The galaxy luminosity function

Schechter ApJ 203, 297 (1976)

Binggeli et al Ann Rev. Astron Astrophys 26, 509 (1988)

Let $\phi(L)\,dL$ be the number of galaxies per unit volume in the luminosity interval between L & $L+dL$

$$\phi(L) \propto L^{\alpha} e^{-L/L_*} \qquad \text{(Schechter)}$$

* Note that some authors use luminosity function ϕ to describe the probability distribution fn. of galaxies, not the number density *

absolute magnitude M_* corresp. to L_*

of order $M_{*B_T} = -21$

$\alpha \simeq -1.2$

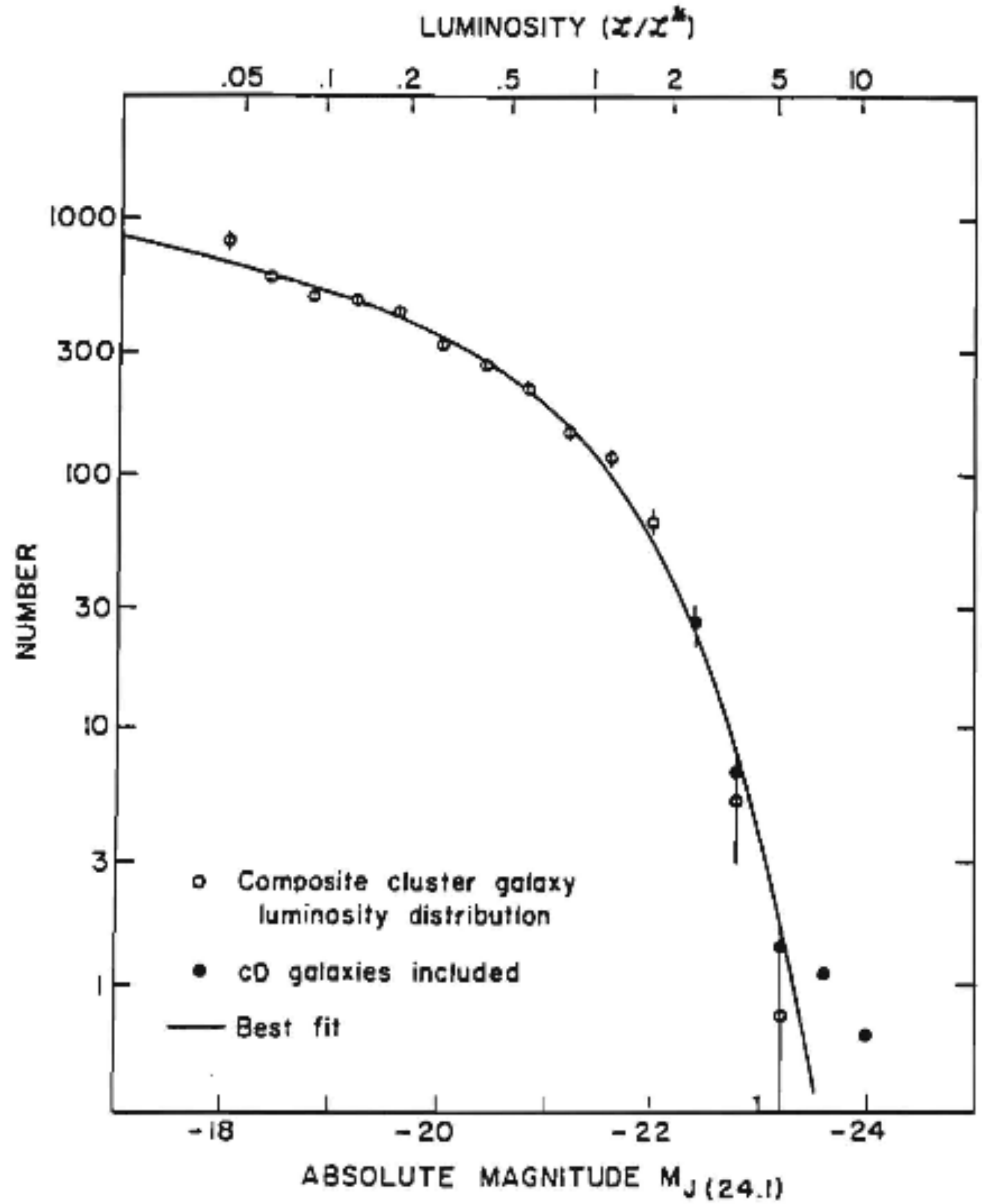
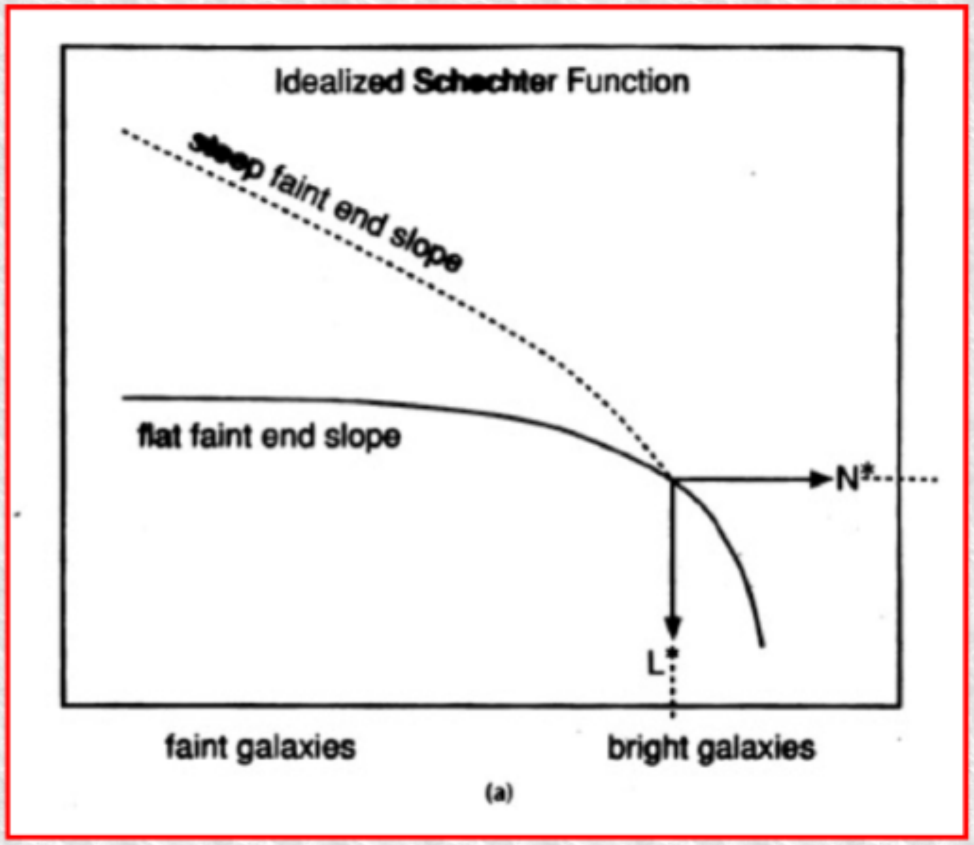


