ICRAR

International Centre for Radio Astronomy Research

Galaxy evolution with HI spectral stacking

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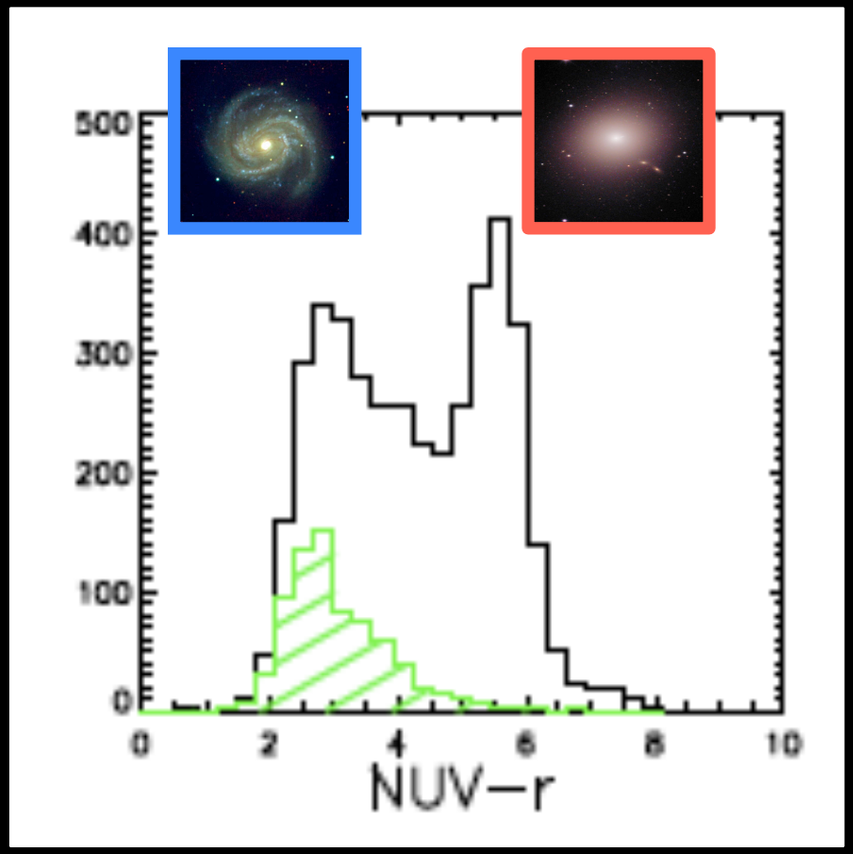
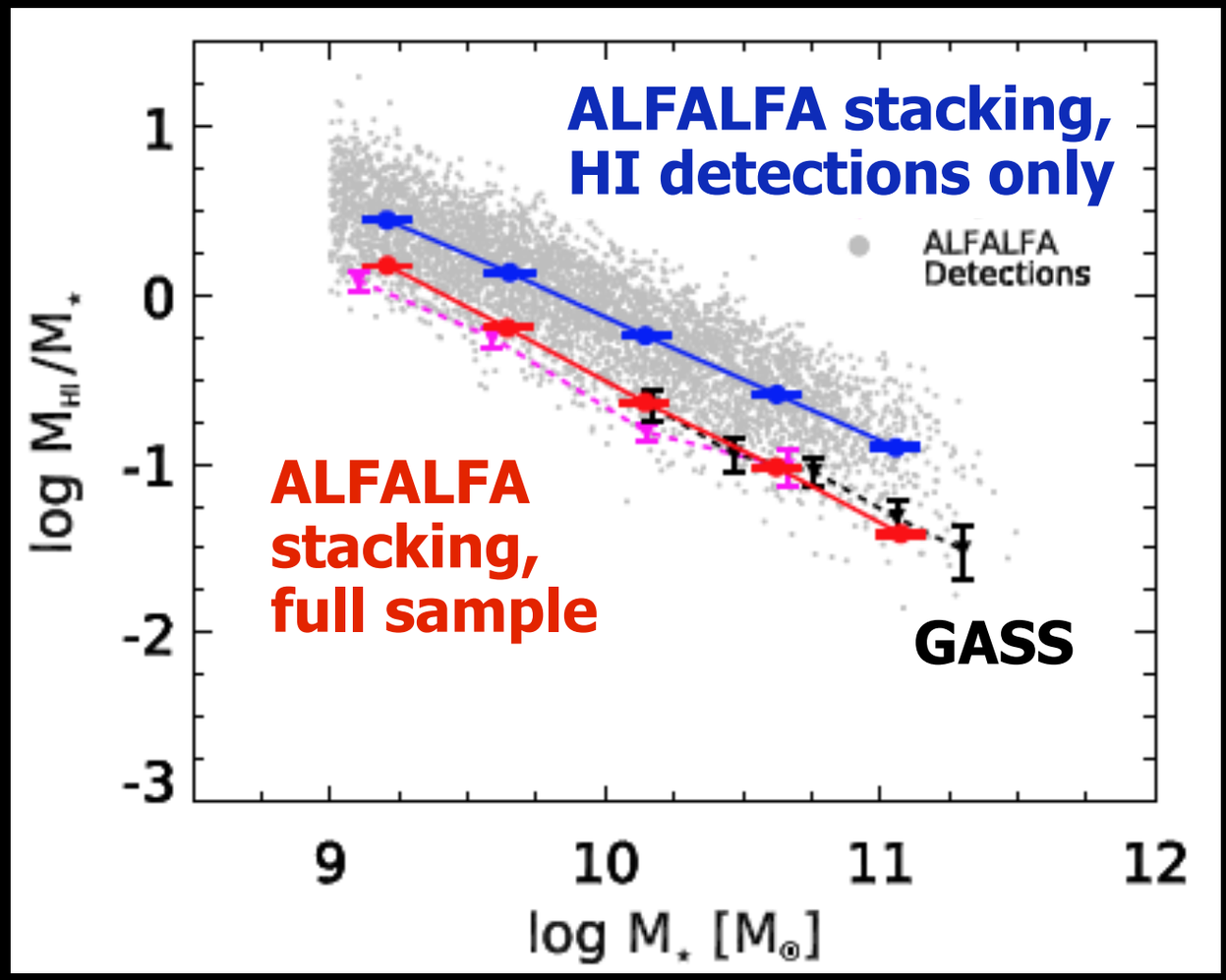
Galaxy population sampled by HI-blind surveys

