RESOLVED ANALYSIS OF THE ISM AND STAR FORMATION PROPERTIES OF SPIRAL GALAXIES IN DIFFERENT ENVIRONMENTS

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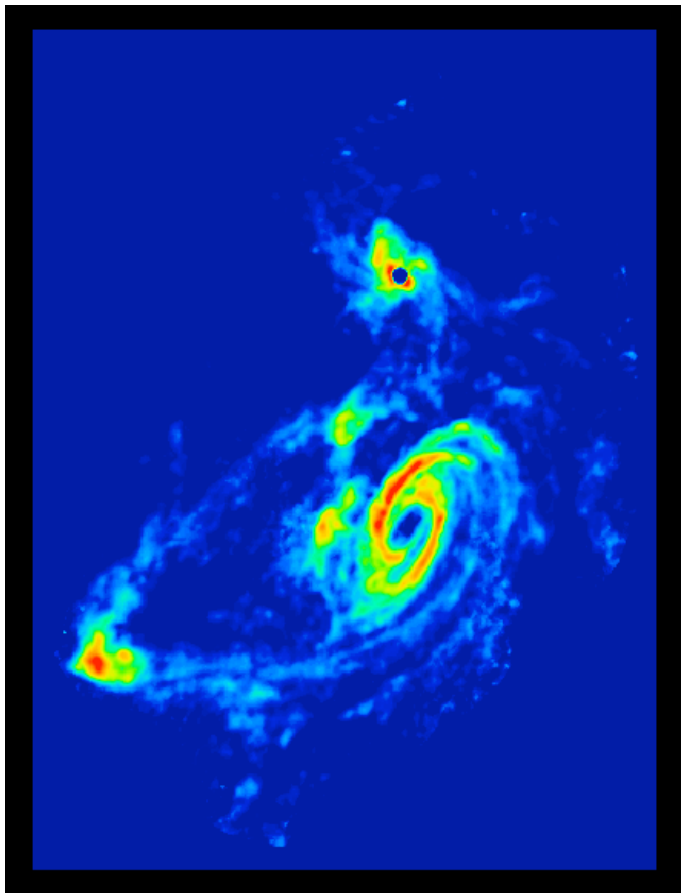
Environmental Effects



HI in M81 Group of Galaxies (Yun+ 1994)

- Denser environments dominated by quiescent galaxies (Blanton & Moustakas 2009)
- HI-deficient galaxies rises towards the centre of clusters (Solanes+ 2001)
- Possible Mechanisms:
  - Starvation (Larson+ 1980)
  - Ram pressure stripping (Gunn & Gott 1972)
  - Gravitational harassment

