Exploring large-scale environment of SDSS DR7 quasars with SDSS DR12 CMASS galaxies

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Introduction

- Quasars are intriguing objects in the universe for their central, active, bright SMBHs.
- Many studies have been done so far about quasars and their environment.
- With recently-completed spectroscopic survey of galaxies by SDSS, it is again a good chance to explore large-scale environment of quasars.

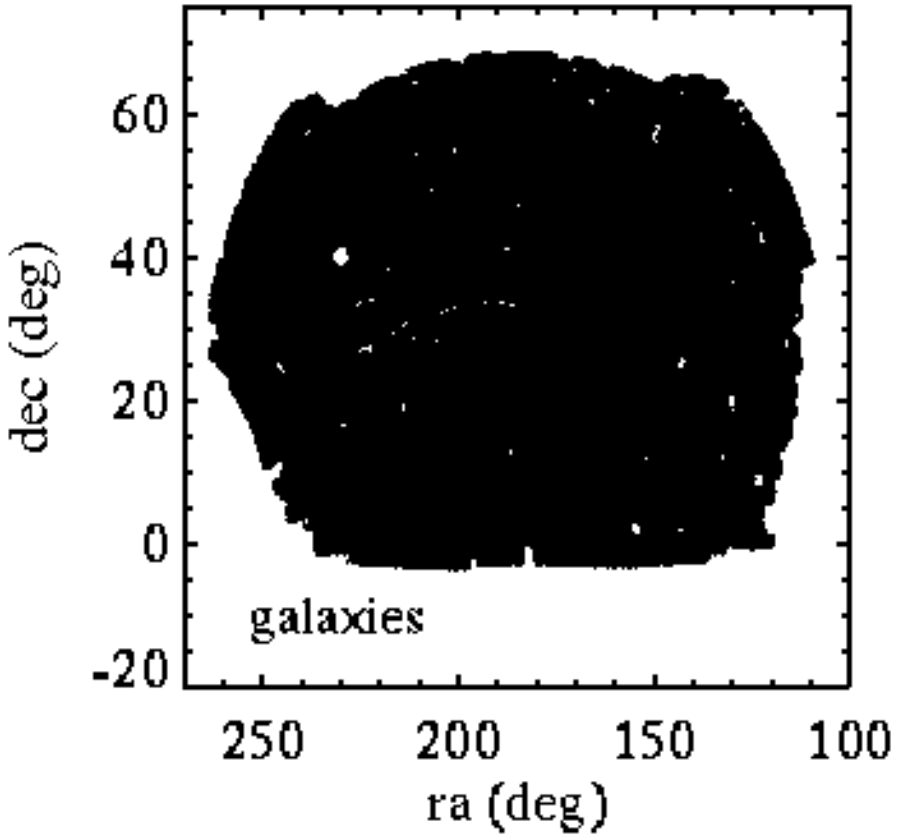
Introduction

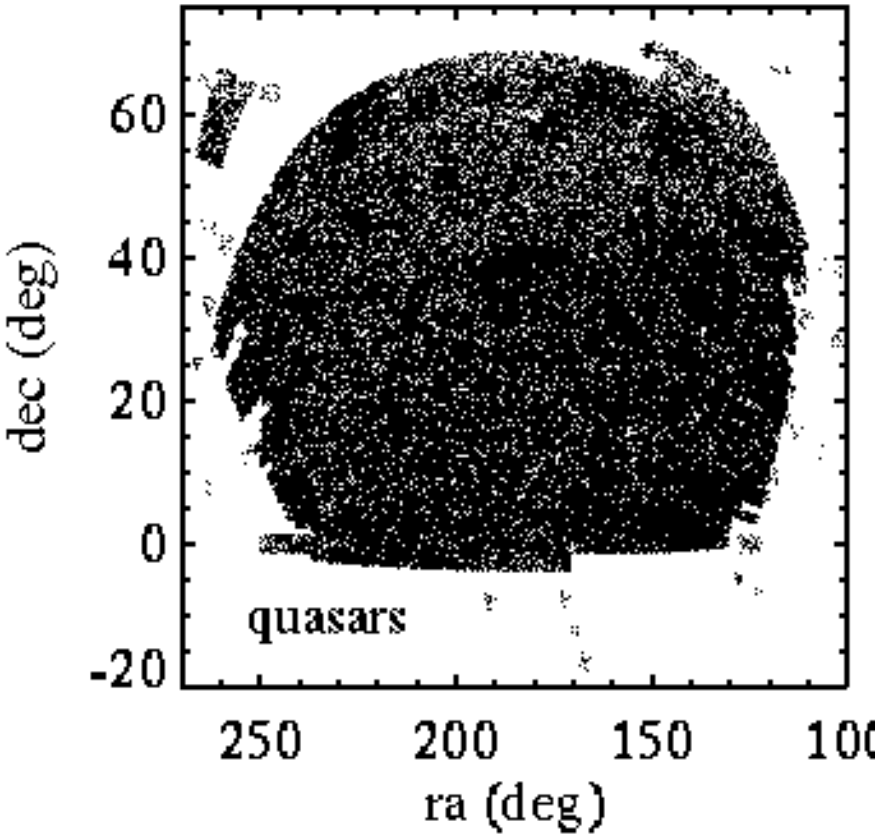
- Shen et al. (2012) have already done cross-correlation study of quasars and galaxies(DR10 CMASS), and found quasar linear bias b_Q=1.38 and its weak luminosity dependence.
- With *more complete* data of galaxies(DR12), we explore large-scale environment of quasars using *more intuitive* method.

