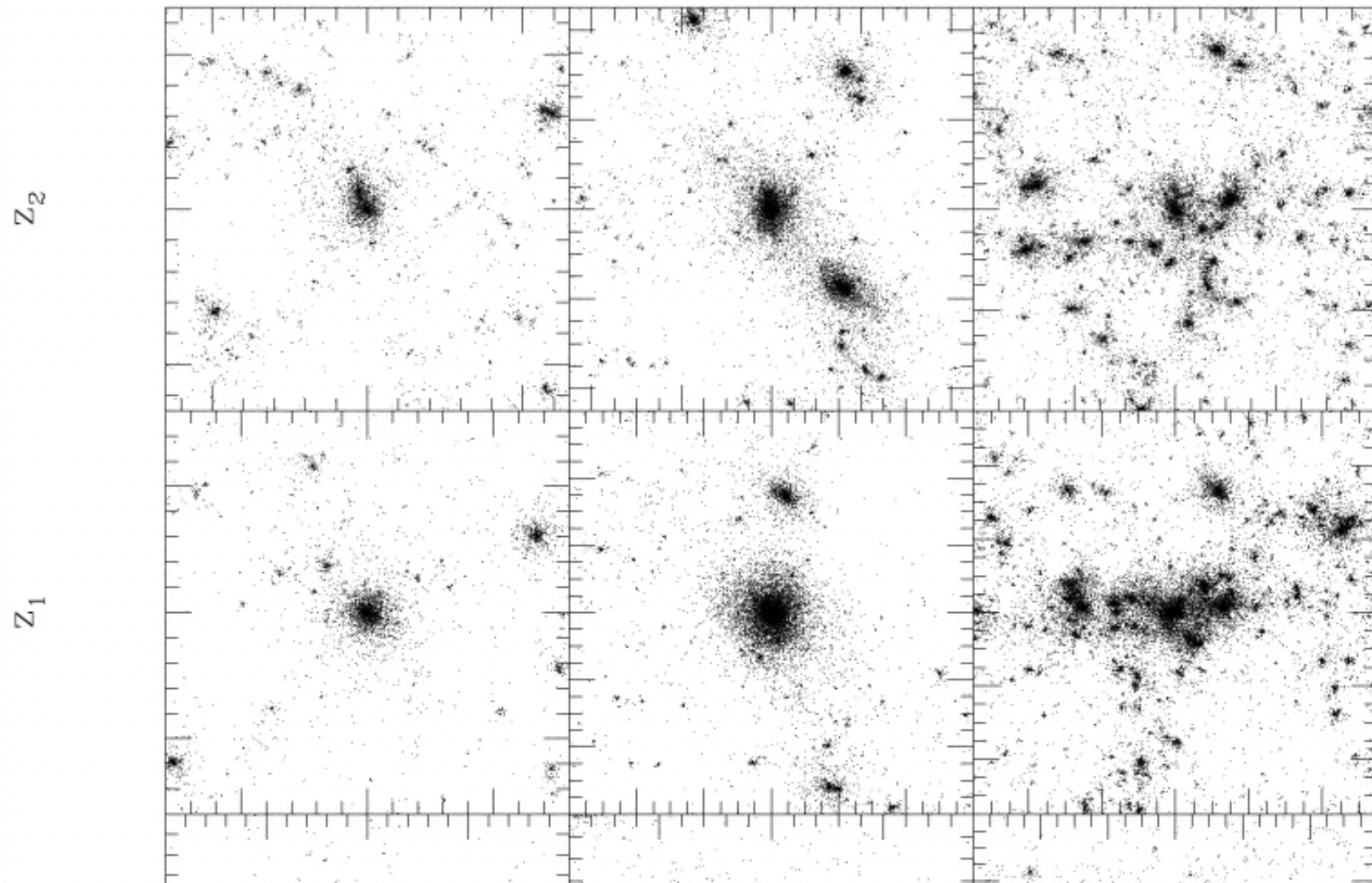
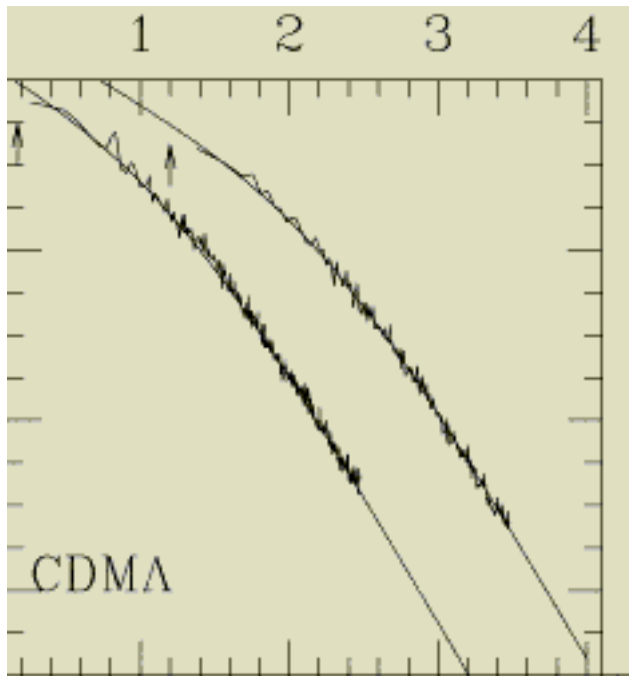
$$\mu_{0D} = \rho_0 R_C$$

