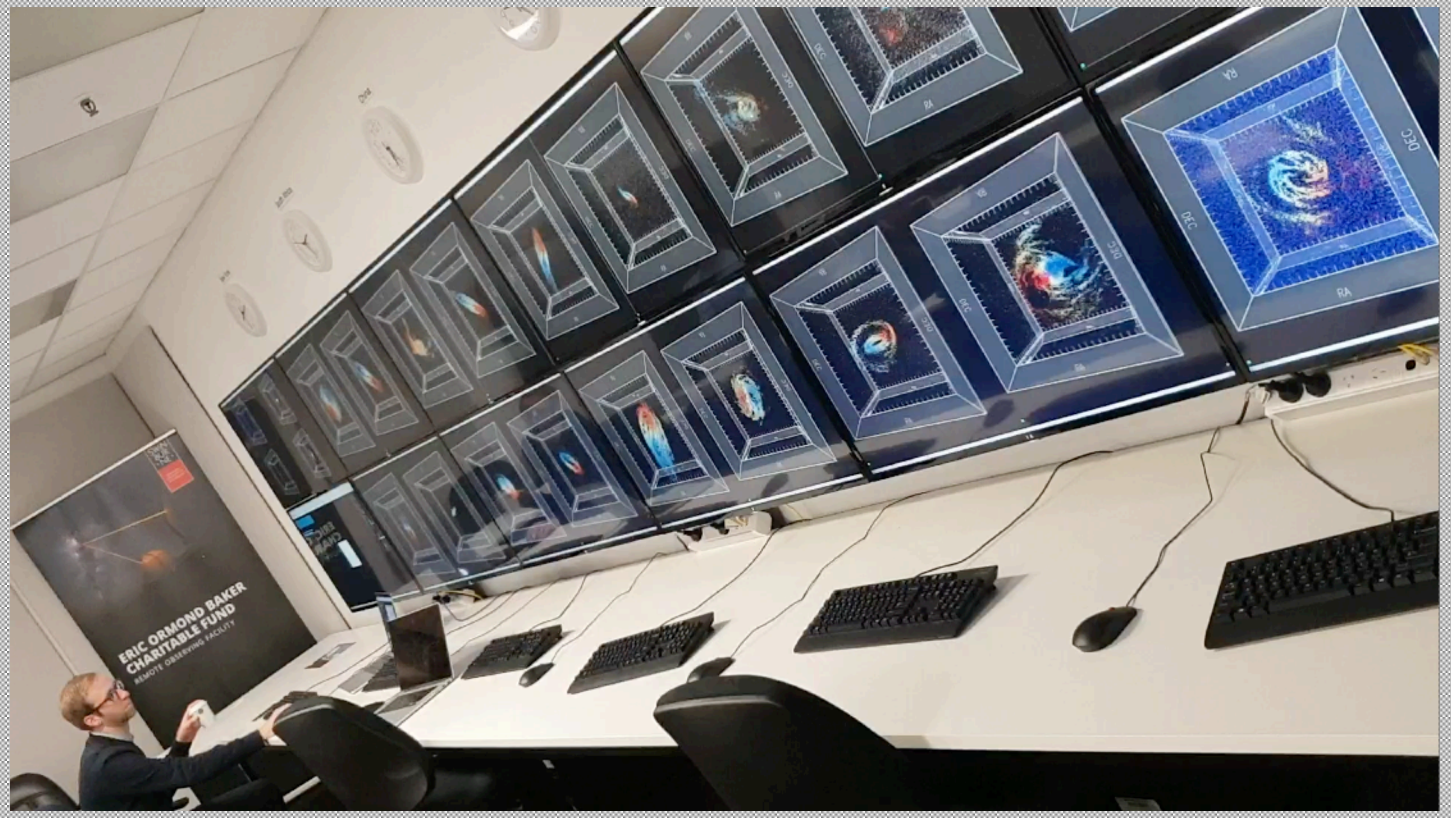
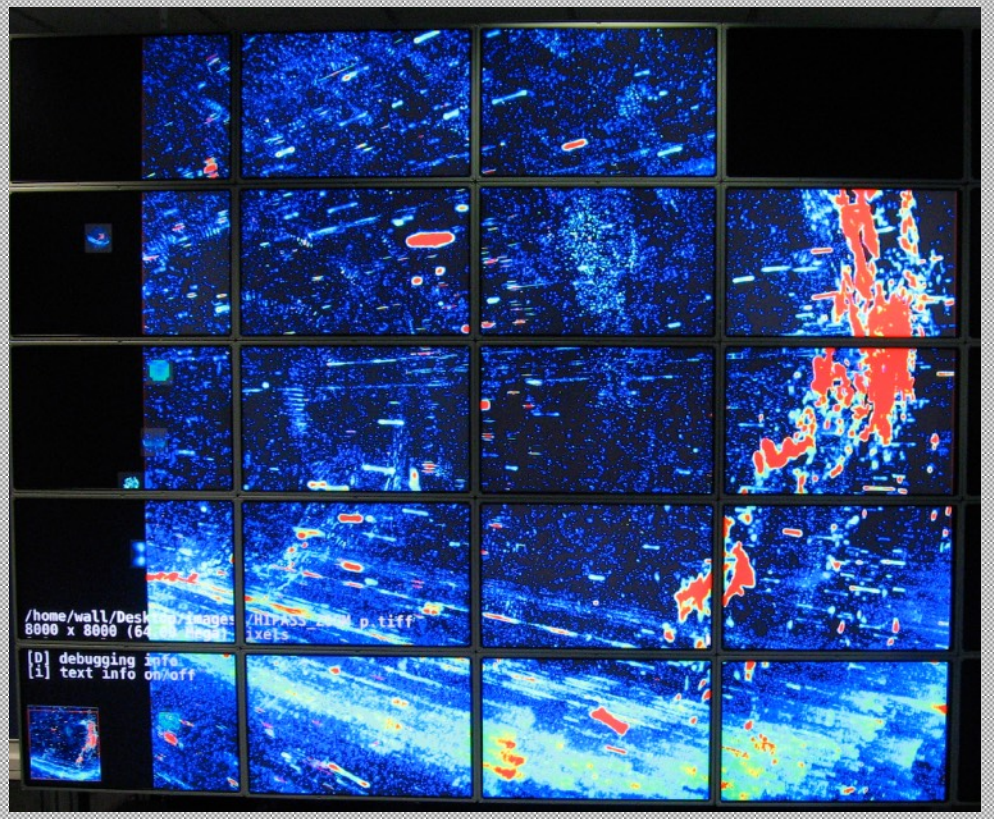
Physical processes governing the HI in galaxies