FIG. 2.—Best fit of analytic expression to observed composite cluster galaxy luminosity distribution. Filled circles show the effect of including cD galaxies in composite.

Schechter 1976

Idealized Schechter Function



Sketch of the Schechter luminosity function, illustrating the role of its three parameters. The "break" luminosity marks the change from power law (low luminosity) to exponential cutoff (high luminosity). The normalization is the amplitude at the break luminosity. The slope of the power law specifies the left hand gradient.

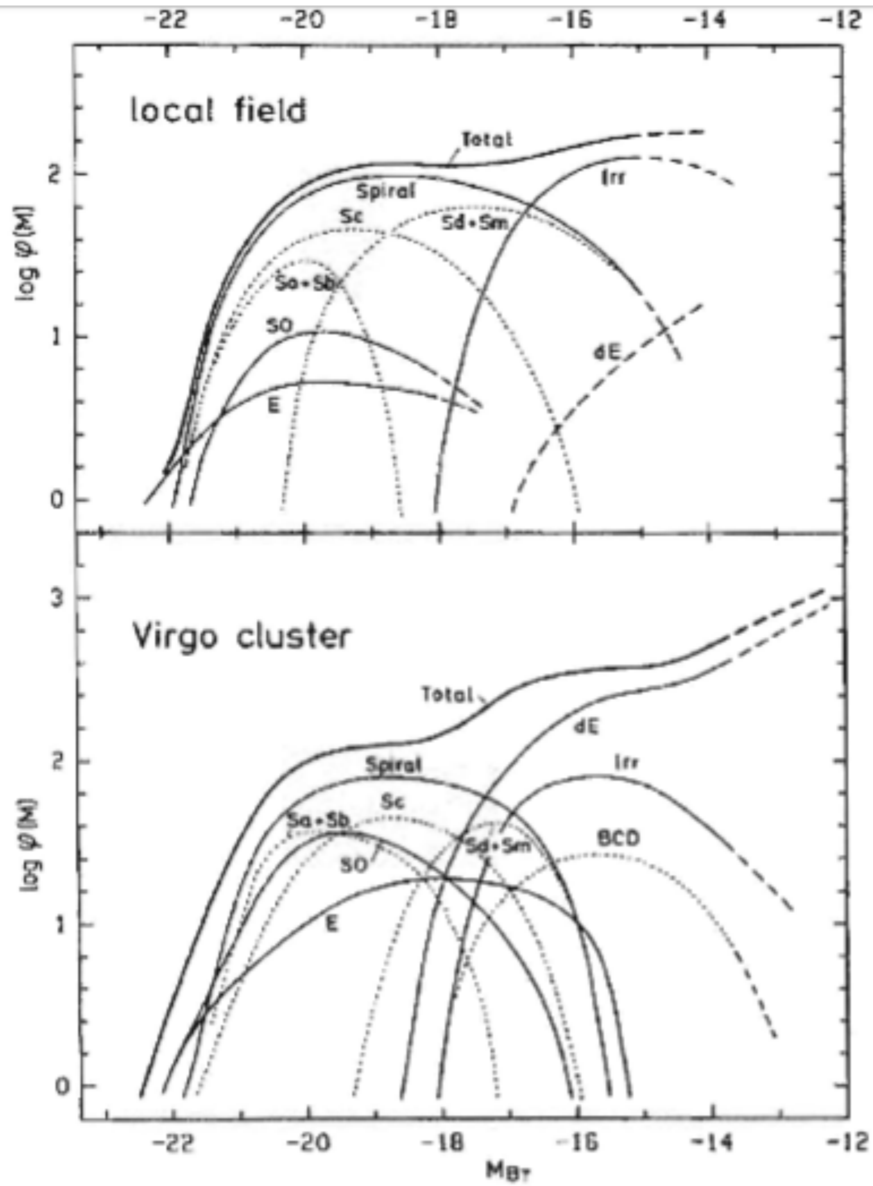
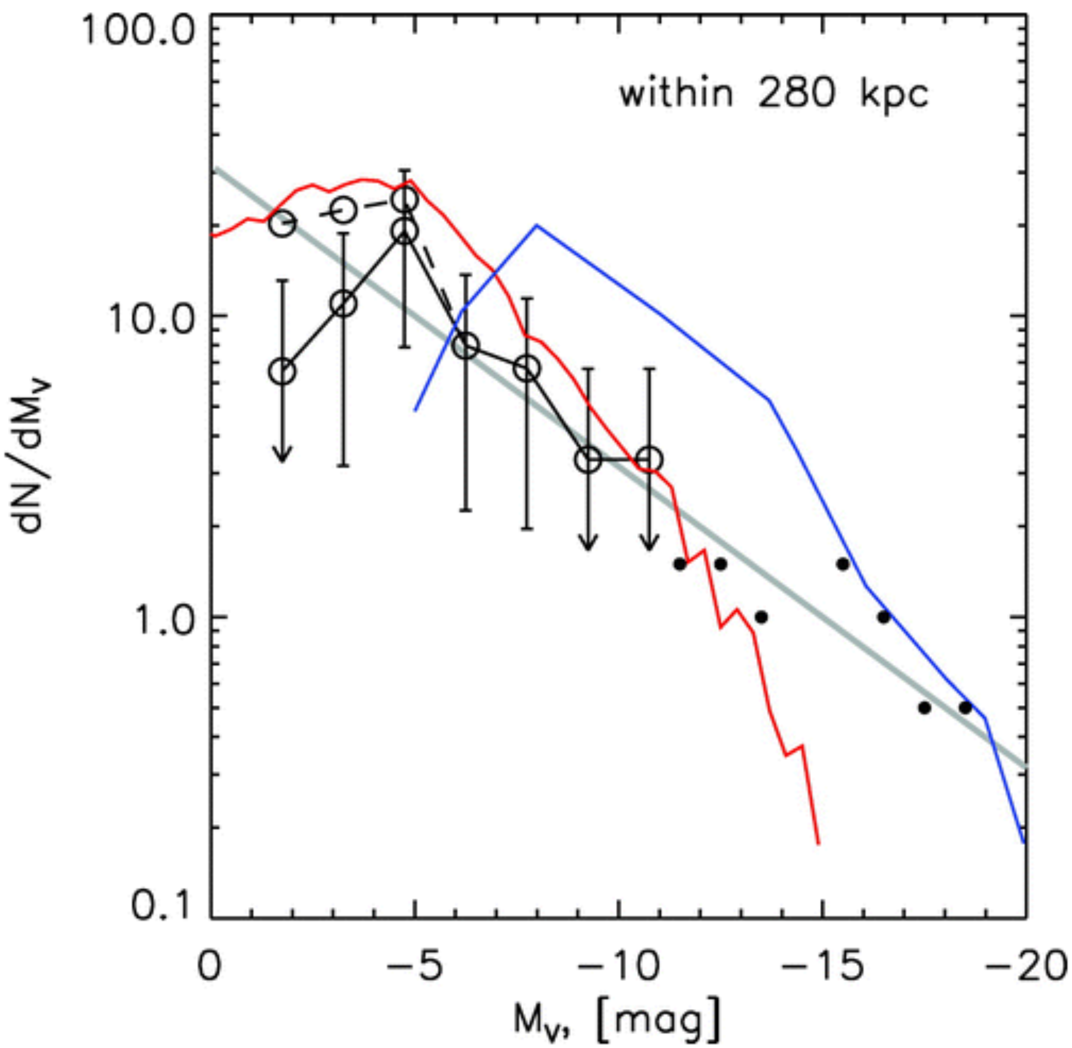


