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# A comparison between galaxy and quasar clustering and what it can tell us about galaxy formation and evolution.

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today

**ABSTRACT**

**Key words:** galaxies: clustering – luminous red galaxies: general – cosmology: observations – large-scale structure of Universe.

## 1 CLUSTERING COMPARISONS

Figures 1 and 2 show comparisons with correlation studies from other surveys. It should be noted straight off that a direct comparison is very difficult to interpret as each survey has different selection criteria and hence samples different aspects of the same galaxy population. However, as a "schematic" for seeing how correlation length depends not only on galaxy type but also on redshift, this diagram is essential. Once observational data at $z > 1$ is more stable, comparisons of this sort will be vital in order to successfully test theoretical models to the percent level.

## 2 NOTES

LBGs Adelberger, Steidel et al etc. Blain, quoting Overtier 03, A&A, 405, 53

DRGs EROs Kong, Almani? SMGs Blain

Go back to the .sm plots and put on the Simple xi(r) evolution model(s) from Croom et al. (??!)

$\xi(r) = \frac{r}{r_0}^{-\gamma+\epsilon}$ what's the tag for the "euro" sign/symbol that goes in this equation?!?!? (heck, that small "slash epsilon" tag seems to work fine!

ALSO!!!

$M_{halo}$ MODELS vs. redshift ... e.g.

**Farrah, D et al., 2006 ApJ 643L 139** and **Farrah, D et al., 2006 ApJ 641, L17**. Comoving correlation length, r0, vs. redshift. Other data are taken from Moscardini et al. (1998), Overzier et al. (2003), Daddi et al. (2004), Blain et al. (2004), Ouchi et al. (2004), Adelberger et al. (2005), Croom et al. 2005; Georgakakis et al. (2005), and Allen et al. (2005). The fixed mass lines show the predicted clustering amplitude of halos of a given mass at any particular redshift, whereas the $\epsilon$ lines show the predicted clustering amplitude of an individual halo for three halo growth models, described in the text. The stable and linear lines give a qualitative indicator of the range of how DM halos may grow with redshift, and we have normalized stable and linear lines to the clustering amplitudes of the B2 and B3 sources. The shaded regions therefore indicate what these halos may host at lower and higher redshifts the halos hosting B3 sources may contain an optically bright LBG at z $\simeq$ 4 (upper green circle) and may grow to host very rich galaxy clusters at z = 0, whereas the halos hosting B2 sources may contain optically fainter LBGs at $4 < z < 5$, SMGs at z *sim* 2.5, radio-bright AGNs (upper pink triangle) and (old) EROs at z $\simeq$ 1, and poor to rich clusters at z = 0.

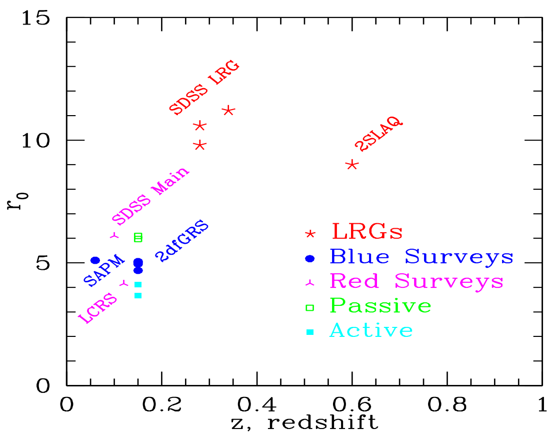


**Figure 1.** A comparisson of the real-space correlation length, $r_0$ between various surveys. Note that this should only be taken as a guide as different surveys have differnet galaxy selection criteria and sample different populations. Care has to taken even when comparing the 2SLAQ and SDSS LRG surveys.

