$\Omega_{g,lb} \simeq 0.004$ if $M/L = 10\text{-}25$, $\Omega_{g_m} \approx 0.04 - 0.1$

$\Omega_{LG} = 0.1 - 0.2$

$\Omega_{clust} = 0.2 - 0.3$

Ω_b introduces TWO distinct missing mass problems

Missing baryon problem: $\Sigma \Omega_{stuff} < \Omega_b$ from BBN

Missing cosmological mass problem: $\Omega_b < \Omega_m$ dynamical ↳ CDM

Ω from dynamics: section 20 of Peebles, Bothun ch. 3, 4, 5

Ω_m from spherical infall $\quad \frac{\Delta v}{v} = \frac{d \ln H}{d \ln \rho} \frac{\Delta \rho}{\rho} + O\left(\frac{\Delta \rho}{\rho}\right)^2$

$$\frac{\delta v}{v} \simeq -\frac{1}{3} \Omega_m^{0.6} \frac{\delta \rho / \rho}{(1 + \delta\rho/\rho)^{1/4}} \simeq -\frac{1}{3} \Omega_m^{0.6} \frac{\delta \rho}{\rho}$$

$\frac{\delta v}{v}$ = peculiar velocity caused by density contrast $\delta\rho/\rho$

Spherical shell approximation ASSUMES we can treat our local motion as overdense mini-universe

BIAS: usually we measure motions of luminous galaxies, and assume light traces mass. Allowance for a more diffuse mass component is made through linear bias, b:

$$\frac{\delta \rho_m}{\rho_m} = b^{-1} \frac{\delta \rho_g}{\rho_g} \qquad \frac{\delta \rho_g}{\rho_g} = b \frac{\delta \rho_m}{\rho_m}$$

only $b > 1$ makes sense

so what measurements of $\delta v / v$ and $\delta\rho_g/\rho_g$ really constrain is $\Omega^{0.6}/b = \beta$

$b = \frac{\sigma}{\sigma_g}$

$b \approx 1\text{-}2$ for galaxies; $\gtrsim 2.5$ for rich clusters

b corresponds roughly to the # of sigma of the density fluctuation from which the object formed

2dF luminosity density $j_K = 2.5 \pm 0.2 \times 10^8 h\, L_\odot\, Mpc^{-3}$

$M^* = -19.75$

$\Phi^* = 2 \times 10^{-2}$

The Local Group & Virgo - a worked example

$$\frac{\delta V}{V} = -\frac{1}{3} \frac{\Omega_m^{0.6}}{b} \frac{\delta \rho_g}{\rho_g}$$

$\frac{\delta \rho_g}{\rho_g} \approx 2$ from counting galaxies — ~ twice average density ~ Virgo out to LG.

So

$V_{Virgo} \approx 1500$

$\delta V_{Virgo} \approx -300$

$$\beta = \frac{\Omega_m^{0.6}}{b} \approx -3 \frac{(-300/1500)}{2} \approx 0.3$$

for $1 < b < 2$, $0.13 < \Omega_{m_0} < 0.43$

only $b > 1$ makes physical sense in CDM picture: need a smooth component of mass to make Ω big; baryons dissipate and become more concentrated than CDM (which is dissipationless).