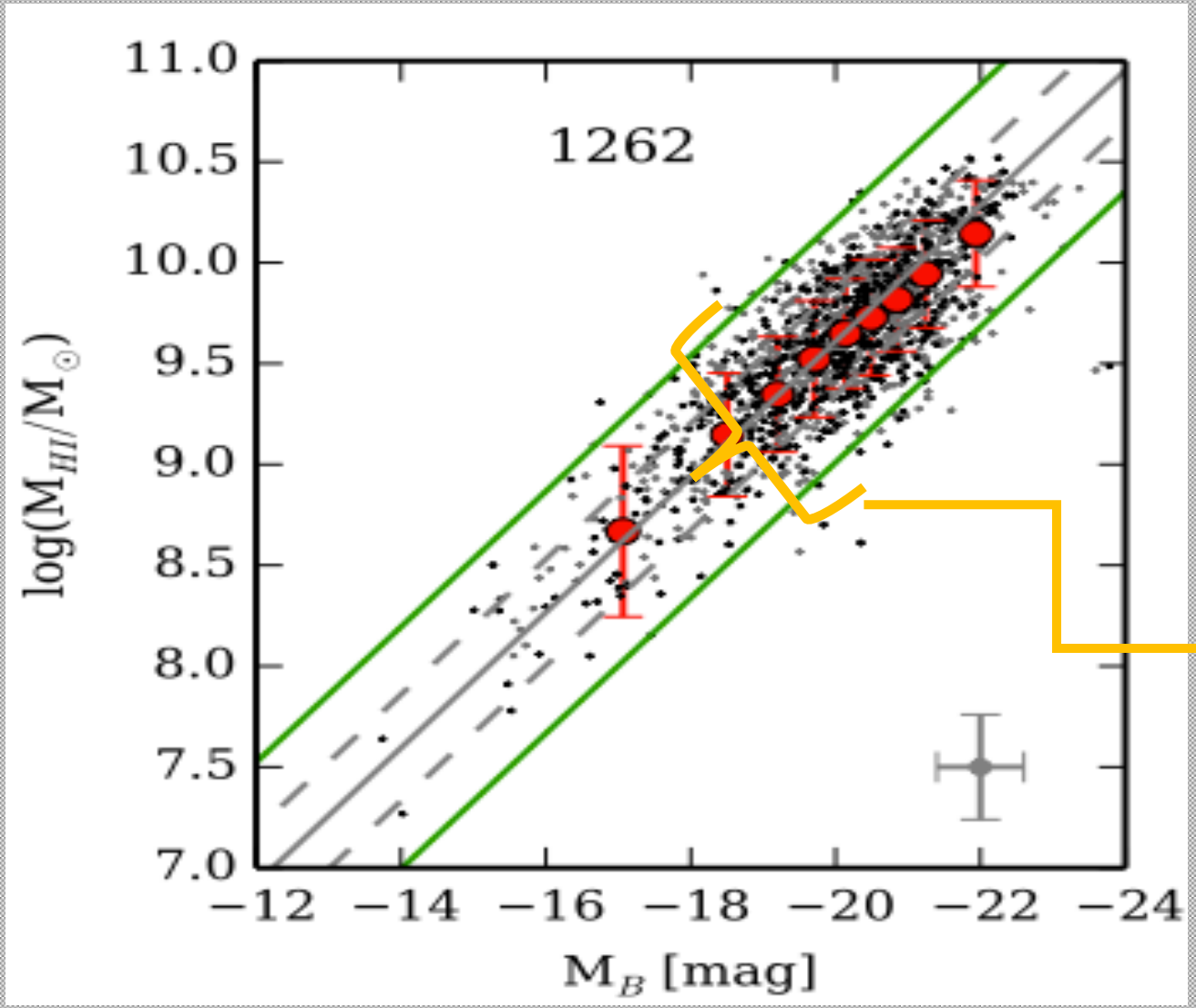
3D visualisation by Dany Vohl

Virginia Kilborn

HI/story, Groningen, 2018

SWINBURNE UNIVERSITY OF TECHNOLOGY

Scaling relations: Global galaxy properties



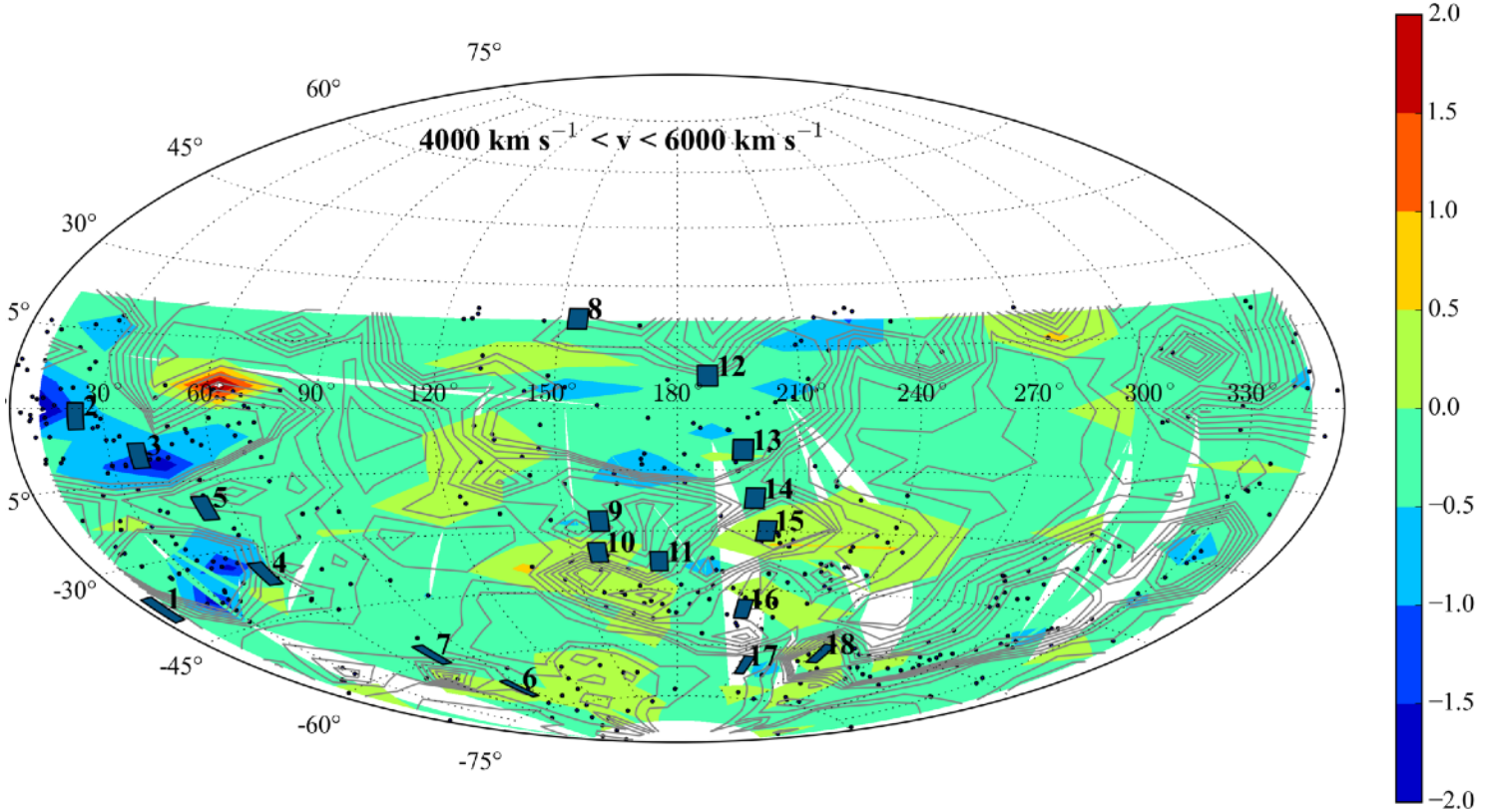
Use HI-optical scaling relationships to determine HI deficiency of a galaxy with particular optical properties (e.g. optical diameter, etc)

Where does the scatter come from?
Environment?

Denes et al. 2014

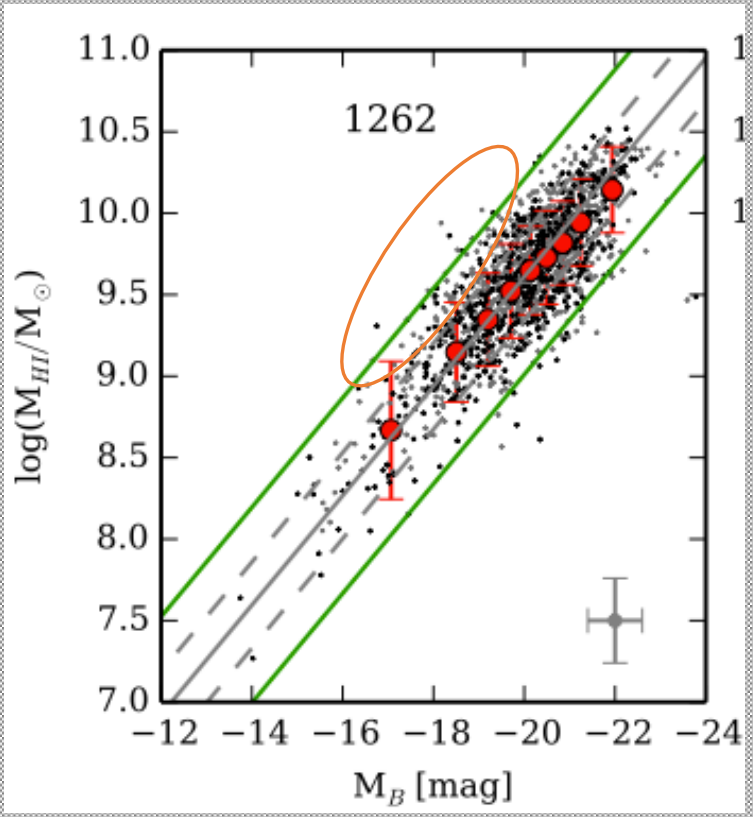
Global HI deficiency map of the local Universe