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| Survey | Sample | $z$-interval | median $z$ | Mag. limit | $N_{\rm gals}$ | $r_0$ | $\gamma_r$ | Reference |
|---|---|---|---|---|---|---|---|---|
| 2SLAQ LRG | ‘Gold’ | 0.4,0.8 | 0.55 | | 8 656 | $\mathrm{r_0}$= 7.45±0.35 | 1.72±0.06 | 1 |
| | | 0.4,0.8 | 0.55 | | 8 656 | $\mathrm{s_0}$= 9.40±0.19$^{\rm a}$ | 2.02±0.07 | 1 |
| SDSS LRG | “full, faintest” | 0.16,0.36 | 0.28 | $-23.2 < M_g < -21.20$, $\langle M_g \rangle = -21.63$ | 29 298 | 9.80±0.20 | 1.94±0.03 | 2 |
| SDSS LRG | “brighter half” | 0.16,0.44 | 0.34 | $-23.2 < M_g < -21.8$, $\langle M_g \rangle = -22.01$ | 12 992 | 11.21±0.24 | 1.92±0.03 | 2 |
| SDSS LRG | “fainter half” | 0.16,0.36 | 0.28 | $-22.6 < M_g < -21.6$, $\langle M_g \rangle = -21.84$ | 14 500 | 10.59±0.29 | 1.88±0.03 | 2 |
| SDSS MAIN | | 0.,0. | | | | | | 3 |
| VVDS | | 0.,0. | | | | | | 4 |
| DEEP2 | full | 0.7,1.35 | $z_{\rm eff} = 0.99$ | $R_{AB}$=24.1 | 2 219 | 3.19±0.51 | 1.68±0.07 | 5 |
| DEEP2 | full, w/o $J_3$ | 0.7,1.35 | $z_{\rm eff} = 0.99$ | $R_{AB}$=24.1 | 2 219 | 3.19±0.51 | 1.68±0.07 | 5 |
| DEEP2 | lower-$z$ | 0.7,1.35 | $z_{\rm eff} = 0.99$ | $R_{AB}$=24.1 | 2 219 | 3.19±0.51 | 1.68±0.07 | 5 |
| DEEP2 | higher-$z$ | 0.7,1.35 | $z_{\rm eff} = 0.99$ | $R_{AB}$=24.1 | 2 219 | 3.19±0.51 | 1.68±0.07 | 5 |
| DEEP2 | $(B-R) > 0.7$ | 0.7,1.25 | $z_{\rm eff} = 0.96$ | $(B-R)_0 > 0.7$ | 855 | 4.32±0.73 | 1.84±0.07 | 5 |
| DEEP2 | $(B-R) < 0.7$ | 0.7,1.25 | $z_{\rm eff} = 0.93$ | $(B-R)_0 < 0.7$ | 964 | 2.81±0.48 | 1.52±0.06 | 5 |
| DEEP2 | $(R-I) > 0.9$ | 0.7,1.25 | $z_{\rm eff} = 0.96$ | $(B-R)_0 > 0.7$ | 855 | 4.32±0.73 | 1.84±0.07 | 5 |
| DEEP2 | $(R-I) > 0.09$ | 0.7,1.25 | $z_{\rm eff} = 0.96$ | $(B-R)_0 > 0.7$ | 855 | 4.32±0.73 | 1.84±0.07 | 5 |
| DEEP2 | absorption-line | 0.7,1.25 | $z_{\rm eff} = 0.96$ | $(B-R)_0 > 0.7$ | 855 | 4.32±0.73 | 1.84±0.07 | 5 |
| DEEP2 | emission-line | 0.7,1.25 | $z_{\rm eff} = 0.96$ | $(B-R)_0 > 0.7$ | 855 | 4.32±0.73 | 1.84±0.07 | 5 |
| DEEP2 | $M_B < -19.75$ | 0.7,1.25 | $z_{\rm eff} = 0.96$ | $(B-R)_0 > 0.7$ | 855 | 4.32±0.73 | 1.84±0.07 | 5 |
| DEEP2 | $M_B > -19.75$ | 0.7,1.25 | $z_{\rm eff} = 0.96$ | $(B-R)_0 > 0.7$ | 855 | 4.32±0.73 | 1.84±0.07 | 5 |
| 2dfGRS | Full, (P) | 0.01,0.2 | $\simeq 0.11$ | $b_{\rm J} = 19.45$ | 165 659 | 5.05±0.26 | 1.67±0.03 | 6 |
| 2dfGRS | Full, (I) | 0.01,0.2 | $\simeq 0.11$ | $b_{\rm J} = 19.45$ | 165 659 | 5.05±0.26 | 1.67±0.03 | 6 |
| 2dfGRS | Full, (P) | 0.01,0.2 | $\simeq 0.11$ | $b_{\rm J} = 19.45$ | 165 659 | 5.05±0.26 | 1.67±0.03 | 7 |
| 2dfGRS | Full, (I) | 0.01,0.2 | $\simeq 0.11$ | $b_{\rm J} = 19.45$ | 165 659 | 5.05±0.26 | 1.67±0.03 | 7 |
| 2dfGRS | Passive, (P) | 0.01,0.15 | $z_{\rm s} = 0.11$ | $b_{\rm J} = 19.45$ | 36 318 | 5.97±0.29 | 1.93±0.03 | 7 |
| 2dfGRS | Passive, (I) | 0.01,0.15 | $z_{\rm s} = 0.11$ | $b_{\rm J} = 19.45$ | 36 318 | 5.97±0.29 | 1.93±0.03 | 7 |
| 2dfGRS | Active, (P) | 0.01,0.15 | $z_{\rm s} = 0.11$ | $b_{\rm J} = 19.45$ | 60 473 | 7.1±0.1 | 1.50±0.04 | 7 |
| 2dfGRS | Active (P) | 0.01,0.15 | $z_{\rm s} = 0.11$ | $b_{\rm J} = 19.45$ | 60 473 | 7.1±0.1 | 1.50±0.04 | 7 |
| SAPM | | 0.01,0.15 | $z_{\rm s} = 0.11$ | $b_{\rm J} = 19.45$ | 60 473 | 7.1±0.1 | 1.50±0.04 | 8 |
| ESP | | 0.01,0.15 | $z_{\rm s} = 0.11$ | $b_{\rm J} = 19.45$ | 60 473 | 7.1±0.1 | 1.50±0.04 | 9 |
| Durham UKST | | 0.01,0.15 | $z_{\rm s} = 0.11$ | $b_{\rm J} = 19.45$ | 60 473 | 7.1±0.1 | 1.50±0.04 | 10 |
| LCRS | | 0.01,0.15 | $z_{\rm s} = 0.11$ | $b_{\rm J} = 19.45$ | 60 473 | 7.1±0.1 | 1.50±0.04 | 11 |

