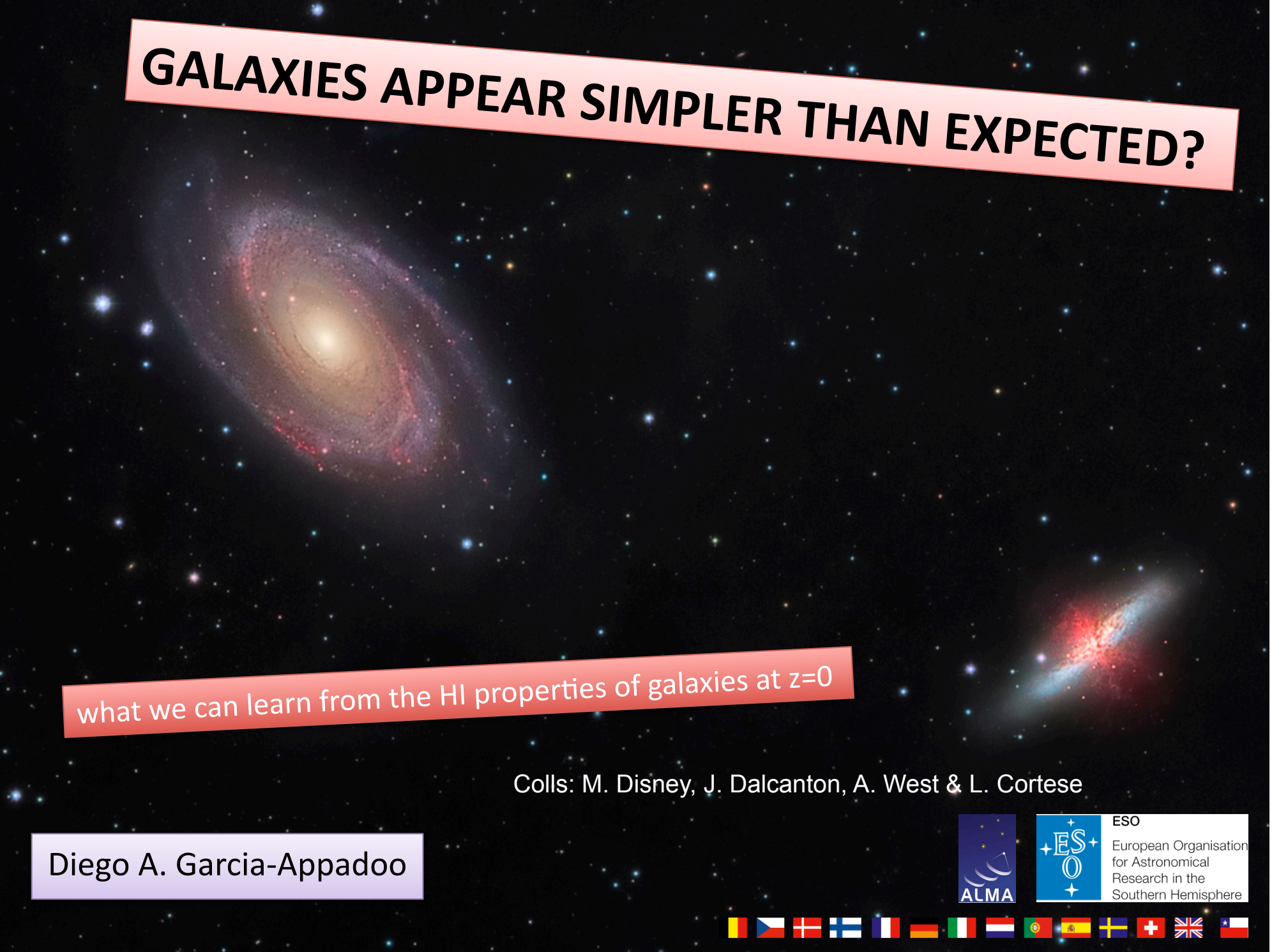
GALAXIES APPEAR SIMPLER THAN EXPECTED?



what we can learn from the HI properties of galaxies at z=0

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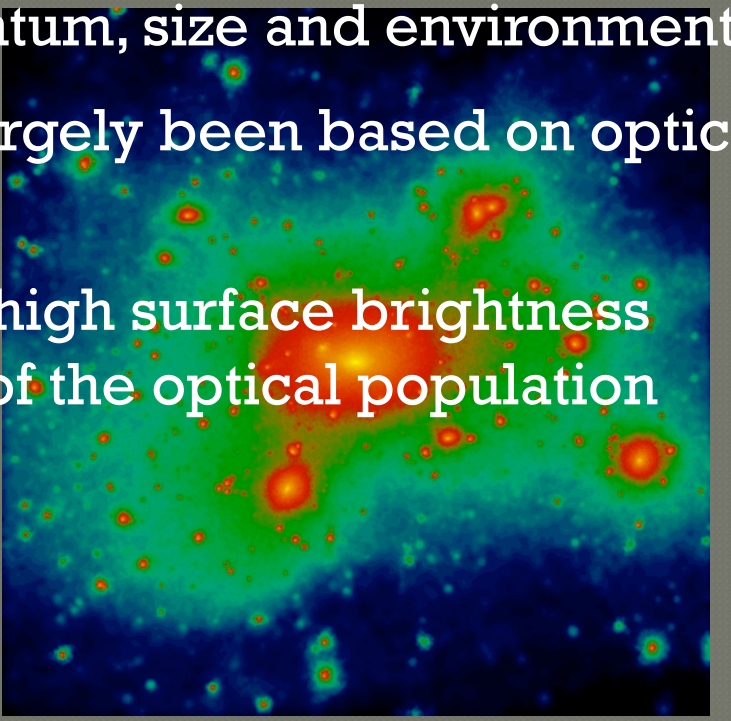
Background & motivation

