

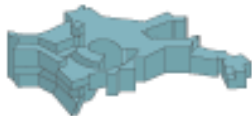
*H I Scaling relations for  
active and passive bulge-dominated massive galaxies*

S. Fabello

G. Kauffmann, B. Catinella (MPA),  
R. Giovanelli, M. P. Haynes (Cornell U.),  
D. Schiminovich (Columbia U.),  
T. Heckman (John Hopkins U.)

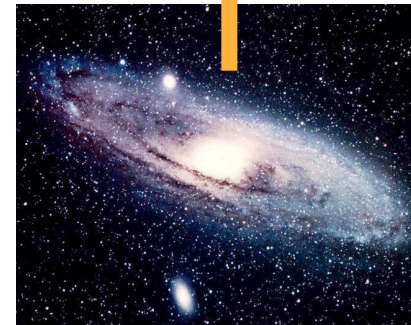
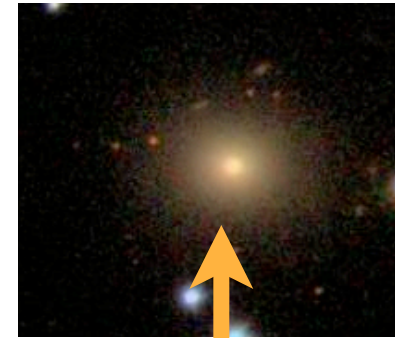
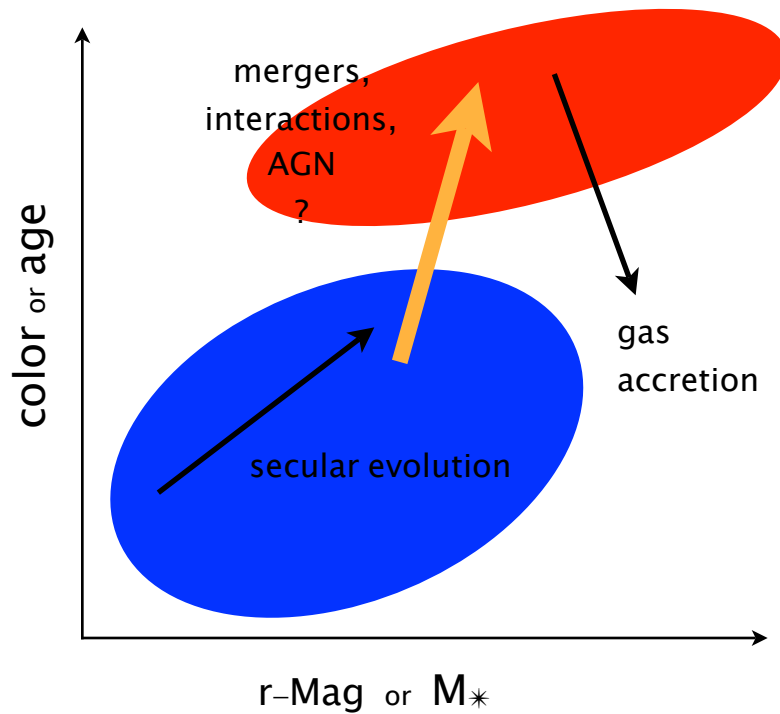
.....

Max-Planck-Institut  
für Astrophysik



GAS IN GALAXIES  
June, 15<sup>th</sup> 2011

Cold Gas is fundamental:  
fuel for future Star  
Formation



How does it respond  
to different effects?

Schimminovich+08 (Faber+07)

- ◆ If gas is removed  $\Rightarrow$  SF is suppressed
- ◆ New gas reservoirs could lead to new SF

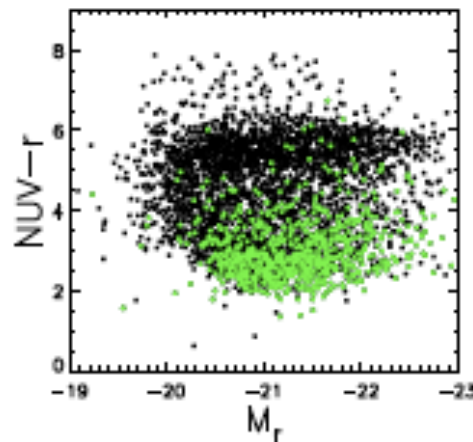
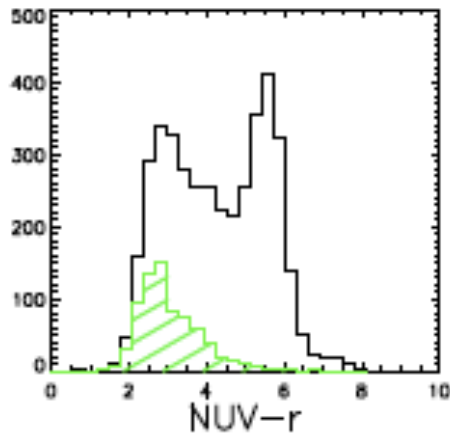
# The sample

Selection criteria as GASS - GALEX Arecibo SDSS Survey: (Catinella+ 2010)

- ◆  $10 < \log(M_*/M_\odot) < 11.5$ ;
- ◆  $0.025 < z < 0.050$ ;
- ◆ SDSS (York+ 2000) spectroscopic survey;  
GALEX (Martin+ 2005) MIS.
- ◆ **ALFALFA** (Giovanelli+ 2005) data available.