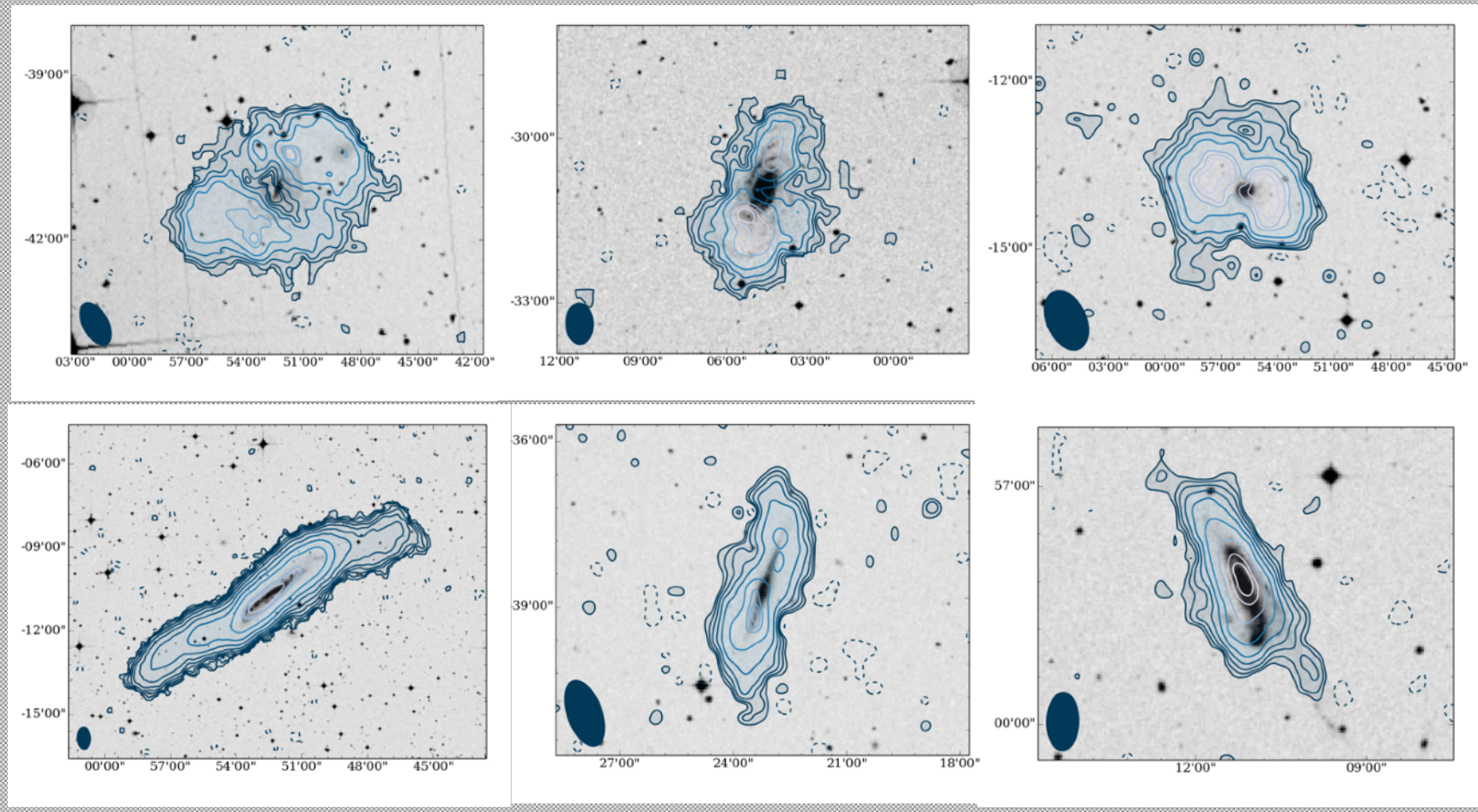
1. Sculptor Group
2. Abell 194
3. NGC 988
4. Fornax Cluster
5. Eridanus Group
6. Doradus
7. HIPASS cube H051
8. HGC 44
9. Hydra Cluster
10. Antlia Cluster
11. NGC 3783
12. Virgo S
13. HIPASS cube H313
14. NGC 5084
15. M 83
16. HIPASS cube H092
17. Circinus
18. Norma Cluster