Late-type galaxies

Early-type galaxies



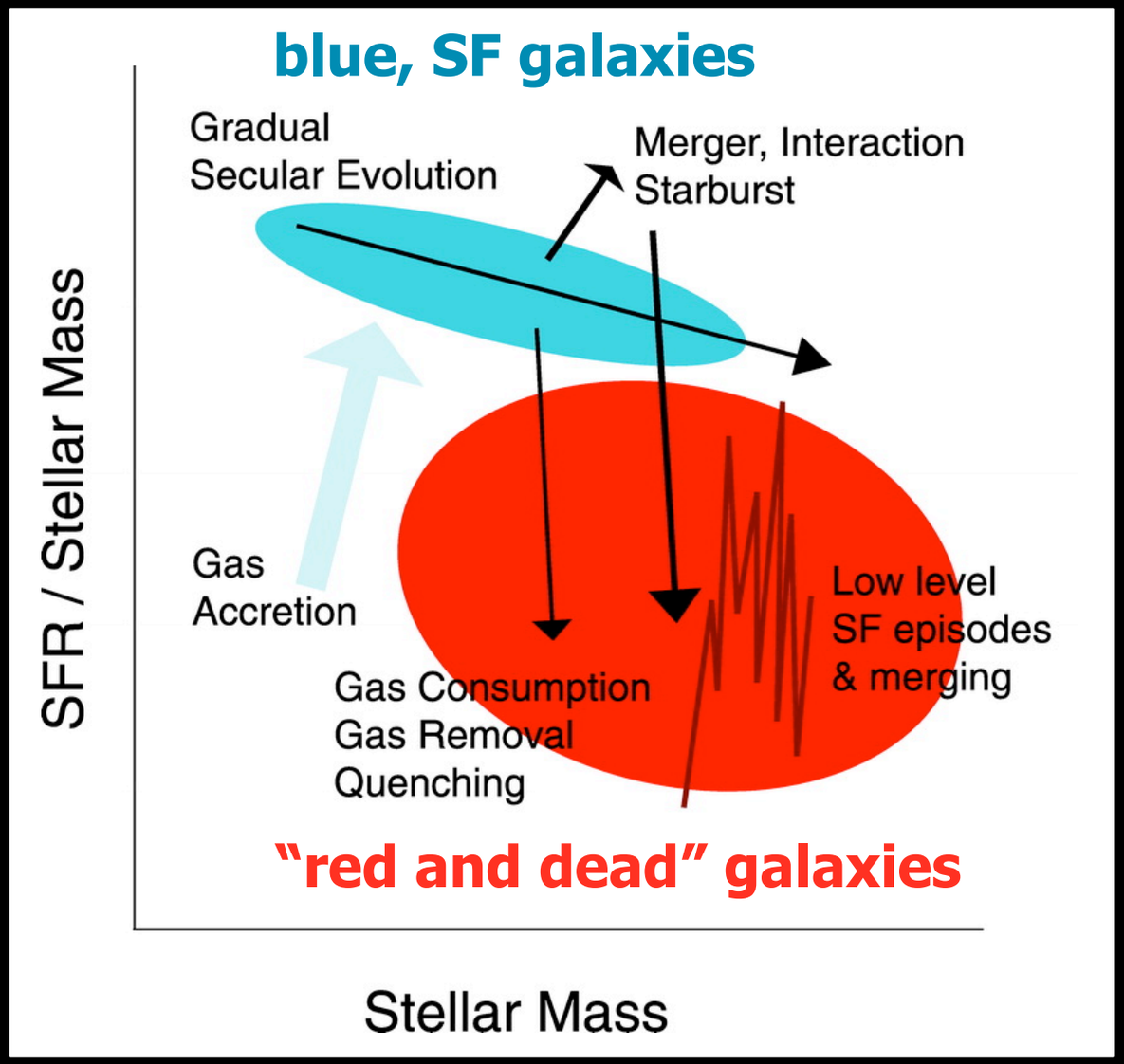
Green: ALFALFA detections

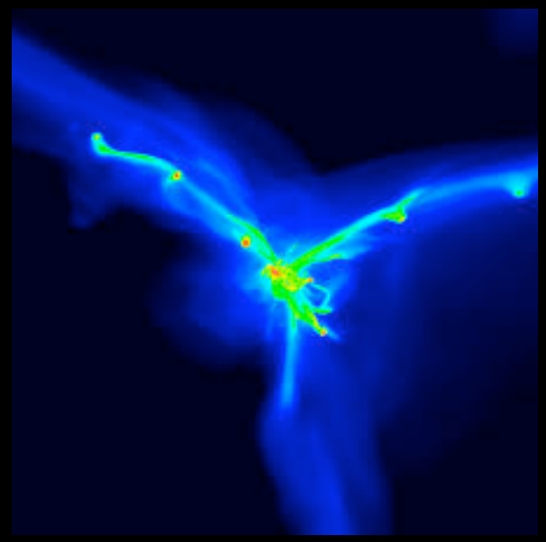


Brown, Catinella et al. 2015

HI-blind surveys biased towards blue, star-forming systems

Galaxy evolution and the role of gas





HI-blind surveys best suited to study HI-rich regime processes (with detections)