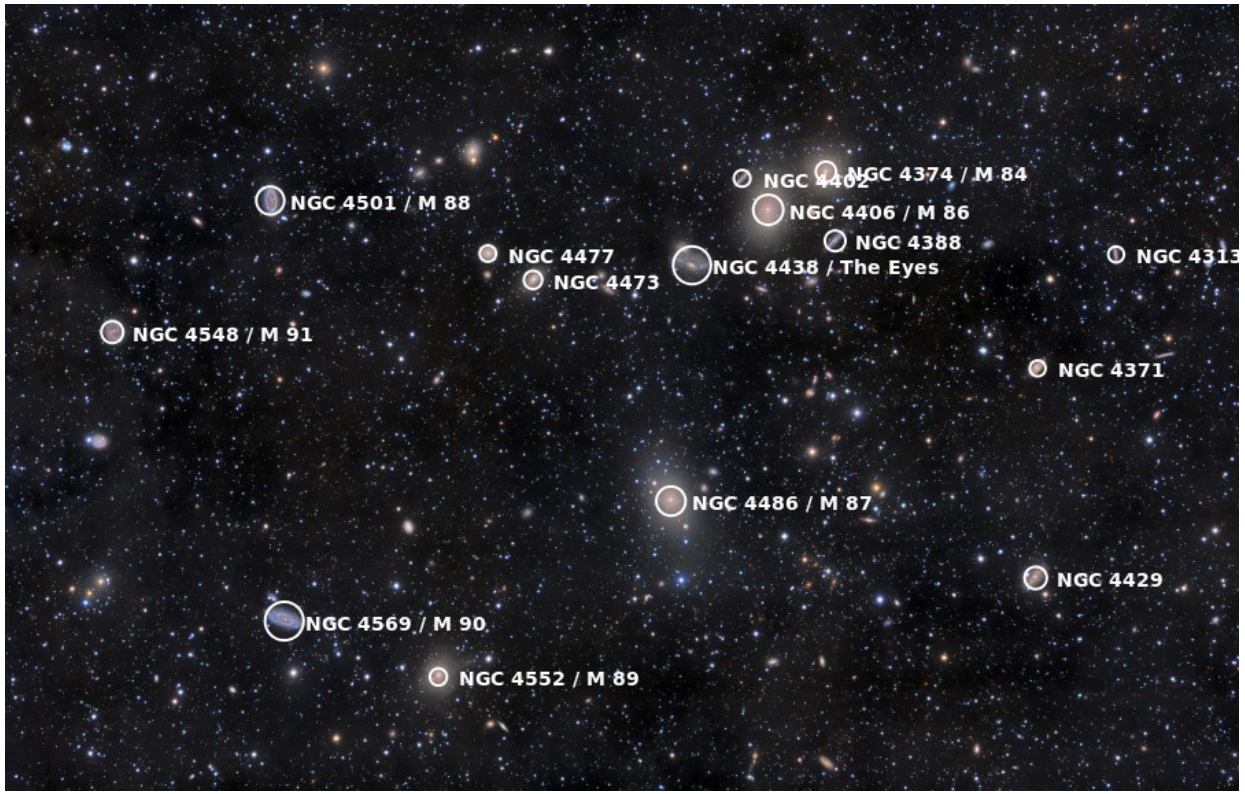
Environmental Effects

NGC 4522 in the Virgo Cluster (HST - http://www.spacetelescope.org/images/heic0911b/)

- Effects on molecular gas content less clear
- Virgo spirals are not as H_2 deficient as would be expected from their HI deficiencies (Kenny & Young 1989)
- Recent results suggests some H_2 deficiency in Virgo spirals (Fumagalli+ 2009, Boselli+ 2014)

Virgo Cluster

- Nearest cluster to us, at a distance of ~16.7 Mpc
- Rich with infalling spiral galaxies



Virgo Cluster (APOD - http://apod.nasa.gov/apod/ap110422.html)

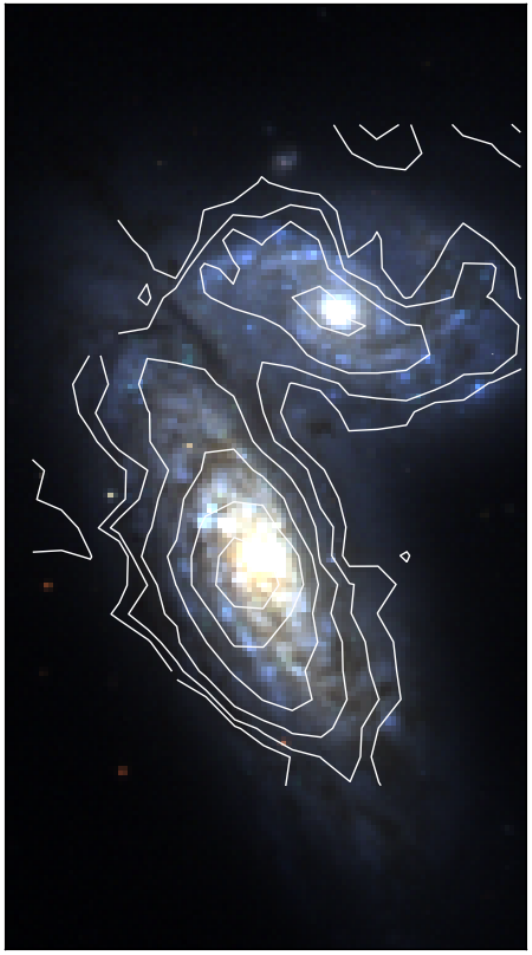
Nearby Galaxies Legacy Survey (NGLS)