Data

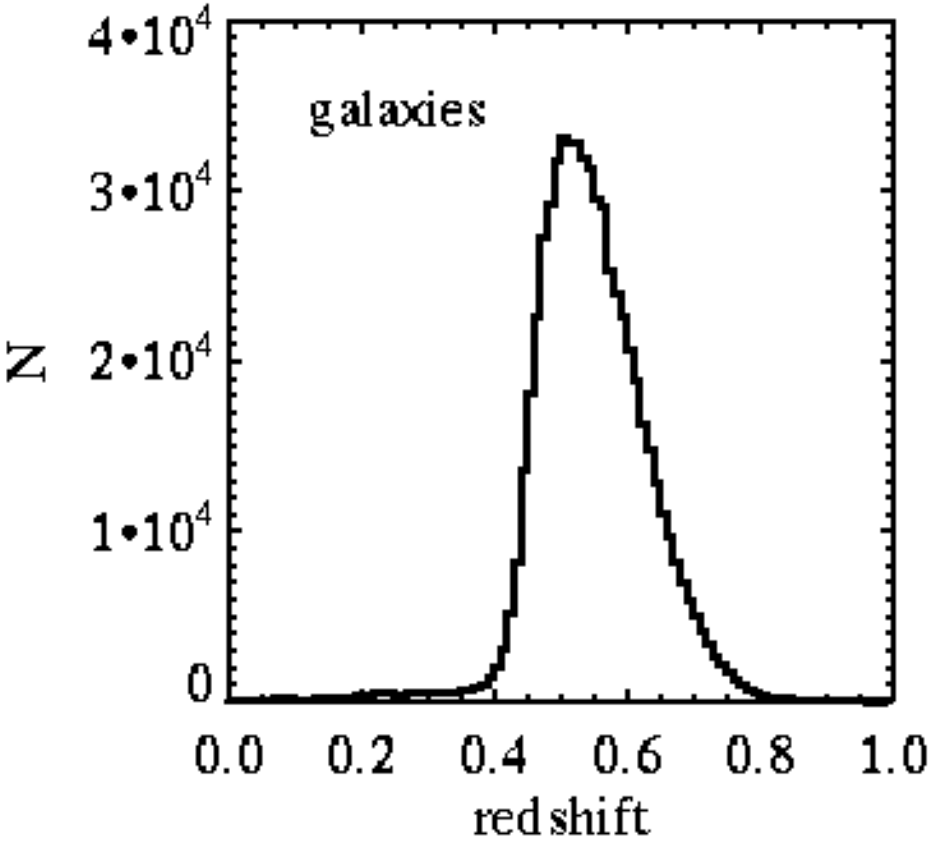
- SDSS DR7 N quasar catalogues of Schneider et al. (2010) and Shen et al. (2011)
  - 105783 quasars, $z<5.46$
- SDSS *DR12* CMASS N galaxy catalogue (to be released soon)
  - 621849 galaxies, $z<1$

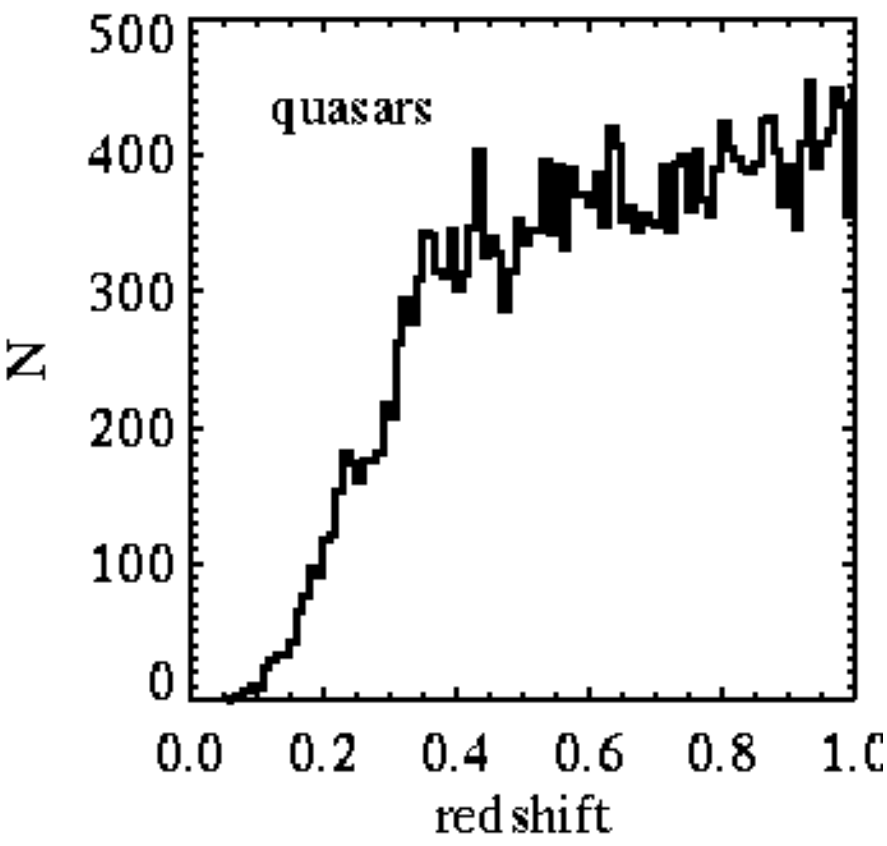
Data


60
40
20
0
-20
dec (deg)
galaxies
250
200
150
100
ra (deg)