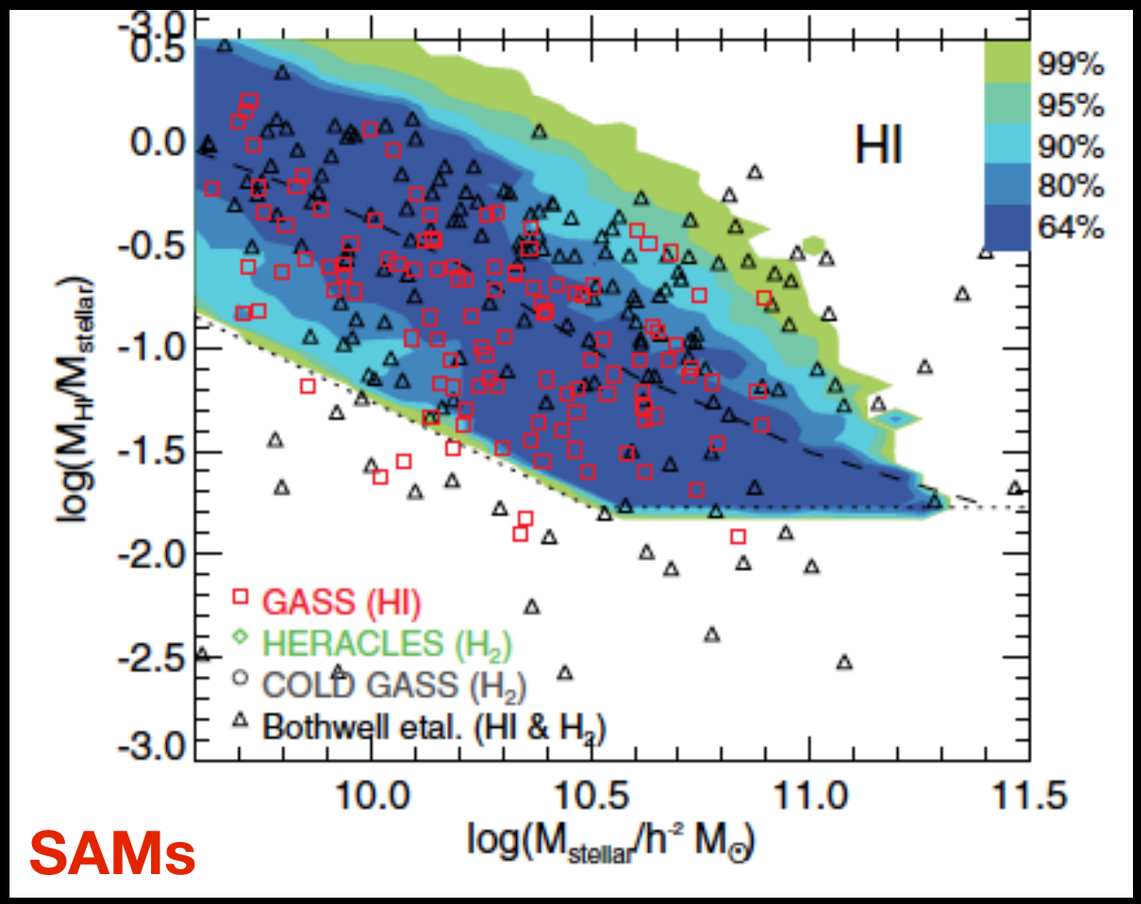
Quenching processes (e.g., gas stripping) --> stacking

Key questions for HI stacking science

- Gas content, stellar mass, SFR, morphology are all related: which of these relations are primary?
- How is the gas content affected by the environment?
- How does all the above depend on redshift?