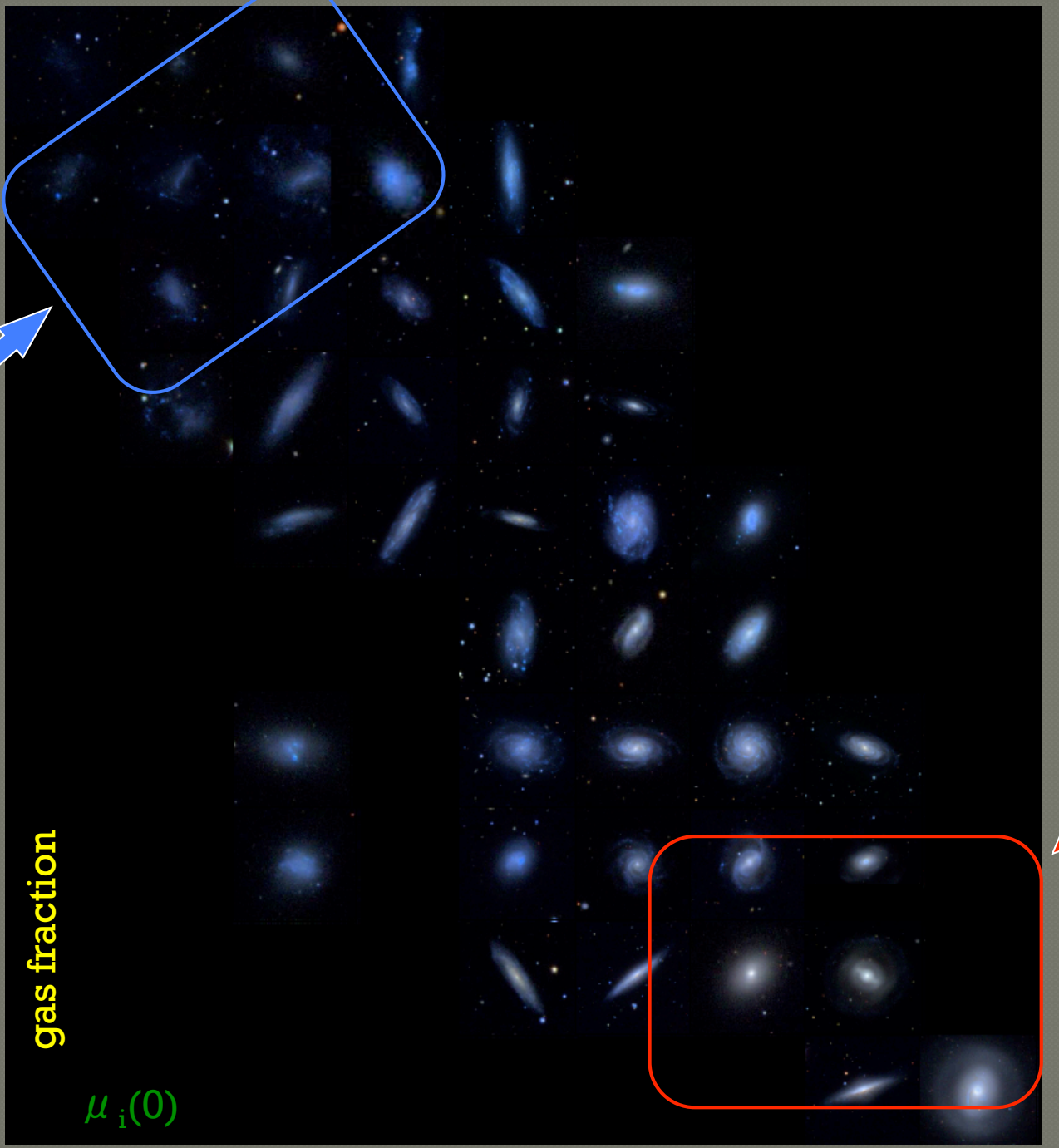
- Current theory of galaxy formation says that galaxies were assembled through the chaotic hierarchical merging of massive dark matter haloes, with star-forming matter being later embedded
- Expect the properties of individual galaxies to be determined by numerous independent factors, such as star-forming history, merger history, mass, angular momentum, size and environment.
- The study of galaxy formation has largely been based on optical surveys of galaxies
- Optical surveys are biased towards high surface brightness objects and a substantial proportion of the optical population may be missed