Denes et al. 2014

Mapping HI-excess galaxies

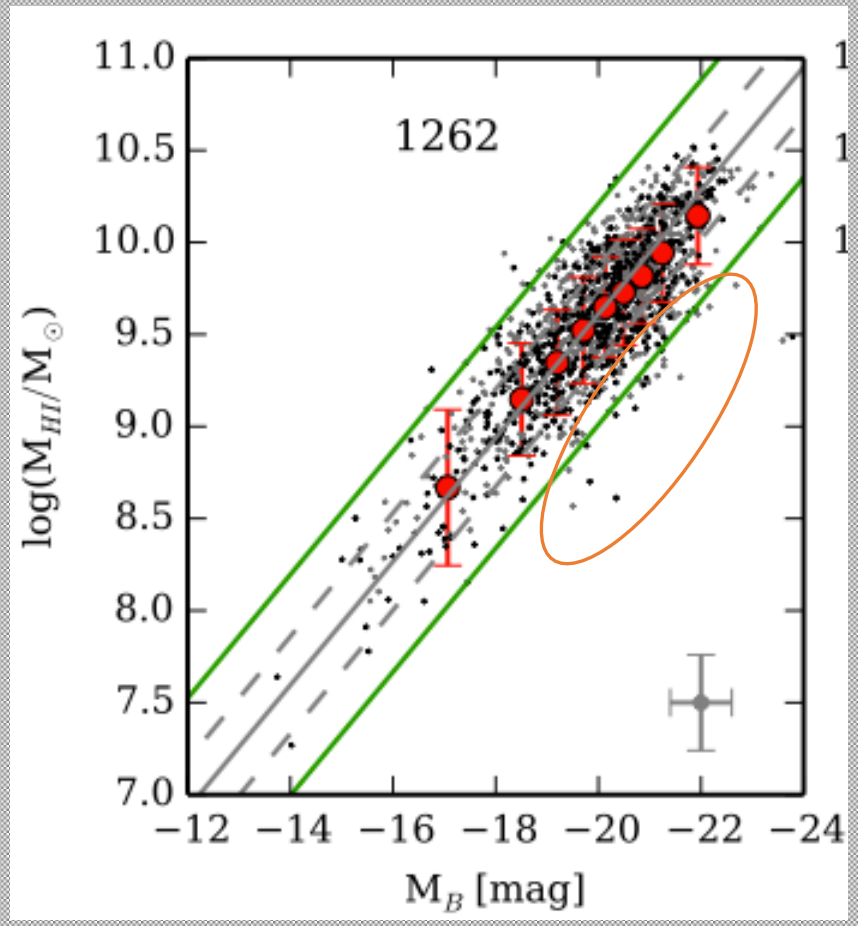


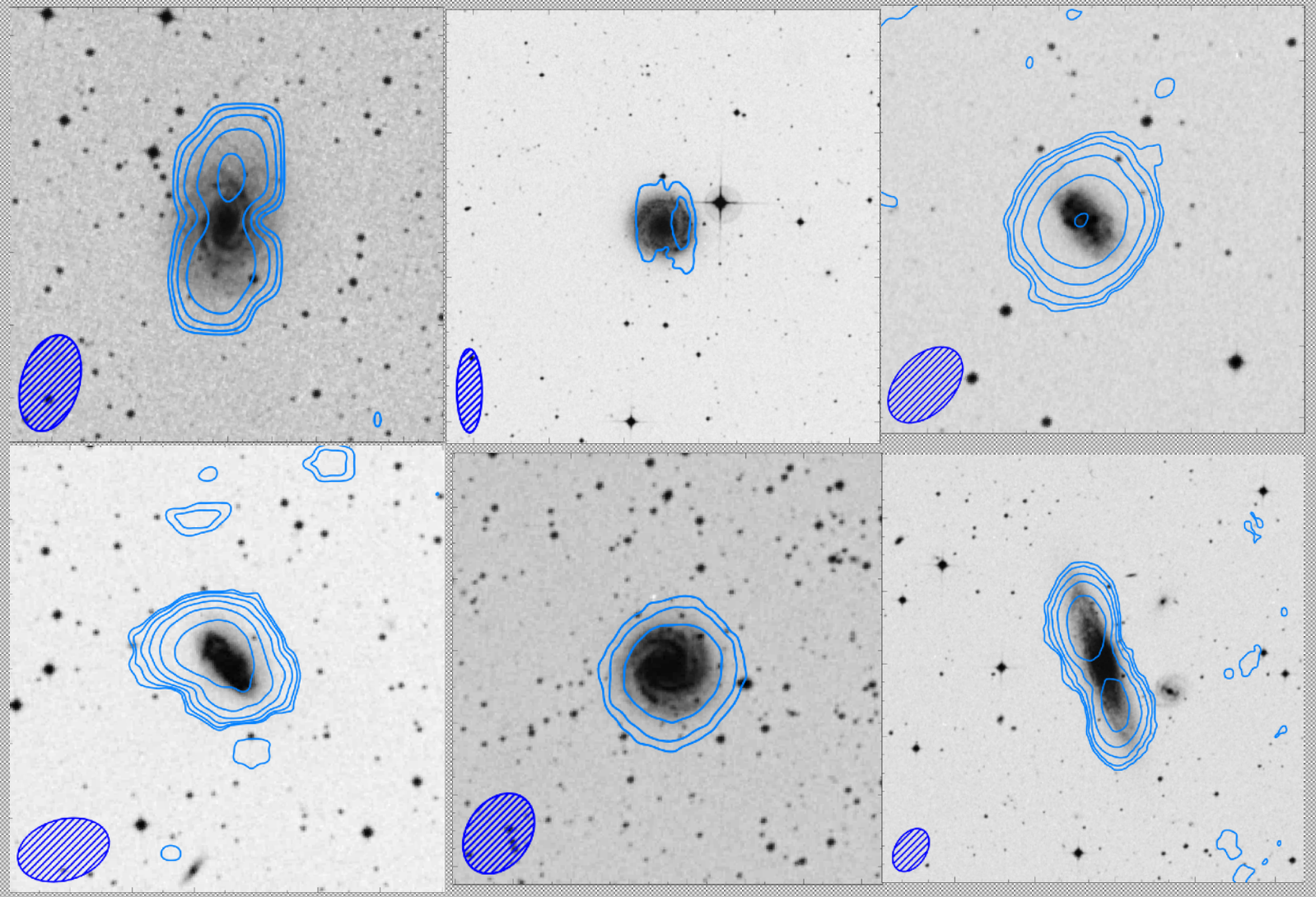


- Large HI disks
- Very low SFE (SFR/HI)
- Isolated environment

Lutz, Kilborn et al. MNRAS, 2018

Mapping HI deficient galaxies

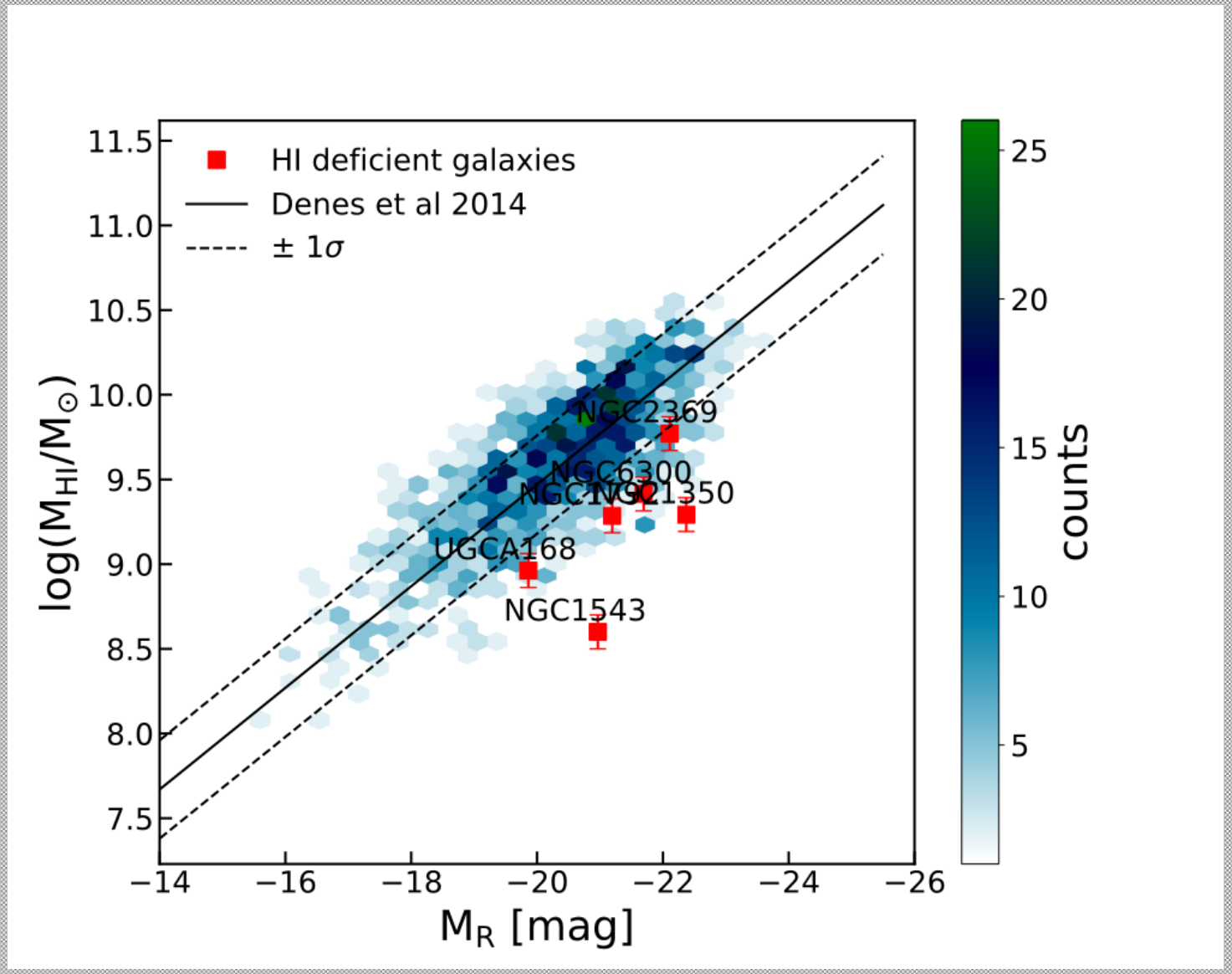




- Small HI disks
- In or nearby small groups and/ or show signs of interaction

Denes, Kilborn et al 2016

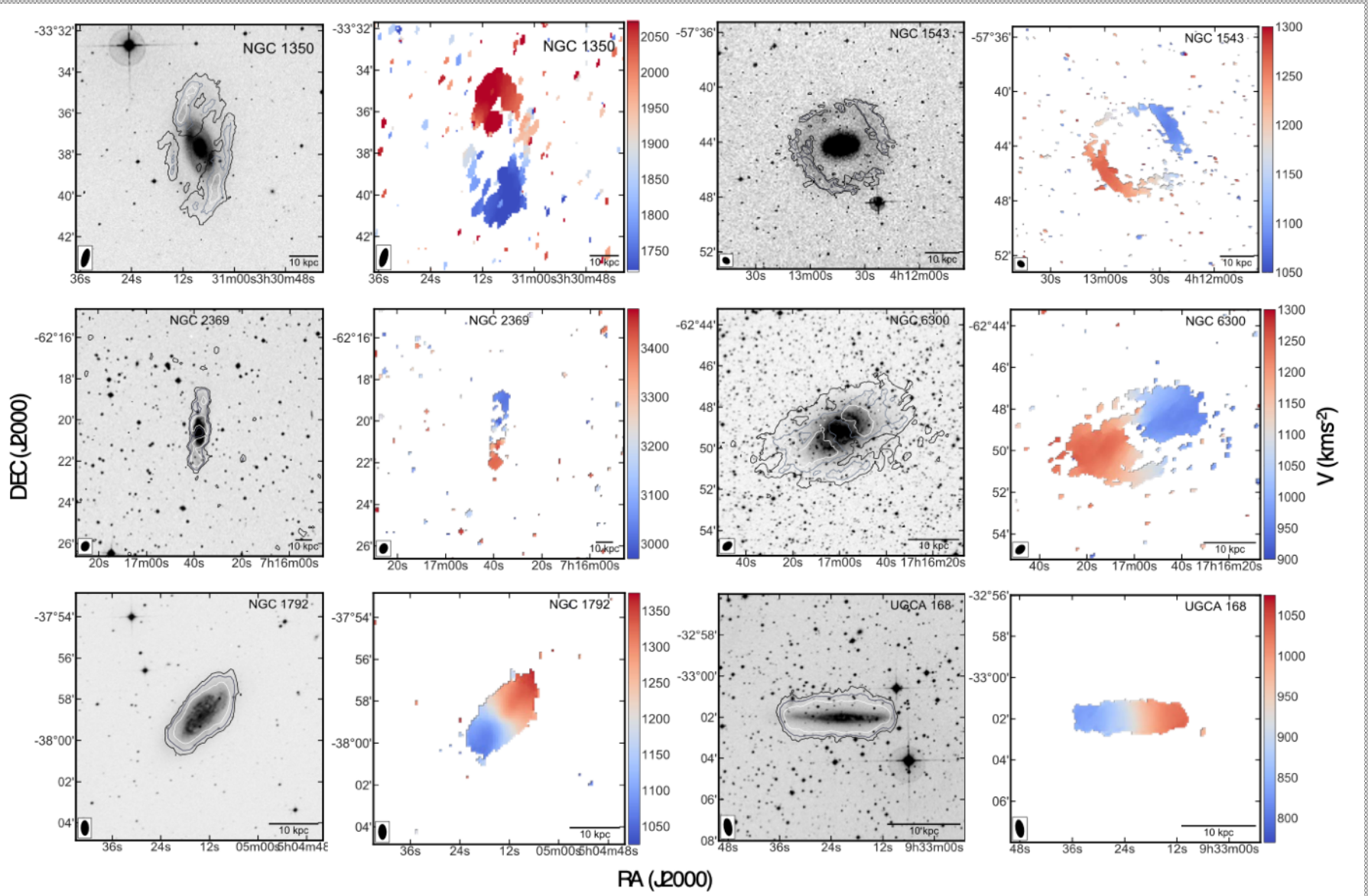
Imaging of *low density* HI deficient galaxies