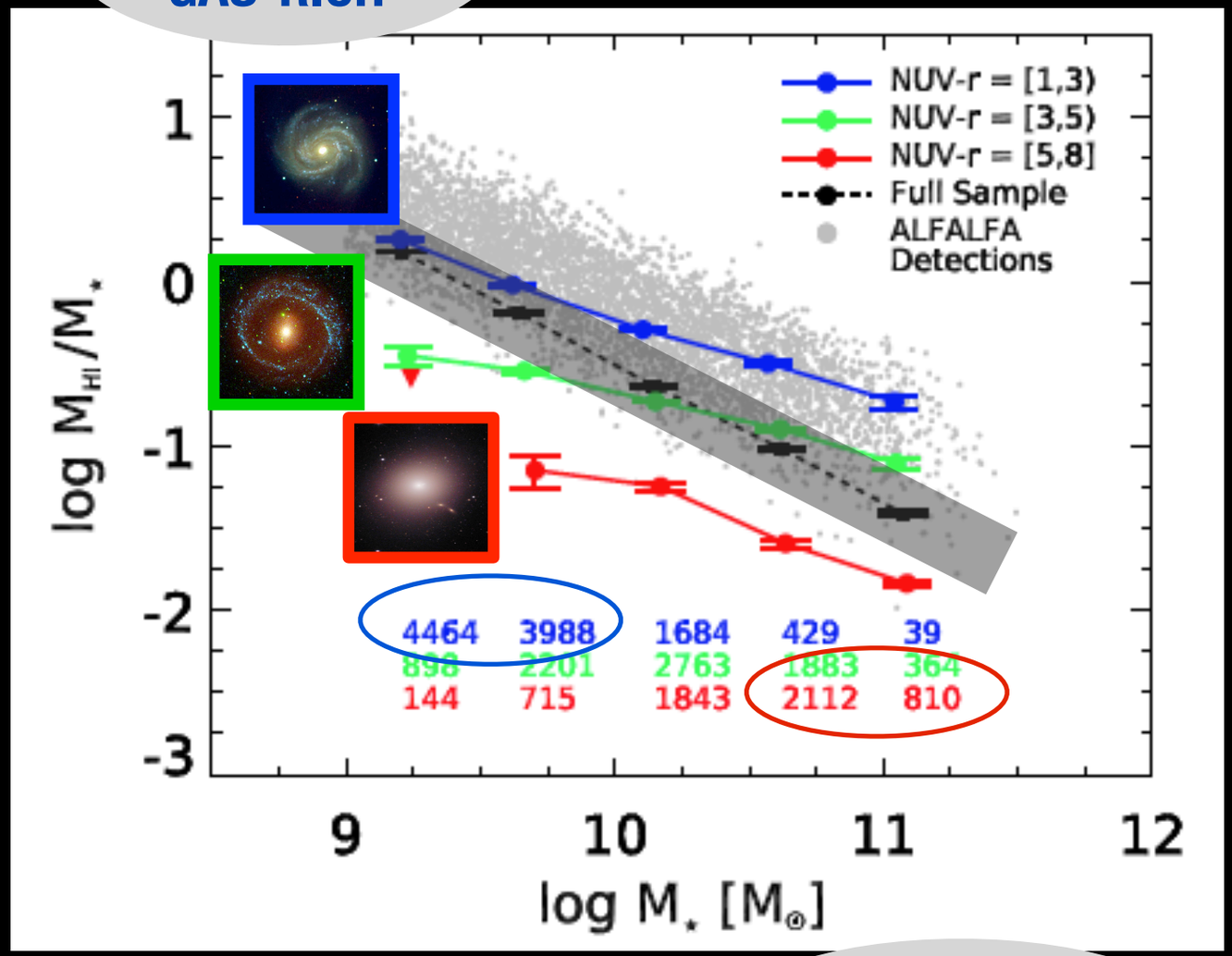
To address these questions we need **very large statistics**
and the ability to probe the **HI-poor regime**

Primary vs secondary dependencies



Lagos et al. 2011 (see also Dave' et al 2013, Rafieferantsoa et al. 2015, Bahe et al 2015...)