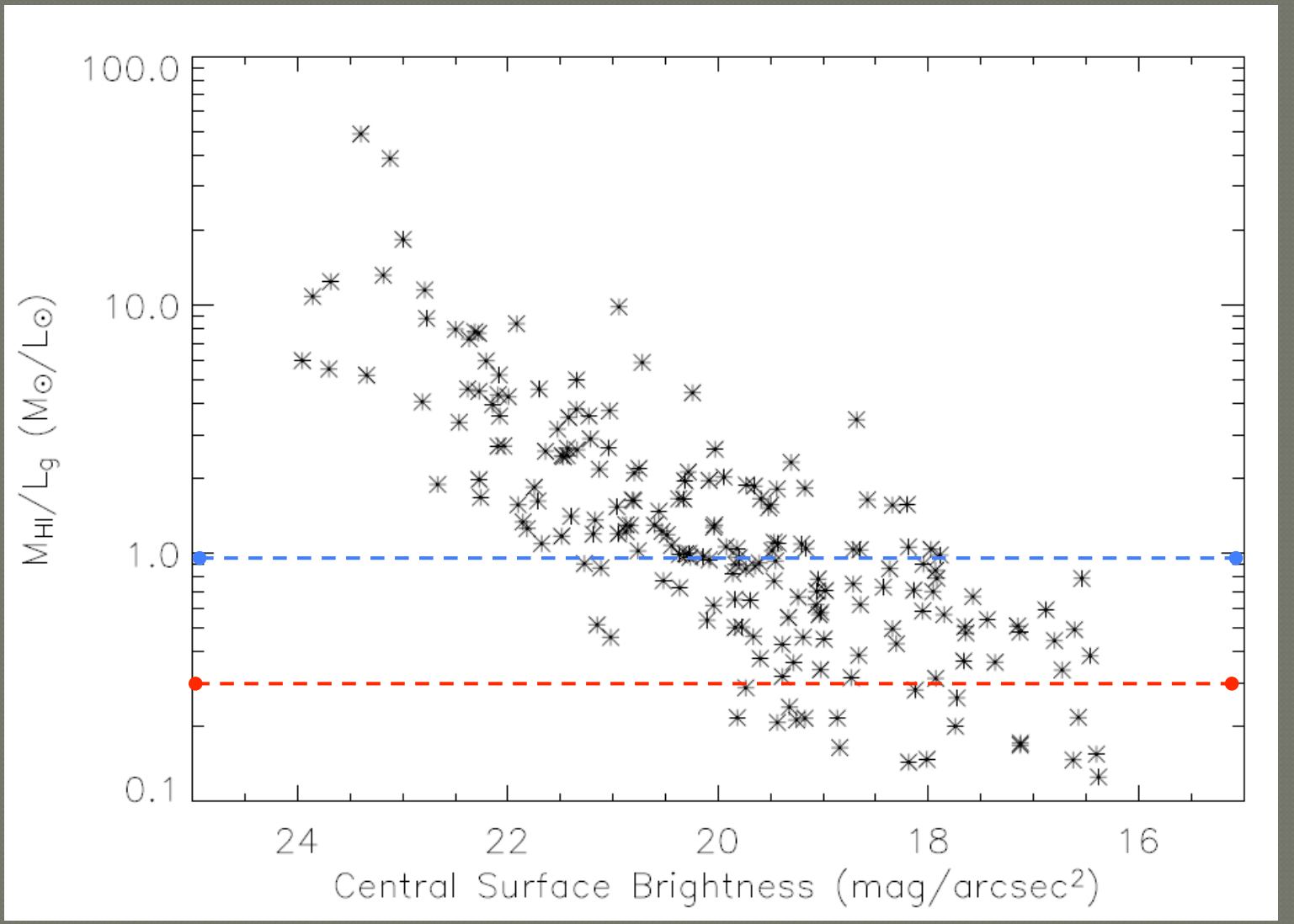


The Equatorial Strip Sample

- HI is the primordial fuel of star formation and its detection is ***independent of optical selection effects***
- ~ 1100 HI sources detected (30% deeper than HIPASS)
- Area of ~ 6000 deg^2 (-6° < δ < +10°) out to ~ 150 Mpc
- 195 galaxies selected from their ***HI content alone***
- Complete and homogeneous optical data from SDSS for 195 galaxies (extended objects)
- Representative of the whole range of galaxies from giant spirals to extreme dwarfs