**Table 1.** Comparison of Real-Space Correlation Lengths with other surverys. [1]Ross et al. (2007) [2]Zehavi et al. (2005a), [3]Zehavi et al. (2005b, Table 1), [4]**?**, [5]Coil et al. (2004), [6]Hawkins et al. (2003), [7]Madgwick et al. (2003).

| Survey | Sample | $z$-interval | median $z$ | Mag. limit | $N_{\rm gals}$ | $r_0$ | $\gamma_r$ | Reference |
|---|---|---|---|---|---|---|---|---|
| SDSS Quasars | | | | | | | | 1 |

**Table 2.** Comparison of Real-Space Correlation Lengths with other QUASAR surverys. [1]Ross et al. (2008) [2]2nd SDSS, lo-$z$ ref?? [3]Shen et al. (2007) [4]Croom et al. (2005) [5]Porciani & Norberg (2006)

| Survey | Sample | $z$-interval | median $z$ | Mag. limit | $N_{\rm gals}$ | $r_0$ | $\gamma_r$ | Reference |
|---|---|---|---|---|---|---|---|---|
| ULIRGs | | | | | | | | 1 |
| NIR-selected[a] | | | | | | | | 2 |

**Table 3.** Comparison of Real-Space Correlation Lengths with other “high-$z$” surverys. [1]Farrah et al. (2006b,a) [2]Daddi et al. (2004) [3]**?** [4]Overzier et al. (2003) [5] Notes: [a]Watch cosmology!!

