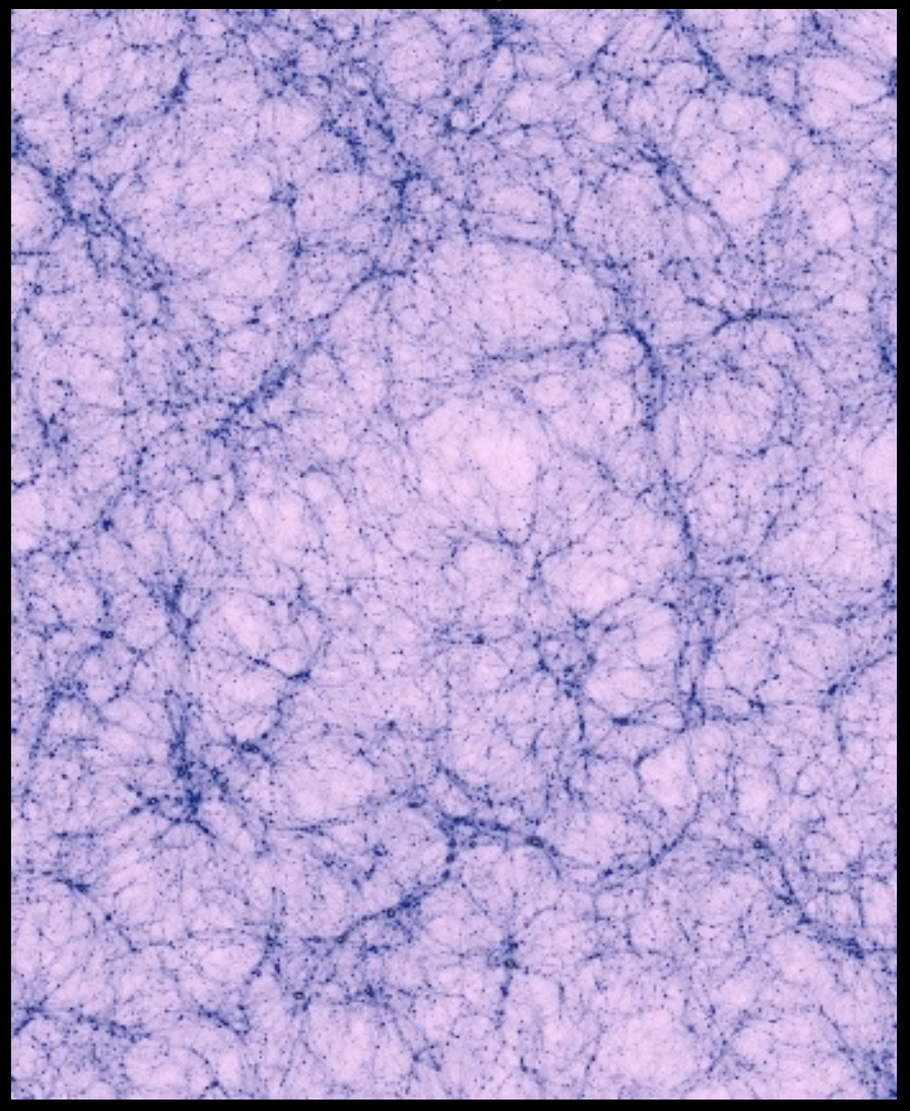
Evidence for a ~300 Mpc Radius Underdensity in the Local Galaxy Distribution

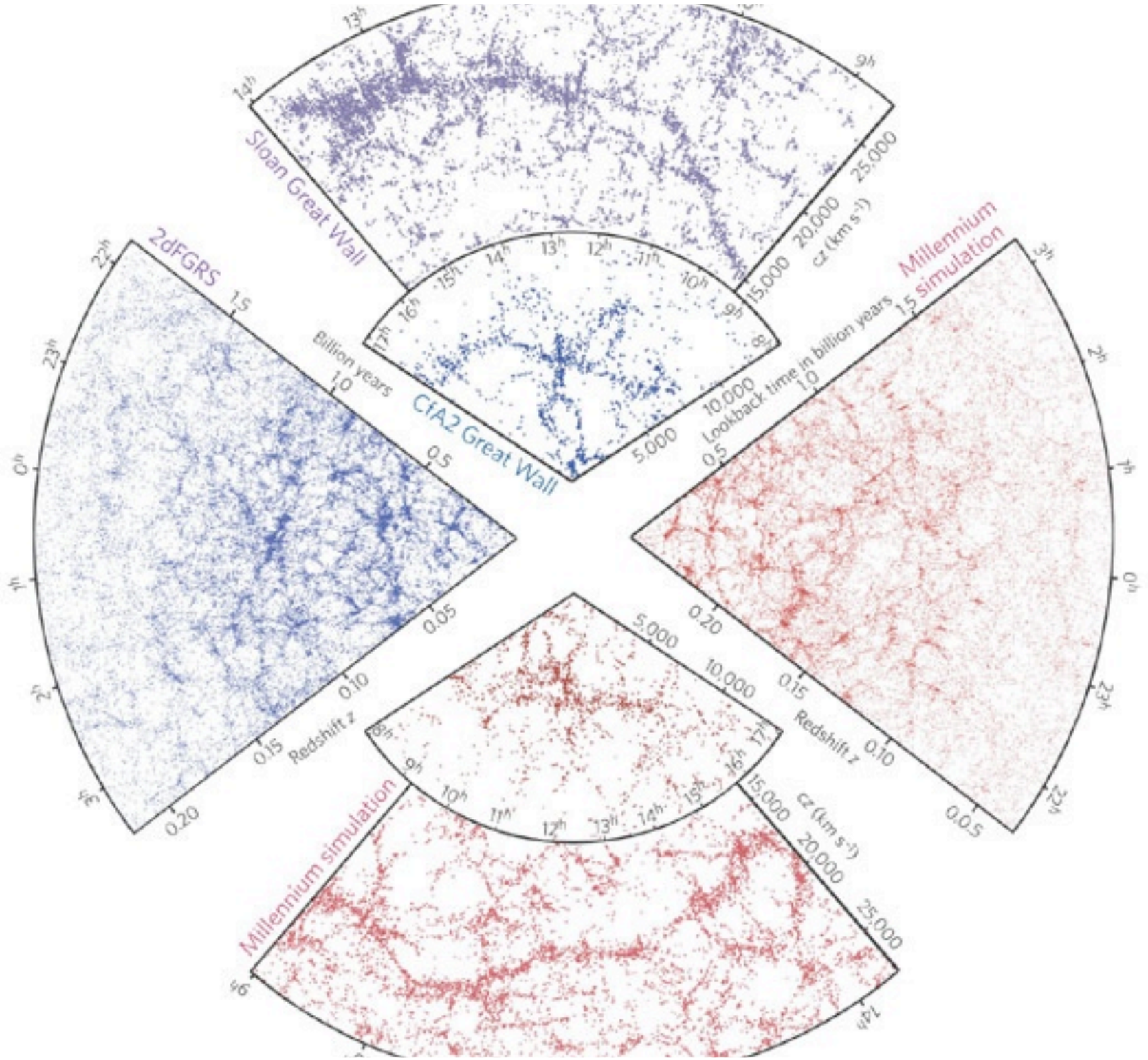


Ryan Keenan (ASIAA, Taiwan)

Collaborators: Amy Barger (U. Wisconsin), Lennox Cowie (IfA, Hawaii), Wei-Hao Wang (ASIAA, Taiwan), Isak Wold (U. Wisconsin), Laura Trouille (Northwestern, IL)