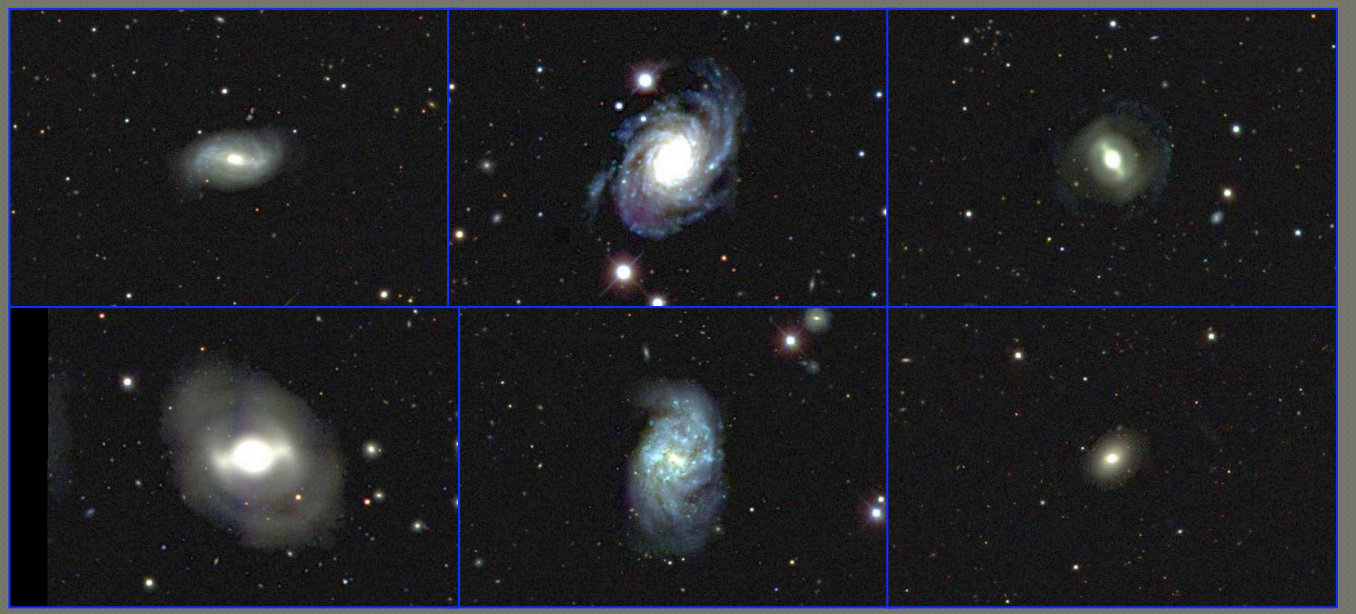
Global Properties of the sample


LSB galaxies
HSB galaxies
gas fraction
$\mu_i(0)$

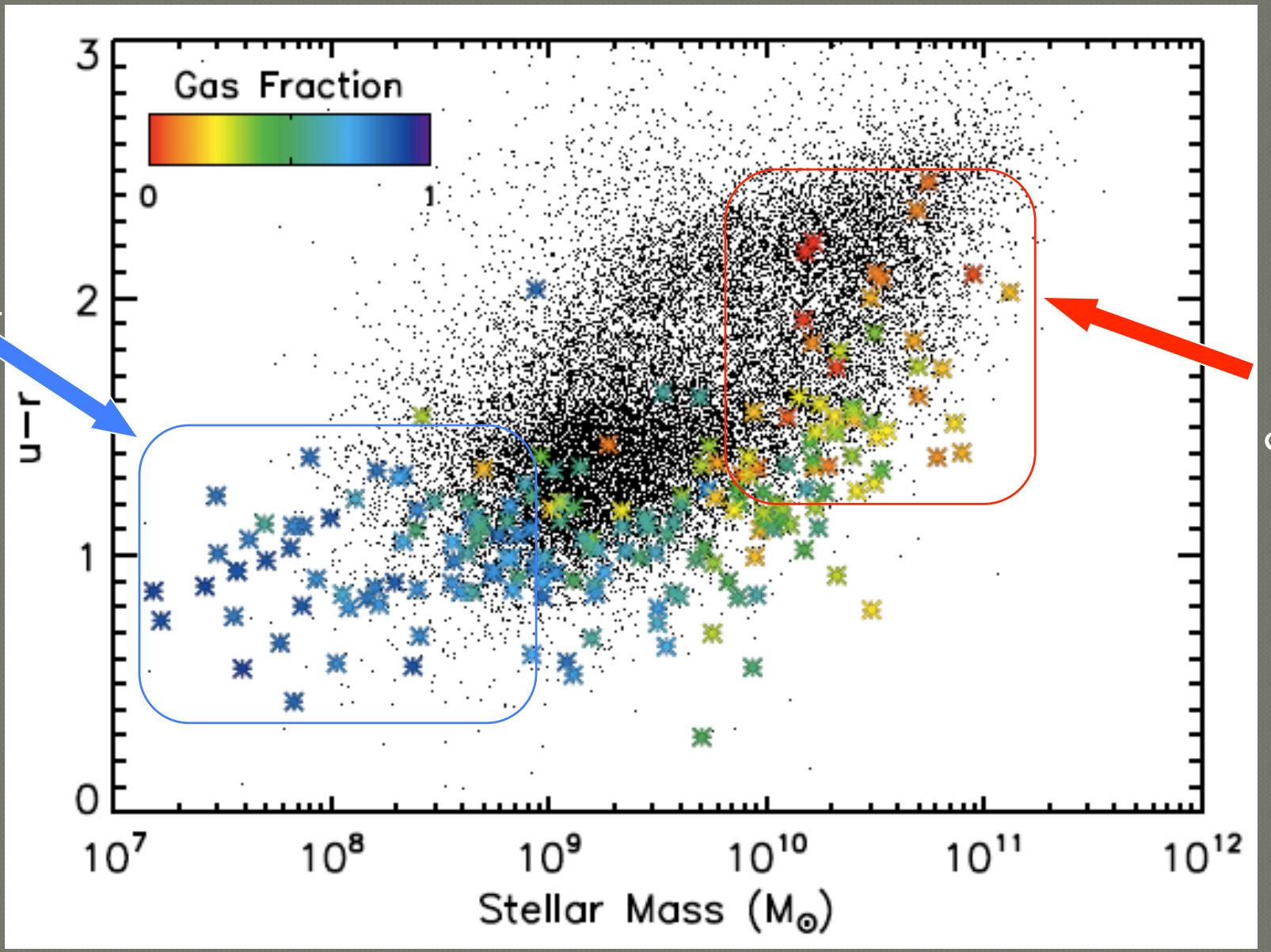


HI mass to light ratio vs Central Surface Brightness

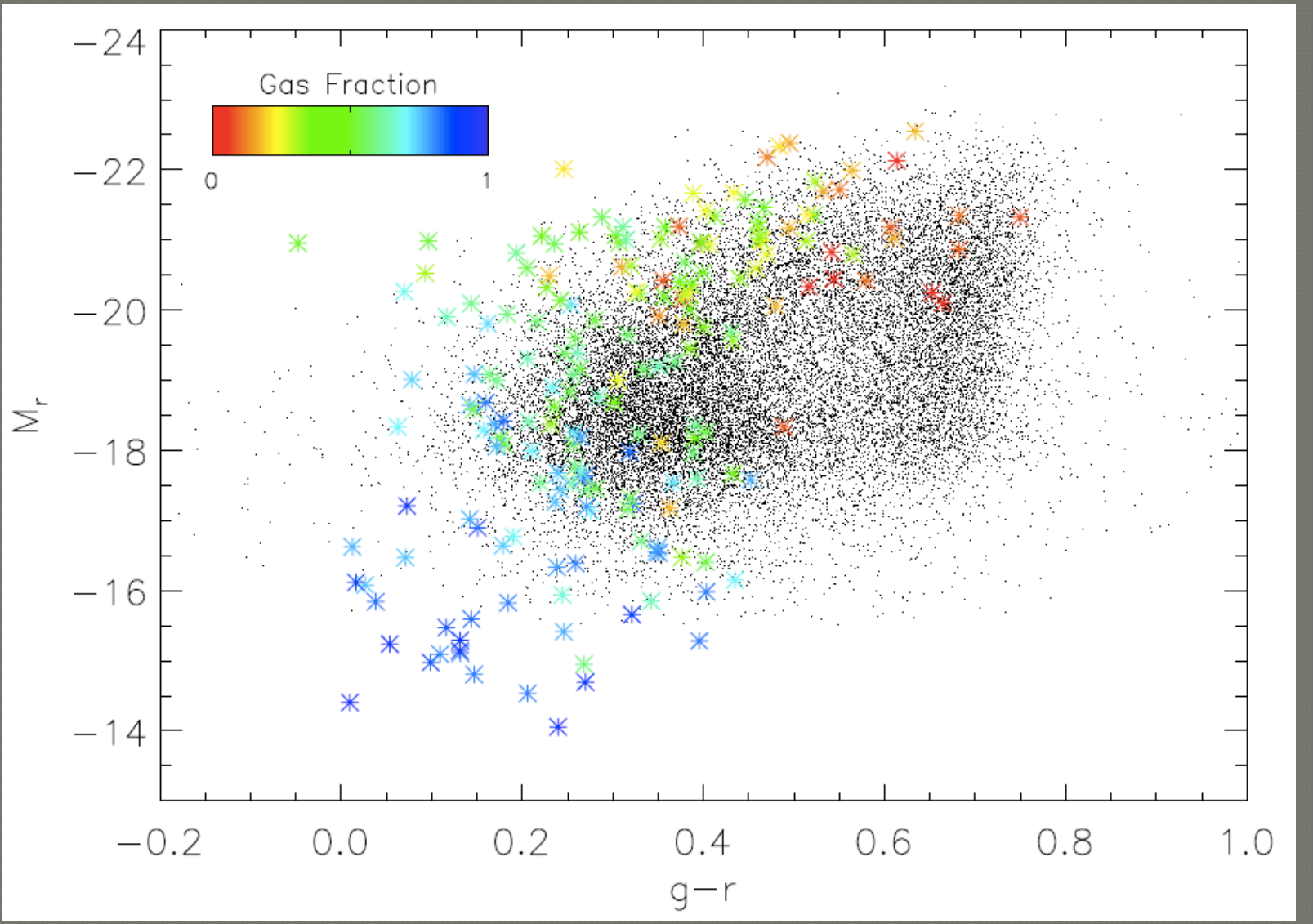
$M_{HI}/L_g > 10$



$M_{HI}/L_g < 1$



The u − r colors as a function of stellar mass