60
40
20
0
-20
dec (deg)
quasars
250
200
150
ra (deg)

Data

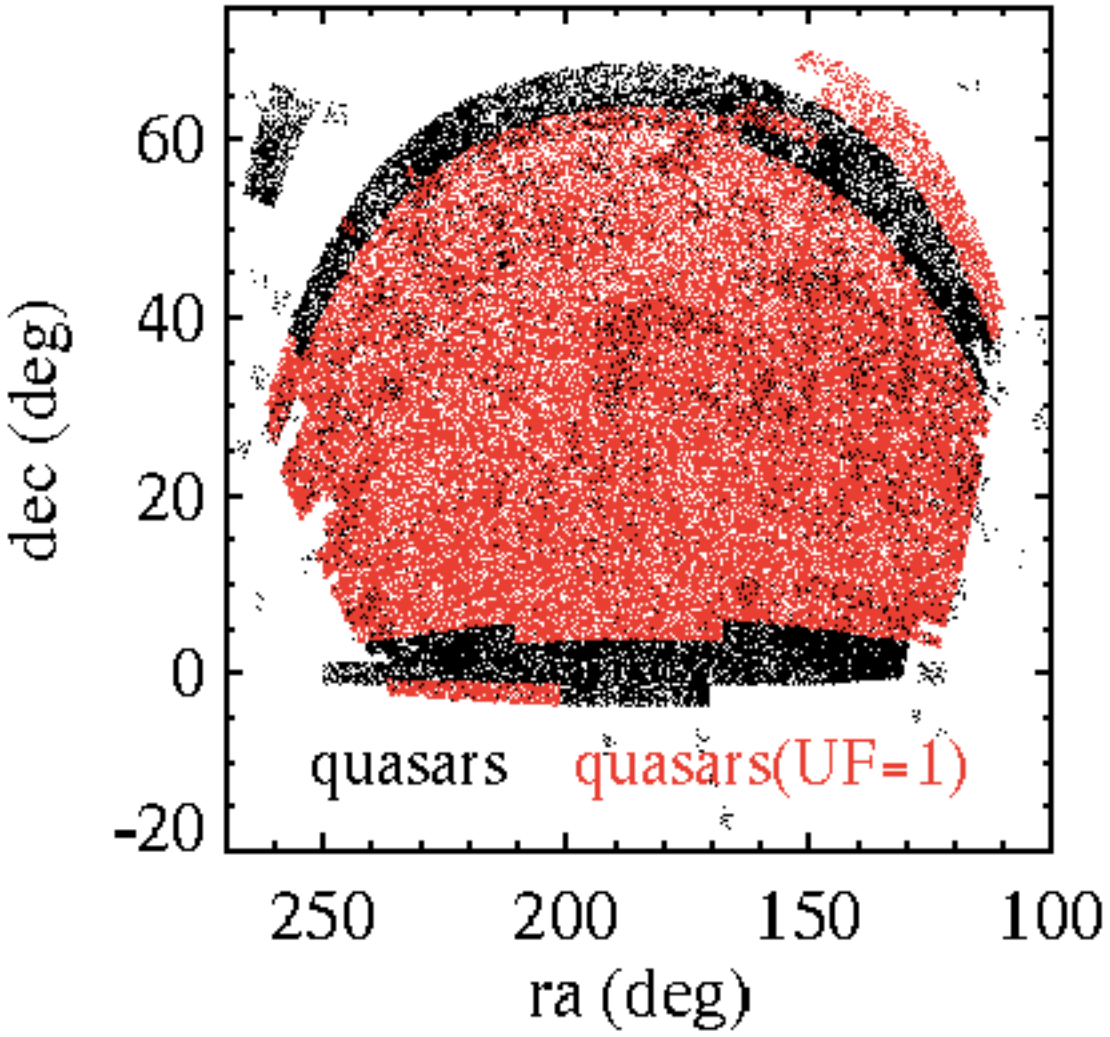

galaxies
N
4•10^4
3•10^4
2•10^4
1•10^4
0
0.0
0.2
0.4
0.6
0.8
1.0
redshift


quasars
N
500
400
300
200
100
0
0.0
0.2
0.4
0.6
0.8
1.0
redshift

Data

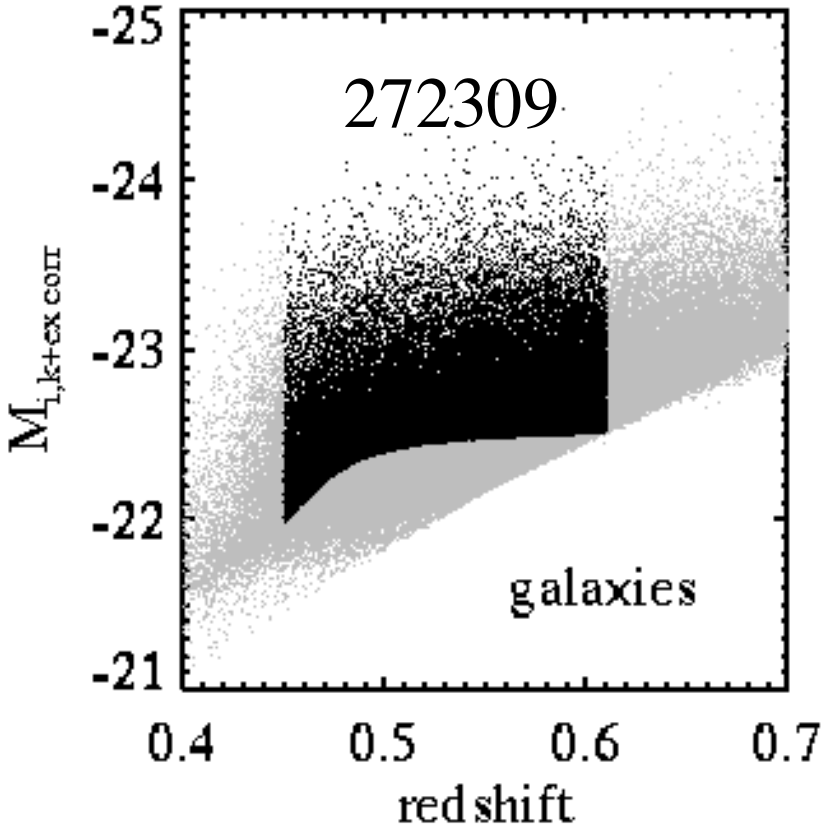
- *Uniform sample*s are needed for statistical study.
  - CMASS galaxies – weights and completeness are used to recover missing targets.
  - Quasars – Uniform Flag=1 quasars are selected.