LOW MASS, SF GAS-RICH



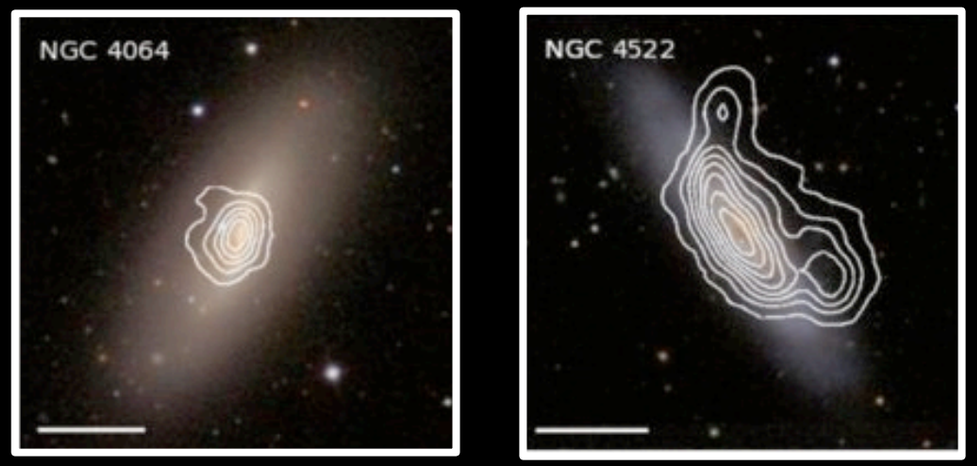
Brown, Catinella et al. 2015

HIGH MASS, not SF GAS-POOR

The gas fraction-stellar mass relation is a consequence of galaxy bimodality

Environment: beyond galaxy clusters

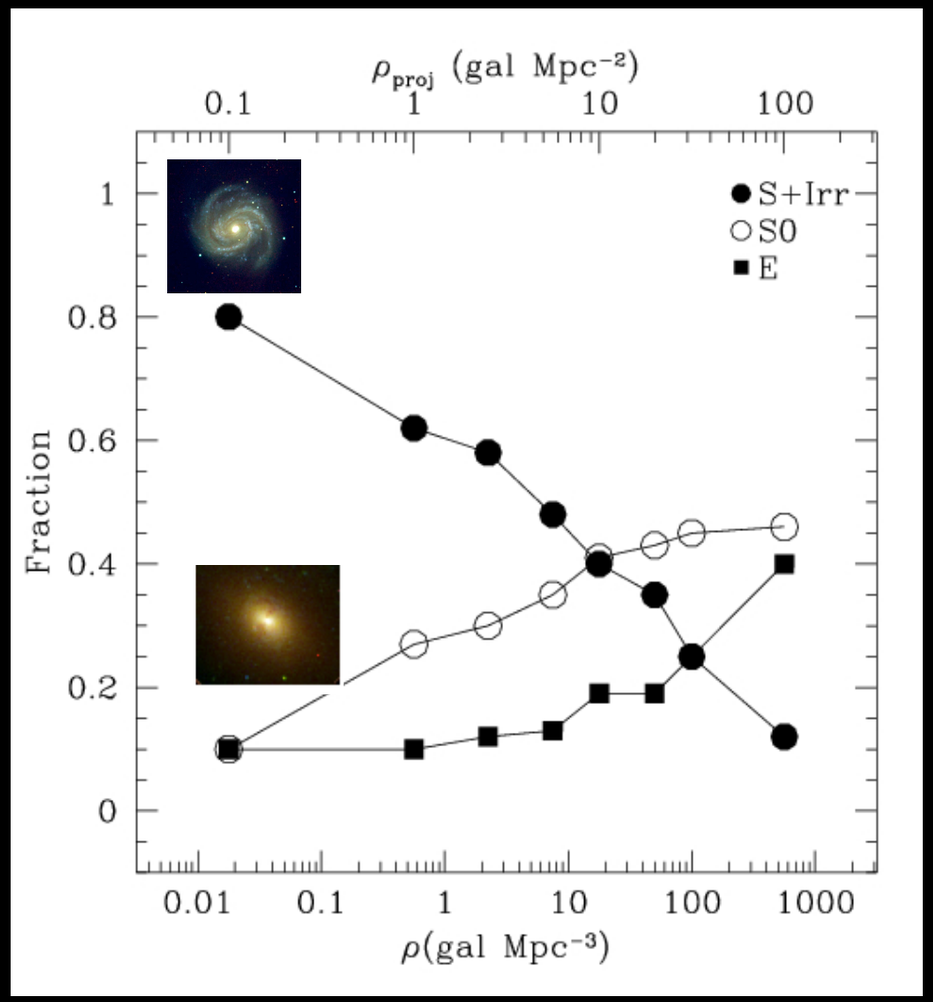
HI-deficient galaxies in Virgo



Chung et al. (2009)

HI deficiency (Haynes & Giovanelli 1984, Solanes et al. 1996...)

HI def ≡ Log <M(HI, D_{opt},Type)>
— Log $M(HI)_{obs}$

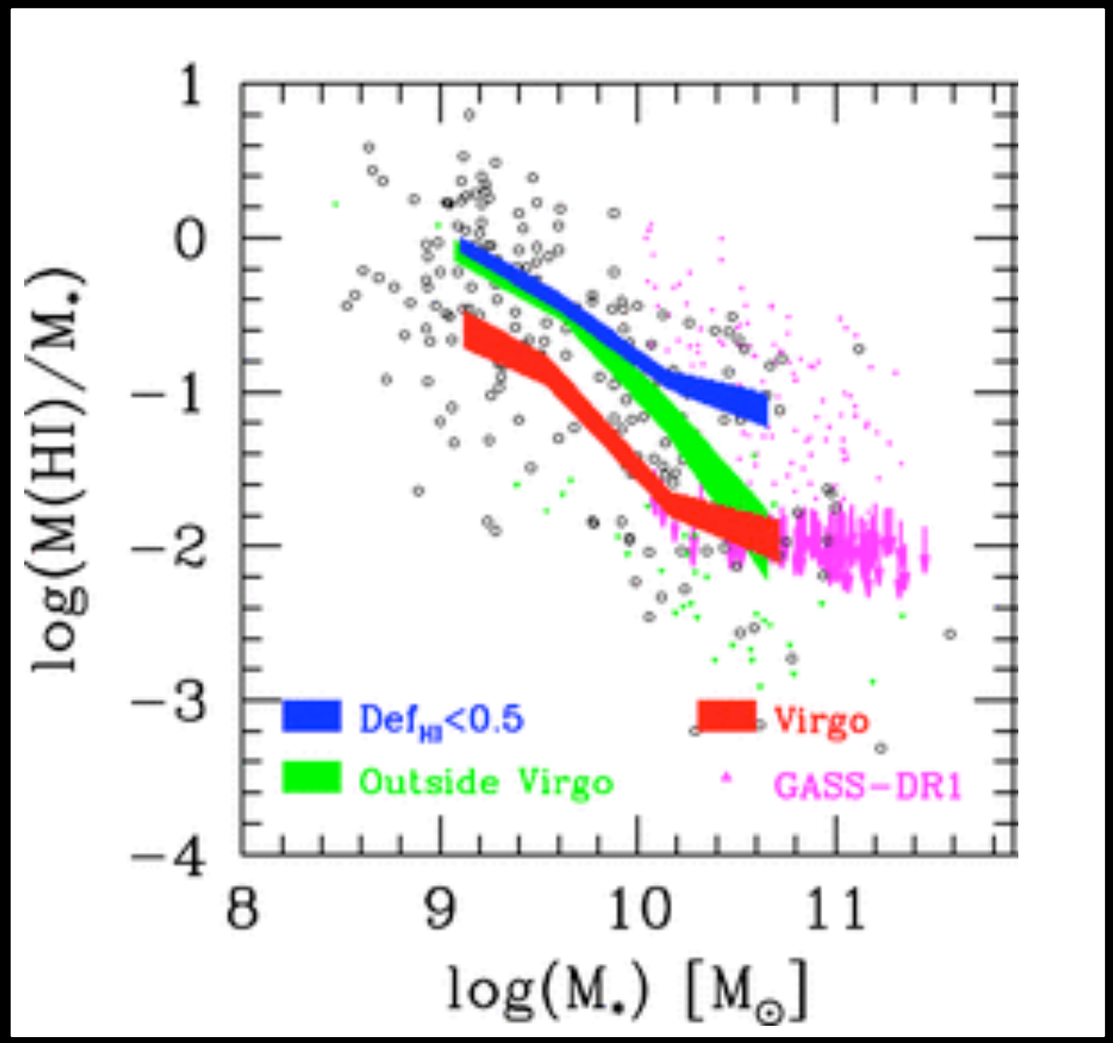


Adapted from Dressler (1980)

Optical studies show that environment acts well before reaching the dense cluster environment (Dressler 1980, Lewis et al 02, Gomez et al 03...) Also, clusters are rare!