$$\log \mu_{0D} = 2.2 \pm 0.25 M_\odot \text{pc}^{-2}$$

NFW

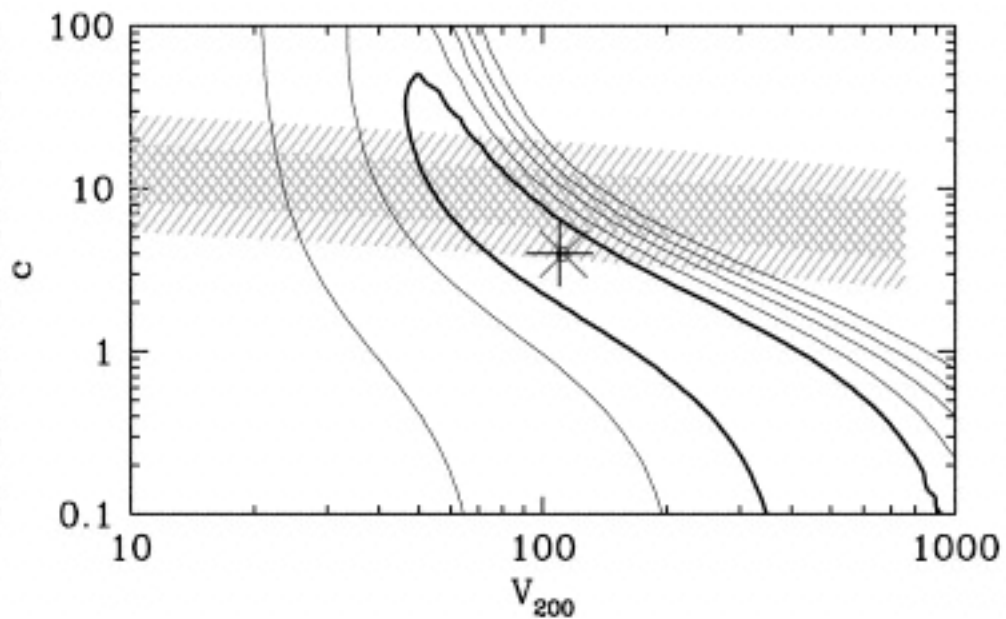