- Sample of 155 HI-flux selected galaxies in the nearby universe (Wilson+ 2012)
- All: Hα, JCMT
- Some: VLA, Herschel, Spitzer

NGC 4567 and 4568 (http://www.sdss.org/)

CO(3-2) Observations

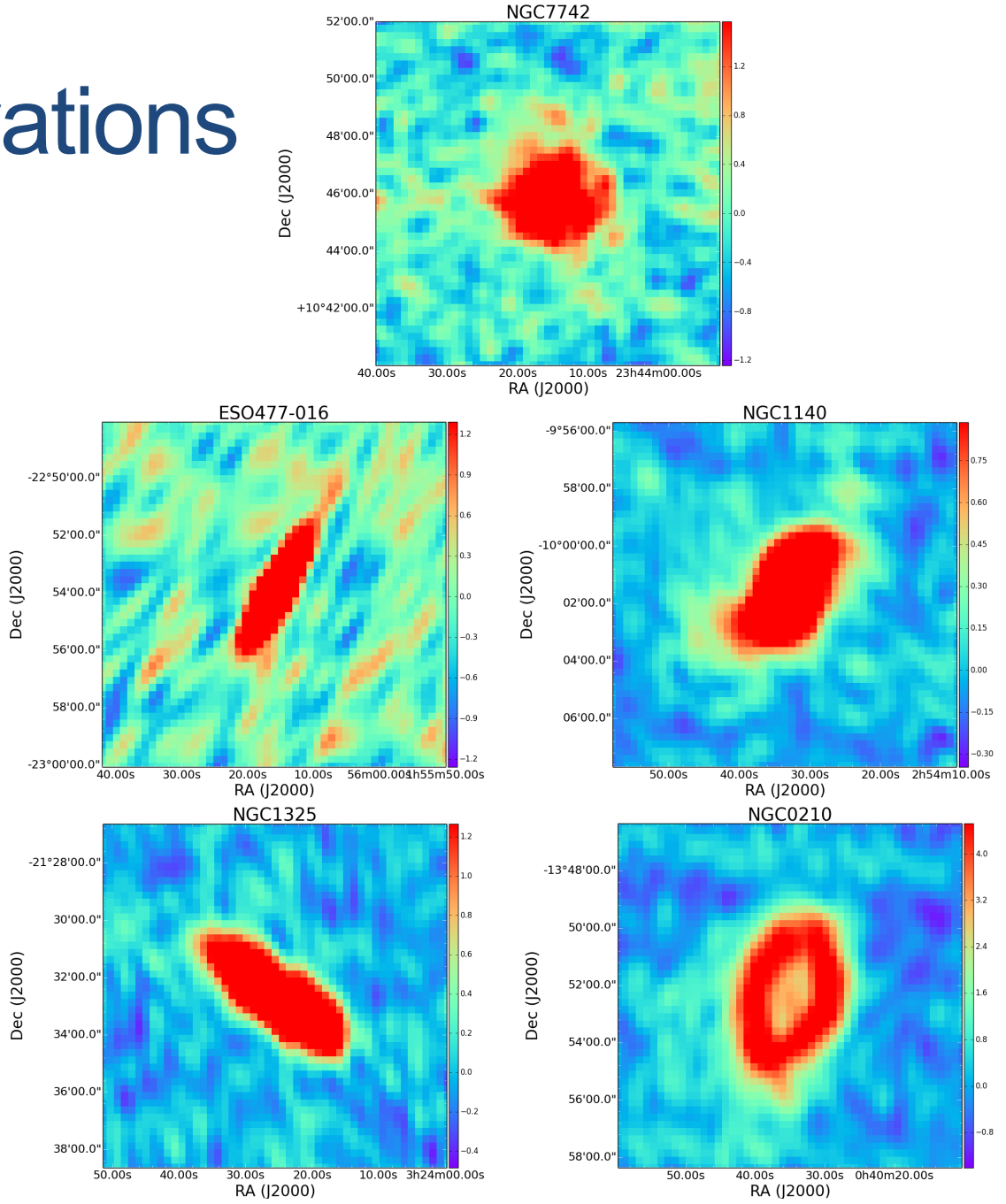
- Sample of 98 gas-rich spiral galaxies from the NGLS and follow-up surveys
- Map the CO(3-2) transition using HARP on the JCMT
  - 19 mK (T_A*) out to at least D_{25}/2 at 20 km/s
  - 14.5” angular resolution



