Star-Galaxy classification in SDSS DR12

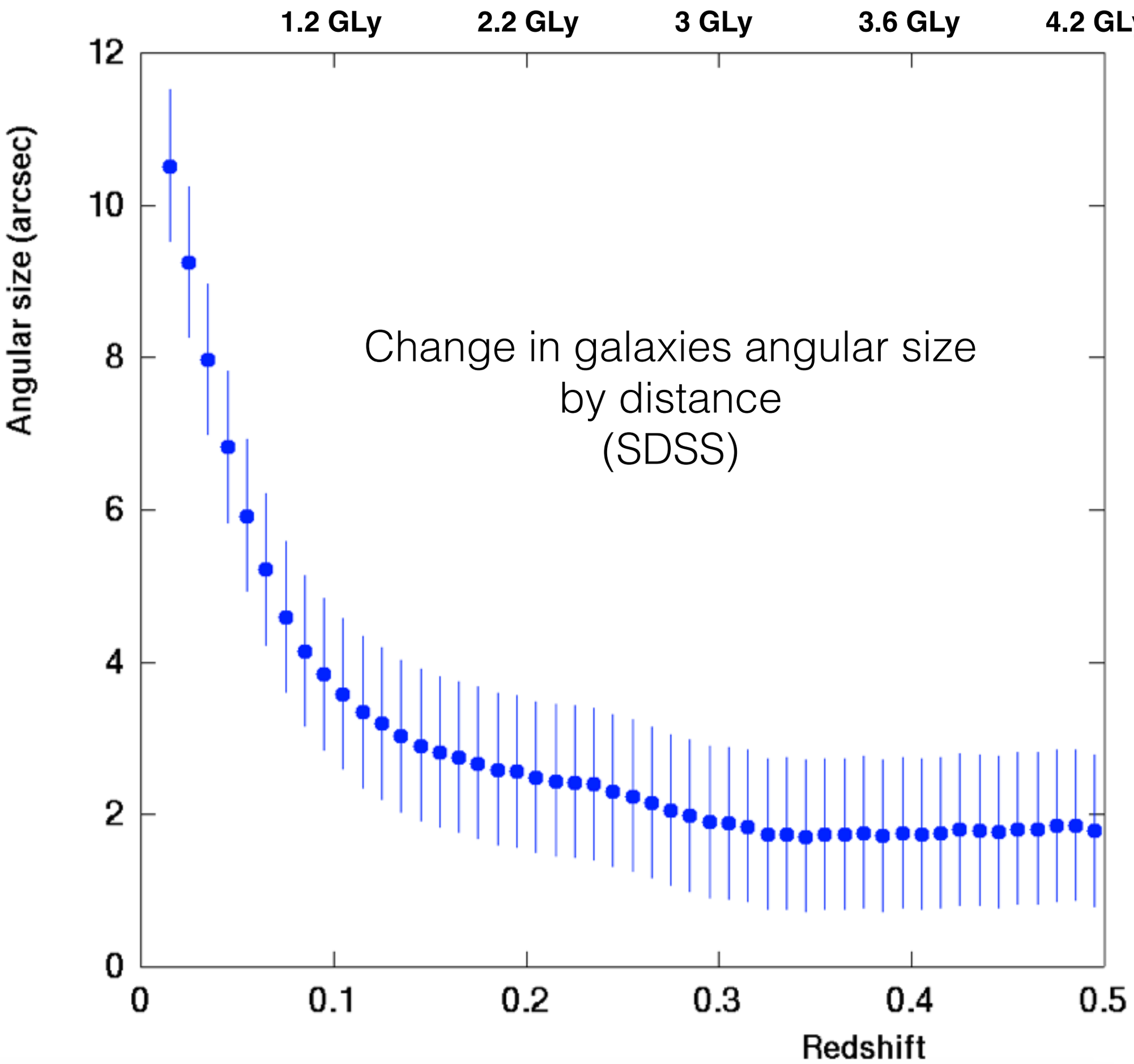
Farhang Habibi
LAL

Aim

To automatically separate stars from galaxies by using the objects colours in absence of spectroscopical data.