The Horizon Simulation: www.horizon-project.fr

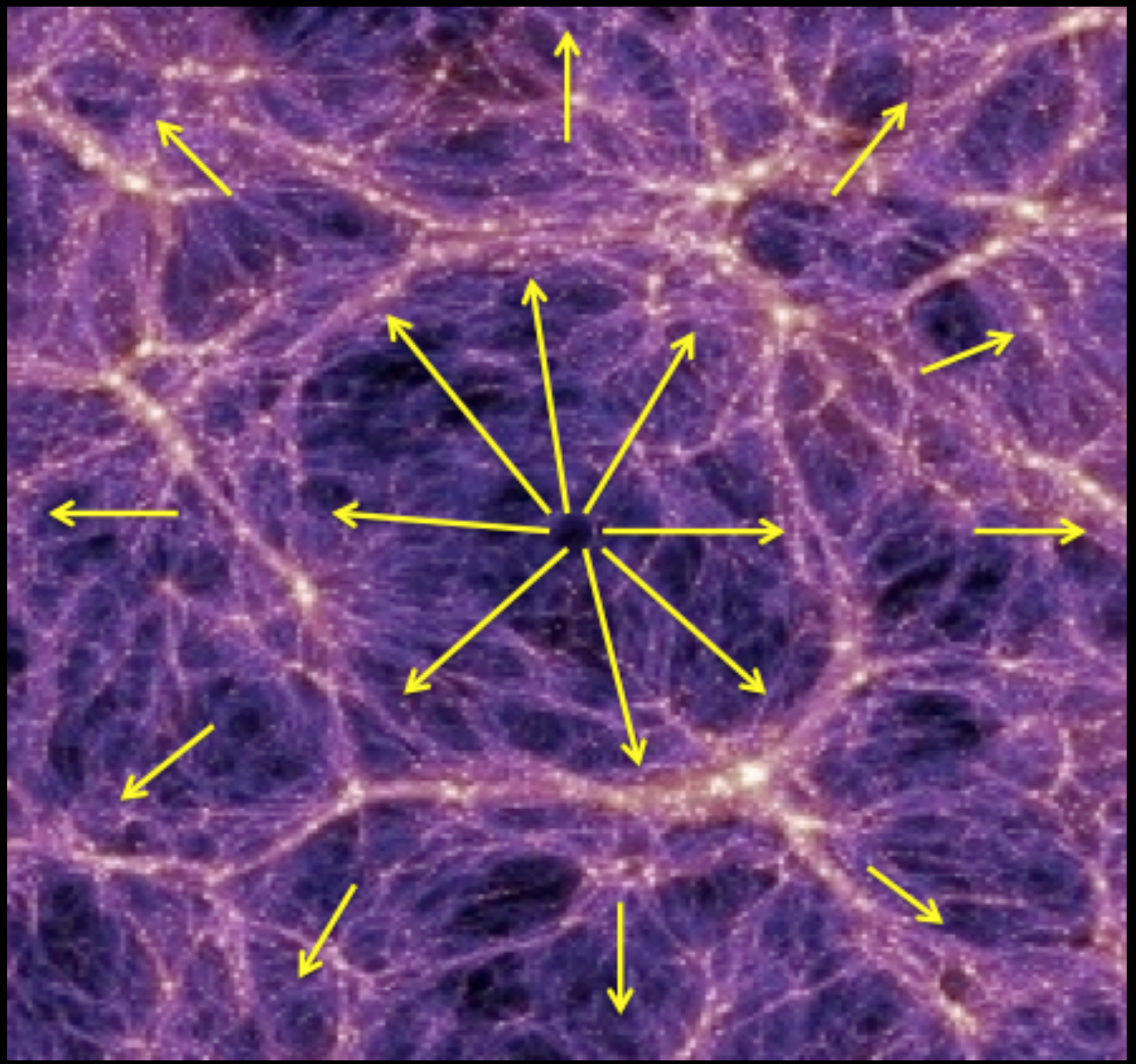
Observations: CFA2, 2DFGRS, SDSS



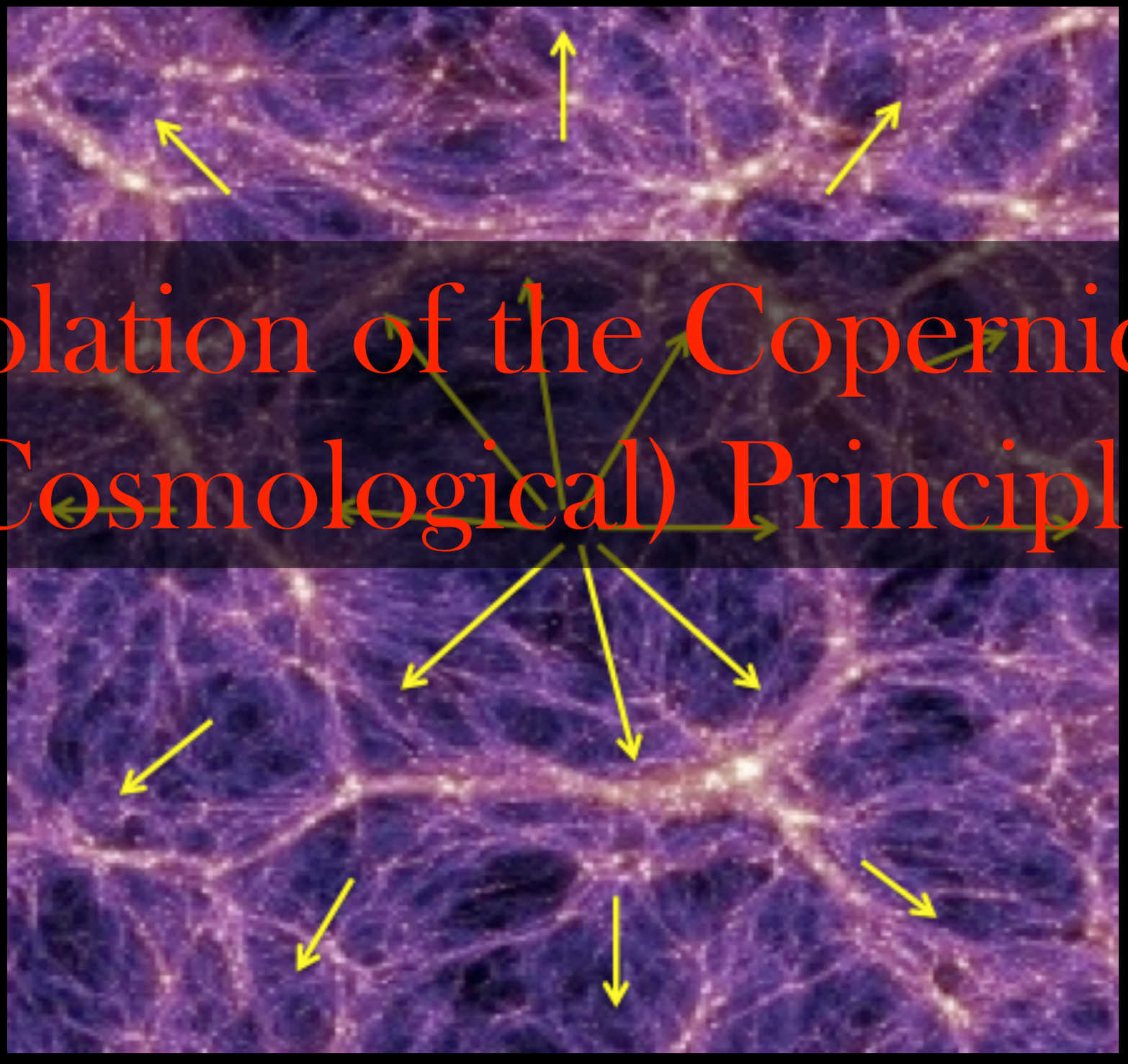
Millennium Simulation Springel et al. (2006)