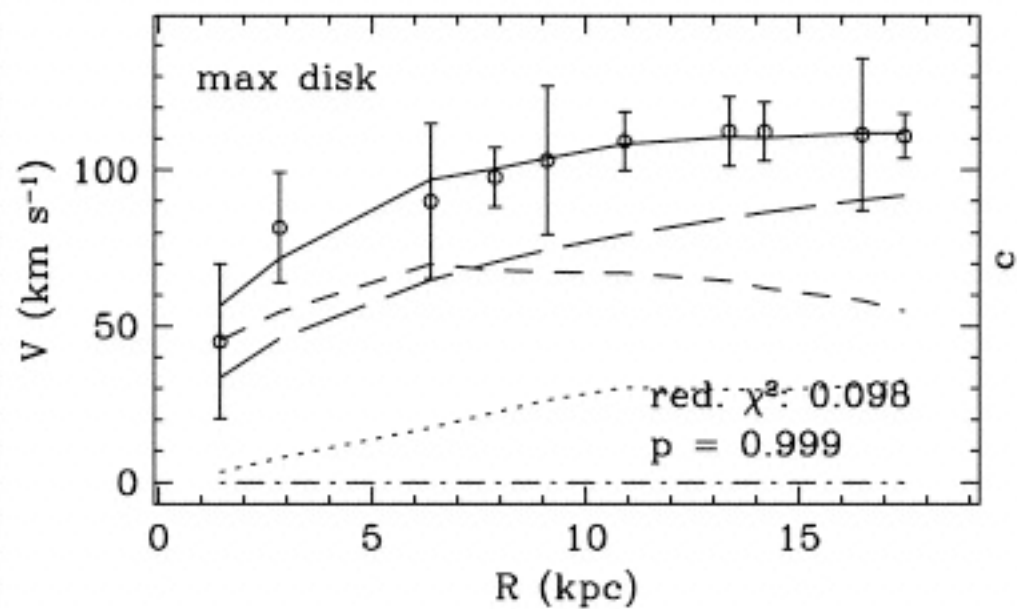
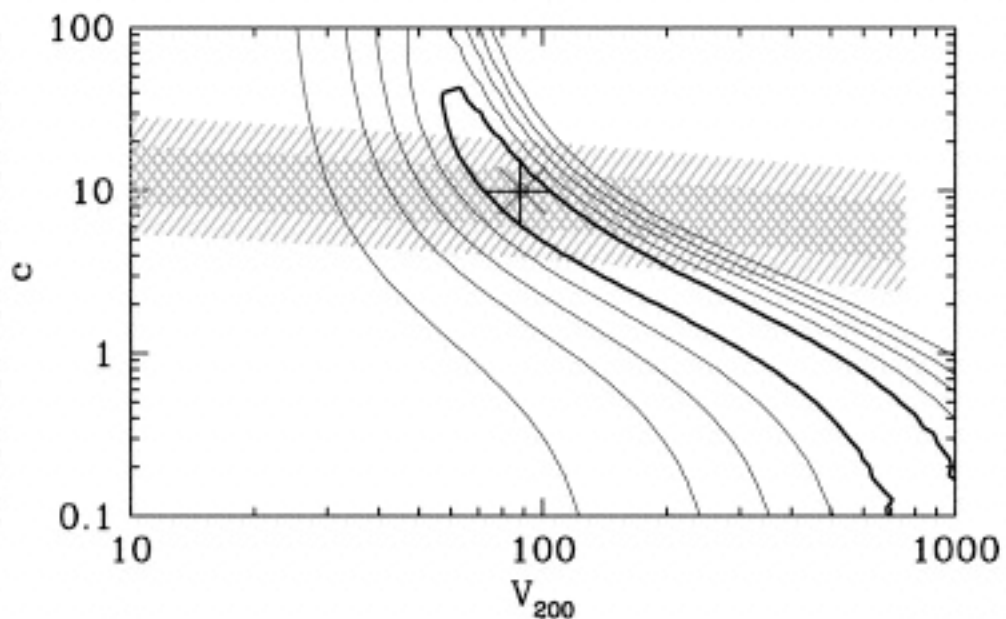
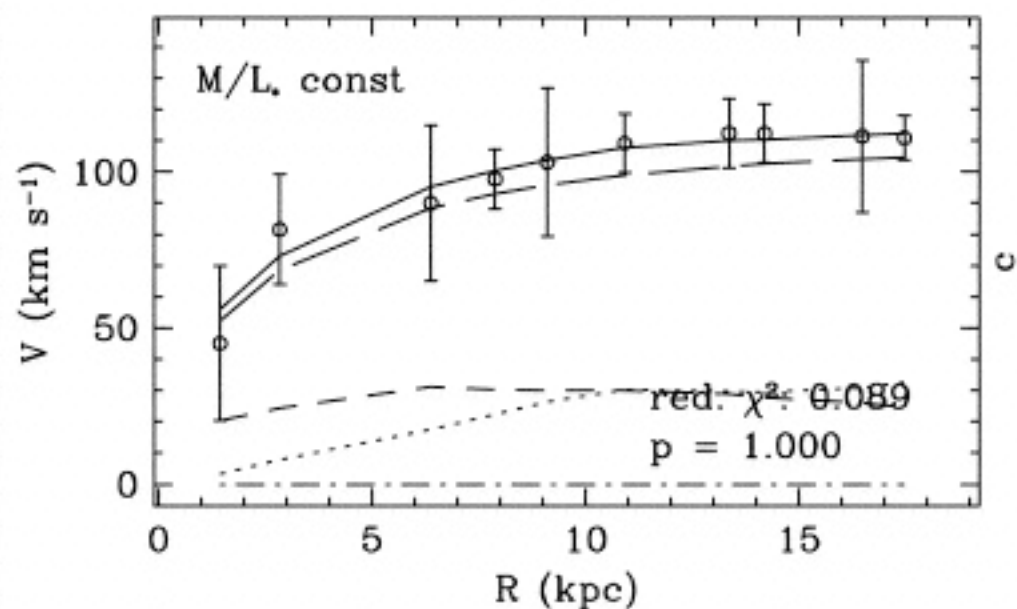