Nearby galaxies

luminosity spread on CCD:
stars ~ 1 arcsec
galaxies ~ 10 arcsec


1.2 GLy
2.2 GLy
3 GLy
3.6 GLy
4.2 GLy
Angular size (arcsec)
12
10
8
6
4
2
0
0
0.1
0.2
0.3
0.4
0.5
Redshift
Change in galaxies angular size
by distance
(SDSS)

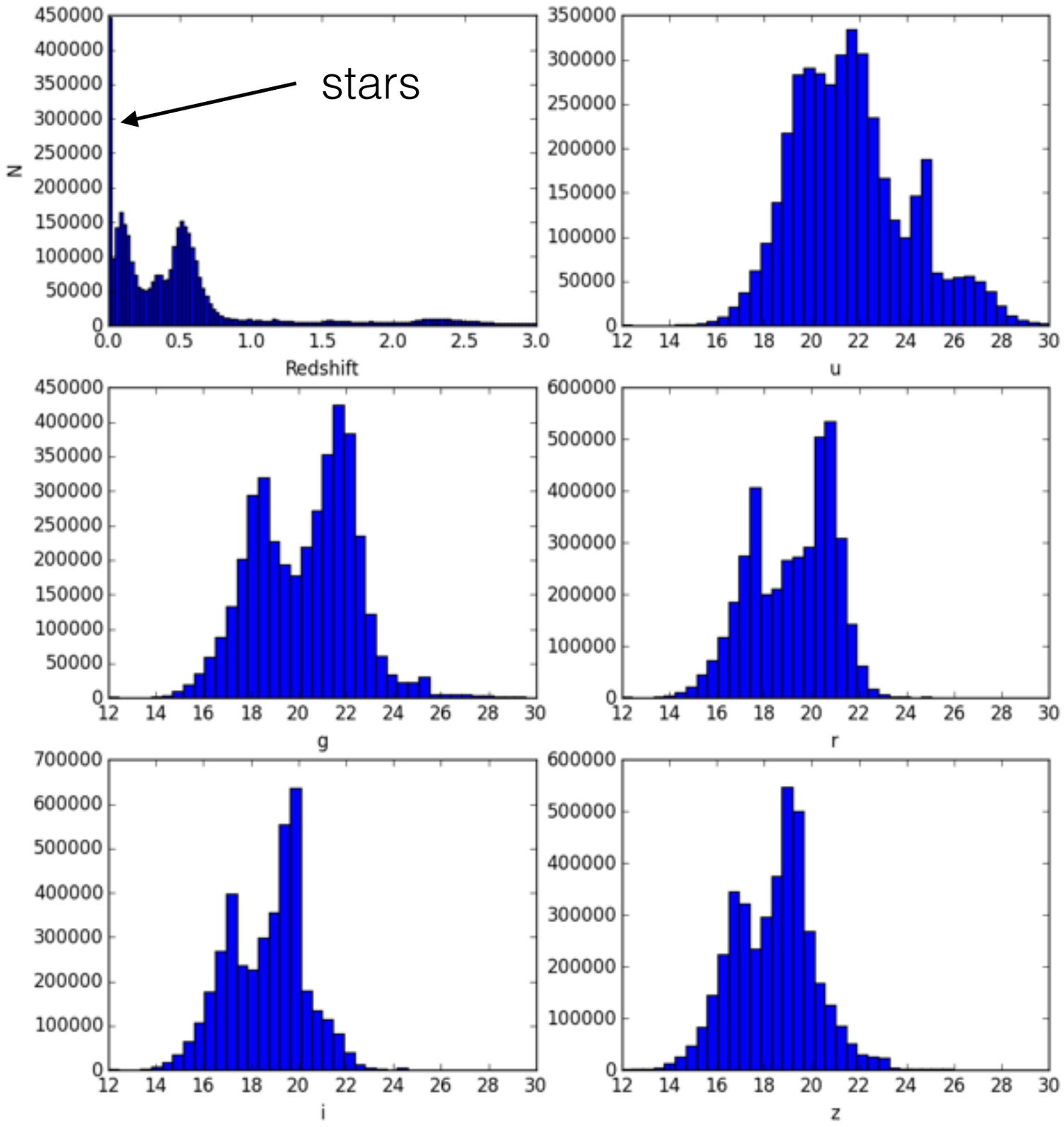
Far galaxies

luminosity spread on CCD:

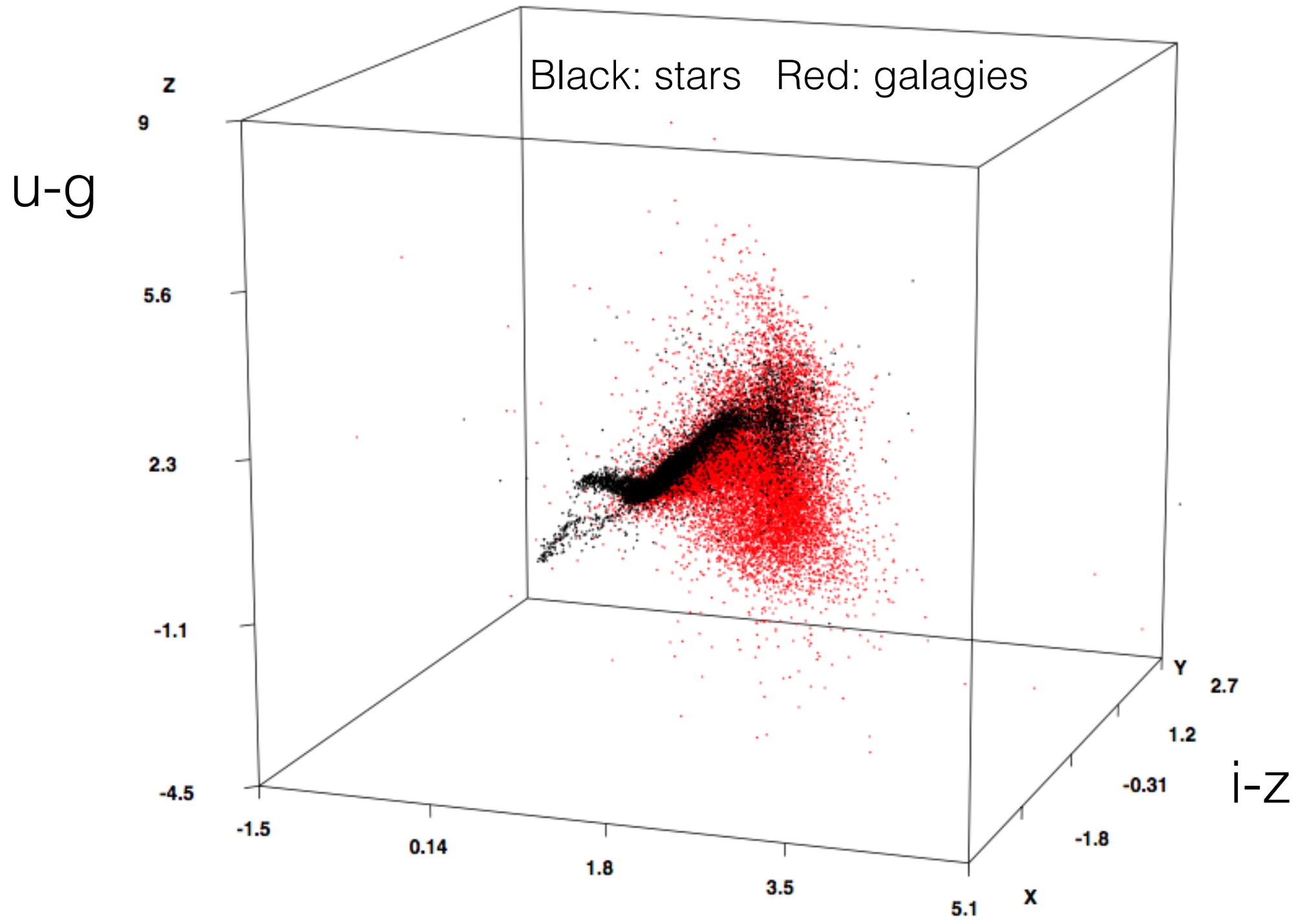
stars ~ 1 arcsec

galaxies ~ 1 arcsec