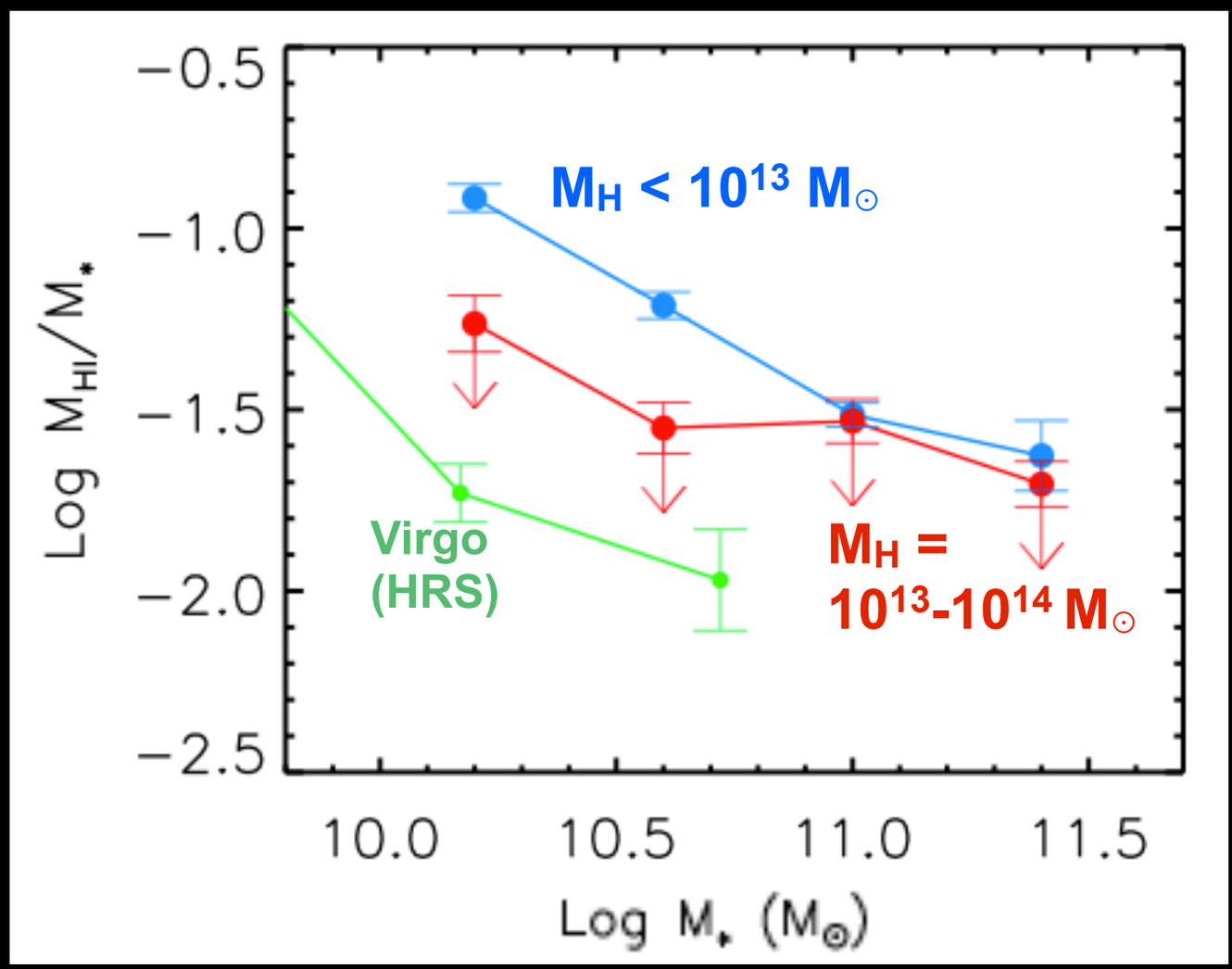
Clues from deep HI observations

Herschel Reference Survey



Cortese, Catinella et al. (2011)