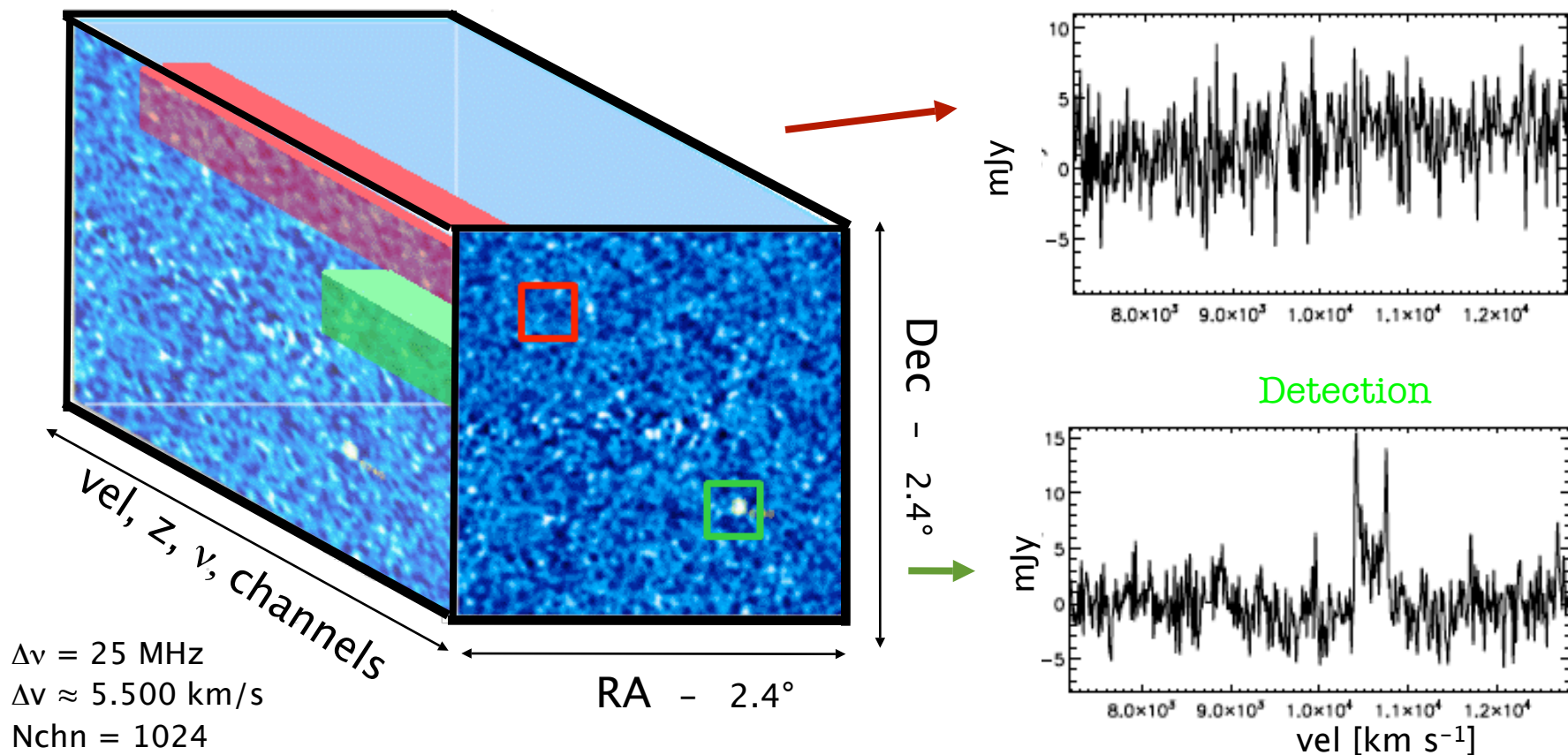
Sample A:  
4726 targets.

(23 % already detected)