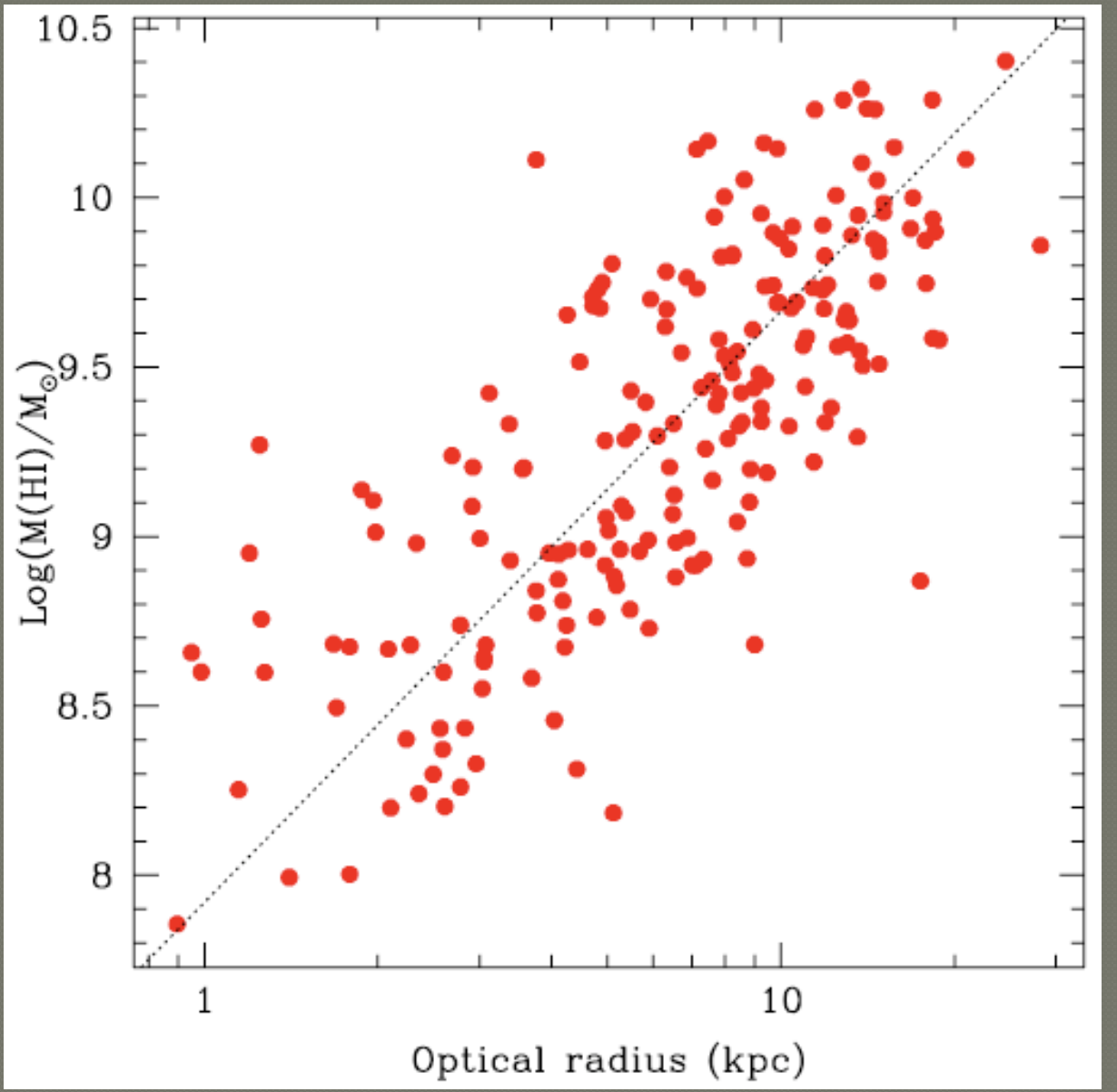


Absolute r-band magnitude as a function of g − r for the HI-selected galaxies

Correlations in the data

- HI mass – optical radius relation – $M_{HI} \propto R^2_{50}$
- Dynamical mass – Luminosity relation – $M_{dyn} \propto L_g$
- R_{90}/R_{50} relation – $R_{90} \propto R_{50}$
- Surface Brightness – Luminosity relation –