6 isolated HI deficient galaxies
Imaged with ATCA

Murugeshan et al. 2018, *in prep*

Imaging of HI deficient galaxies

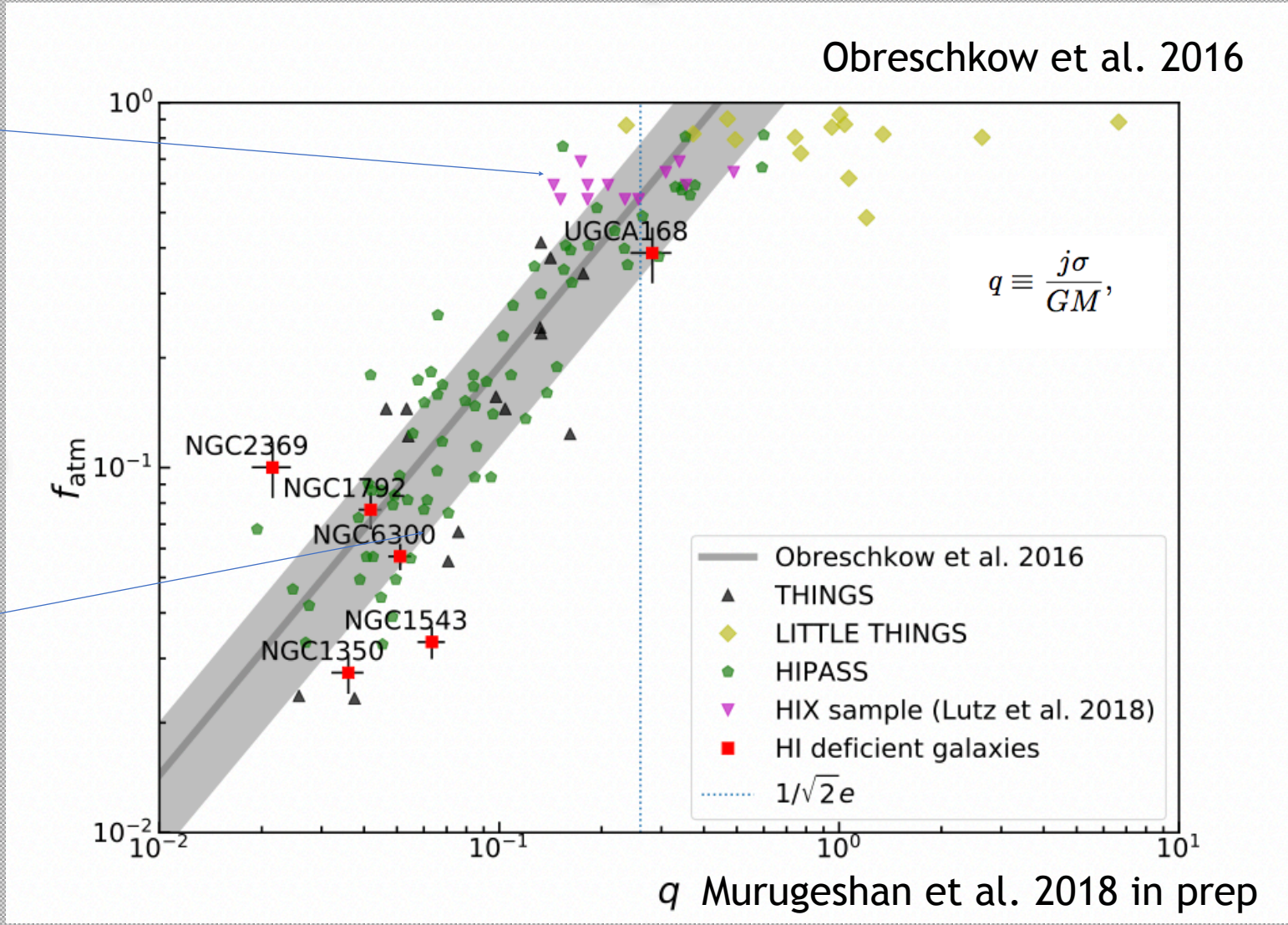


Murugeshan et al. 2018, *in prep*

Anglular momentum drives the HI fraction in (isolated?) galaxies

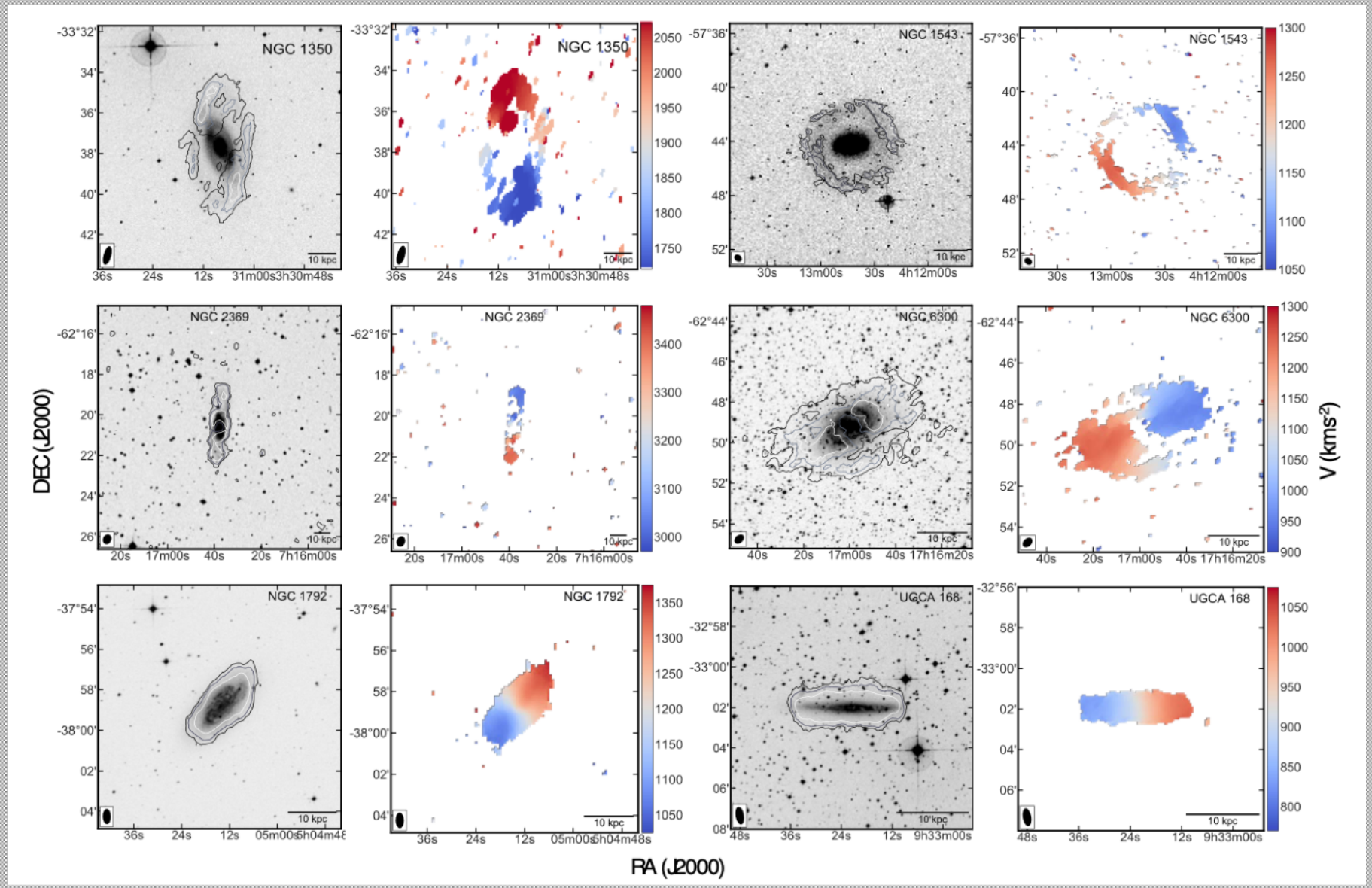
- **HI-Excess:**
- Disk is supported by high angular momentum
- Comparison with simulations (Dark Sage; Stevens et al. 2017) suggests these galaxies could live in isolated high-spin haloes

- **HI deficient:**
- Low angular momentum leads to more efficient star formation



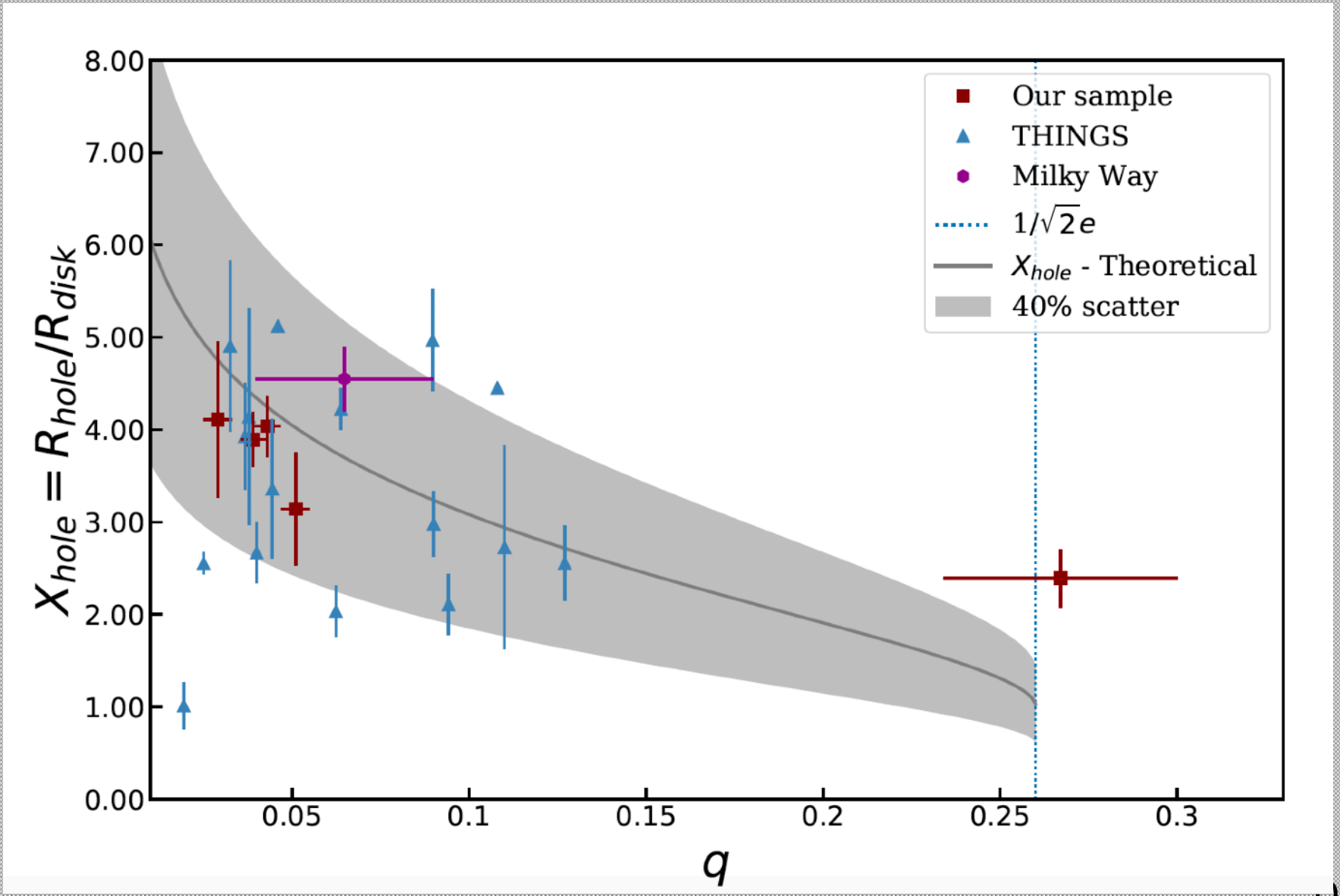
HI content of isolated HI def and HI excess galaxies can be explained through global stability parameter, q