The Horizon Simulation: www.horizon-project.fr

A Large Underdensity Can Produce an Apparent Acceleration of Expansion

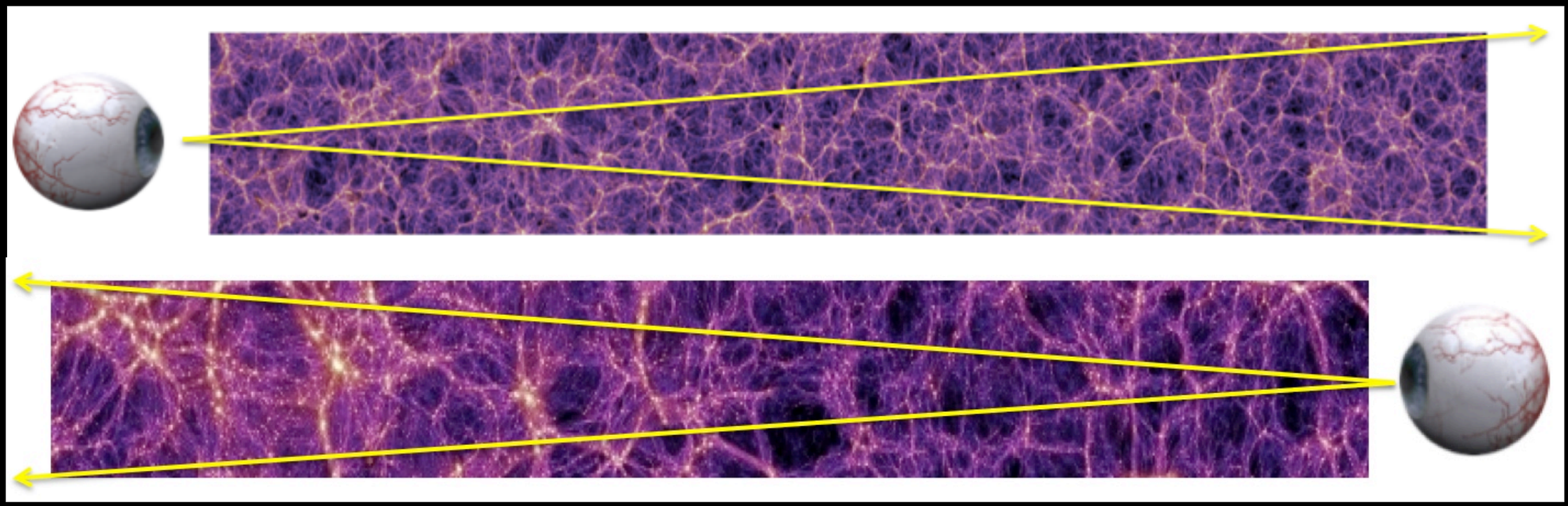


A Large Underdensity Can Produce an Apparent Acceleration of Expansion

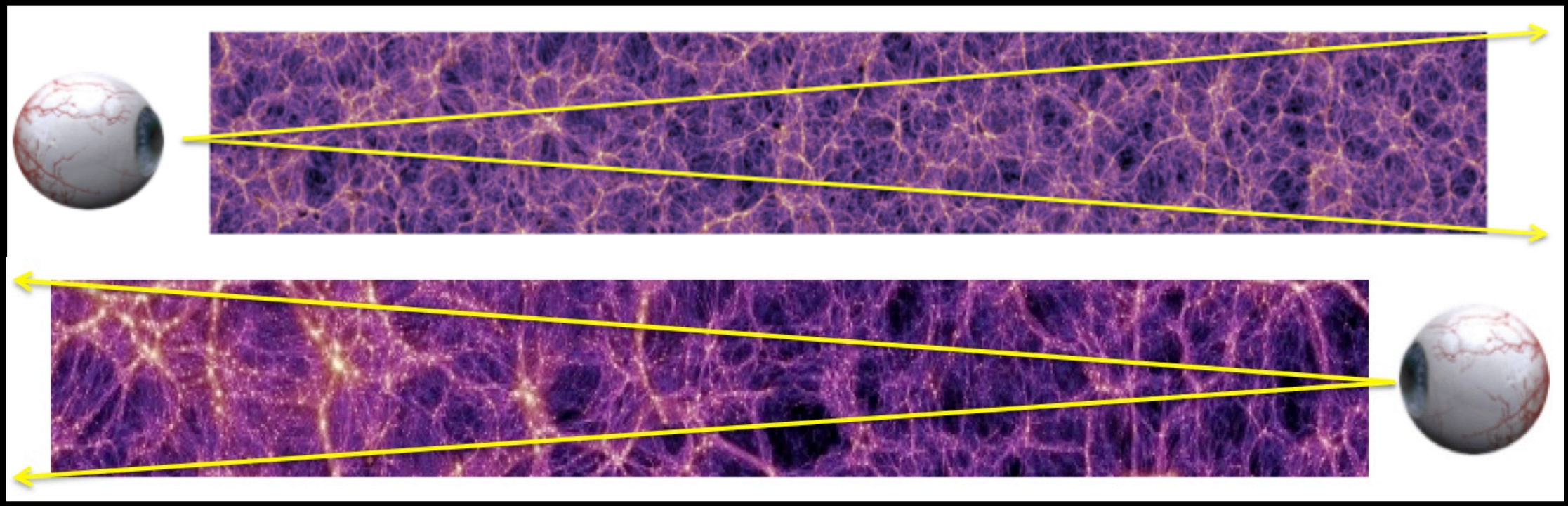


Violation of the Copernican (Cosmological) Principle!

(NIR) Galaxy Counts to Probe Structure



(NIR) Galaxy Counts to Probe Structure



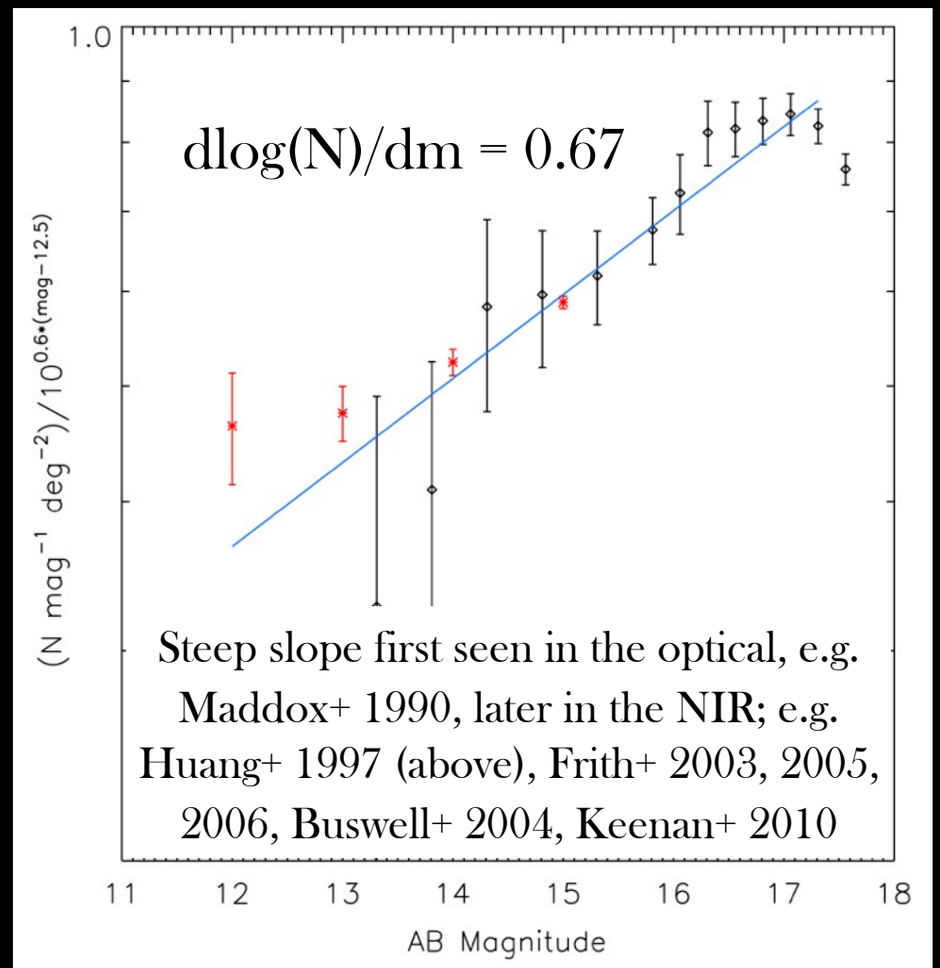
$$F \sim \frac{1}{R^2} \longrightarrow R \sim F^{-\frac{1}{2}}$$

$$N(F > F_0) = n_* V \sim R^3 \sim F^{-\frac{3}{2}}$$

$$m = -2.5log(F) \longrightarrow F = 10^{-0.4m}$$

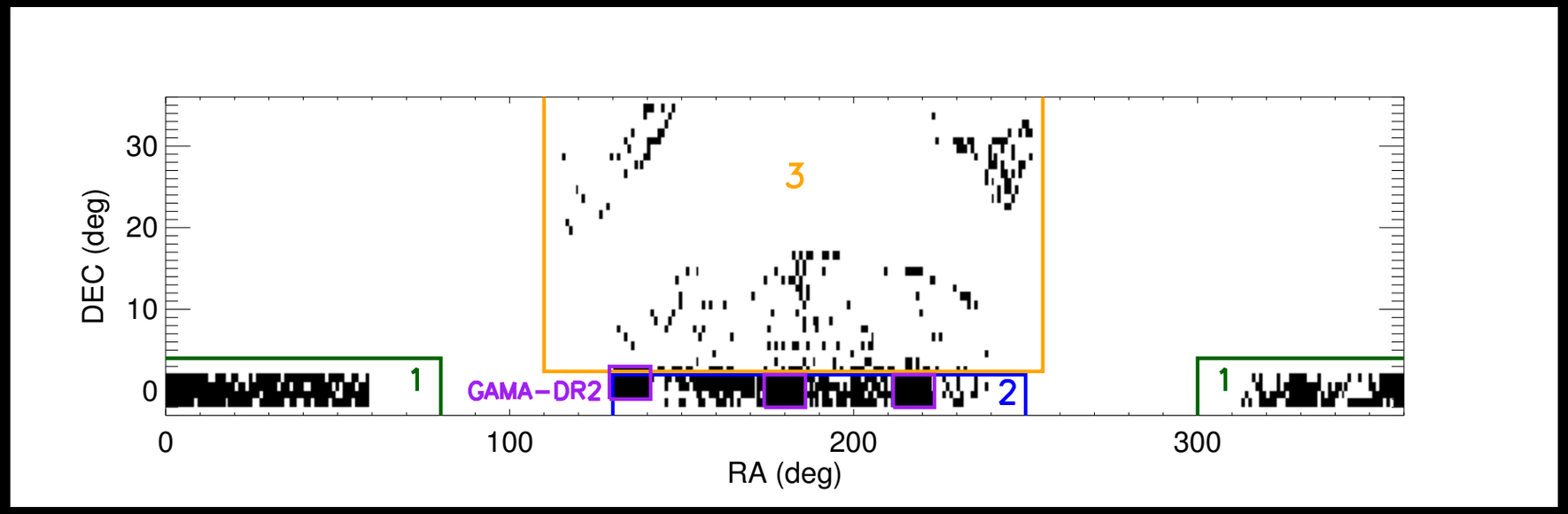
$$F^{-\frac{3}{2}} = 10^{0.6m} \sim N(m < m_0)$$