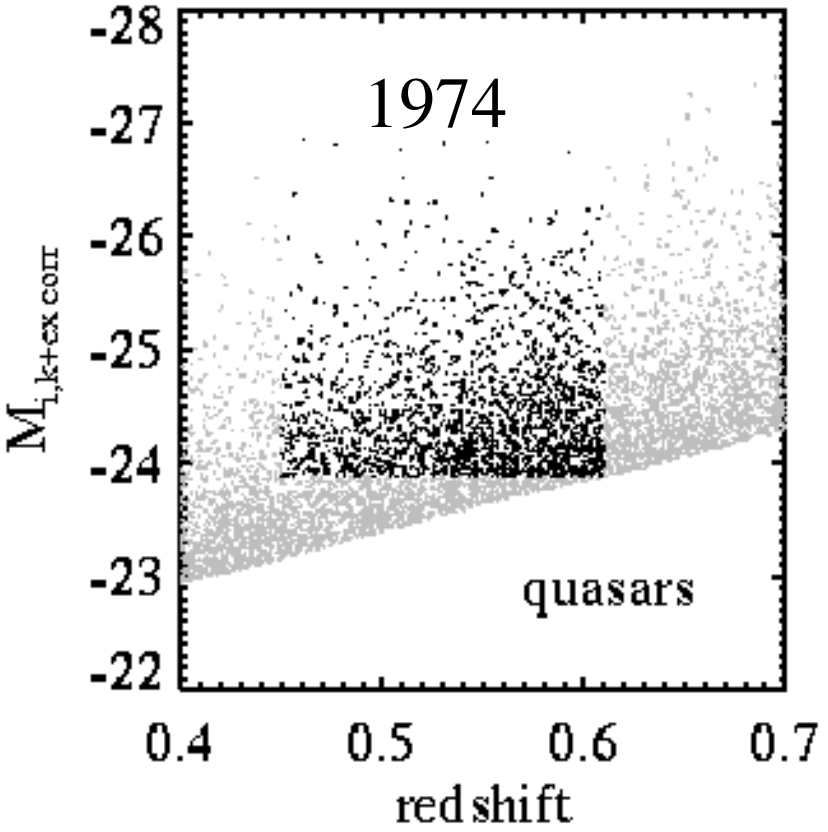
Data



Data

0.45<z<0.61





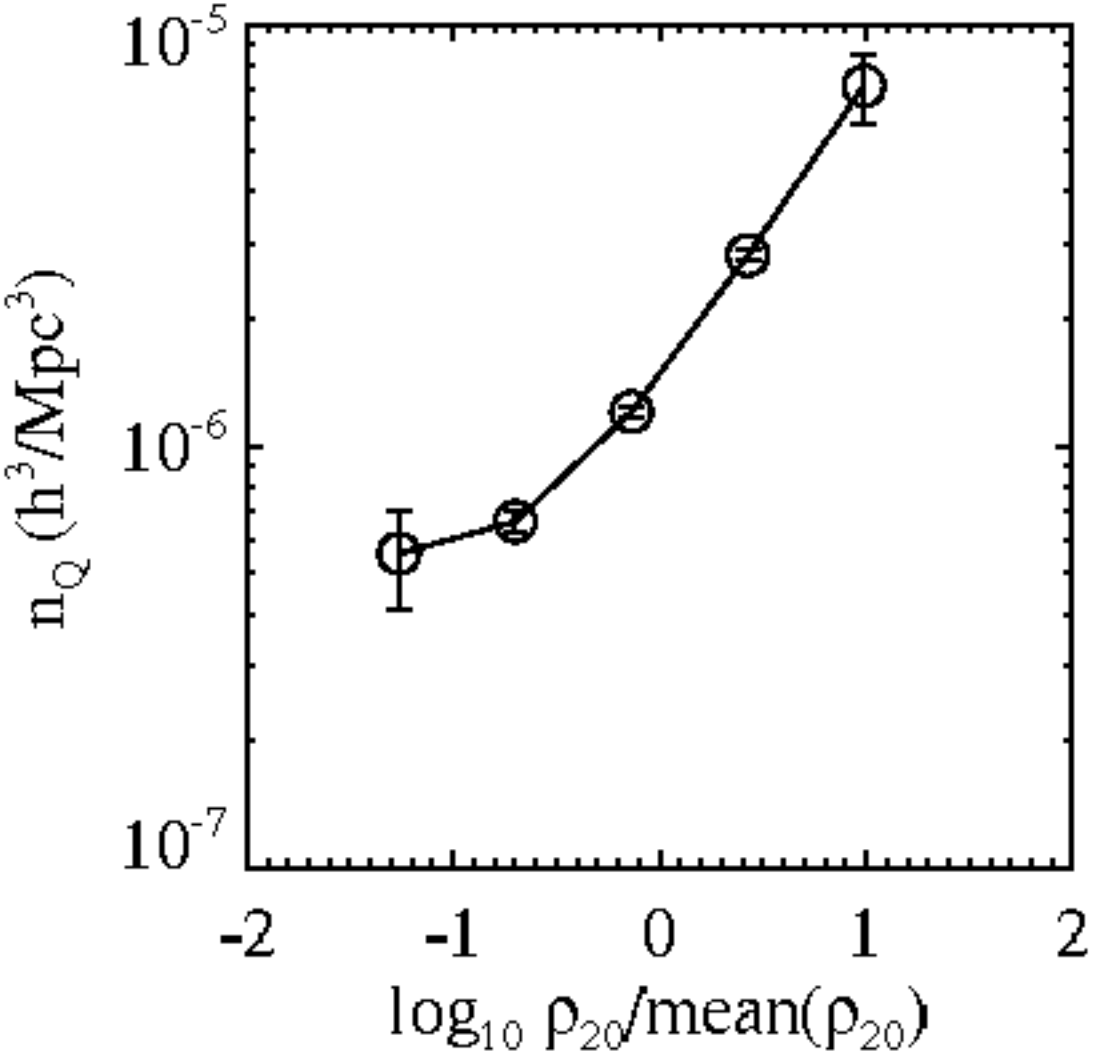
$n_G=2.00\times10^{-4}$ $(h/Mpc)^3$, 17.1Mpc/h

$n_Q=1.44\times10^{-6}$ $(h/Mpc)^3$, 88.6Mpc/h

Analysis

- Construct background (number) density field with CMASS galaxies by using 20 nearest-neighbors method and Spline kernel.
  - *Many corrections are needed for data completeness and boundary effect*.
- Investigate quasar population / properties in different background density levels.