GASS

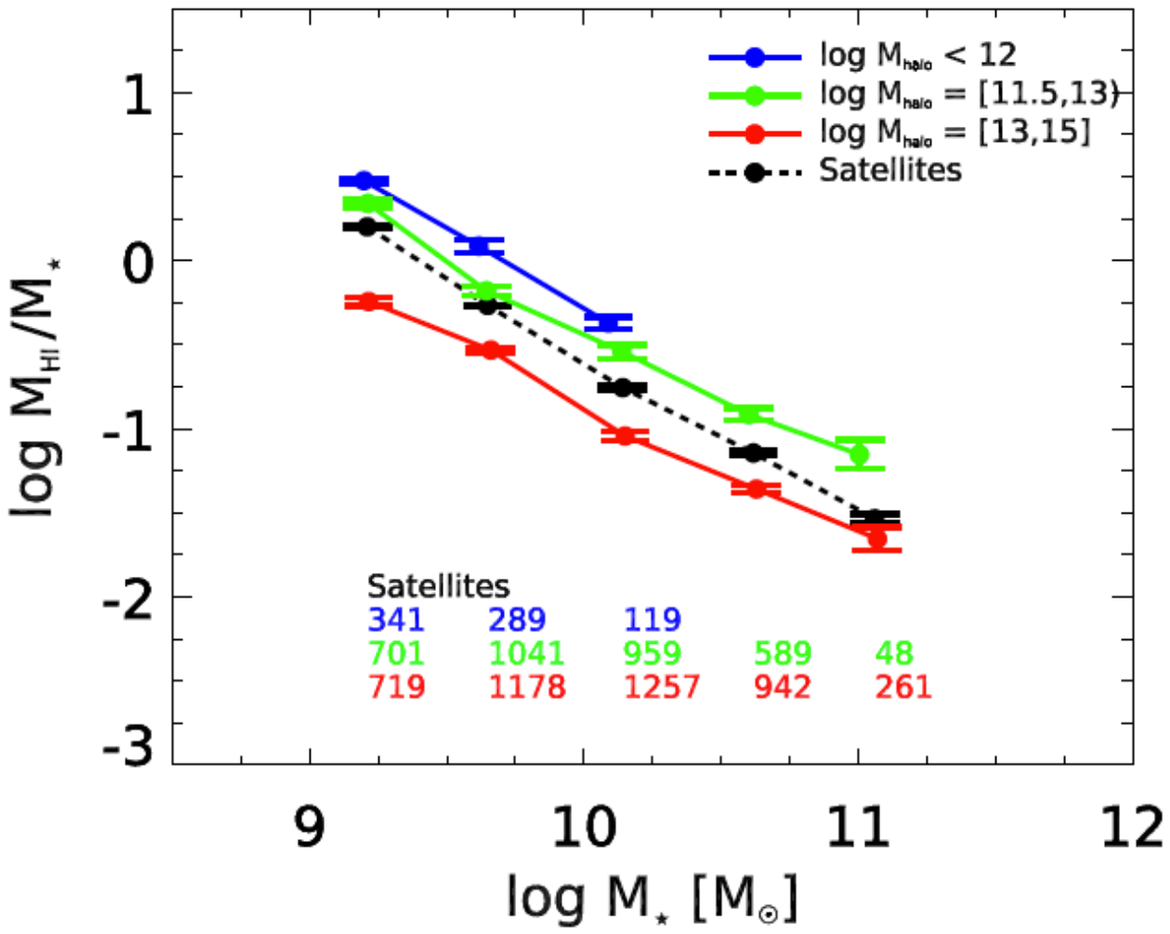


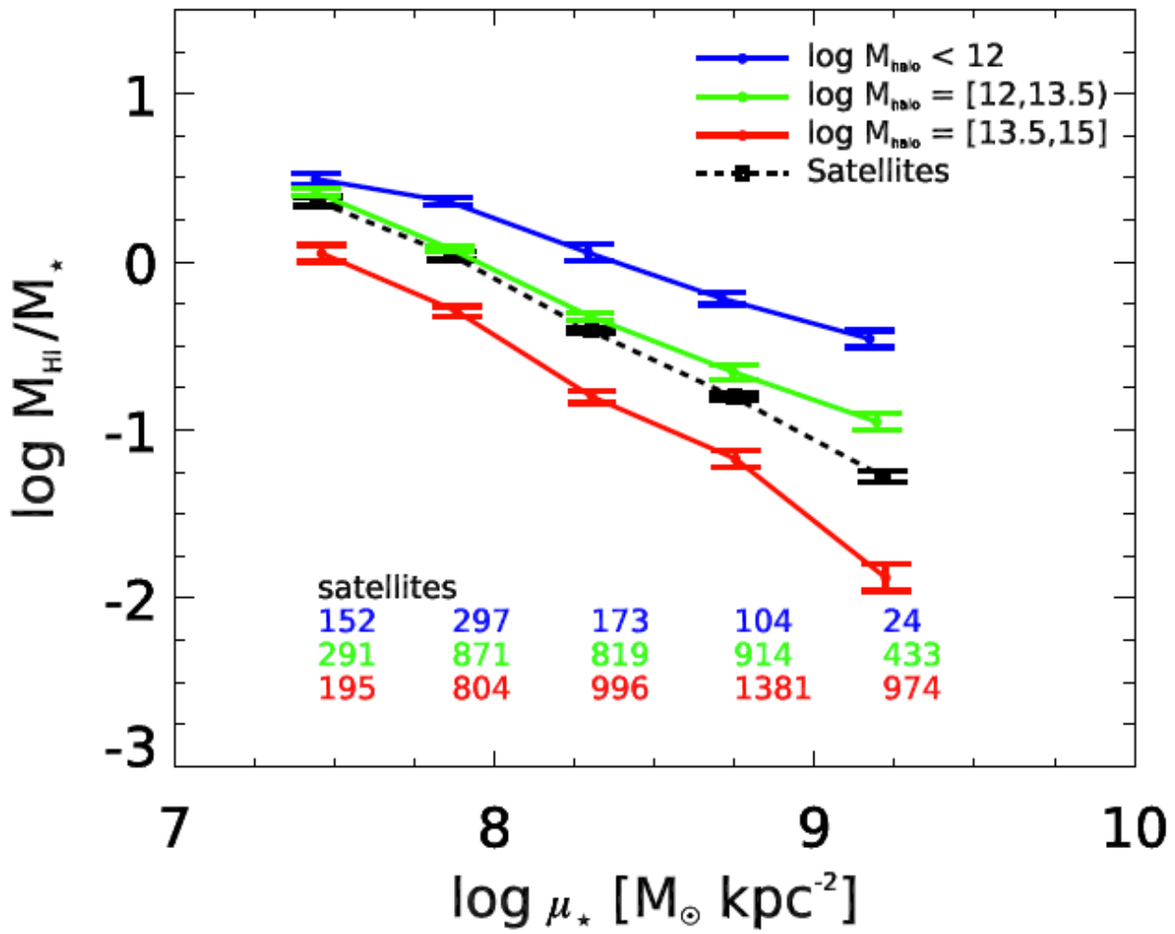
Catinella, Schiminovich, Cortese et al. 2013