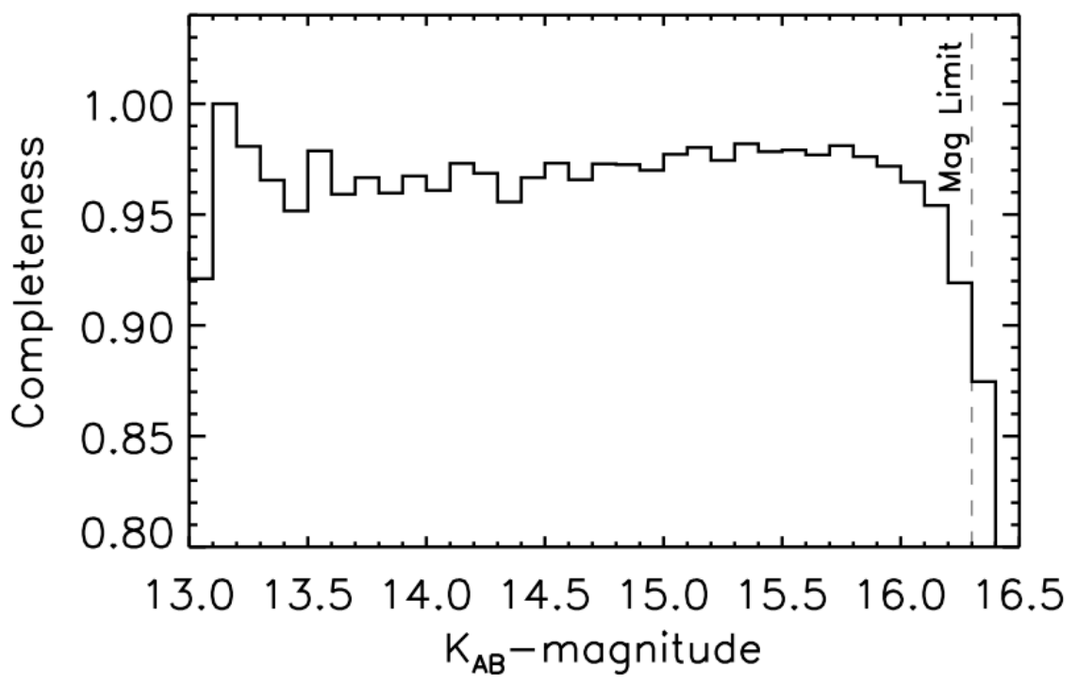
So, $\frac{dlog(N)}{dm} = 0.6$ expected from homogeneity

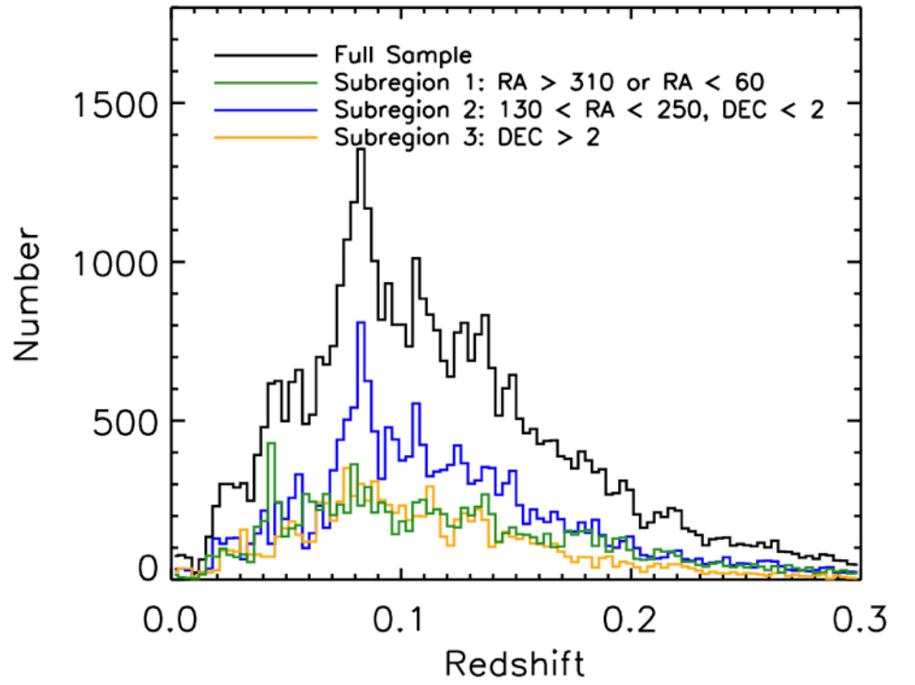


Steep slope first seen in the optical, e.g. Maddox+ 1990, later in the NIR; e.g. Huang+ 1997 (above), Frith+ 2003, 2005, 2006, Buswell+ 2004, Keenan+ 2010

UKIDSS K-band + redshifts (SDSS, 2DF, GAMA)





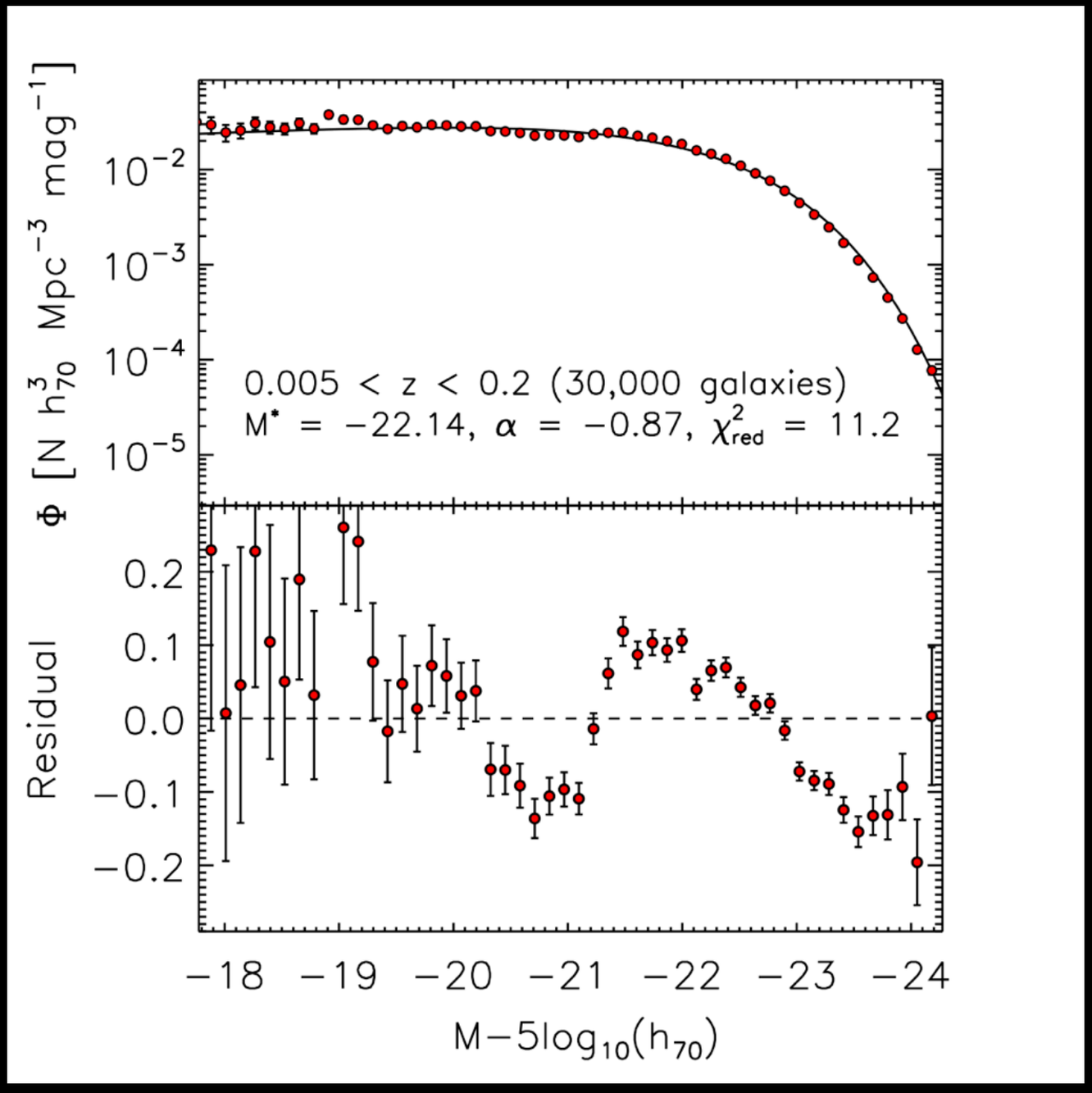


Low-z: 2M++ (2MASS+SDSS, 6DF, 2MR, Lavaux & Hudson 2011)

Estimating the Luminosity Function

The Schechter (1976) Function: $$\Phi(L)dL = \phi^* \left(\frac{L}{L_*}\right)^{\alpha} \exp\left(\frac{-\mathrm{L}}{\mathrm{L}_*}\right) \frac{\mathrm{dL}}{\mathrm{L}_*}$$