Figure 1 The LF of field galaxies (top) and Virgo cluster members (bottom). The zero point of log $\varphi(M)$ is arbitrary. The LFs for individual galaxy types are shown. Extrapolations are marked by dashed lines. In addition to the LF of all spirals, the LFs of the subtypes Sa + Sb, Sc, and Sd + Sm are also shown as dotted curves. The LF of Irr galaxies comprises the Im and BCD galaxies; in the case of the Virgo cluster, the BCDs are also shown separately. The classes dS0 and "dE or Im" are not illustrated. They are, however, included in the total LF over all types (heavy line).

Binggeli et al 1988
Note that LMC has M_B=-18.3



Best available faint end LF:

Koposov et al 2008:
LF of Milky Way satellites
Note Mv axis!

Luminosity functions of Milky Way satellite galaxies within ~280 kpc (virial radius) inferred from our analysis under the assumption of two different radial distributions of satellites, NFW-like (*solid black line*) and isothermal (*dashed black line*). The calculation uses the satellite list and the volume correction factor obtained with the pipeline using the cuts $r < 22.5$ and $S_{\rm star} > 5.95$. The arrows on error bars indicate that there is only one galaxy in that particular bin, and so the Poisson error is formally 100%. The theoretical prediction of Fig. 1 of Benson et al. (2002) is shown as a red line, and the prediction of Somerville (2002) for $z_{\rm reion} = 10$ is shown as a blue line. In addition, the luminosity function for the bright ($M_V < -11$) satellites of the Milky Way sampled over the whole sky together with the bright M31 satellites within 280 kpc from Metz et al. (2007) is plotted with small filled circles (the list of plotted objects consists of Sgr, LMC, SMC, Scl, For, Leo II, Leo I, M32, NGC 205, And I, NGC 147, And II, NGC 185, And VII, and IC 10). The function $dN/dM_V = 10 \times 10^{0.1(M_V+5)}$ is shown in gray.