Sample A  
ALFALFA detections

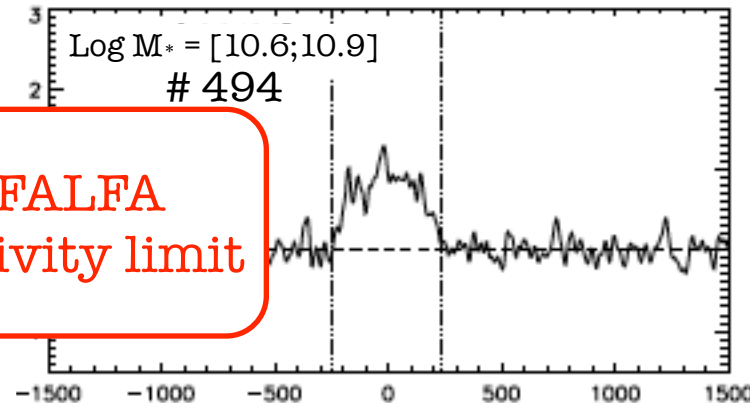
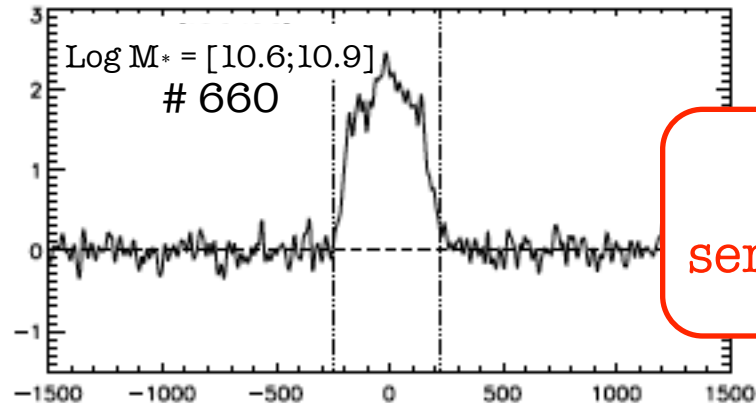
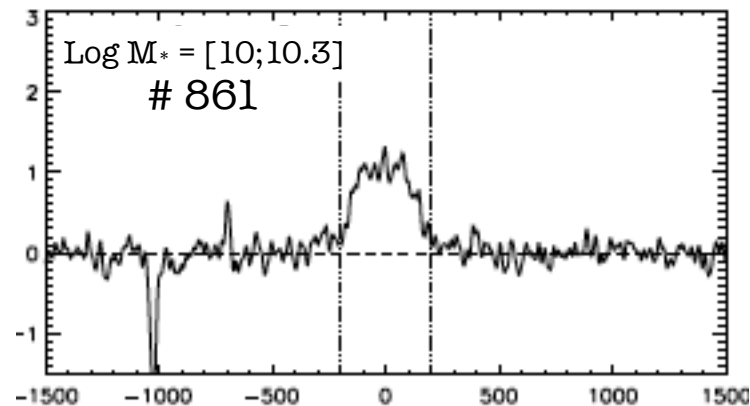
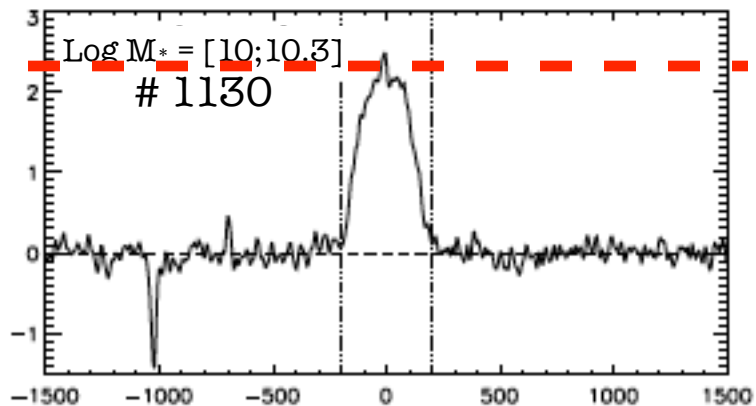
ALFALFA data-cube: RA, Dec, velocity  
extracting spectra at given position and redshift



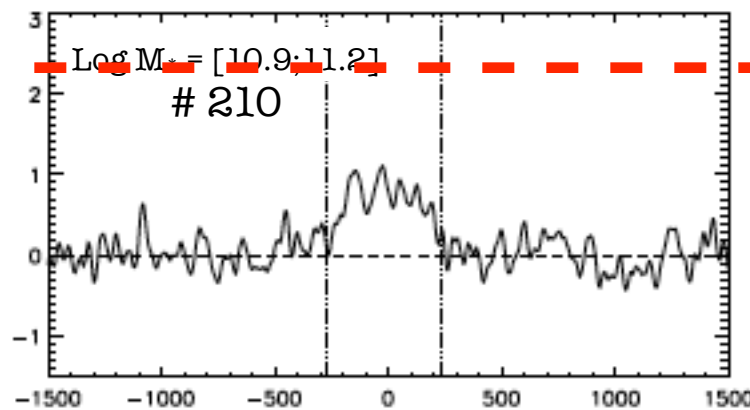
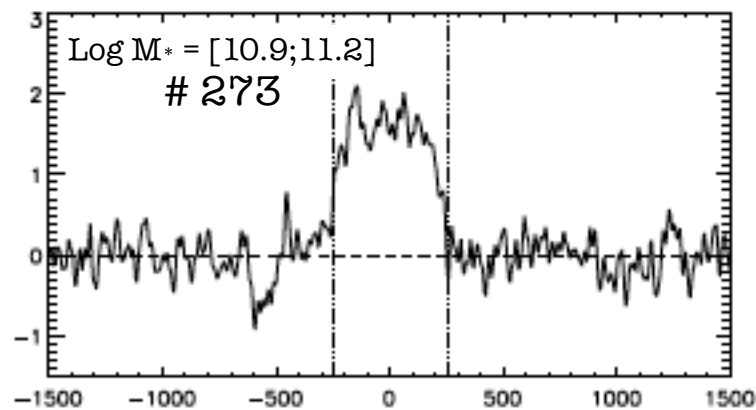
# All spectra

# Non-detection only

Flux density [mJy]



ALFALFA  
sensitivity limit



vel [km s<sup>-1</sup>]

# ALFALFA HI Data Stacking I. Does the Bulge Quench Ongoing Star Formation in Early-Type Galaxies?

Silvia Fabello<sup>1\*</sup>, Barbara Catinella<sup>1</sup>, Riccardo Giovanelli<sup>2</sup>, Guinevere Kauffmann<sup>1</sup>, Martha P. Haynes<sup>2</sup>, Timothy M. Heckman<sup>3</sup>, David Schiminovich<sup>4</sup>

2011, MNRAS, 411, 993

Early-types: quiescent/red sequence/ bulge dominated

- Detection rates vary with samples and depth (from 2 up to 44 %), as well as properties observed.

Missing a statistically representative sample

- Works suggesting that bulge stabilizes gas, preventing it from collapsing into stars

Previous works by: Knapp+ 1985, Wardle & Knapp 1986, Bregman+ 1992, Serra+ 2006, Morganti+ 2006, Helmboldt+ 2007, Grossi+ 2009, ...