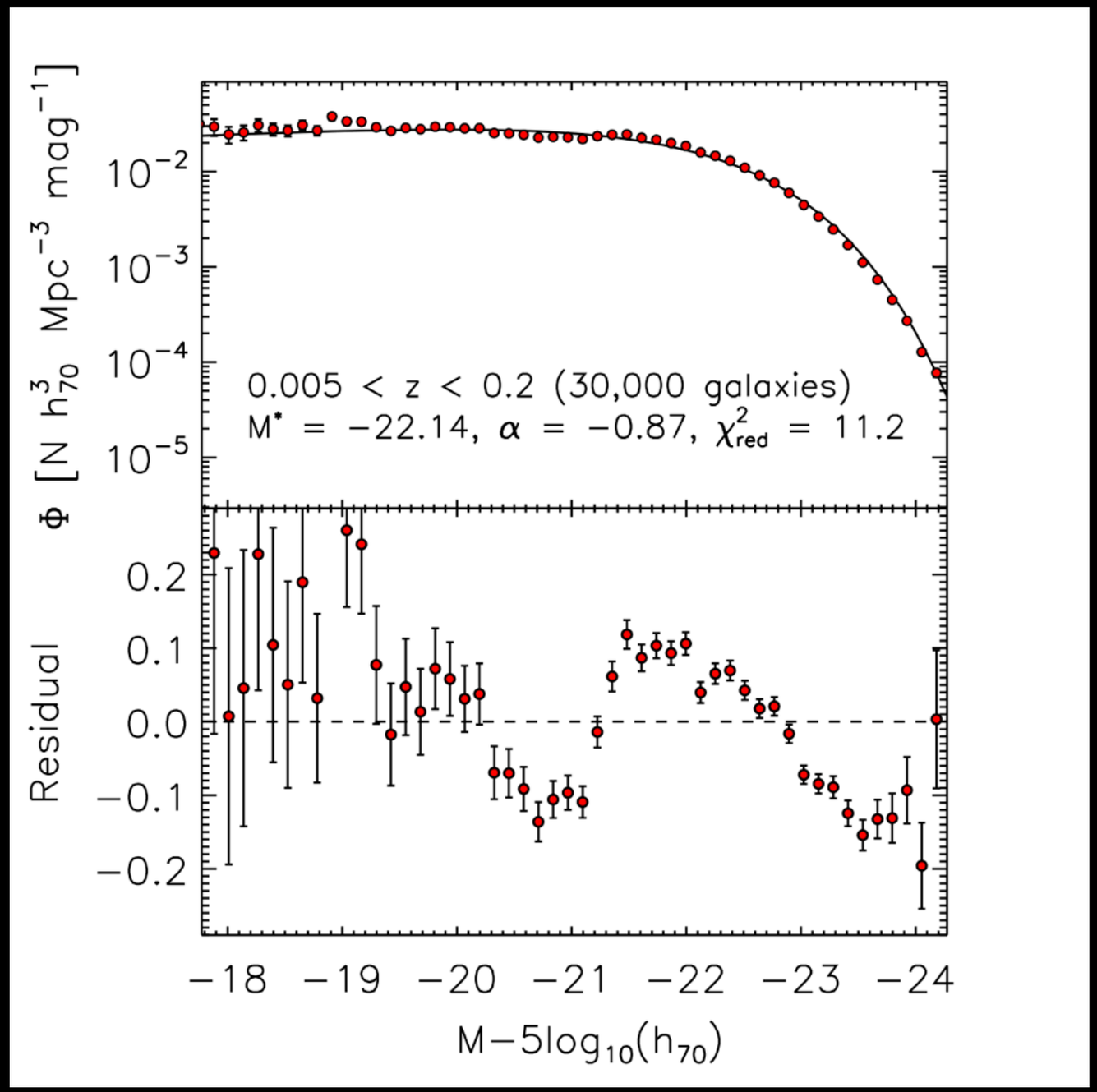
$$\frac{L}{L^*} = 10^{-0.4(M-M^*)}, \qquad \Phi(M) = 0.4\ln(10)\phi^* \frac{(10^{0.4(M^*-M)})^{(\alpha+1)}}{\exp(10^{0.4(M^*-M)})}.$$

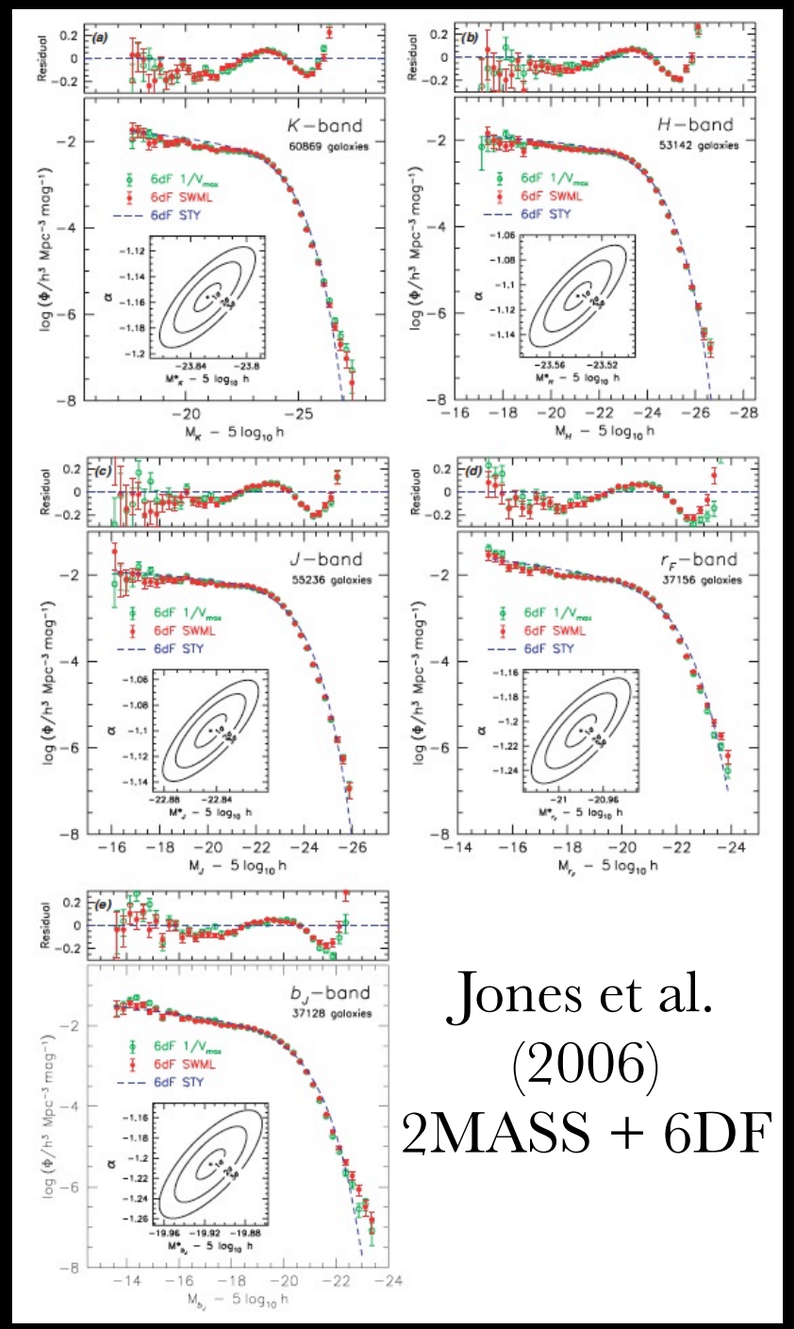


Estimating the Luminosity Function

The Schechter (1976) Function: $\Phi(L)dL = \phi^* \left(\frac{L}{L_*}\right)^{\alpha} \exp\left(\frac{-L}{L_*}\right) \frac{dL}{L_*}$

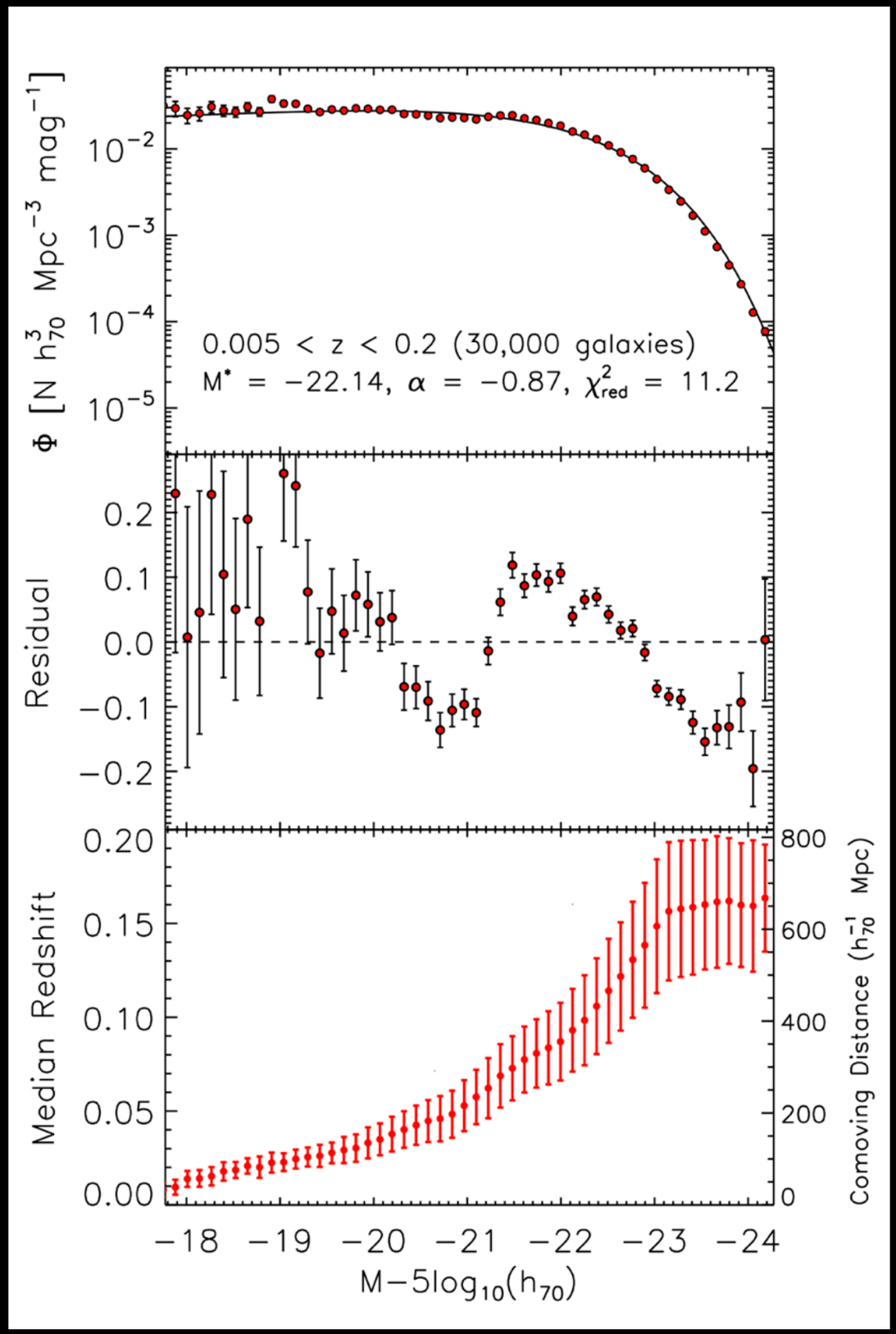
$$\frac{L}{L^*} = 10^{-0.4(M-M^*)}, \qquad \Phi(M) = 0.4\ln(10)\phi^* \frac{(10^{0.4(M^*-M)})^{(\alpha+1)}}{\exp(10^{0.4(M^*-M)})}.$$