NGC 4567 and 4568, with CO (3-2) contours overlaid

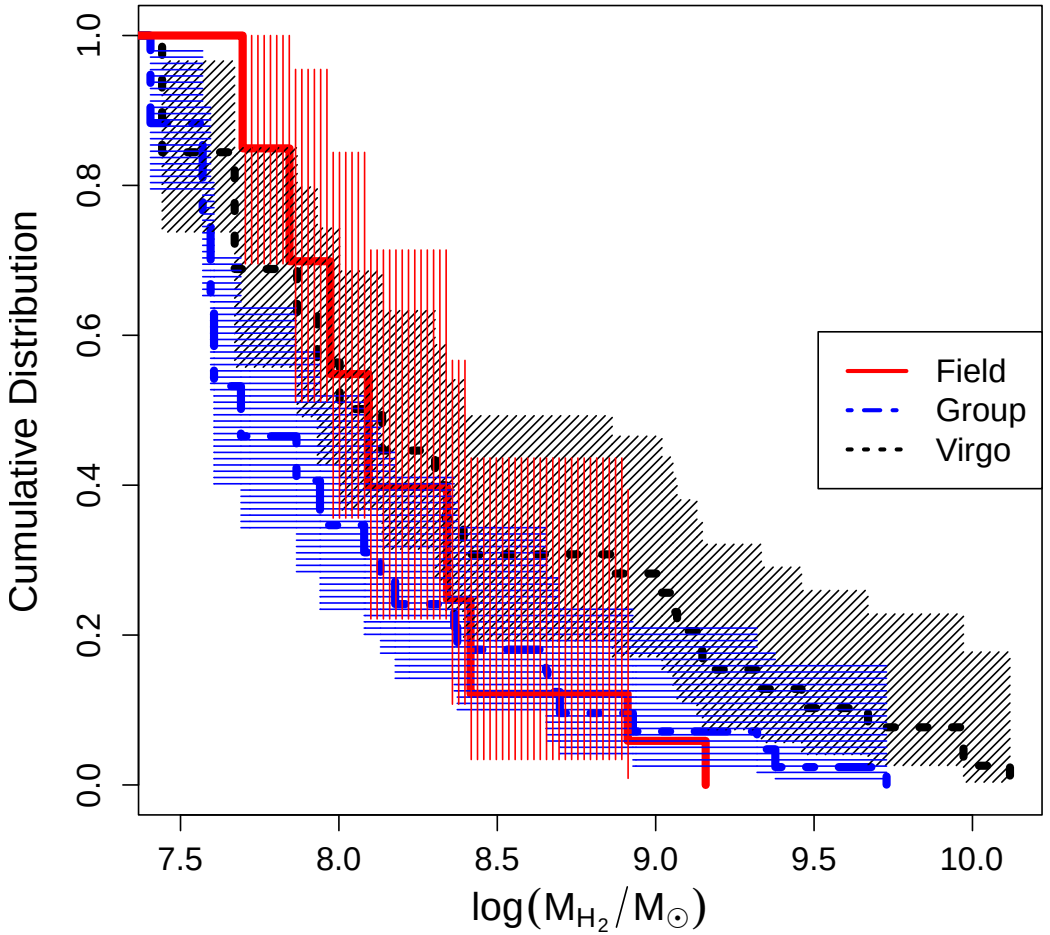
VLA HI Observations

- 30 galaxies
- D-array (~60” resolution)
  - Pilot VLA program in 2007 (AW701) - 9 spirals
  - Follow-up program (15B-111) - 5 spirals
- VLA Imaging of Virgo in Atomic Gas (VIVA) Survey (Chung+2009)
  - 16 spirals
  - High resolution