$$\Sigma = L_g / R^2_{50} \propto L_g^{1/3} \propto R_{50}$$



HI mass vs optical radius

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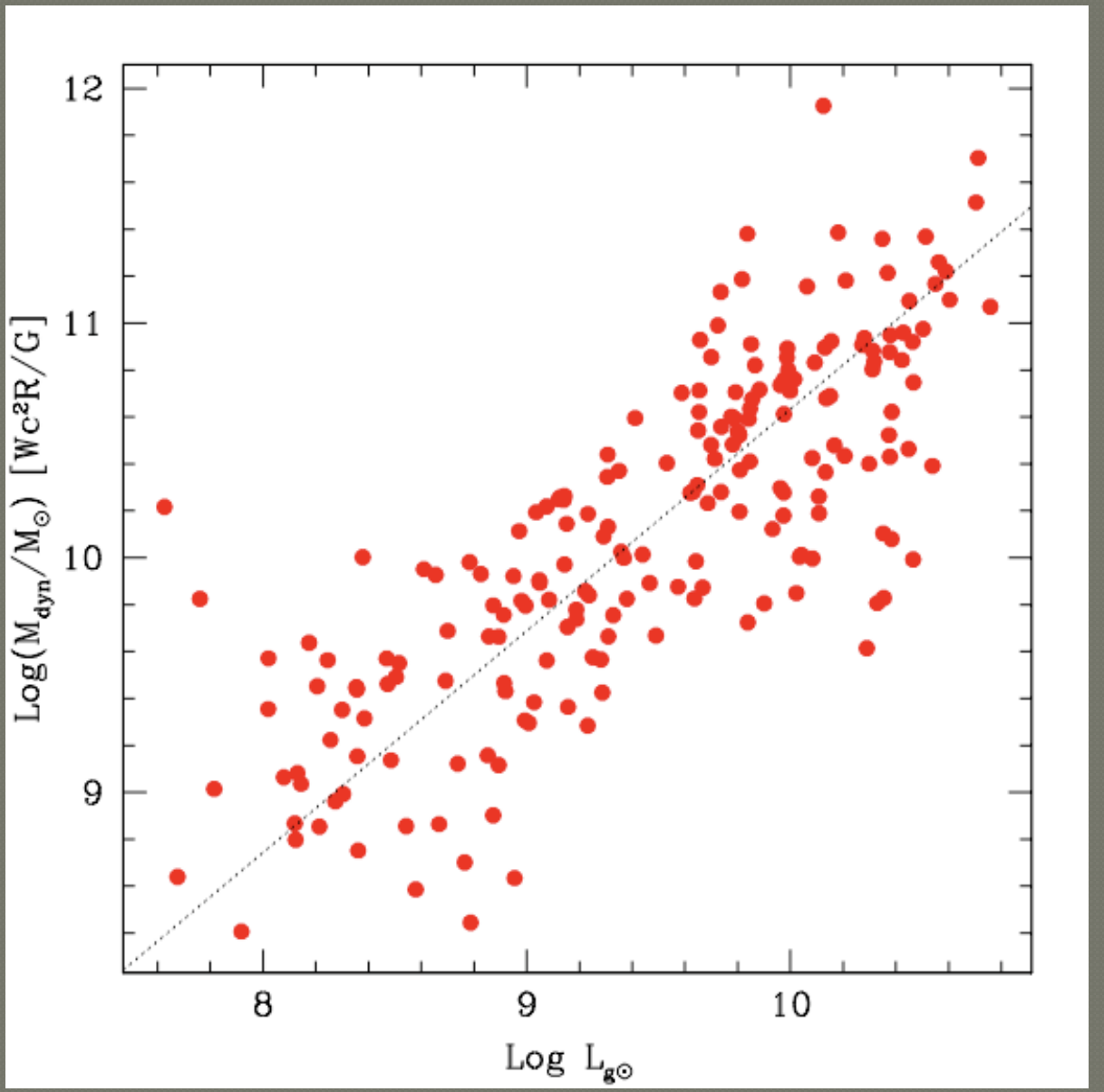

Luminosity (*g*) and Dynamical Mass relation.

Correlations in the data

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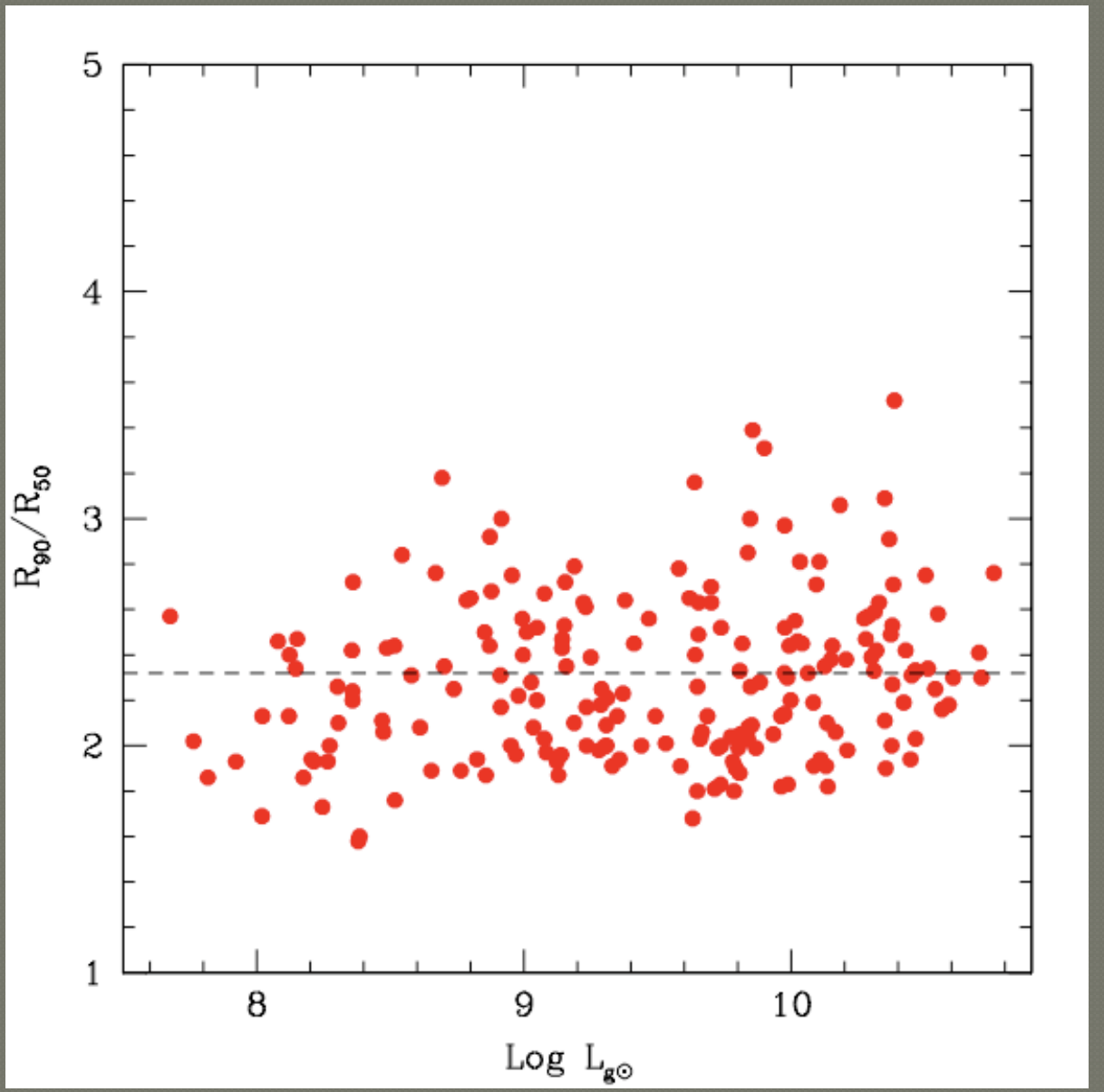