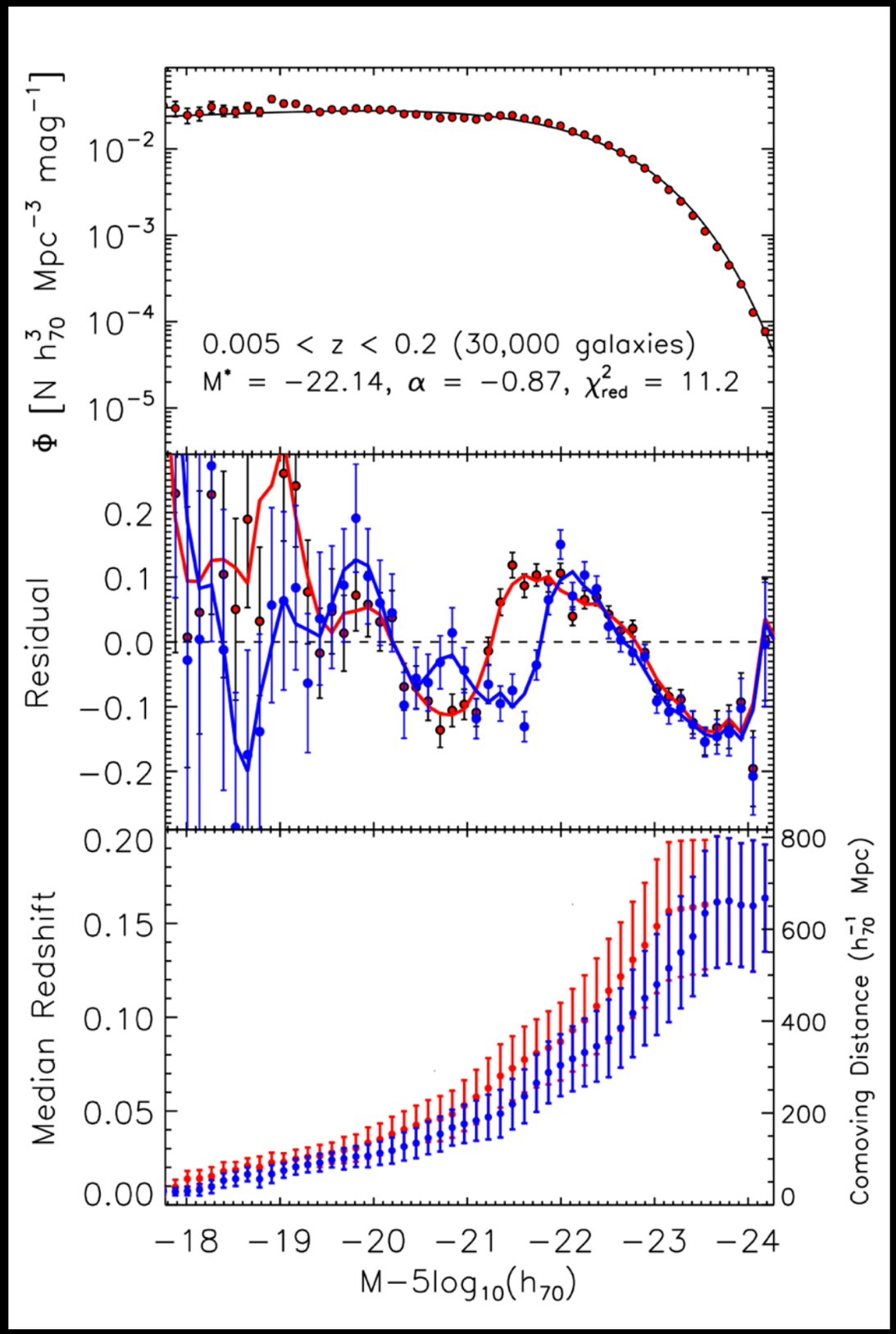


Jones et al. (2006) 2MASS + 6DF

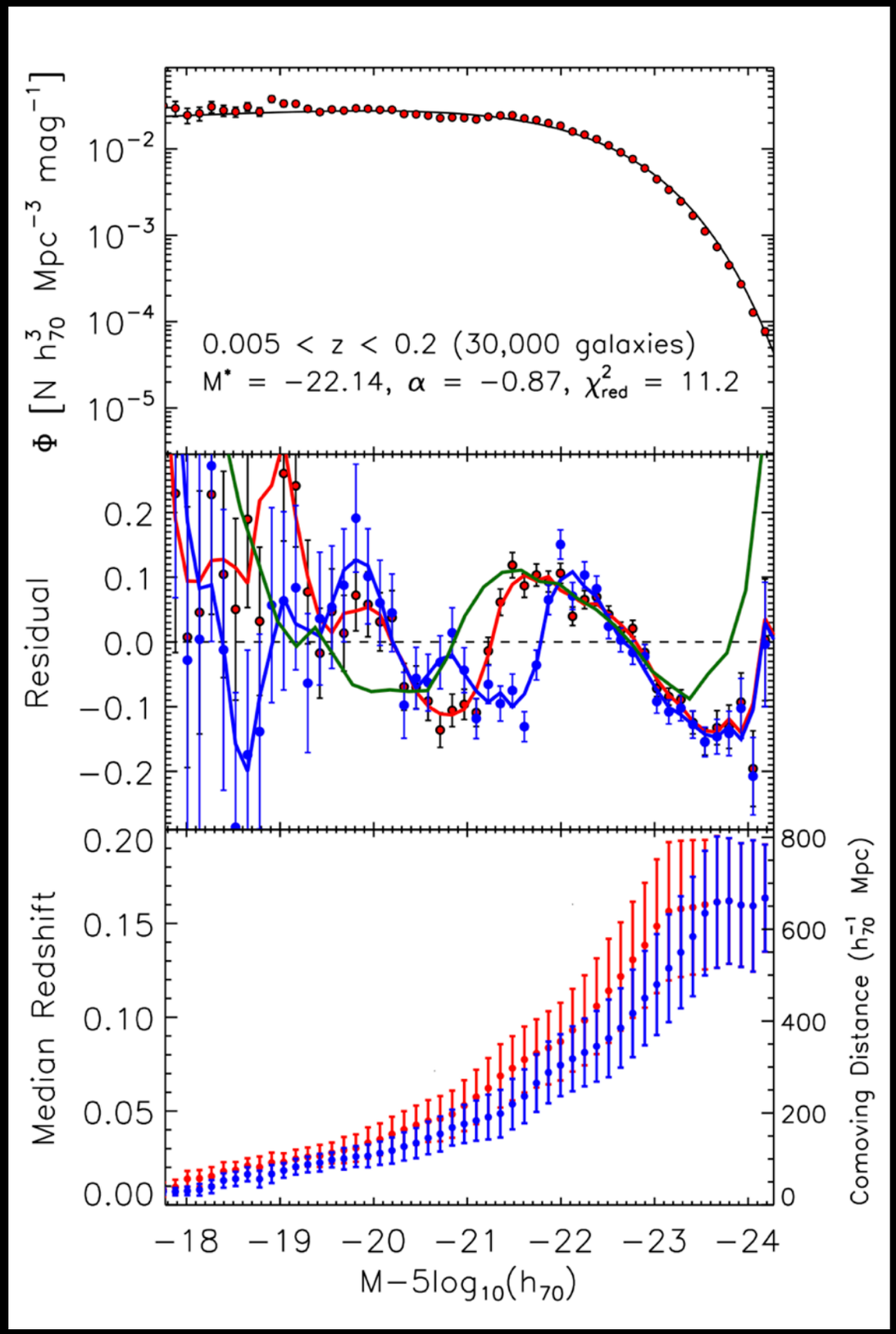
Intrinsic or Inhomogeneity?