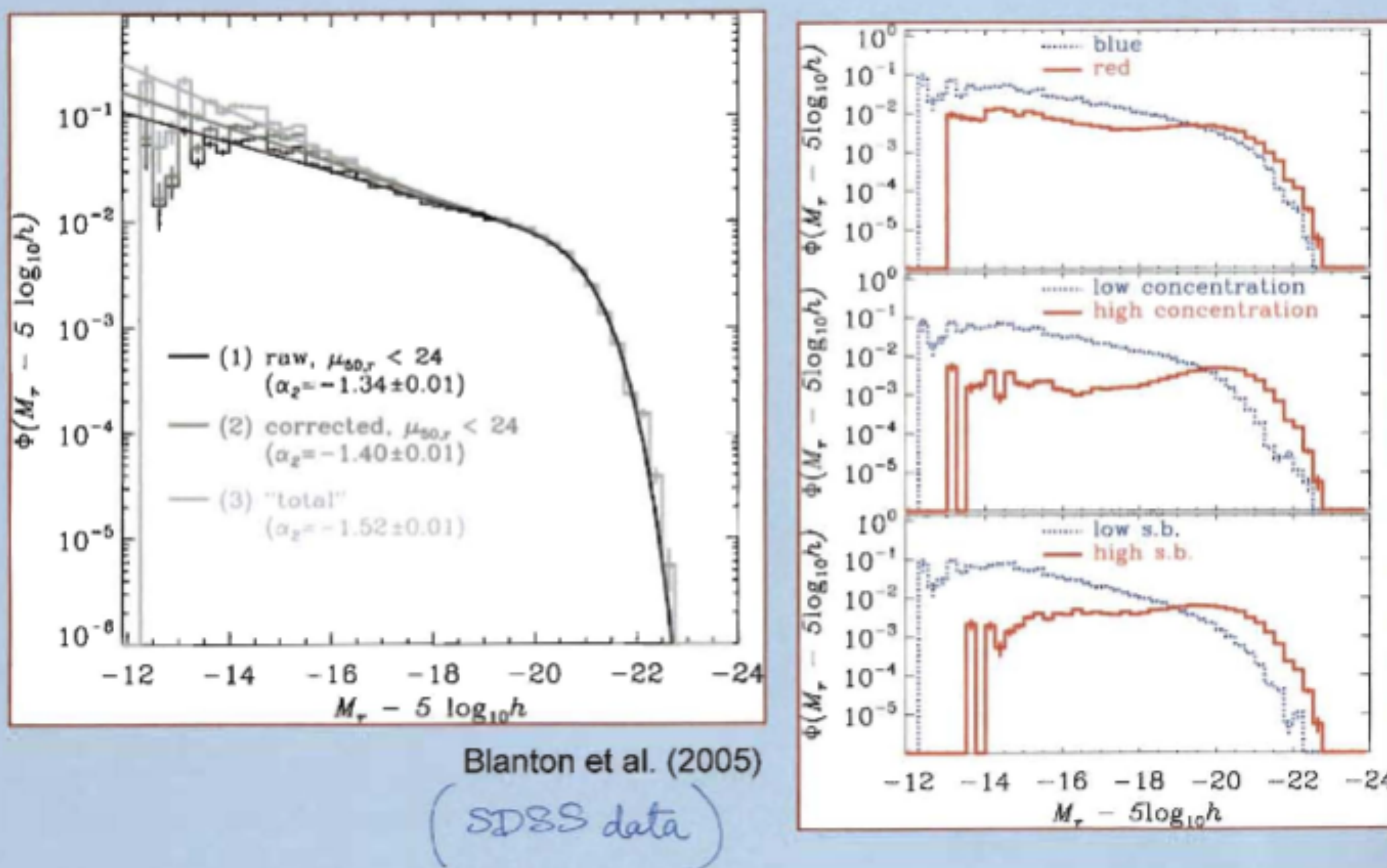
Problem

How would you go about measuring a galaxy LF, in a cluster & in the field?

Q What would be possible biases in the field? In clusters?

Q What effect might large-scale structure have on your results?

LF from SDSS data



Compare variation with color, galaxy concentration and surface brightness with Binggeli et al results