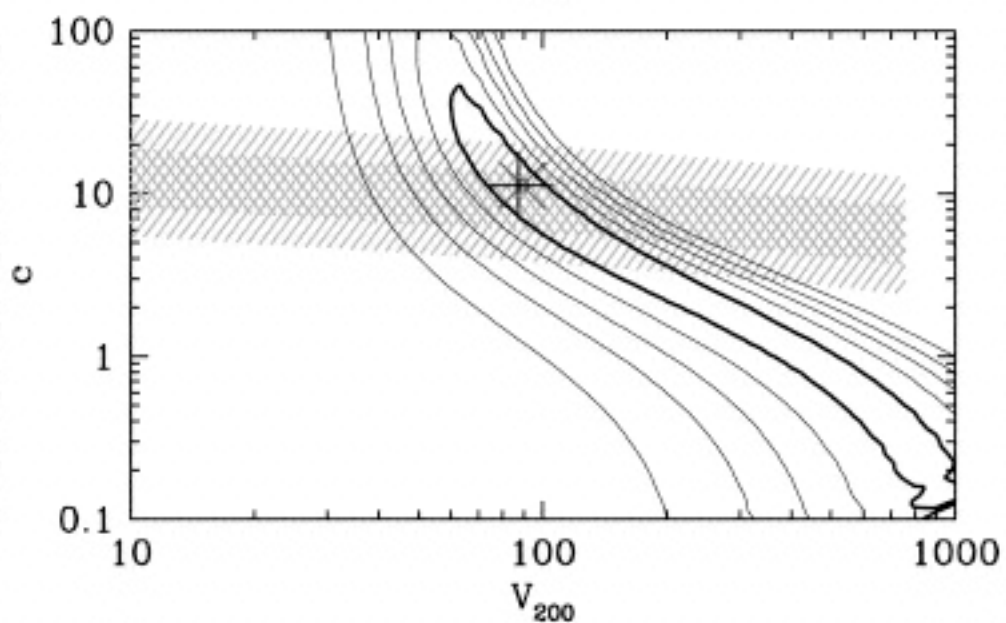
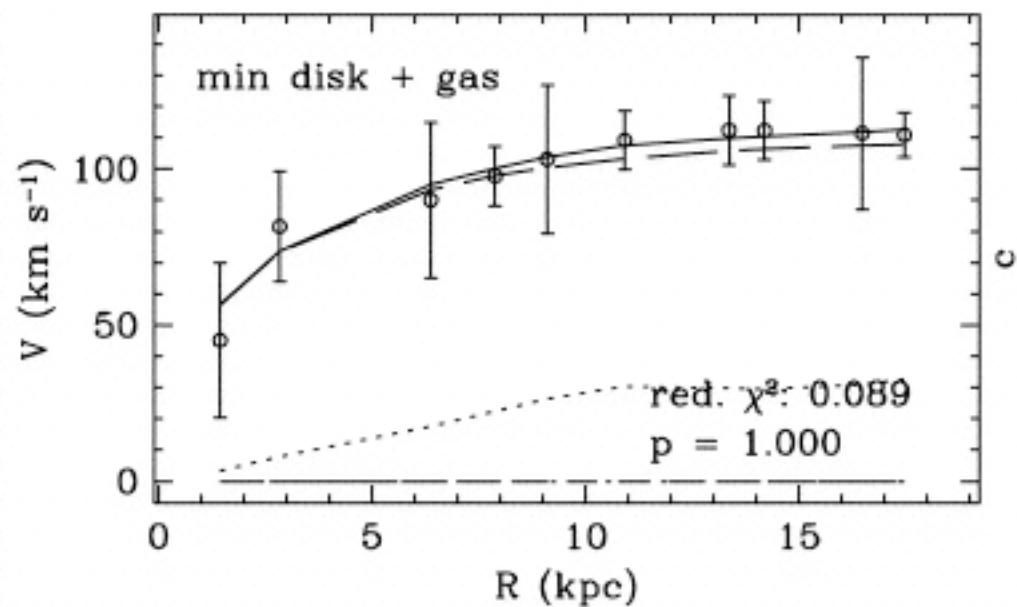


NFW