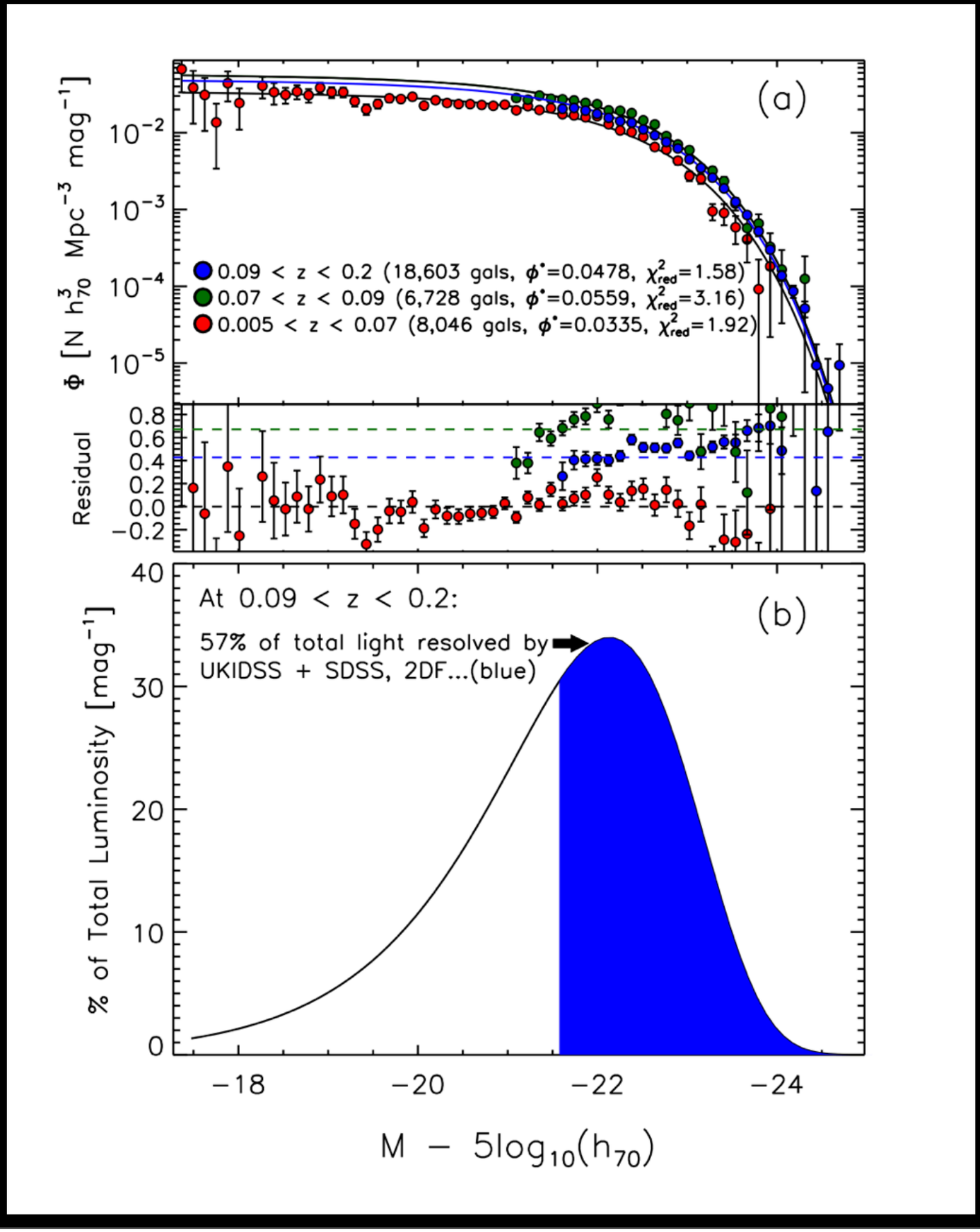
Intrinsic or Inhomogeneity?



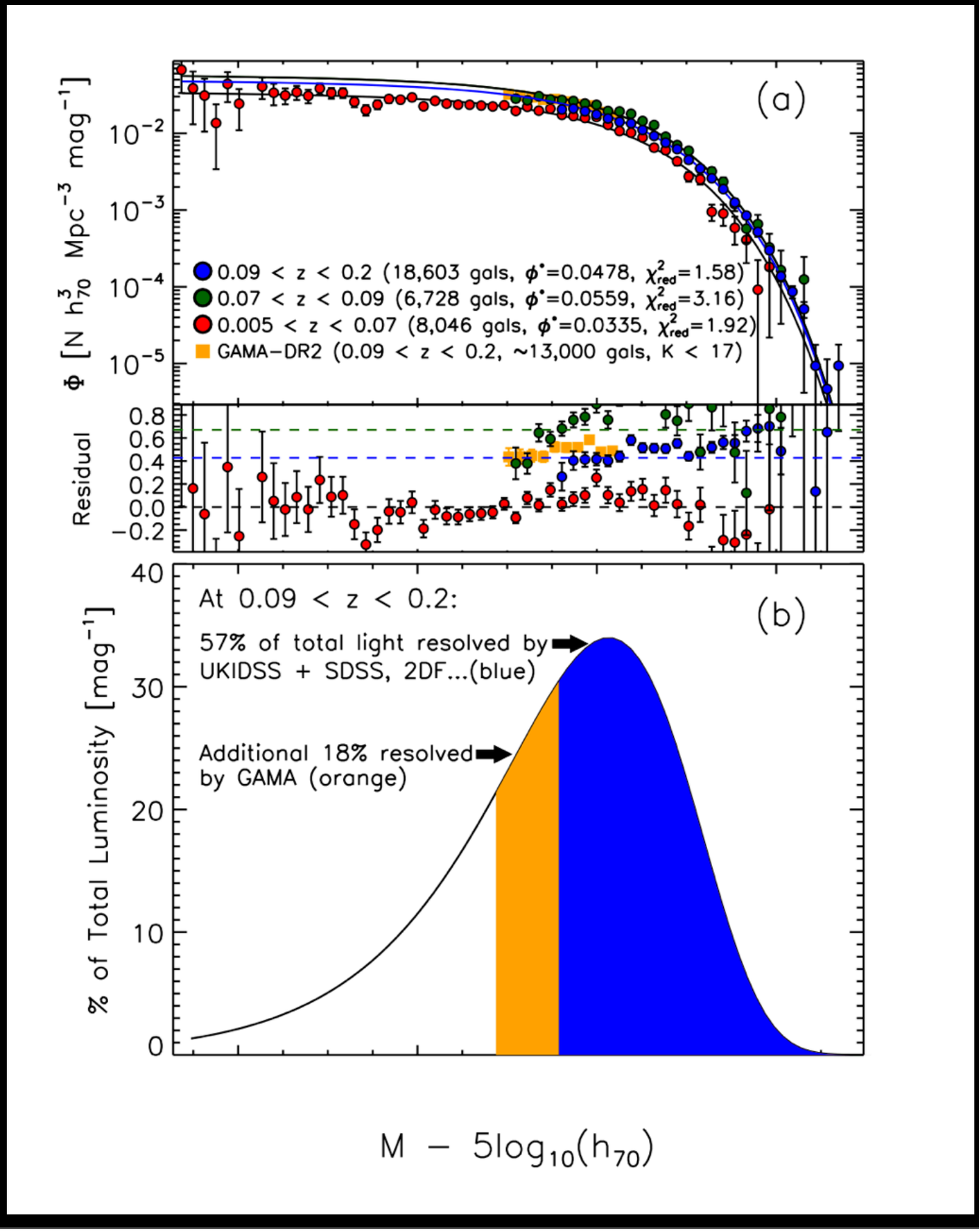
Intrinsic or Inhomogeneity?