Imaging of HI deficient galaxies



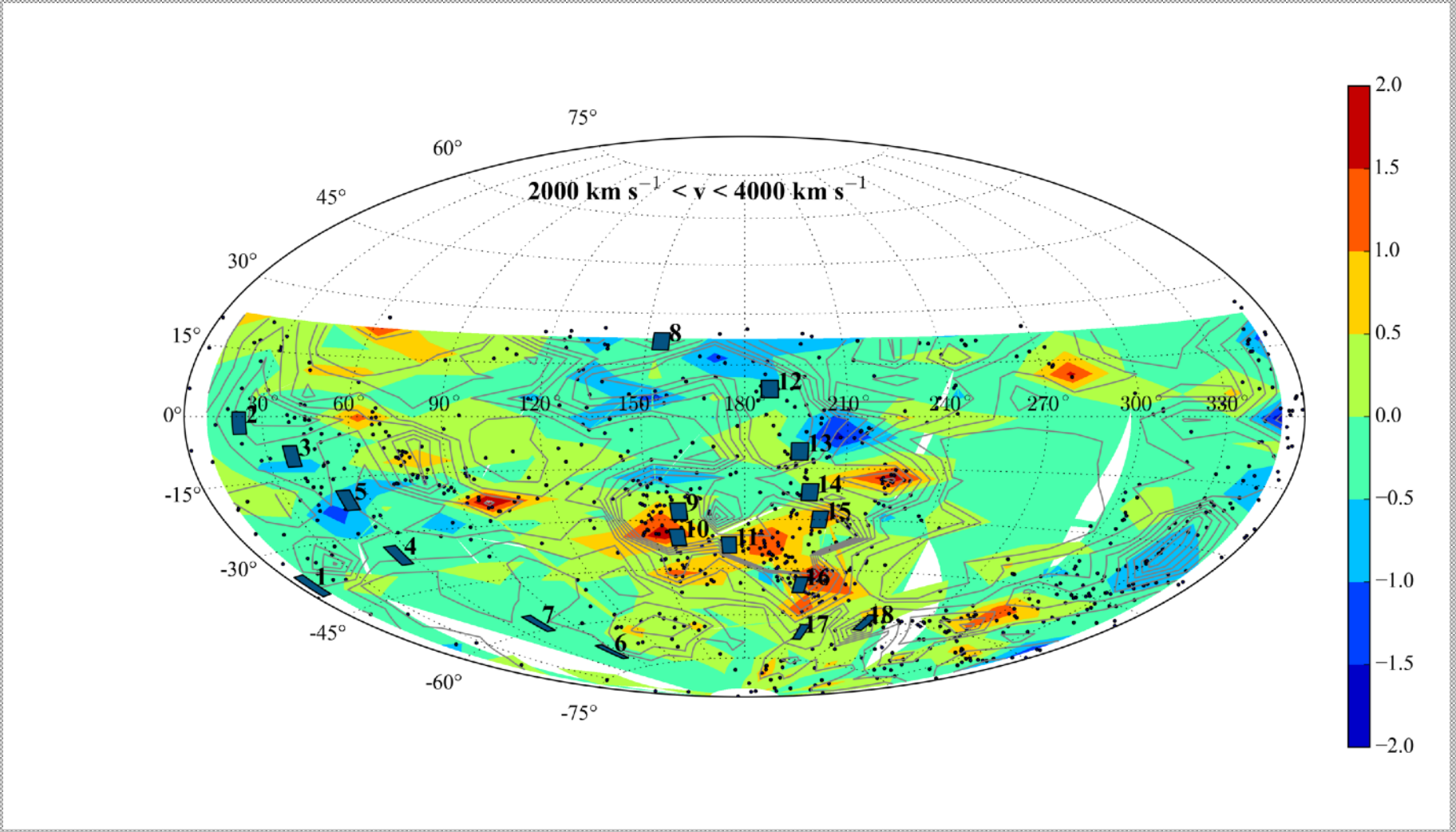
Murageshan et al. 2018, *in prep*

HI holes verus disk stability parameter, q



Obreschkow et al, 2016;
Murugeshan, Kilborn et al. 2018 in prep

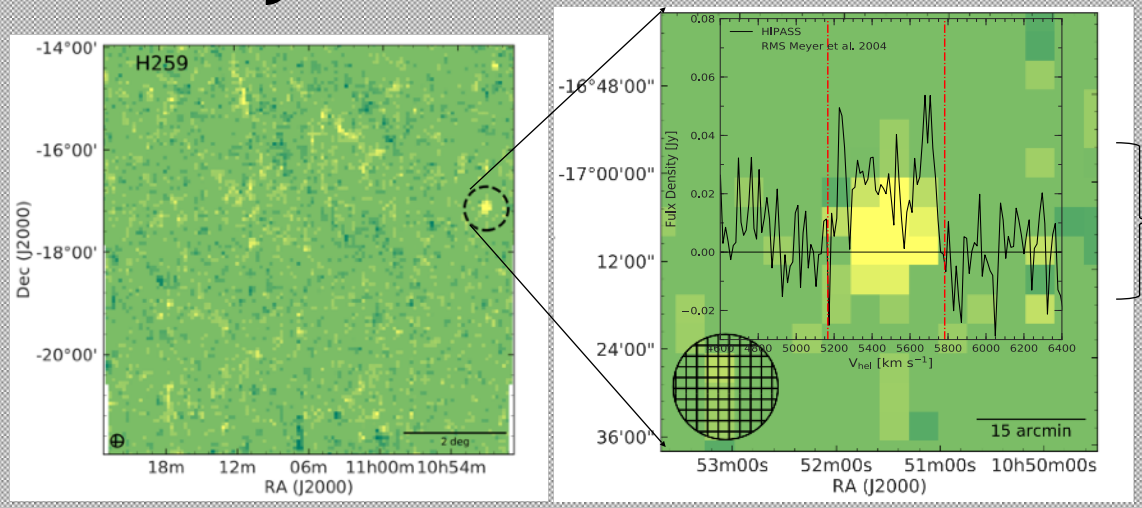
Some HI-excess regions – small groups



Choirs

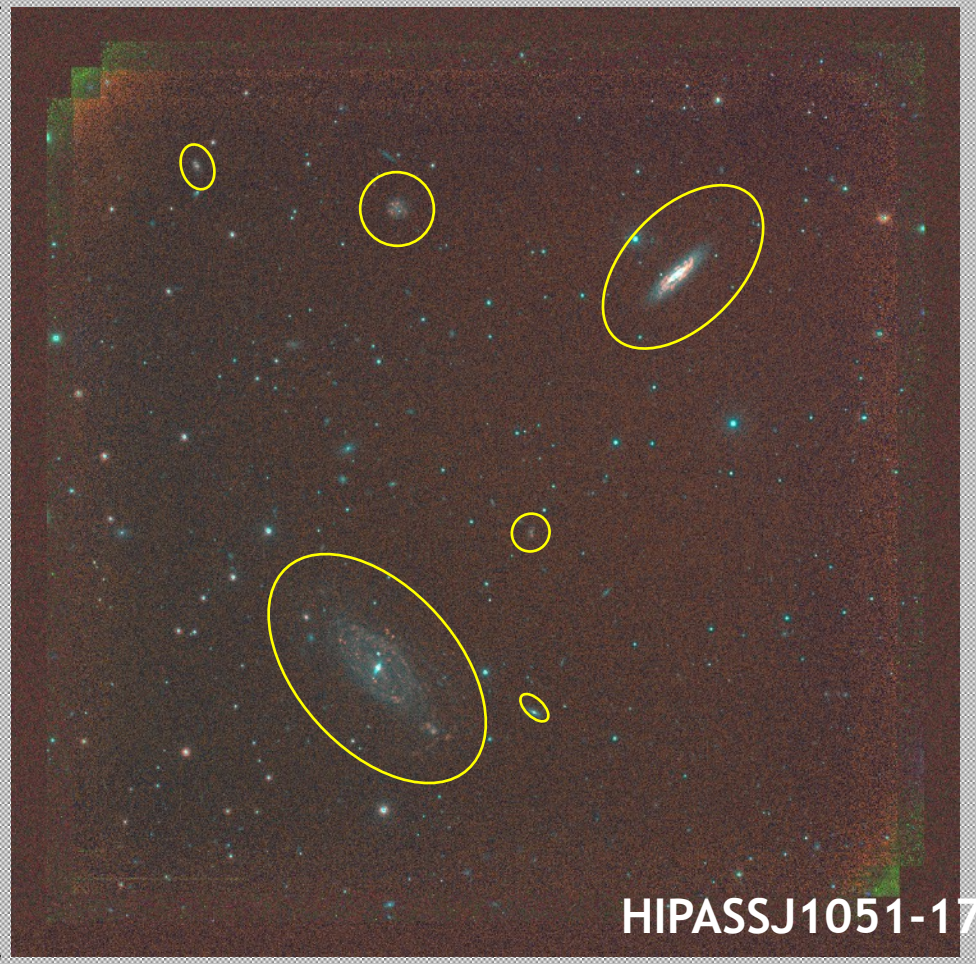