Ostriker & Peebles 1976; Martig+ 2009

# Bulge-Dominated Galaxies

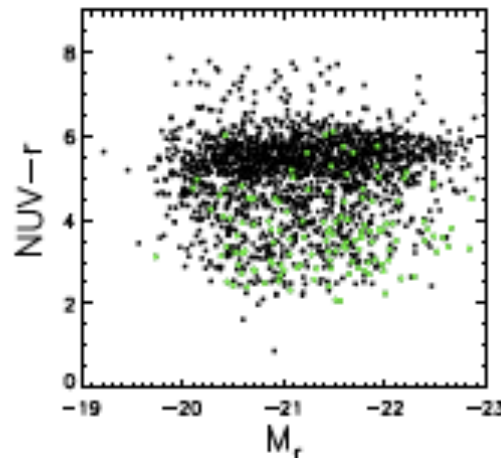
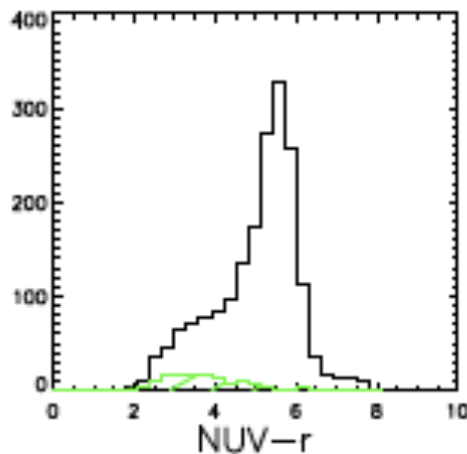
Starting from Sample A, extracted bulge-dominated galaxies:

- ◆  $C \equiv R_{90}/R_{50} \geq 2.6$ ;  
best tracer of bulge-to-total ratio  
(Gadotti 2009; Weinmann+ 2009)
- ◆ Best fit De Vaucouleurs;
- ◆ Inclination  $< 70^\circ$

⇒

B-D sample:  
1833 targets

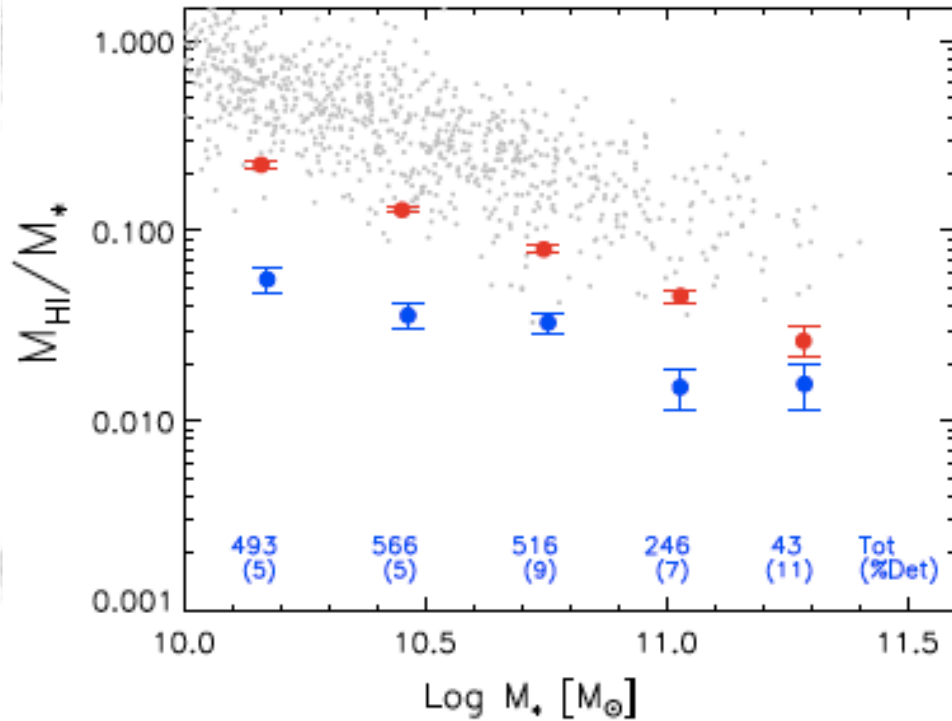
(10 % already detected)