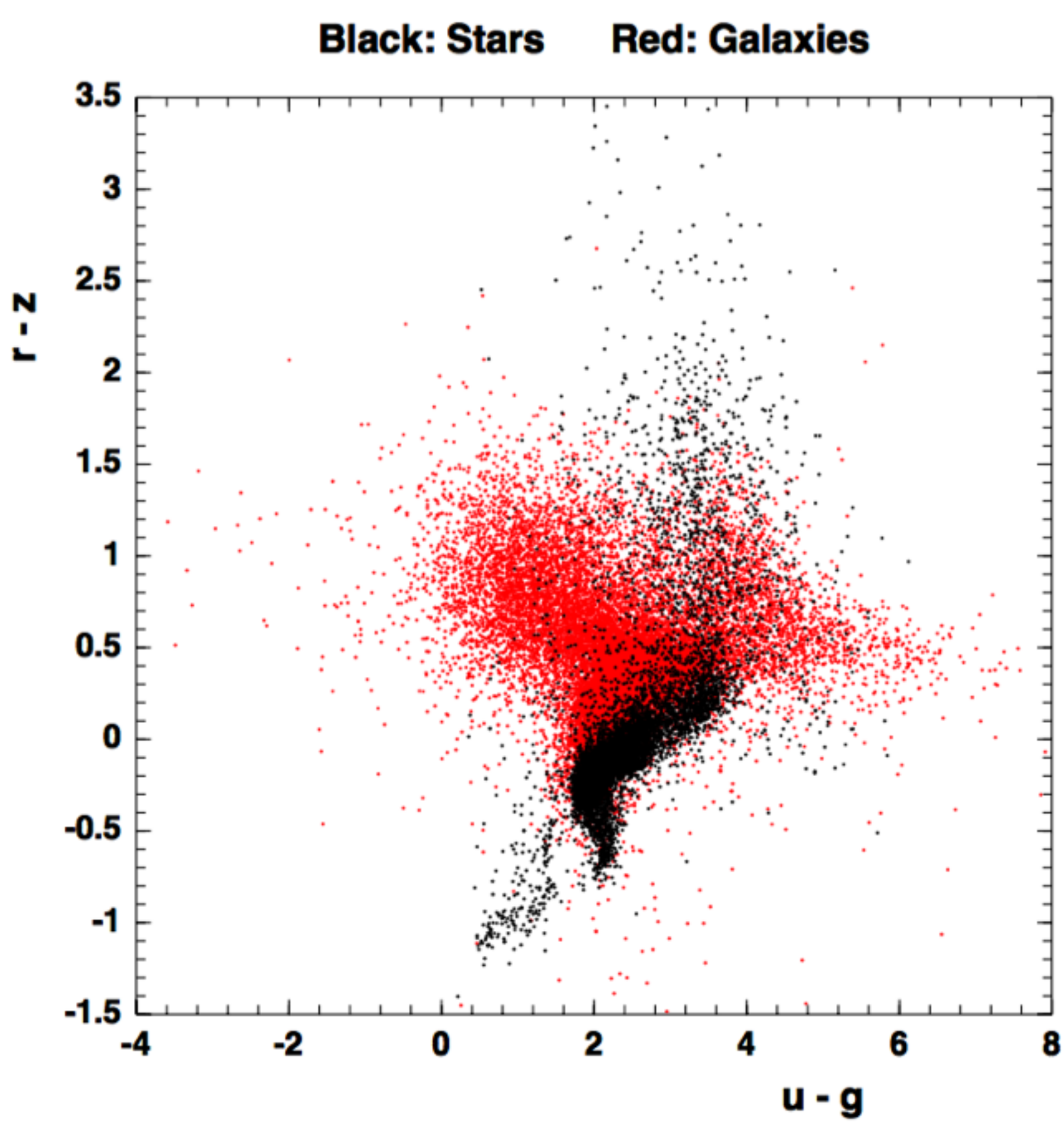
SDSS DR12 spectroscopic sample
~ 2,300,000 stars+galaxies