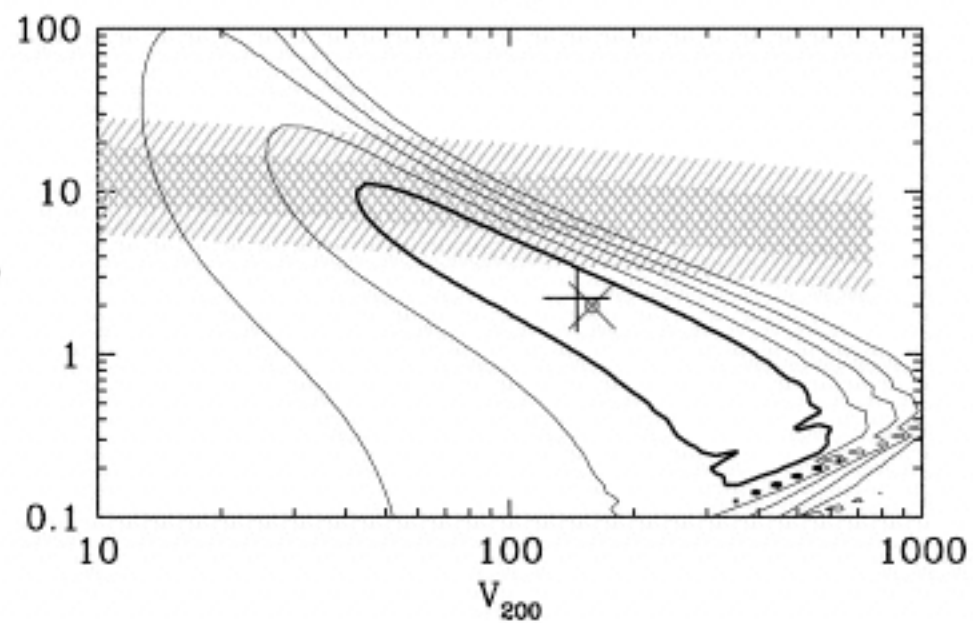
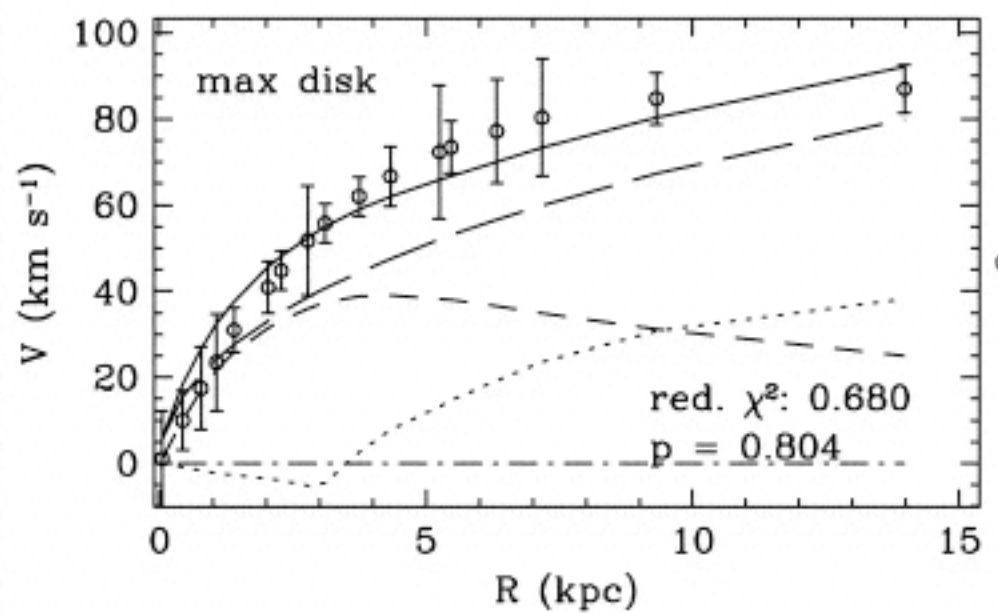
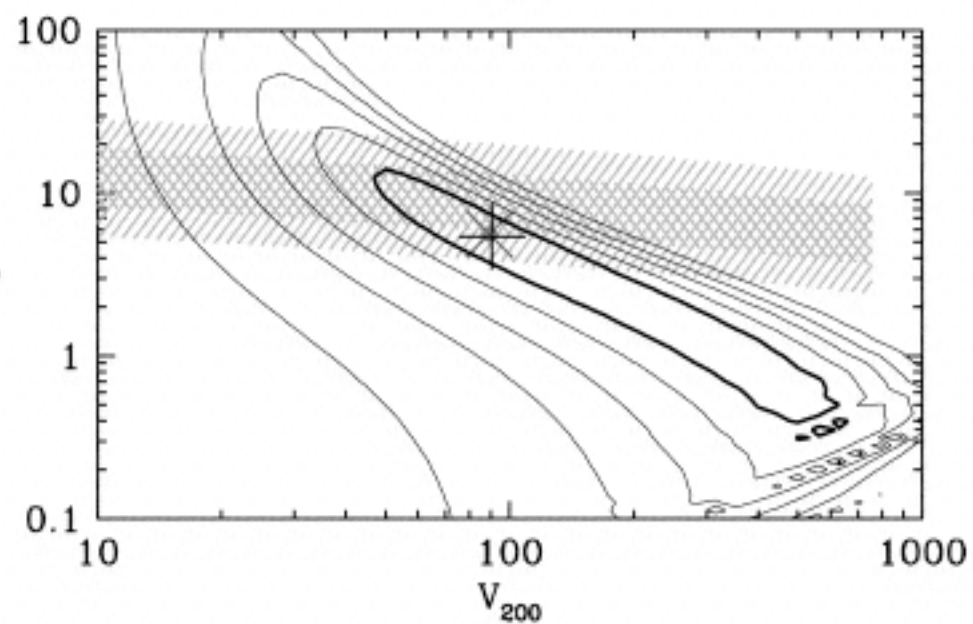