Result

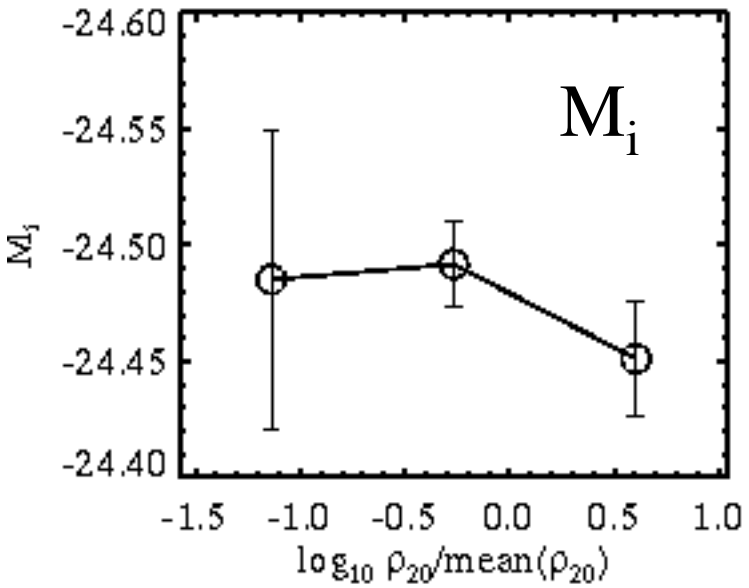


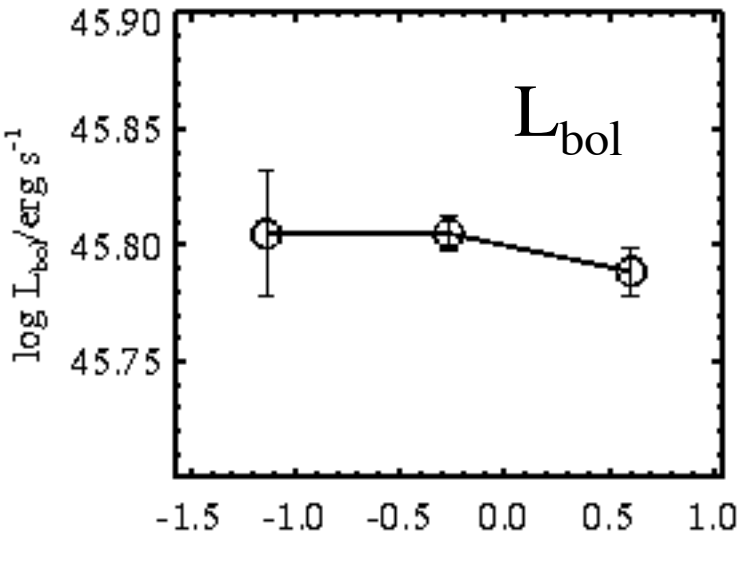
rho_{20} – background number density

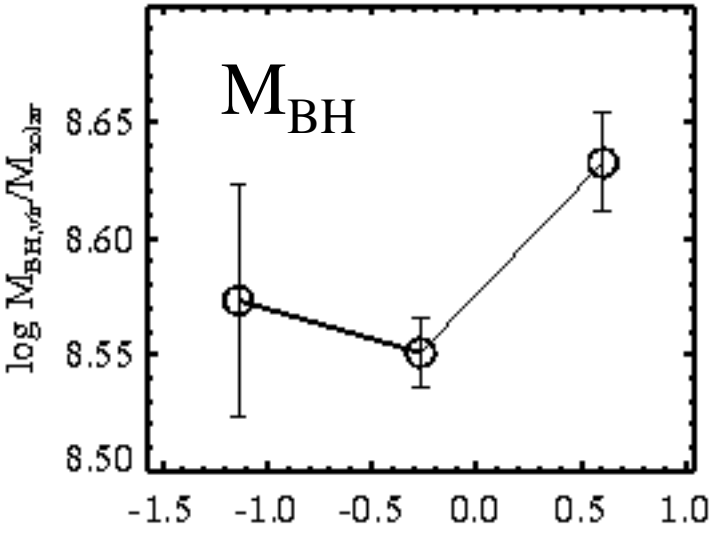
error bars – Jack Knife subsample-to-subsample variation

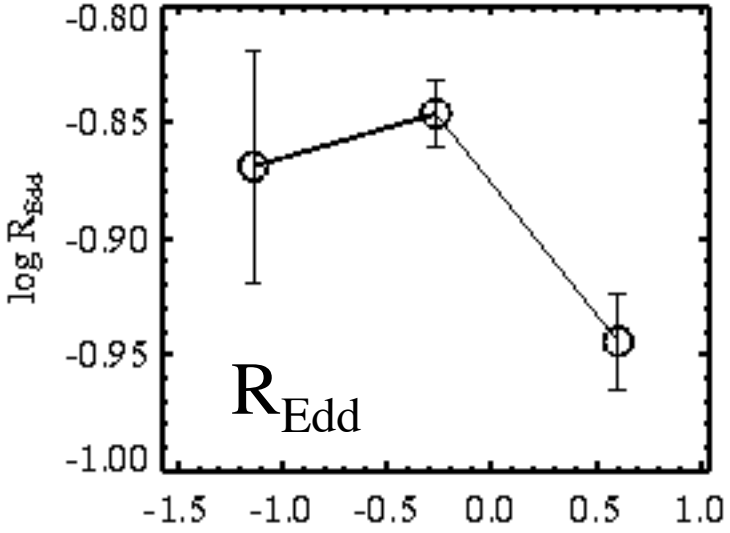
error bars – standard deviation/sqrt(N_{data})