From HIPASS to SINGG to Choirs

HIPASS: HI Parkes All Sky Survey



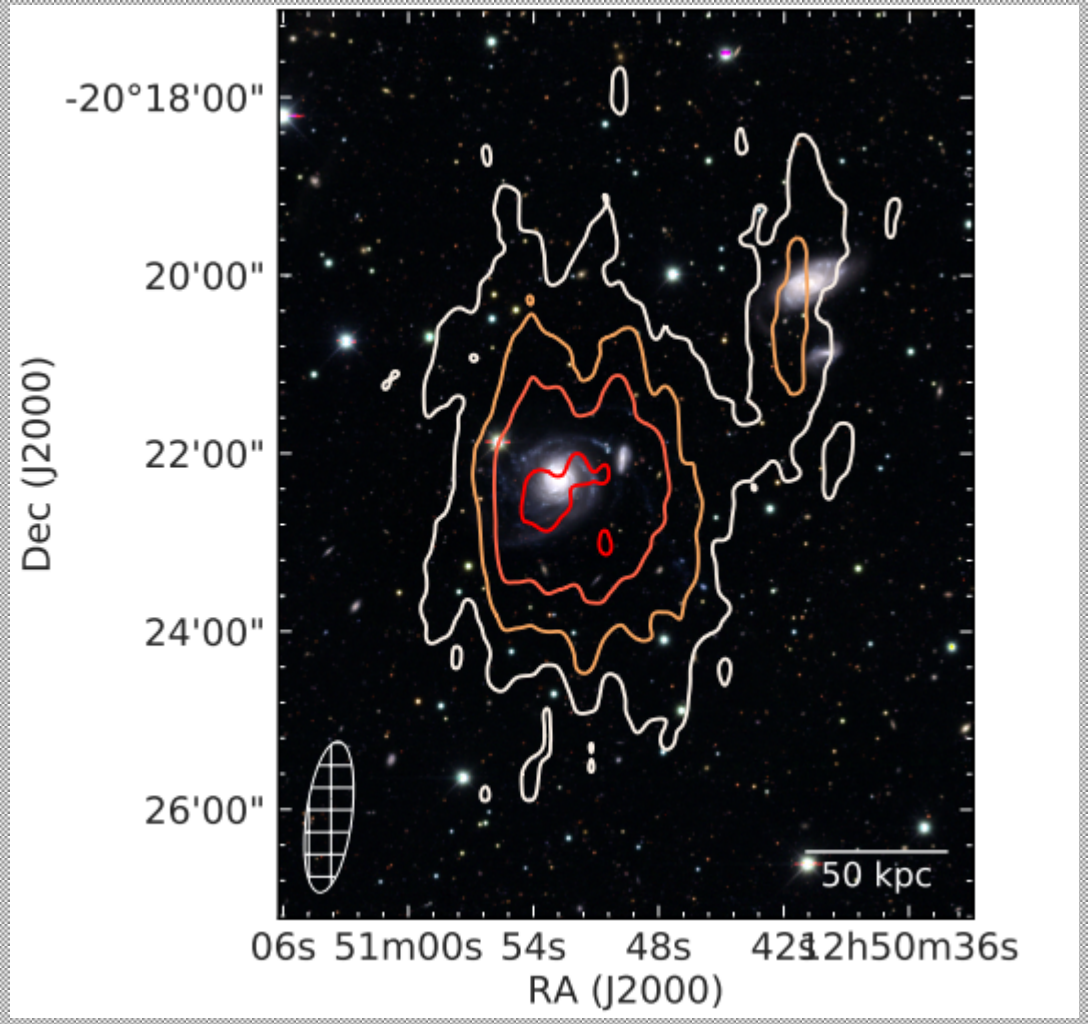
SINGG

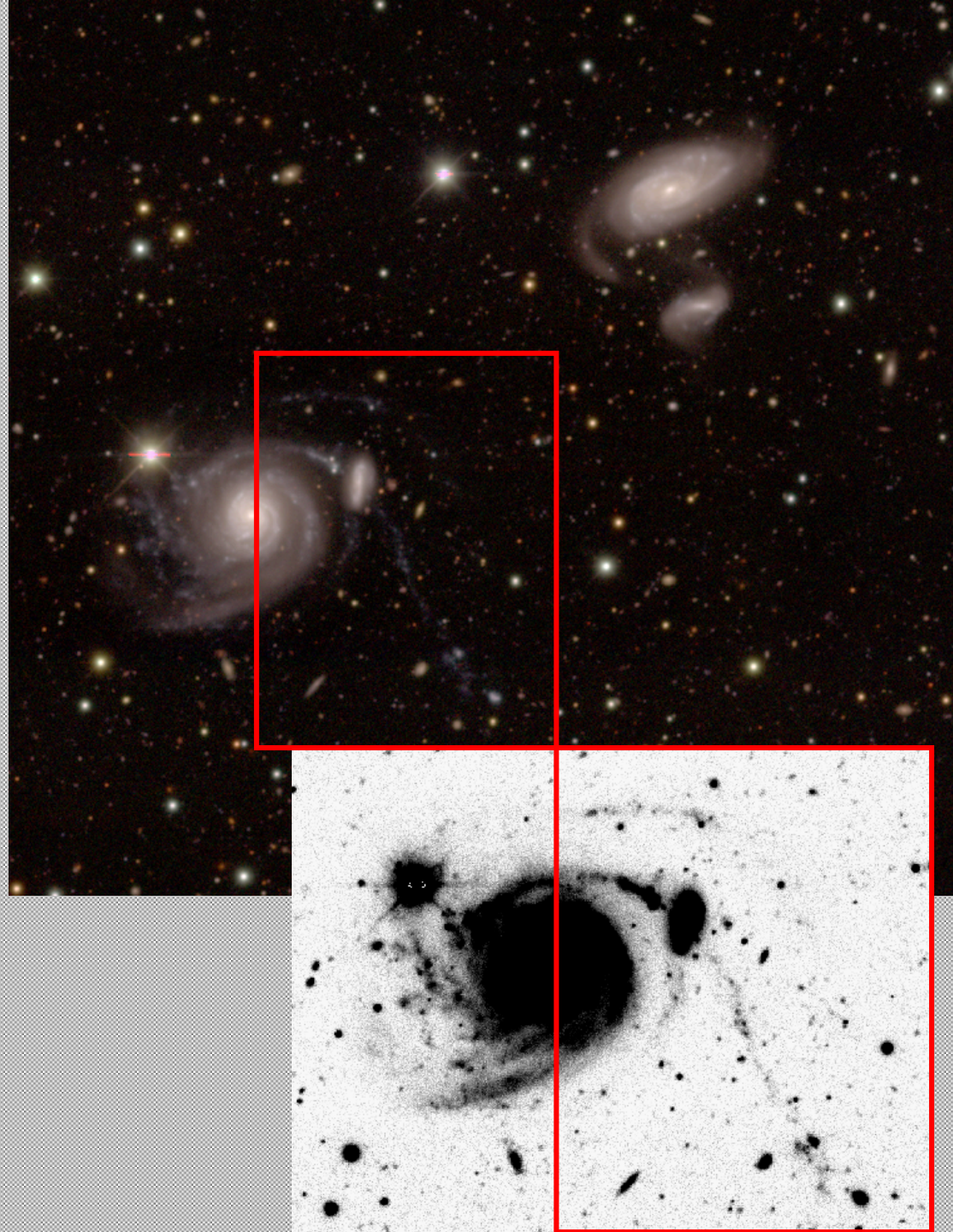
(Meurer et al. 2006)



SINGG: Survey of Ionization in Neutral Gas Galaxies; Hα follow-up

HIPASSJ1250-20
HI: ATCA
Optical: DECam





(Džudžar et al. submitted)