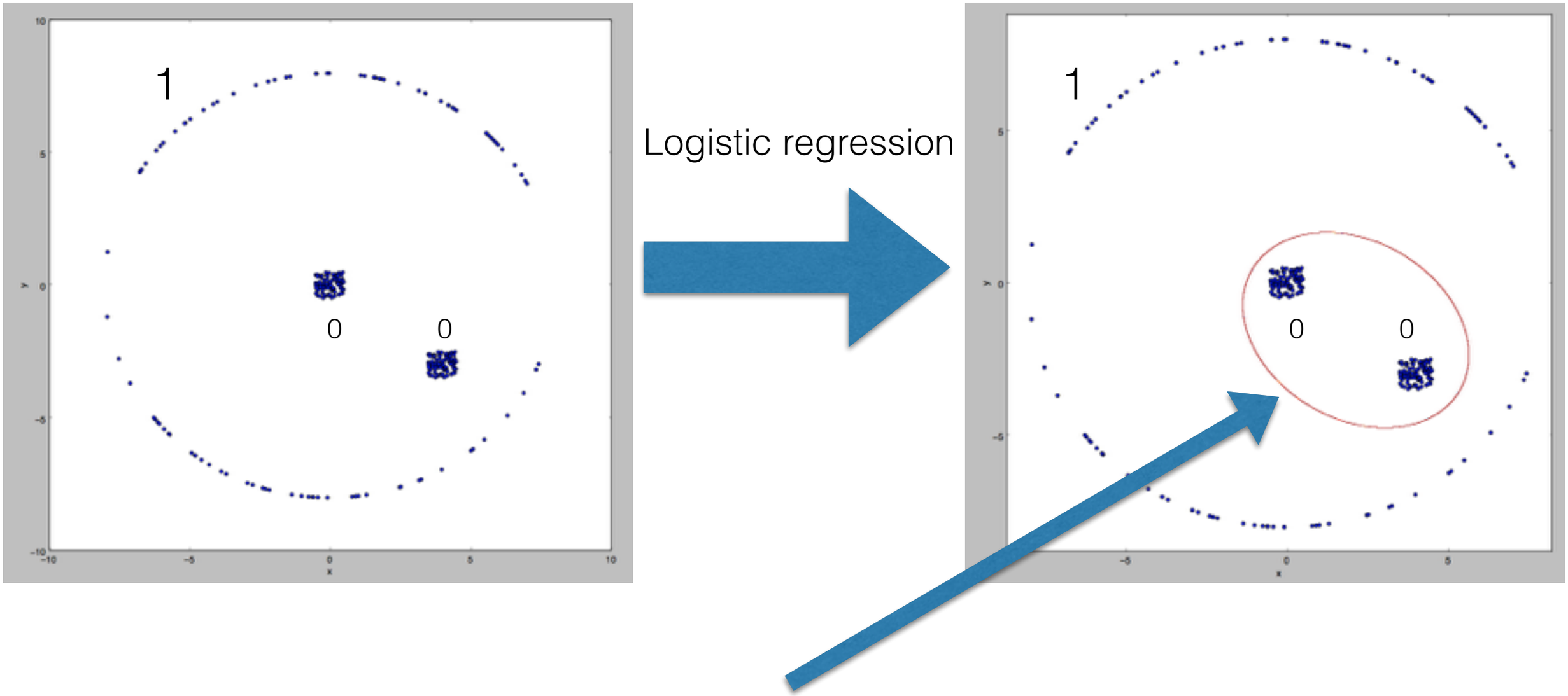
Colour indices as “features” for classification



Colour indices as “features” for classification



Supervised Classification



Parameters of the separating curve are derived by the logistic regression method.