B-Ds

ALFALFA detections

# Bulge-Dominated Galaxies

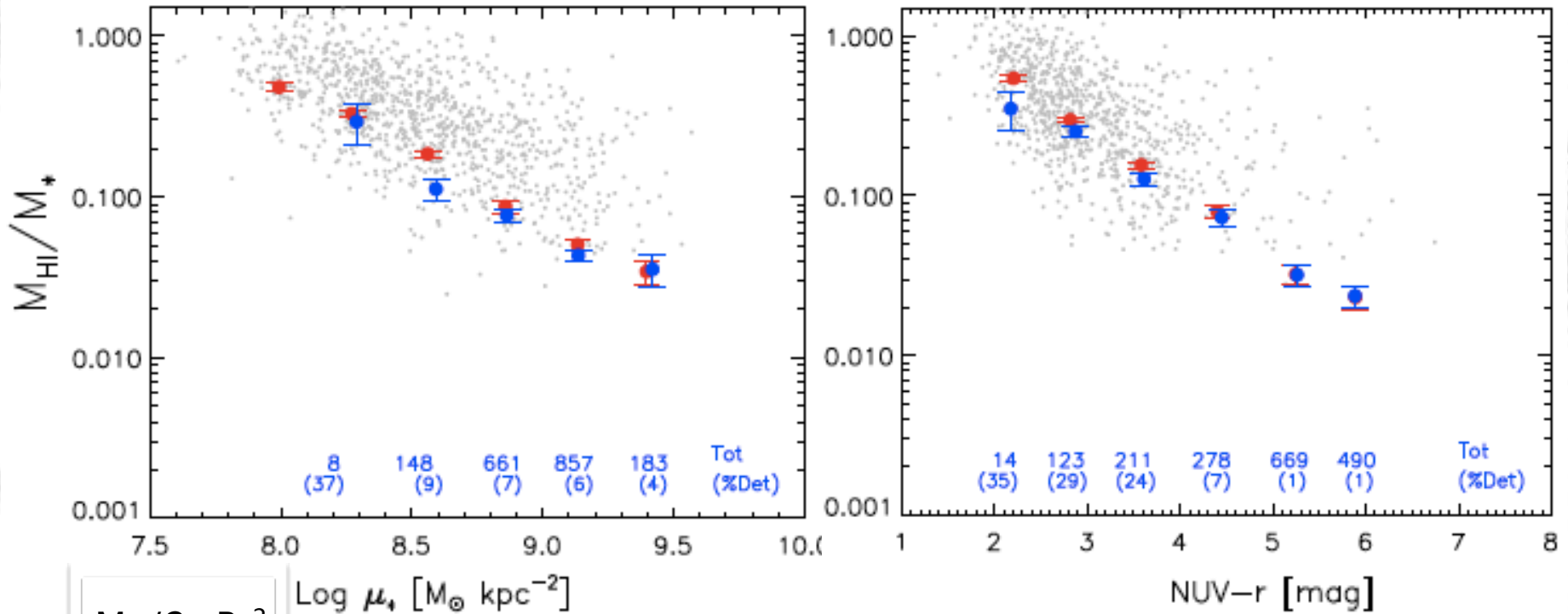


At fixed  $M_*$  Bulge-Dominated  
are gas-poorer, but...

Sample A  
B-D galaxies



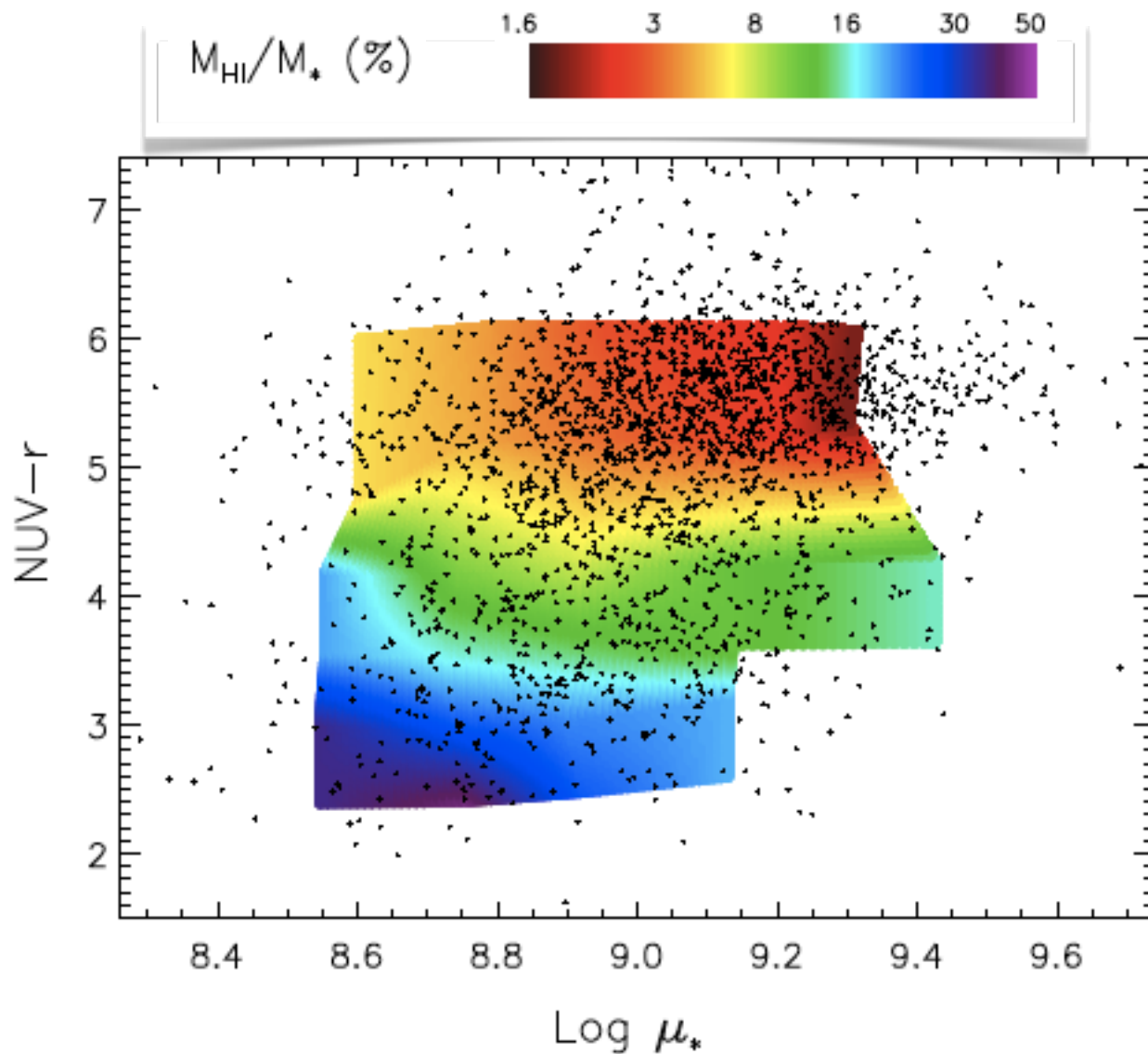
# Bulge-Dominated Galaxies



At fixed colour and  $\mu_*$   
B-D have same HI content!