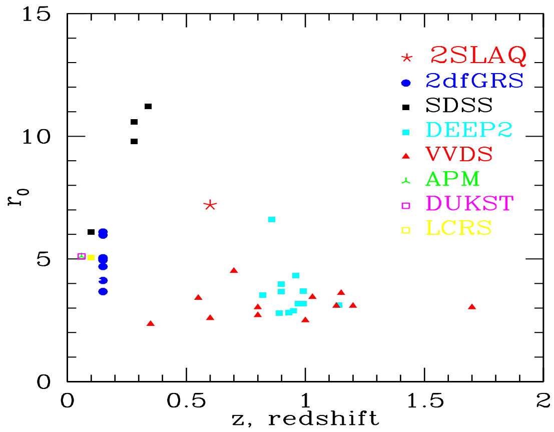


**Figure 2.** A further comparisson of the real-space correlation length, $r_0$ between various surveys. Again care must be taken as comparing "wide and shallow" to "deep and narrow". For instance the areas of the 2dfGRS and SDSS are 1 800 and 4 000 degrees$^2$ respectively, while COMBO-17, DEEP2 and VVDS are of order 1 degree$^2$.

**Hayashi et al. astro-ph/0701637.pdf** - for star-forming BzKs...

## 3 $\Omega_{\rm M} - \beta$ FITTING MODELS

[1]Is this really correct??

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Shen Y., et al., 2007, AJ, 133, 2222
Zehavi I., et al., 2005a, ApJ, 621, 22
Zehavi I., et al., 2005b, ApJ, 630, 1

**Table 4.**

| O/P file name | I/P $\xi(\sigma,\pi)$ files | r0 | $\gamma$ | range | $\xi/w_p$ | $\Omega_{\rm m}$ | beta | $\langle w_z^2\rangle^{1/2}$ | R$\chi^2$ |
|---|---|---|---|---|---|---|---|---|---|
| LS_amp7_3.ps | k2d_output_jack_perl_full.dat??? | 7.30 | 1.78 | 0.4-70(?) | $\xi$ | 0.30 | 0.35 | 480 | |
| | xi_sigma_pi_variances_LS.dat??? | | | | | | | | |
| LS_amp8_3.ps | tbc | 7.54 | 1.85 | 0.4-20 | $w_p$ | 0.50 | 0.45 | 540 | |
| | tbc | | | | | | | | |
| LS_amp9_3.ps | k2d_output_jack_perl_full.dat | 7.45 | 1.73 | 0.4-70 | $\xi$ | 0.50 | 0.35 | 450 | 2.14920 |
| (0.3,0.7) y/n? | xi_sigma_pi_variances_LS.dat | | | | | | | | |
| LS_amp10_3.ps | k2d_output_jack_perl_full_newcor.dat | 7.45 | 1.73 | 0.4-70 | $\xi$ | 0.45 | 0.35 | 450 | 2.18665 |
| (0.3,0.7) y/n? | xi_sigma_pi_variances_LS.dat | | | | | | | | |
| LS_ampX3_3.ps | ” | 7.45 | 1.73 | 0.4-70 | xi | 0.10 | 0.40 | 330 | 2.19586 |
| | Omega_m_StdDev | 0.024552442 | | | | | | | |
| | beta_StdDev | 0.0088388369 | | | | | | | |
| LS_ampRX0.ps | (reduced range in Omega-beta) | | | | | | | | |
| LS_amp11_3.ps | k2d_output_jack_perl_full_newcor.dat | 7.45 | 1.73 | 0.4-70 | $\xi$ | 0.45 | 0.35 | 450 | 2.18665 |
| (0.3,0.7) y/n? | xi_sigma_pi_variances_LS.dat | | | | | | | | |
| LS_ampX5_3.ps | | 7.30 | 1.84 | 0.4-70 | $w_p$ | 0.02 | 0.40 | 360 | 2.26280 |
| | Omega_m_StdDev | 0.068530072 | | | | | | | |
| | beta_StdDev | 0.028398096 | | | | | | | |
| LS_amp12_3.ps | k2d_output_jack_perl_full_newcor.dat | 7.60 | 1.69 | 0.4-20 | xi | 0.40 | 0.30 | 420 | 2.35397 |
| (0.3,0.7) y/n? | xi_sigma_pi_variances_LS.dat | | | | | | | | |
| LS_ampX6_3.ps | | 7.60 | 1.69 | 0.4-20 | xi | 0.10 | 0.35 | 300 | 2.35562 |
| | Omega_m_StdDev | 0.051742808 | | | | | | | |
| | beta_StdDev | 0.027679029 | | | | | | | |