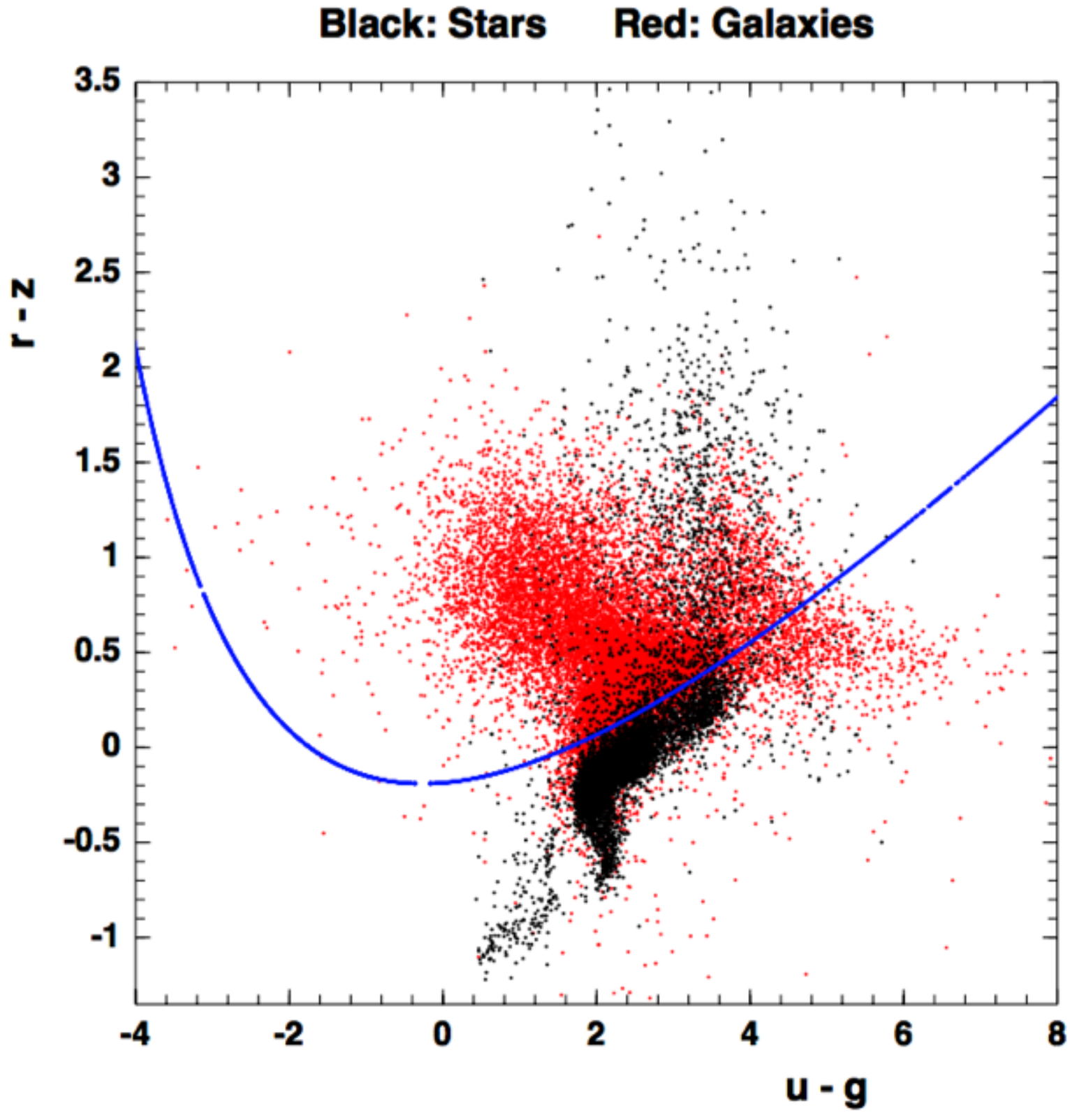
Logistic regression

- We take into account 10 colours (c1=u-g, c2=u-r, …) plus one magnitude (u) and their quadratic function (ci.cj) to have 77 features.

- The separation region is constrained by a 11 dimension hyper parabola defined by 78 parameters.

- From ~600,000 stars and ~1,500,000 galaxies, we randomly put 20000 stars and 20000 galaxies into the training sample.

Results from the fit



Results from the classification

- Classification efficiency for the
  whole sample: 92%
  galaxies: 93%
  stars: 90%

- Mean redshift of the galaxies classified
  wrongly: 0.14
  correctly: 0.25

- Mean colour (extinction corrected) of the stars classified
  wrongly: u-z = 4 (redder stars)
  correctly: u-z = 2

Conclusions & Perspectives

- in SDSS DR12, more than 90% of galaxies and stars can be correctly separated using their colours and implementing Logistic Regression.

- Nearby galaxies can be mis-classified as stars.

- Redder stars can be mis-classified as galaxies.

- Quasars of the SDSS will be included

- Classifying the simulated objects according to the LSST observation ability (higher redshifts and fainter objects).

- Comparison with other classifiers

Conclusions & Perspectives

with LSST, MW-like galaxies can be resolved by morphology
but not for faint galaxies (dwarfs)