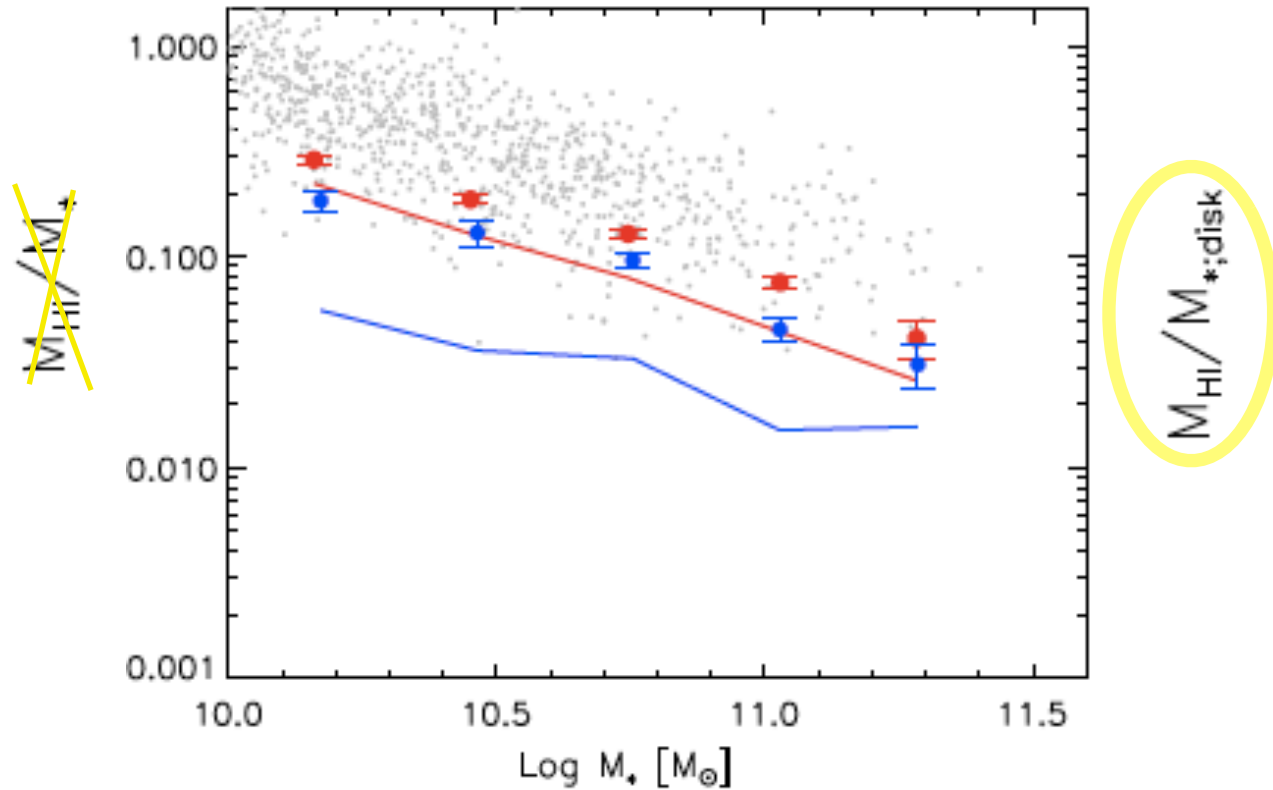
Sample A  
B-D galaxies

# Bulge-Dominated Galaxies



Colour is the main parameter which drives the gas content

# Bulge-Dominated Galaxies



$M_* \rightarrow M_{*,\text{DISK}}$   
offset disappears

**Cold gas associated  
with disk**

Sample A  
B-D galaxies

# ALFALFA HI Data Stacking II.

## HI content of the host galaxies of AGN.

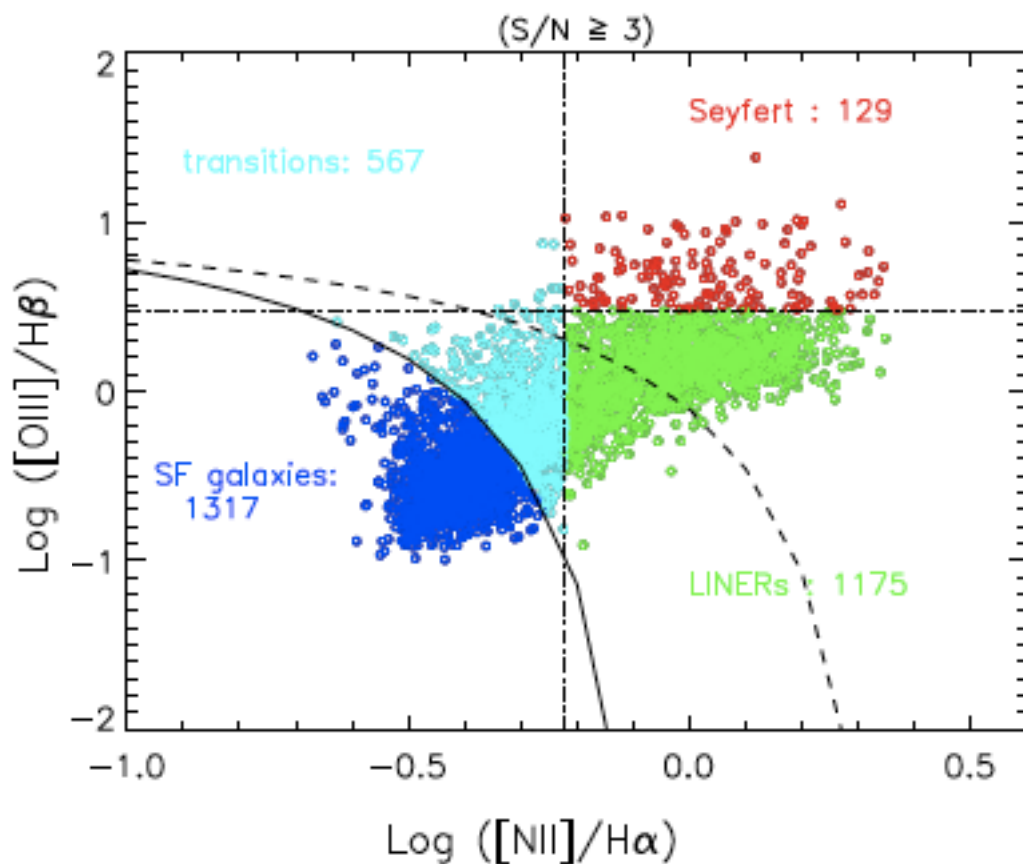
Silvia Fabello<sup>1\*</sup>, Guinevere Kauffmann<sup>1</sup>, Barbara Catinella<sup>1</sup>, Riccardo Giovanelli<sup>2</sup>,  
Martha P. Haynes<sup>2</sup>, Timothy M. Heckman<sup>3</sup>, David Schiminovich<sup>4</sup>