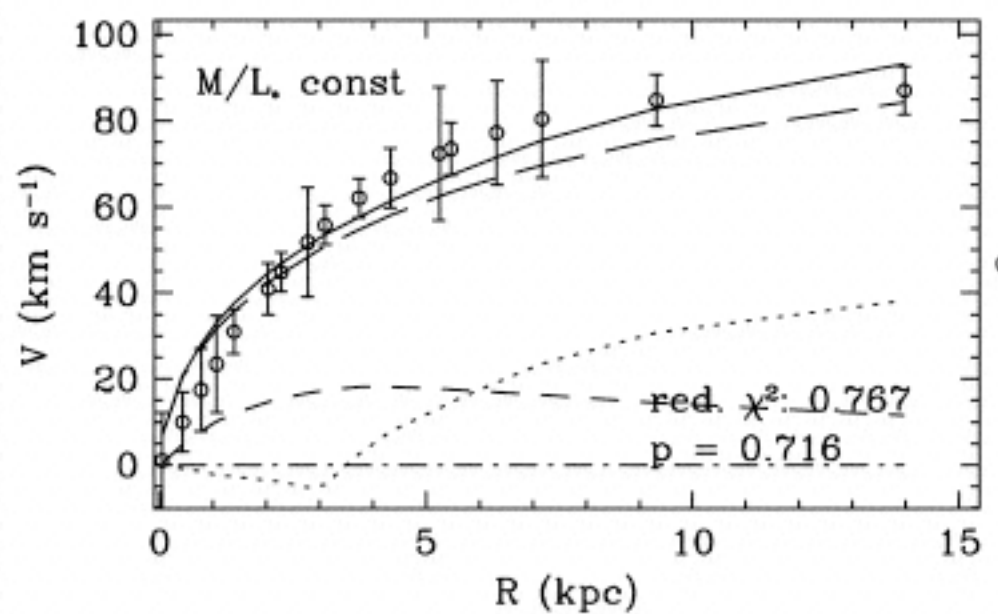
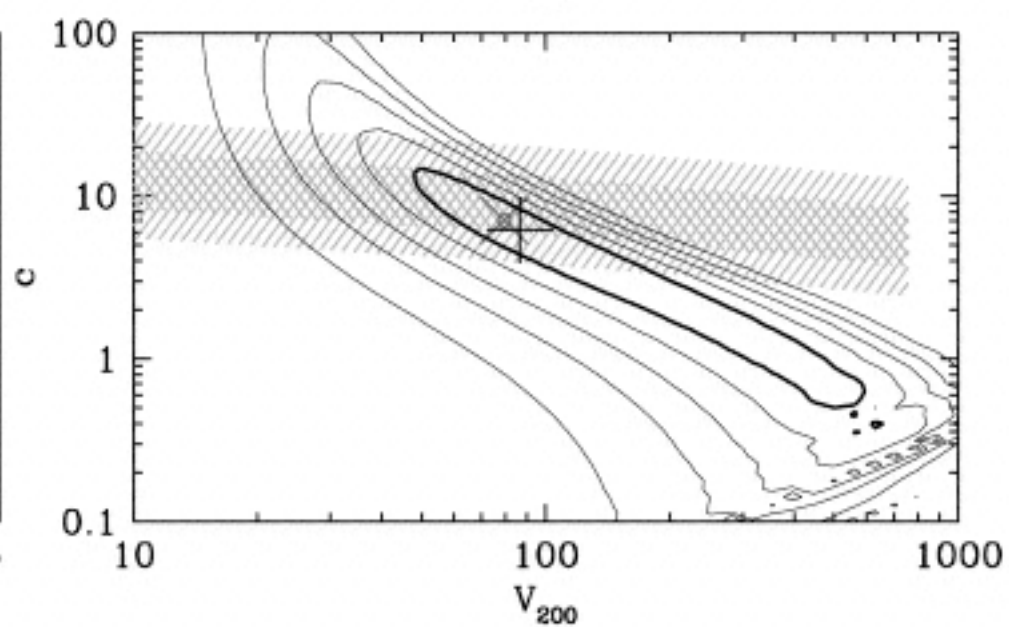