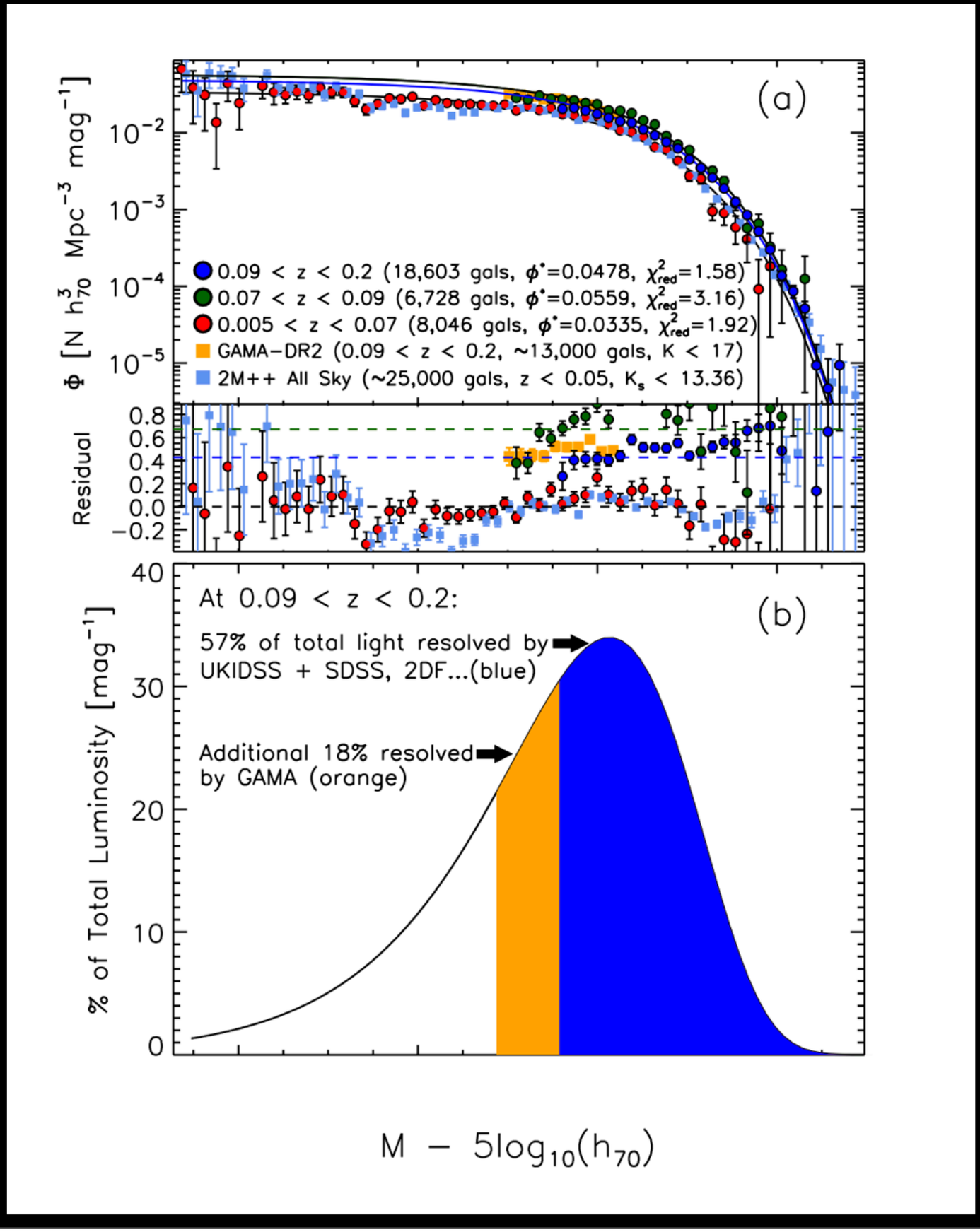
LF As a Function of Redshift



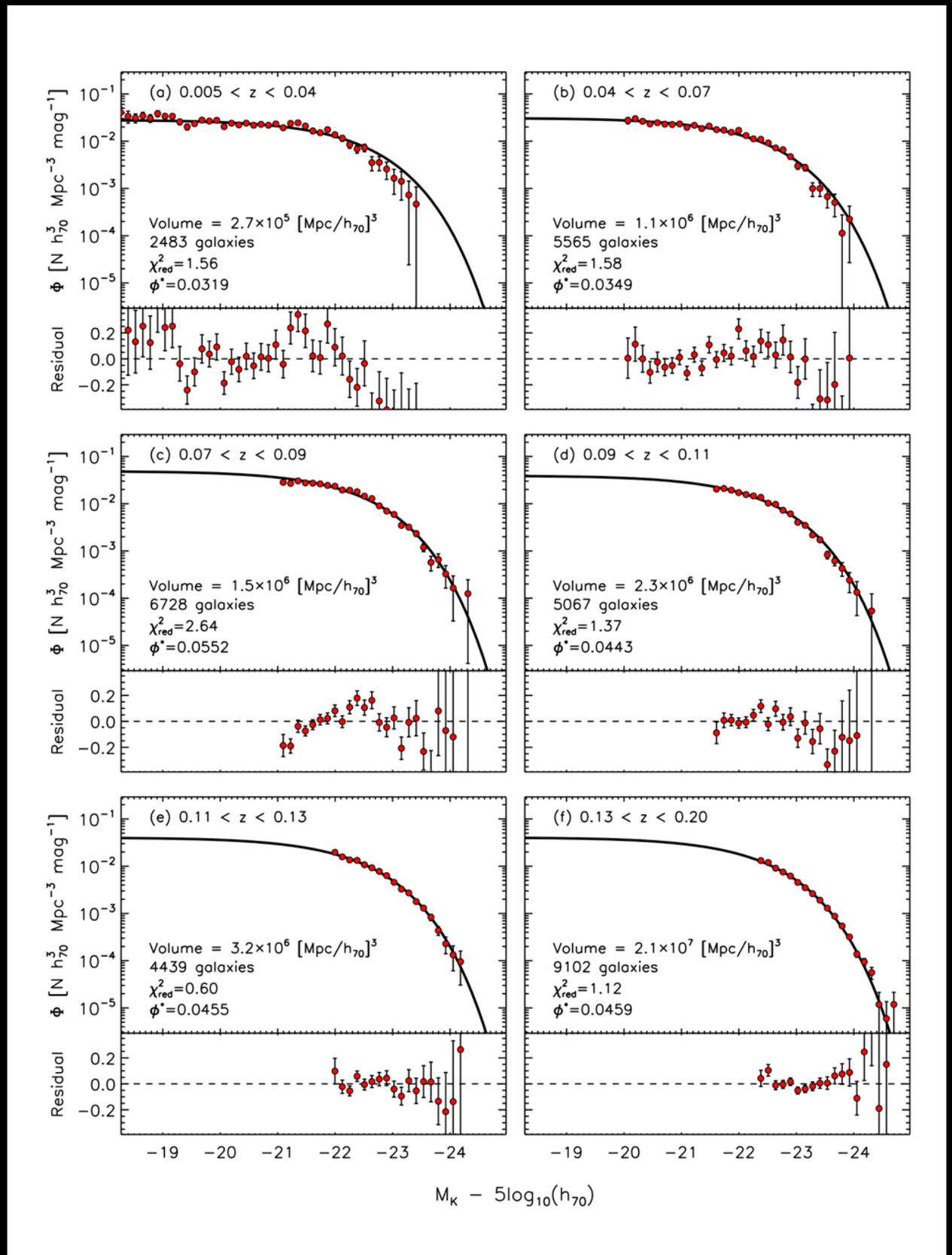
LF As a Function of Redshift



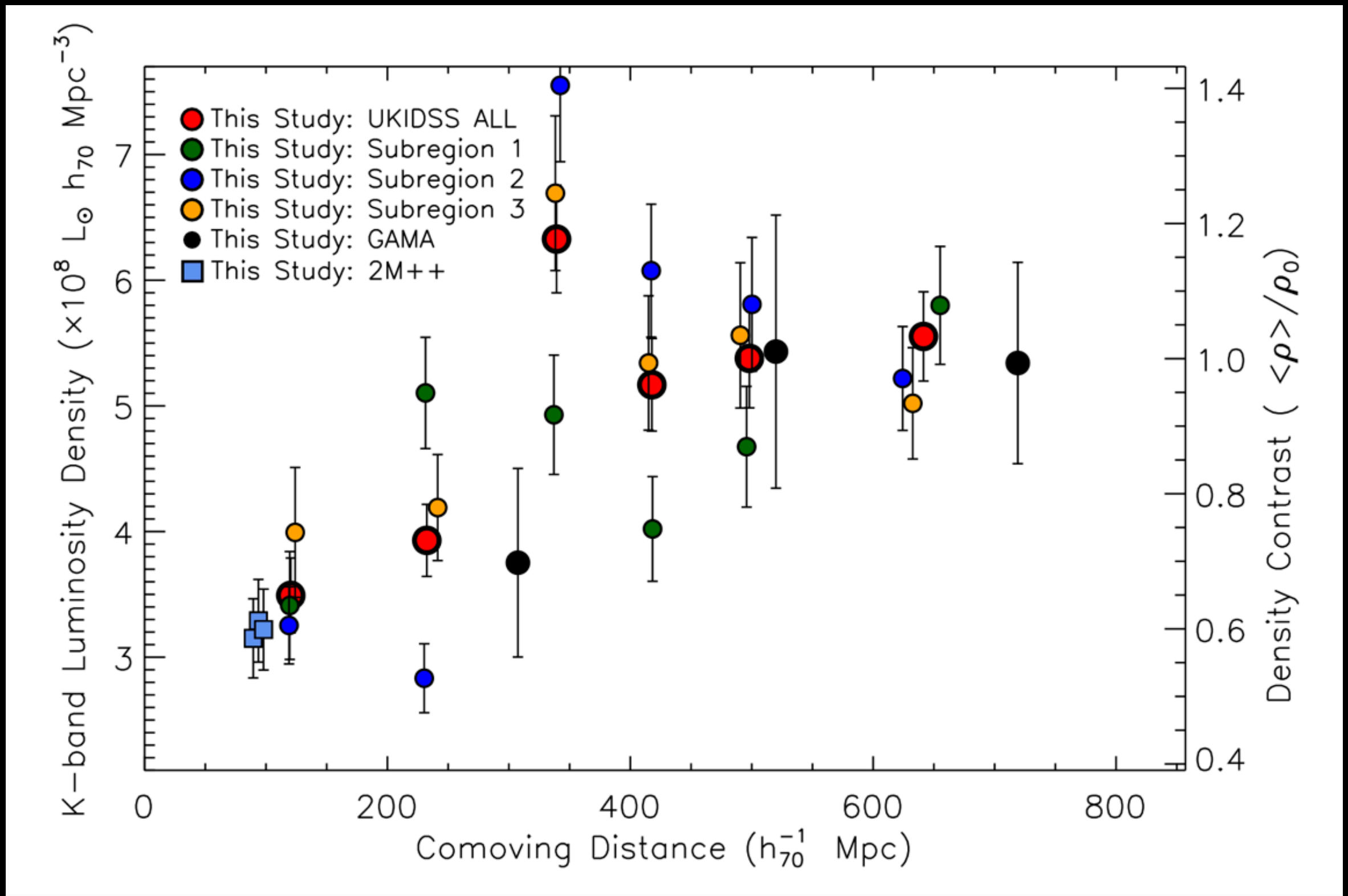
LF As a Function of Redshift



LF As a Function of Redshift



Luminosity Density vs. Distance



Luminosity Density vs. Distance