The relative amount of HI in centrals vs satellites

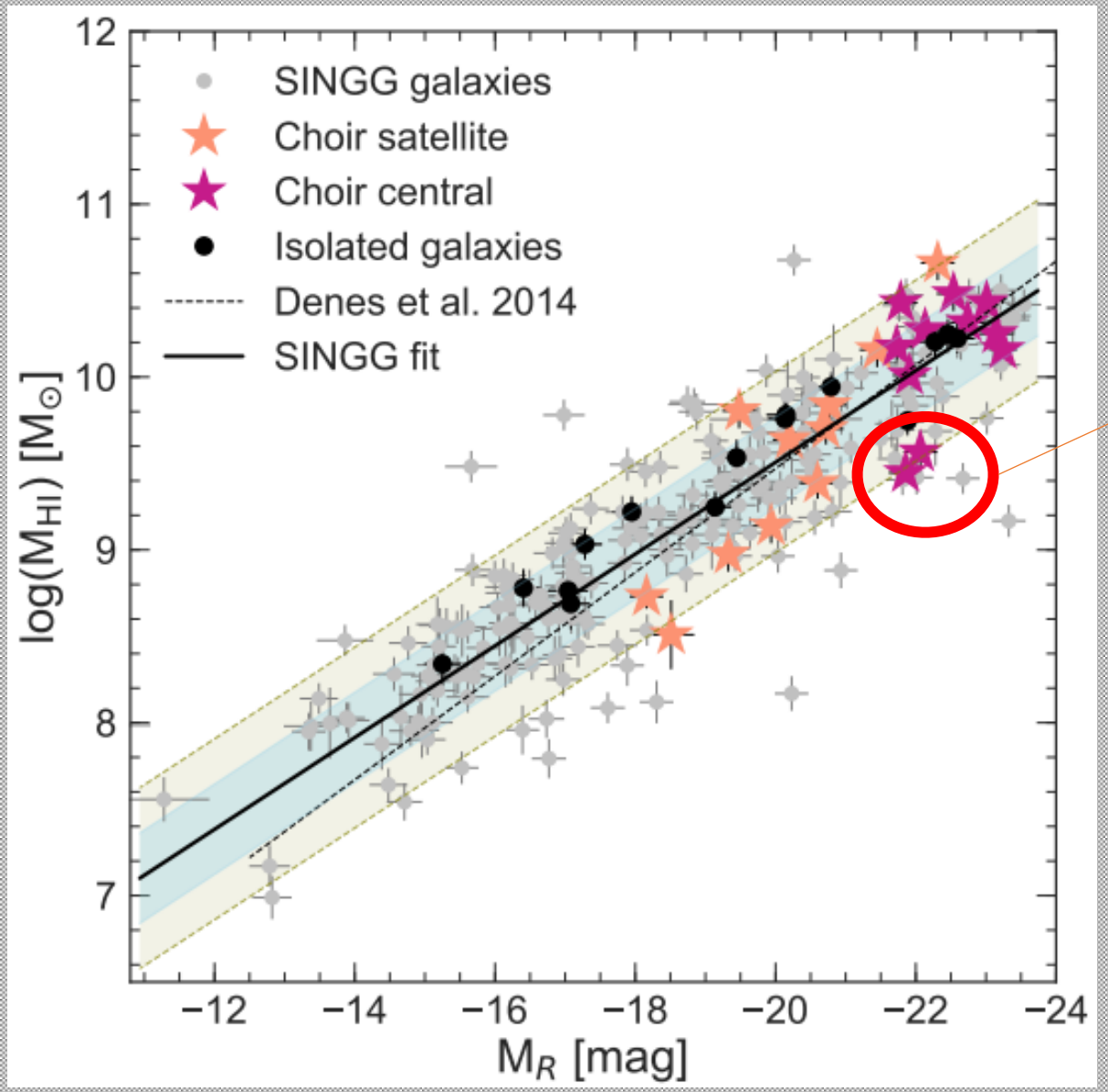
Average values:

Central DEF_{HI}: 0.00 dex

Satellite DEF_{HI}: 0.04 dex

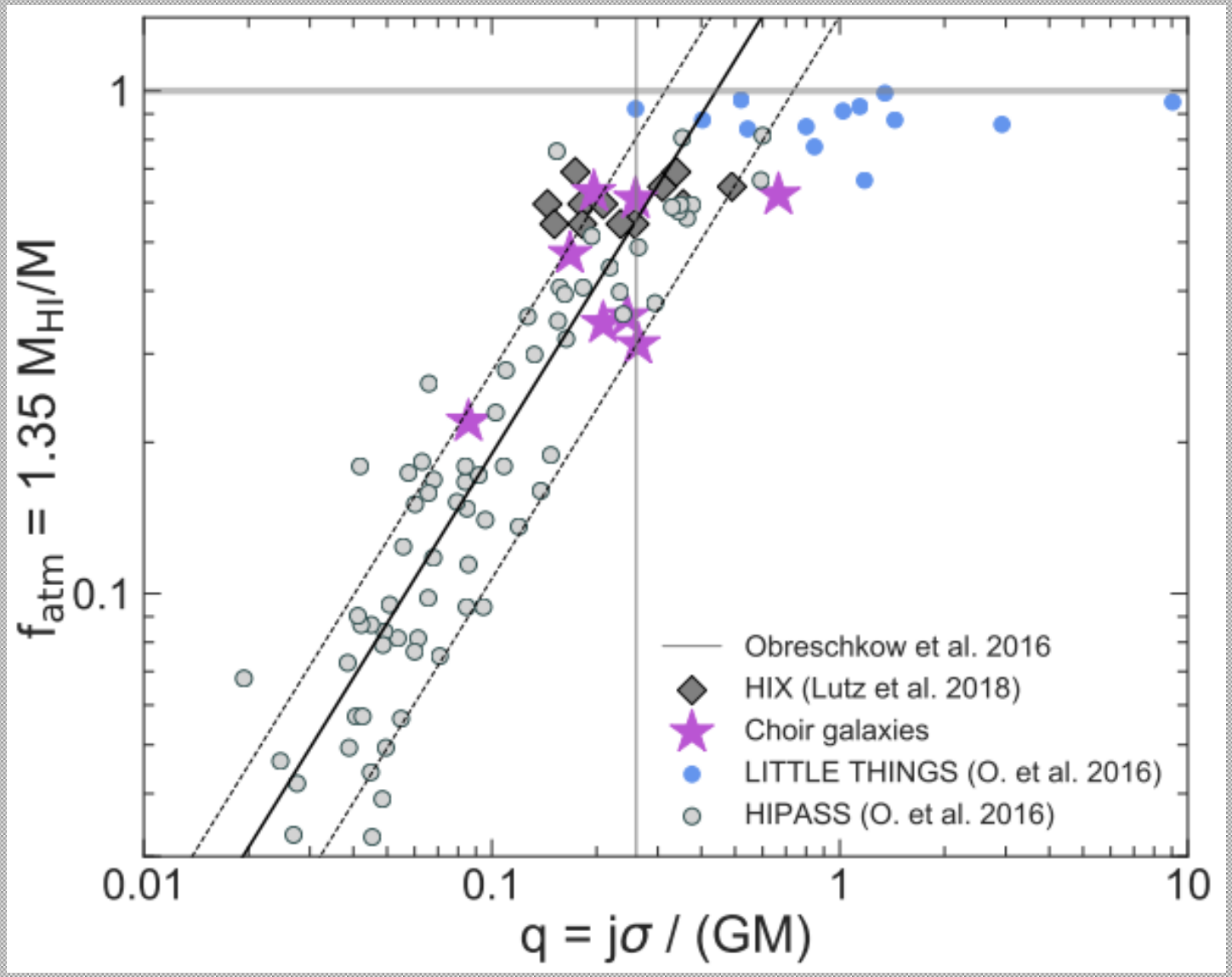
Isolated DEF_{HI}: - 0.11 dex

(Džudžar et al. submitted)



Groups where two galaxies of the same stellar mass are designated as Centrals

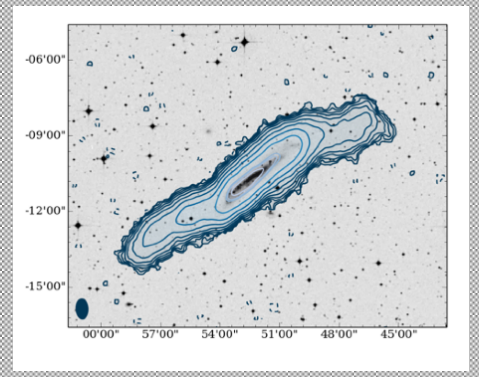
Stability parameter for gas-rich centrals

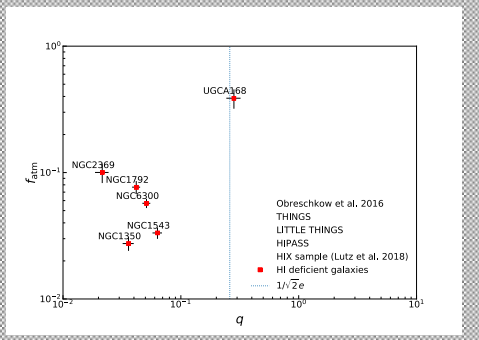


(Džudžar et al. MNRAS, submitted)

Conclusions

- HI observations can reveal the physical processes driving evolution in galaxies at low-z
- Environment is an important factor in the HI content, and hence evolution of galaxies
- Physical properties of galaxies matter outside of environment
  - There is a population of **isolated spiral galaxies**, with very large HI gas fractions – the gas disks have a high angular momentum, supporting them against collapse.
  - There is a population of **low density spiral galaxies** with very low HI gas fractions – the disks have low angular momentum, they have collapsed to form stars
- Small groups – HI content "normal" but detailed imaging shows irregular distributions. Satellites more gas-poor than centrals.





With ASKPA/AFERTiF/MeerKAT HI surveys, we can do this type of analysis for thousands of galaxies