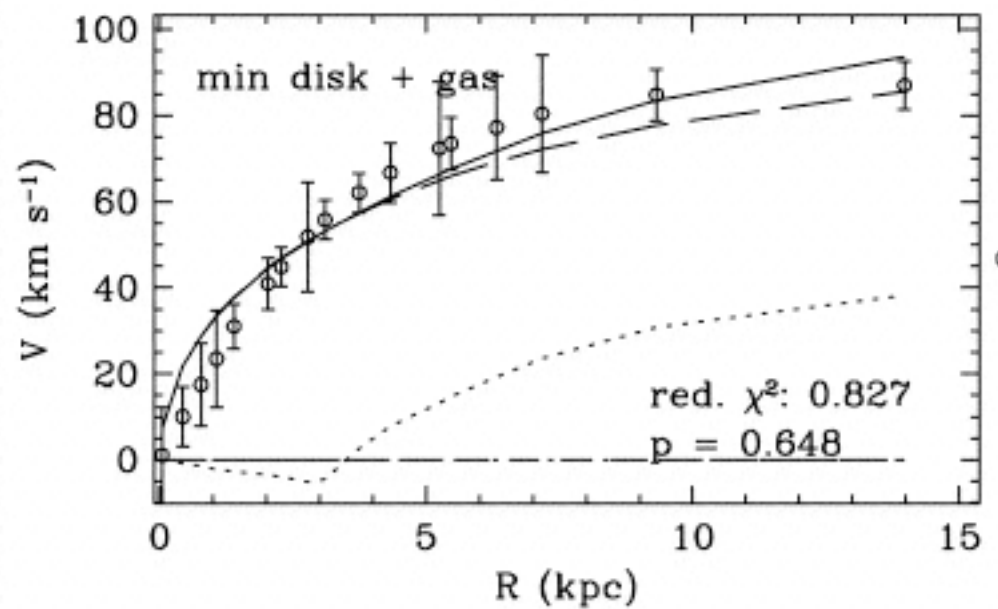
NFW
fits

LSB
F563-1



NFW
fits

LSB
F583-1



NFW
fits

LSB
F583-4