Result





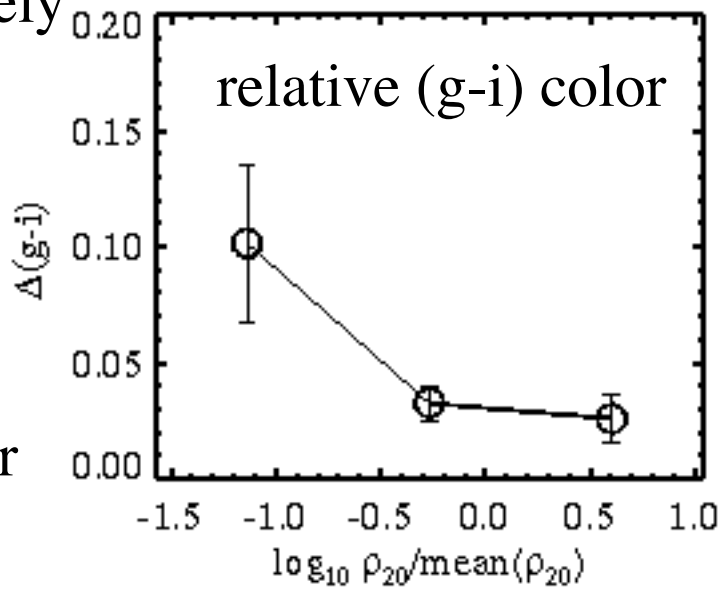


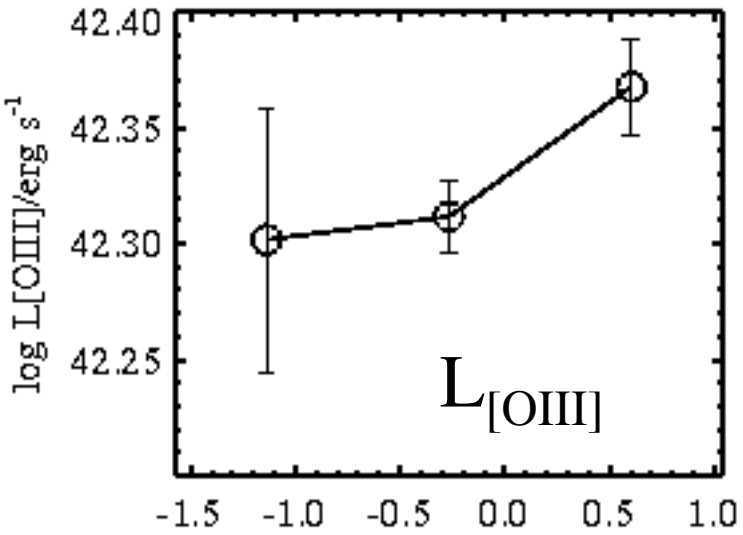


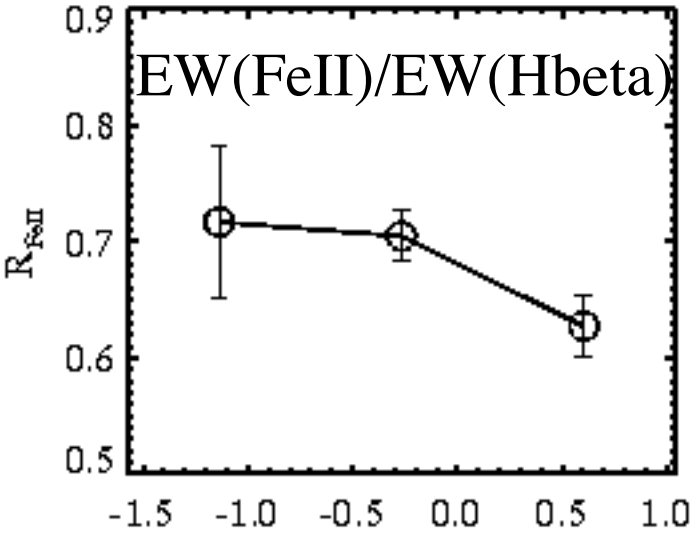
Result

relatively redder

bluer



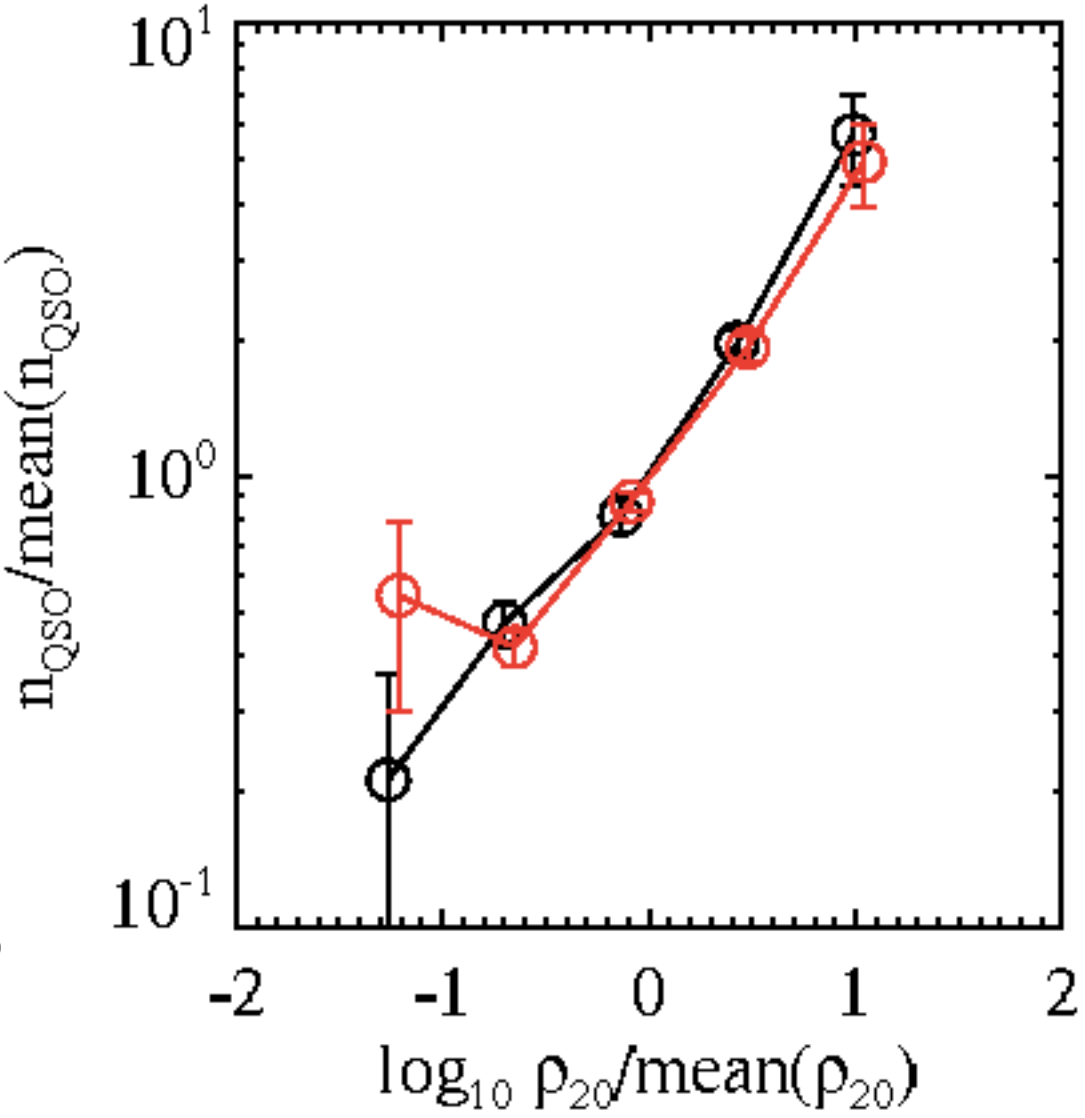




Summary

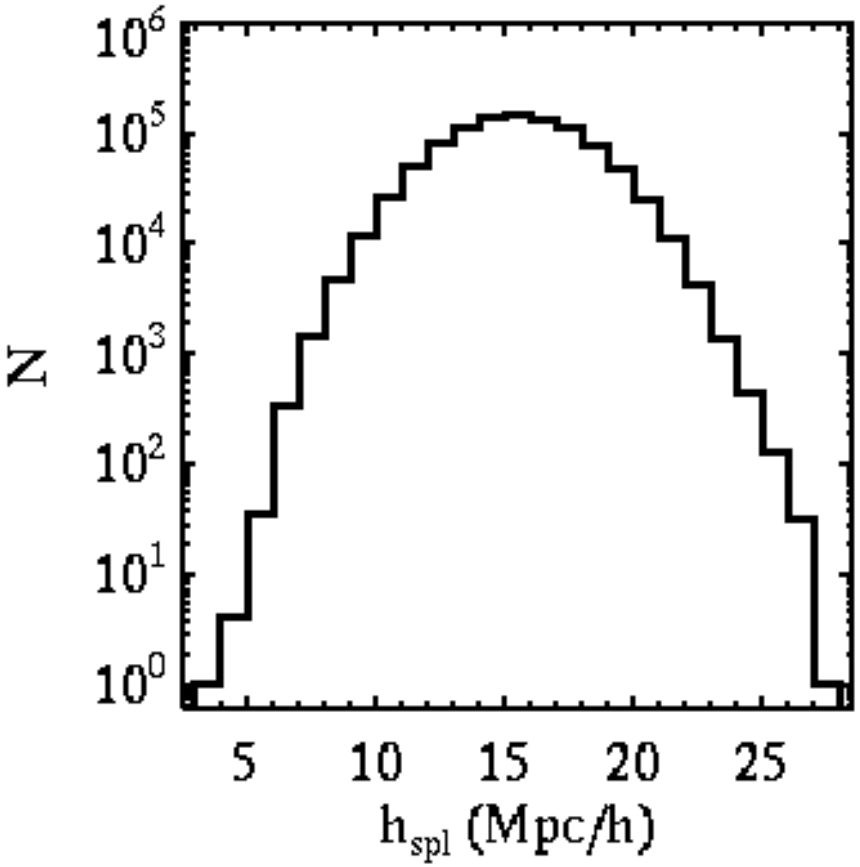