| LS_amp13_3.ps | k2d_output_jack_perl_full_newcor.dat | 7.39 | 1.81 | 0.4-20 | wp | 0.65 | 0.45 | 510 | 2.16416 |
| | xi_sigma_pi_variances_LS.dat | | | | | | | | |
| (1.0,0.0)[1] | | | | | | | | | |
| LS_ampX4_3.ps | | 7.39 | 1.81 | 0.4-20 | wp | 0.10 | 0.45 | 360 | 2.16491 |
| LS_ampX_3.ps | k2d_output_jack_perl_full_newcor.dat | 7.54 | 1.85 | 0.4-20 | wp | 0.65 | 0.50 | 540 | 2.32433 |
| (0.3,0.7) y/n? | xi_sigma_pi_variances_LS_0606016.dat | | | | | | | | |
| LS_ampX2_3.ps | k2d_output_jack_perl_full_newcor.dat | 7.54 | 1.85 | 0.4-20 | wp | 0.65 | 0.50 | 540 | 2.29314 |
| (0.3,0.7) y/n? | xi_sigma_pi_variances_LS.dat | | | | | | | | |
| LS_amp6_EdS_3.ps | k2d_output_jack_perl_EdS_full.dat | 5.60 | 1.71 | 0.25-40 | xi | 0.40 | 0.45 | 330 | 2.22507 |
| (1.0,0.0) y/n? | xi_sigma_pi_variances_LS_EdS.dat | | | | | | | | |
| LS_ampX6_EdS_3 | | 5.60 | 1.71 | 0.25-40 | xi | 0.50 | 0.50 | 330 | 2.37068 |
| LS_ampXX6_EdS_3 | | 5.60 | 1.71 | 0.25-40 | xi | 0.40 | 0.45 | 330 | 2.22507 |
| | (LS_amp6 identical to LS_ampXX6) | | | | | | | | |
| | Omega_m_StdDev | 0.14701328 | | | | | | | |
| | beta_StdDev | 0.033261847 | | | | | | | |
| LS_amp8_EdS_3.ps | k2d_output_jack_perl_EdS_full.dat | 5.61 | 1.77 | 0.25-40 | wp | 0.45 | 0.50 | 360 | 1.91541 |
| (1.0,0.0) y/n? | xi_sigma_pi_variances_LS_EdS.dat | | | | | | | | |
| LS_ampX8_EdS_3 | | 5.61 | 1.77 | 0.25-40 | wp | 0.45 | 0.50 | 360 | 1.91541 |
| LS_amp9_EdS_3.ps | k2d_output_jack_perl_EdS_full.dat | 5.55 | 1.73 | 0.25-15 | xi | 0.40 | 0.50 | 360 | 2.09865 |
| | xi_sigma_pi_variances_LS_EdS.dat | | | | | | | | |
| LS_amp10_EdS_3.ps | k2d_output_jack_perl_EdS_full.dat | 5.67 | 1.74 | 0.25-15 | wp | | | | |
| | xi_sigma_pi_variances_LS_EdS.dat | | | | | | | | |
| LS_amp7_EdS_3.ps | k2d_output_jack_perl_EdS_full.dat | 5.55 | 1.735 | 0.1-15 | xi | 0.40 | 0.50 | 360 | 2.06925 |
| | xi_sigma_pi_variances_LS_EdS.dat | | | | | | | | |

**Table 5.** Best fitting model values of $\Omega_{\rm m}, \beta$ and pairwise velocity dispersion, $\langle w_z^2 \rangle^{1/2}$, using redshift-space distortions alone and assuming a $\Lambda$CDM cosmology.

| $r_0$ | $\gamma$ | range / $h^{-1}$ Mpc | Measure | $\Omega_{\rm m}$ | $\beta$ | $\langle w_z^2 \rangle^{1/2}$/ km s$^{-1}$ |
|---|---|---|---|---|---|---|
| 7.45 | 1.73 | 0.4-70 | $\xi(r)$ | 0.10 | 0.40 | 330 |
| 7.30 | 1.84 | 0.4-70 | $w_p(\sigma)$ | 0.02 | 0.40 | 360 |
| 7.60 | 1.69 | 0.4-20 | $\xi(r)$ | 0.10 | 0.35 | 300 |
| 7.39 | 1.81 | 0.4-20 | $w_p(\sigma)$ | 0.10 | 0.45 | 360 |