HI content determined primarily by stellar mass, environment is **secondary**.
Statistical evidence for HI depletion in **groups**

HI stacking: environment

Halo mass bins

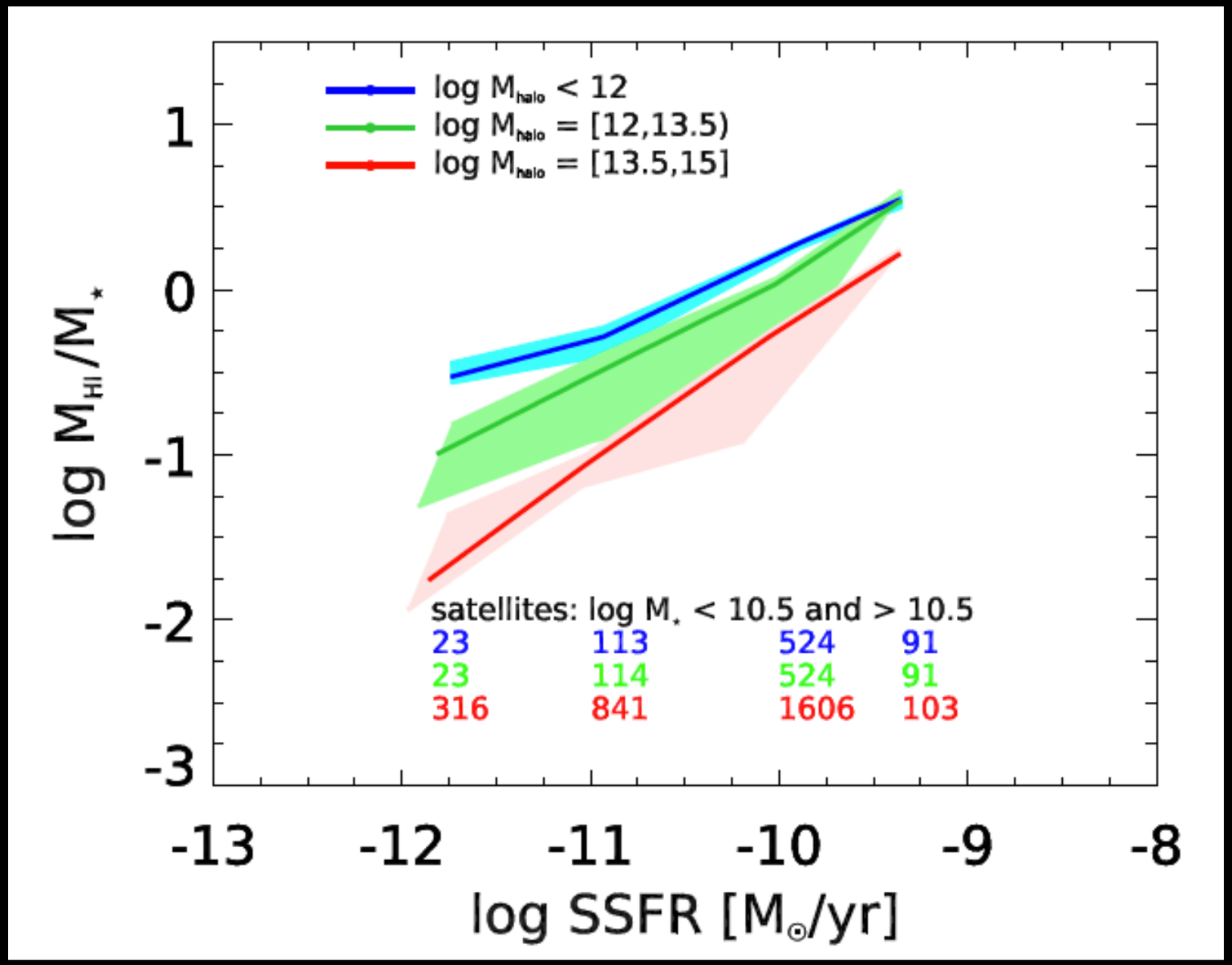




Brown+ in prep.

Gas depletion **at fixed stellar mass and morphology** in satellites for increasing halo mass

HI stacking: environment



Brown+ in prep.

Binning galaxies by SSFR, halo mass and stellar mass!

Comparison with models in progress...

Gas depletion **at fixed SSFR** in satellites for increasing halo mass (not a consequence of the gas fraction-stellar mass relation)

HI spectral stacking: take-home messages

- Key technique to exploit future HI surveys
- Need **more than optical redshifts** to do stacking science!!
  e.g. stellar masses, SFRs, group catalogs...
- Environmental studies require very large statistics and ability to reach the gas-poor regime --> even with SKA-1, this will be feasible only with stacking