MNRAS, in press  
ArXiv: 1104.0414v1

- Most massive galaxies host a BH; (Kormendy 2004)  
BH may be actively accreting
- Can (and how much) energy from AGN influence the HI properties of the host?
- Need a direct link between AGN and cold gas content of host  
(and a well-defined control sample to eliminate secondary trends)

# HI in AGN hosts

Starting from Sample A, extracted:



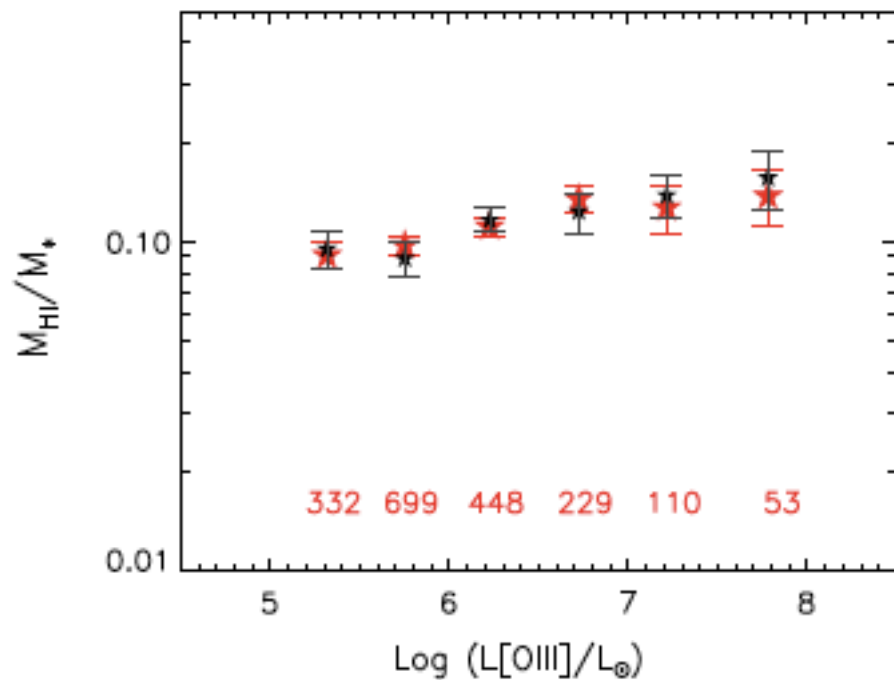
- ◆ **1871 AGN:**

above Kauffmann+O3a  
solid line

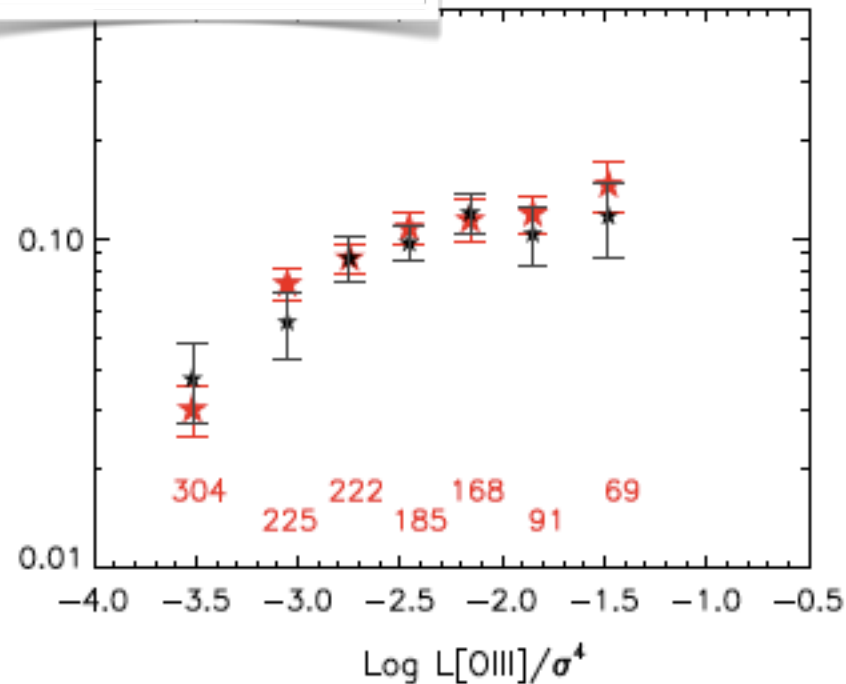
- ◆ **Control galaxies:**

one-to-one matched in  
(NUV-r) and  $\mu_*$

# HI in AGN hosts



$\text{Log } L/L_{\text{Edd}} \sim [-4; -2]$



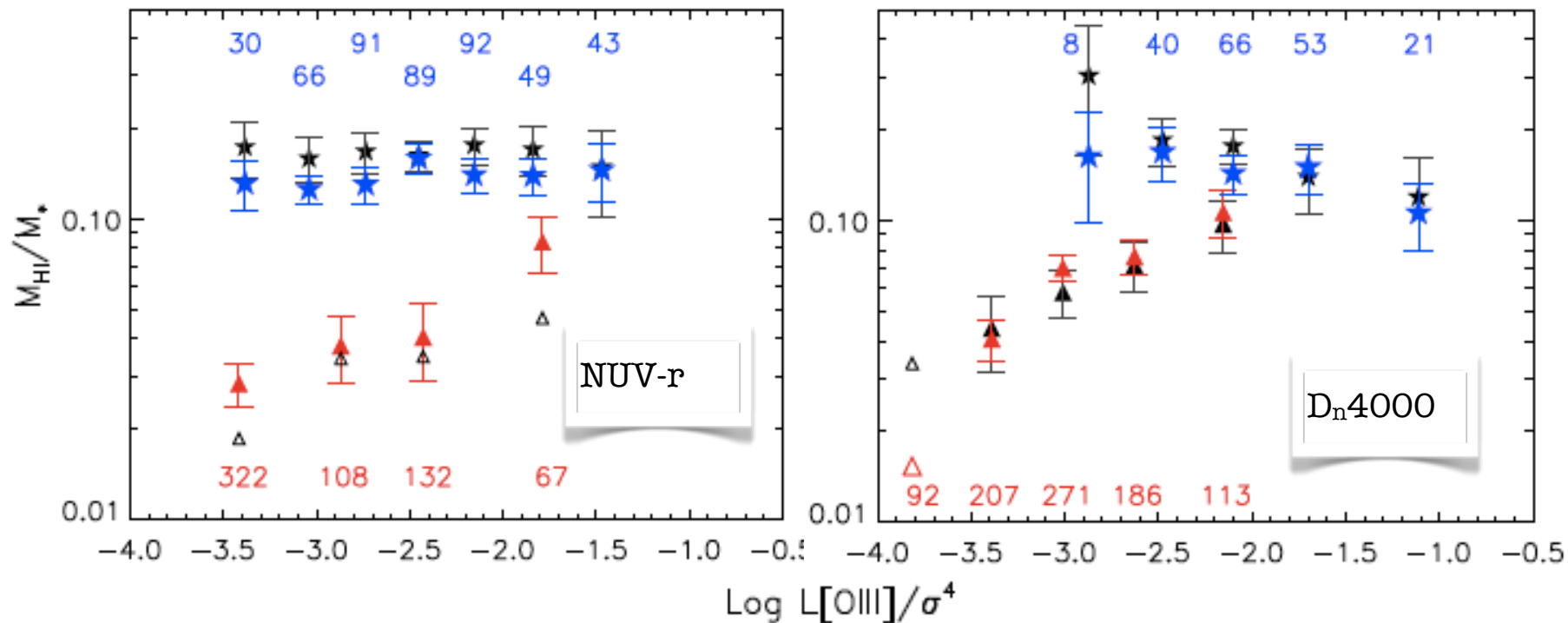
AGN

Control

- ◆ No trend with Luminosity;
- ◆ Gas fraction increases with accretion rate;