- Quasar number density increases monotonically with background density – *expected to trace LSS found from galaxy distribution quite well*.
- Quasars are populated quite much in lower dense region, and also it is hard to find large-scale environment dependence of their properties – *for quasars, large-scale environment doesn't seem to play very important role*.

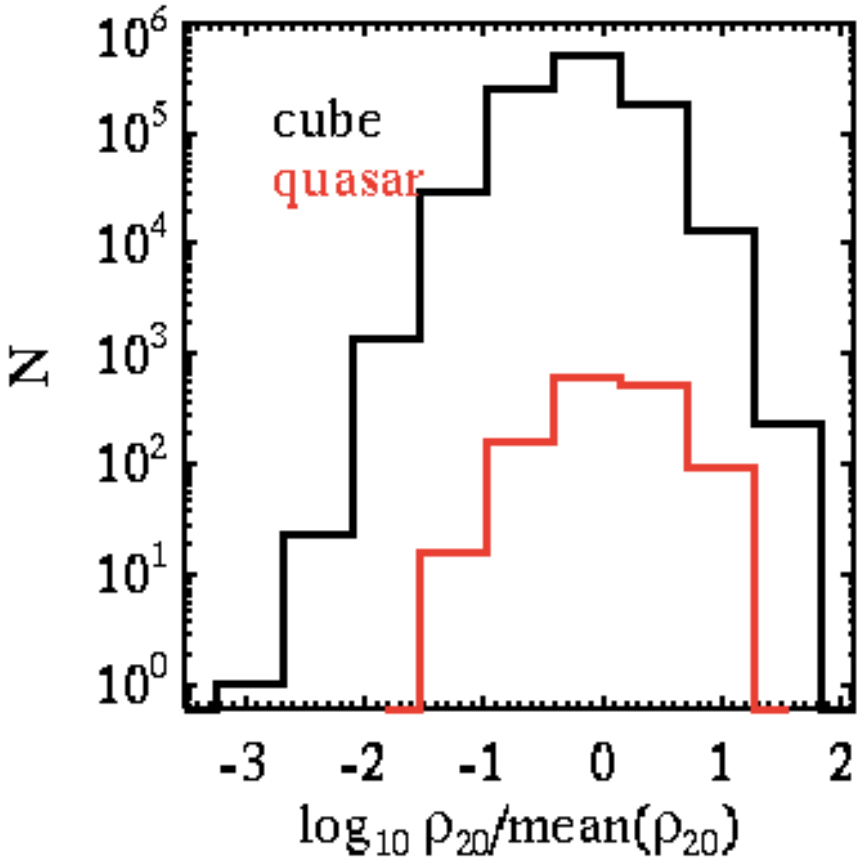
Result



red – higher-z (z>5.56)
black – lower-z (z<0.52)

Result





h_{sph} – smoothing scale used to calculate background density

rho_{20} – background number density