Relation between the 2 optical radii, R_{50} and R_{90}

Correlations in the data

- HI mass – optical radius relation – $M_{HI} \propto R^2_{50}$
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- R_{90}/R_{50} relation – $R_{90} \propto R_{50}$
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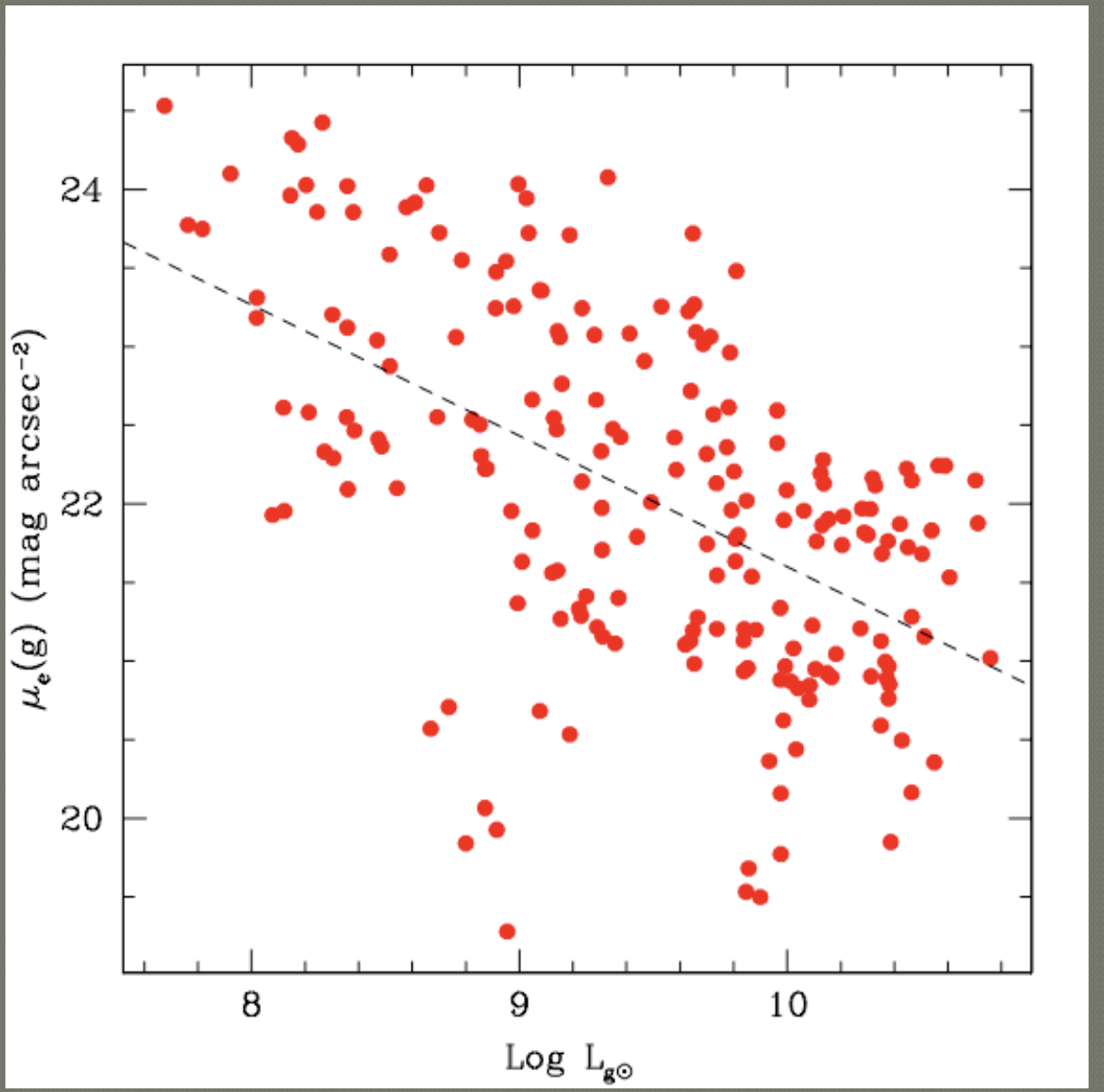