- ◆ No differences between control galaxies and AGN

eg: Ho+08

# HI in AGN hosts



Two accretion regimes?

Kauffmann & Heckman 09

**Gas-rich:** gas content independent of accretion

**Gas-poor:** gas fraction traces accretion

**NO differences between control galaxies and AGN**

# Summary & Conclusions

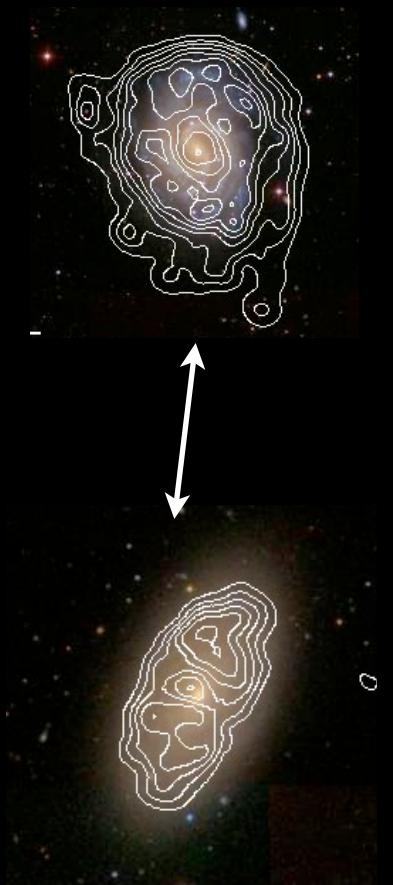
- The HI content in massive galaxies can be quantitatively predicted by color (and mass surface density) only  
⇒ **bulge does not make differences** in the HI content;  
cold gas only associated with disks?

- On global scales the **cold gas is not affected by AGN** emission.
  - Agreement with others (Ho+2008)

**Feedback may effective on smaller scales**

(check with molecular hydrogen) **or higher accretion regimes**

(check with radio sample).





*Thank you!*

