

Luminosity function & Missing Satellite Problem

Schechter fcn:

$$\Phi(M) = \Phi_* e^{-\left(\frac{M}{M_*}\right)} \left(\frac{M}{M_*}\right)^\alpha \quad \# \text{ of galaxies per } \text{Mpc}^3 \text{ per mass}$$

- 3 parameters:
- Φ_* characteristic density (Mpc^{-3}) \approx
 - M_* characteristic mass / luminosity
 - α faint end slope

traditionally used to fit the galaxy luminosity fcn
 captures gross feature; can over-m some details
 may vary with environment (cluster LF steeper than field LF)

Bill et al (2003)

field

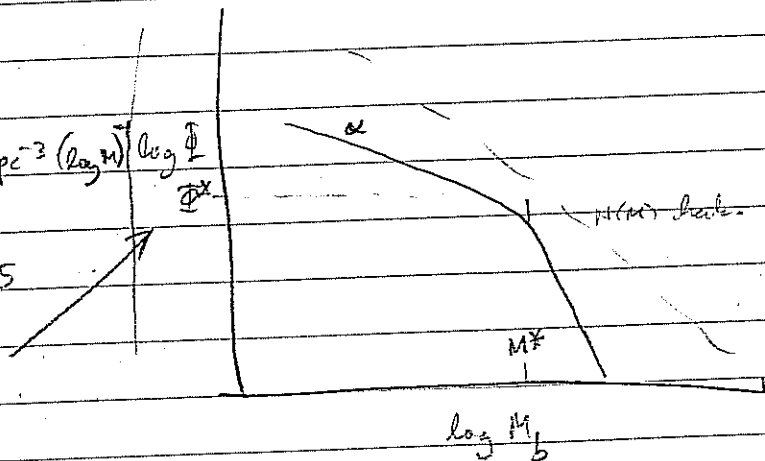
$$\Phi_* = 4 \times 10^{-3} \text{ Mpc}^{-3} (\log M)$$

$$M_* = 10^{11} M_\odot$$

$$\alpha = -1.21 \pm 0.05$$

Sometimes $\frac{dN}{dM}$

Sometimes $\frac{d \log N}{d \log M}$



Waller, Ostriker & Bode (2005)

give $M_* = 1.1 \times 10^{15} M_\odot$

$$\alpha = -1.9$$

for CDM halo mass fcn

Integrated luminosity density

$$j = \int_0^\infty L \Phi(L) dL$$

$$j = L_* \Phi_* \Gamma(\alpha + 2)$$

aw

1.5

Abundance matching: map $\Phi^{\text{expected}}(M_{\text{halo}})$ to $\Phi^{\text{observed}}(M_{*})$

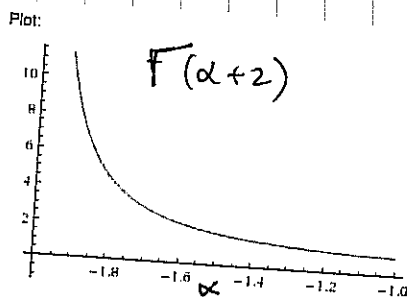
The expected halo abundance is usually determined by matching the clustering of DM halos in simulations to that observed for large galaxy survey like SDSS.

Leads to $M_{*} - M_{\text{halo}}$ relations like that of Moster et al. (2010):

$$\frac{m}{M} = 2 \left(\frac{m}{M} \right)_0 \left[\left(\frac{M}{M_1} \right)^{-\beta} + \left(\frac{M}{M_1} \right)^{\gamma} \right]^{-1}$$

where m is stellar mass and M is halo mass.

$\left(\frac{m}{M} \right)_0$, M_1 , β , γ are fit parameters of a broken power law



Note $\Gamma(\alpha+2) = 1+2$ for $\alpha = -1 \rightarrow -1.5$
 blows up as $\alpha \rightarrow -2$
 (>10 for $\alpha < -1.9$;
 goes to ∞ at $\alpha \rightarrow -2$)