surface-brightness and luminosity relation

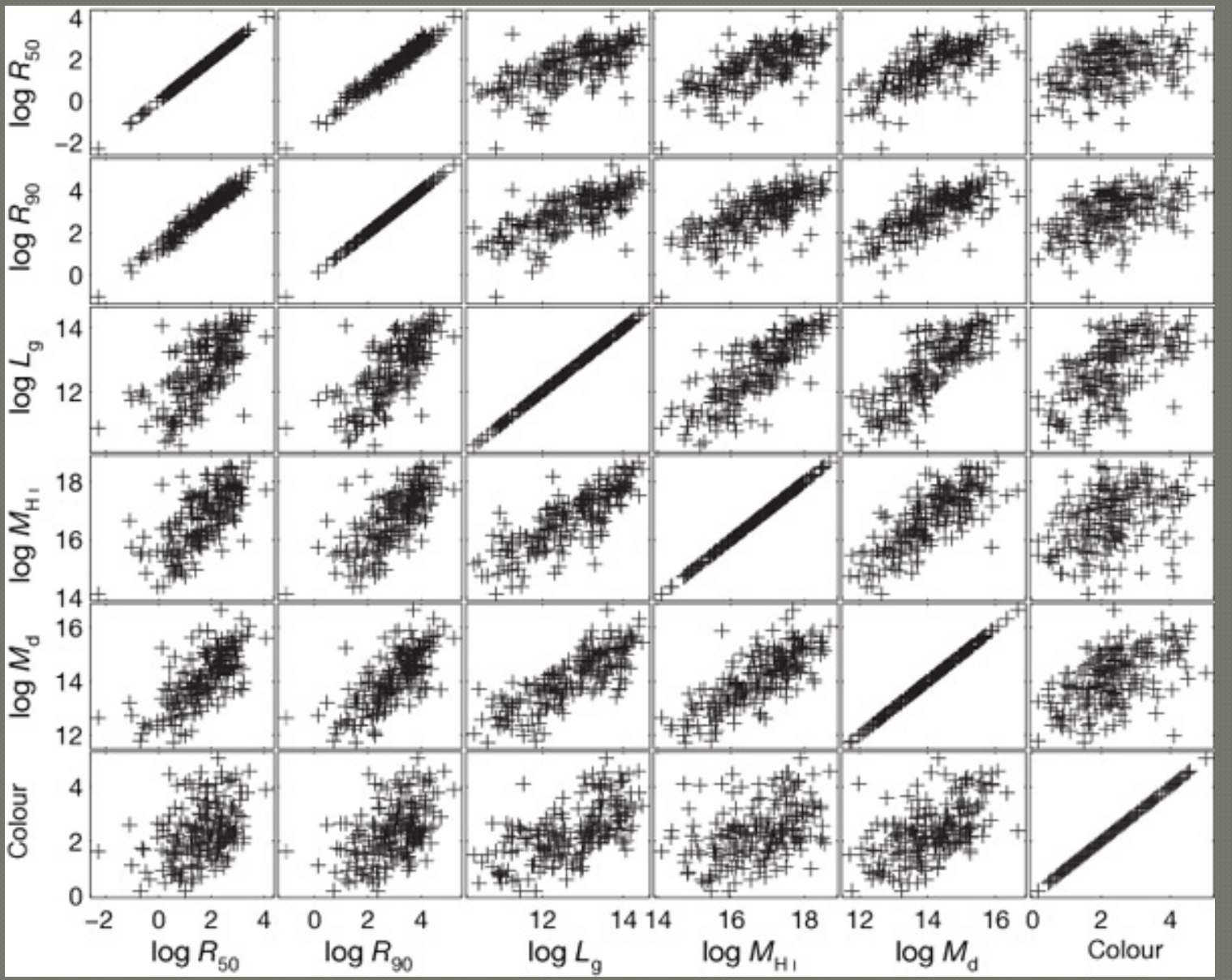
PCA analysis

We examine the correlation structure by means of a principal component analysis (PCA) based on the correlation matrix of the measured data.

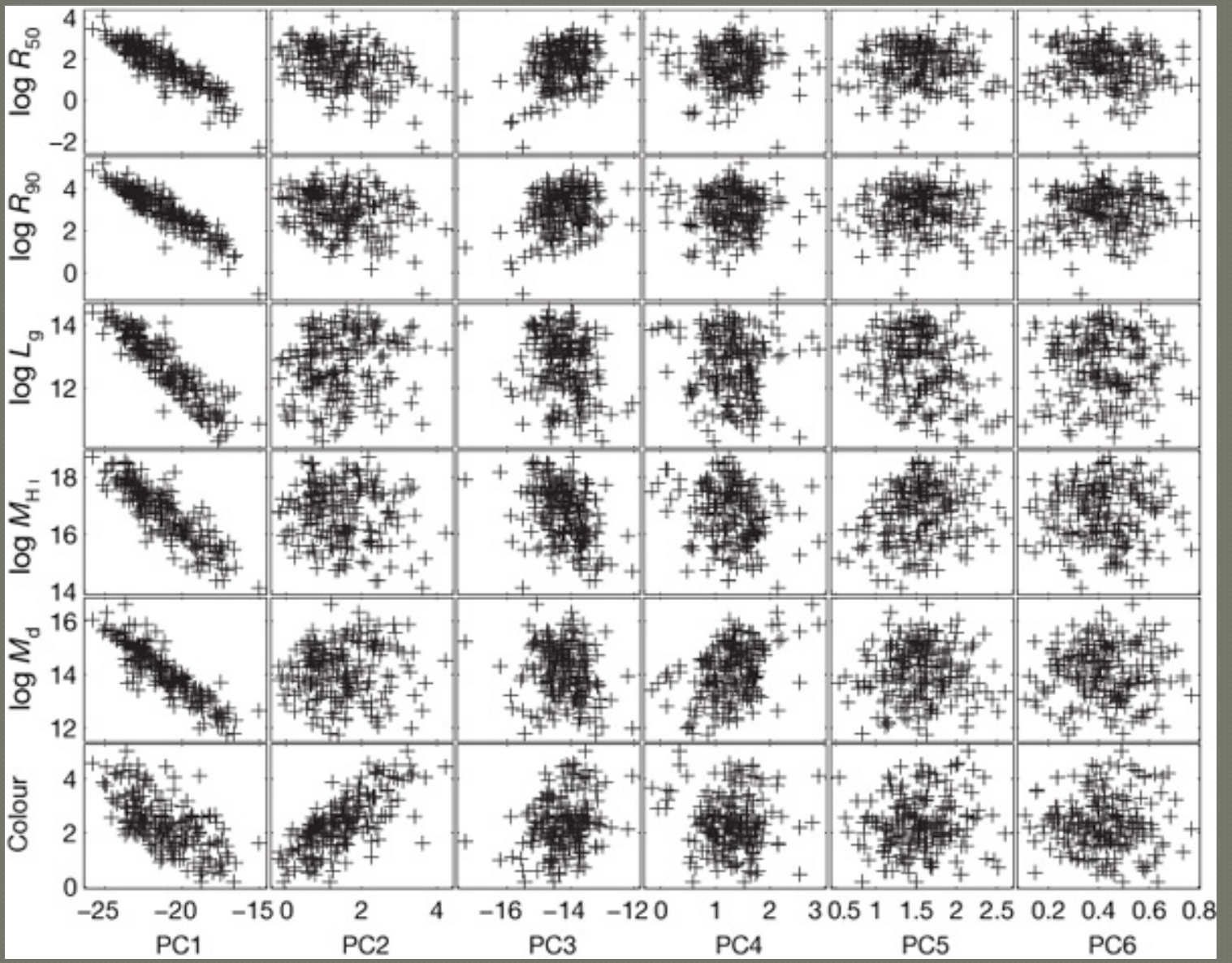
PCA can be thought of as a search in the six-dimensional space of observables for a smaller number of coordinates that describe nearly all the variance.

For instance, PCA has been used to show that elliptical galaxies lie on a 'fundamental plane' that is, in a two-dimensional space.

Nature, 2008, 455, 1082D



Scatter plots showing correlations between the measured variables including colour



Scatter plots showing correlations between all the six measured variables (including colour) and the principal components (PC)

Summary

- Properties of HI selected galaxies are different from optically selected samples. Our sample spans a large range of surface brightnesses, colours and stellar masses

- HI-selection identifies galaxies that are *bluer*, *less luminous* and have *smaller stellar masses* and have *higher gas fraction* and *mass to light ratios* than optically selected samples

- The bluer colours reflects the *larger fraction of low-luminosity, star forming galaxies* (higher SFRs) found in our sample as compared to optically selected samples

- Galaxies appear to be *"controlled" by one parameter*, which could be the mass, hinting that galaxies might be simpler than expected

MNRAS, 2009, 394, 340G
Nature, 2008, 455, 1082D