Integrated Galaxy Properties

- 44% of the spiral galaxies are CO detected
  - Use technique of survival analysis to incorporate upper limits
- Virgo galaxies show an enhancement in their molecular gas content
  - Environment aiding in conversion to H_2



Cumulative distribution functions for the 3 environments (Figure 1 from Mok+ 2016)

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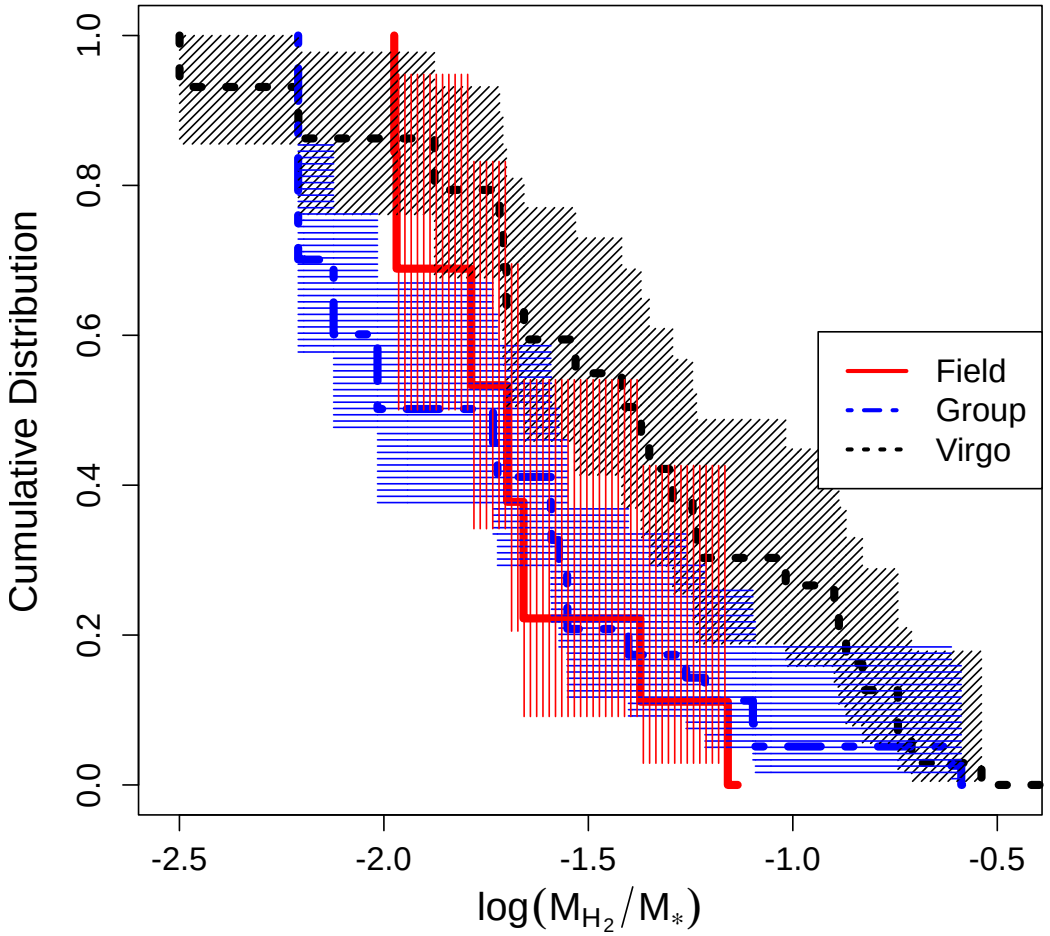
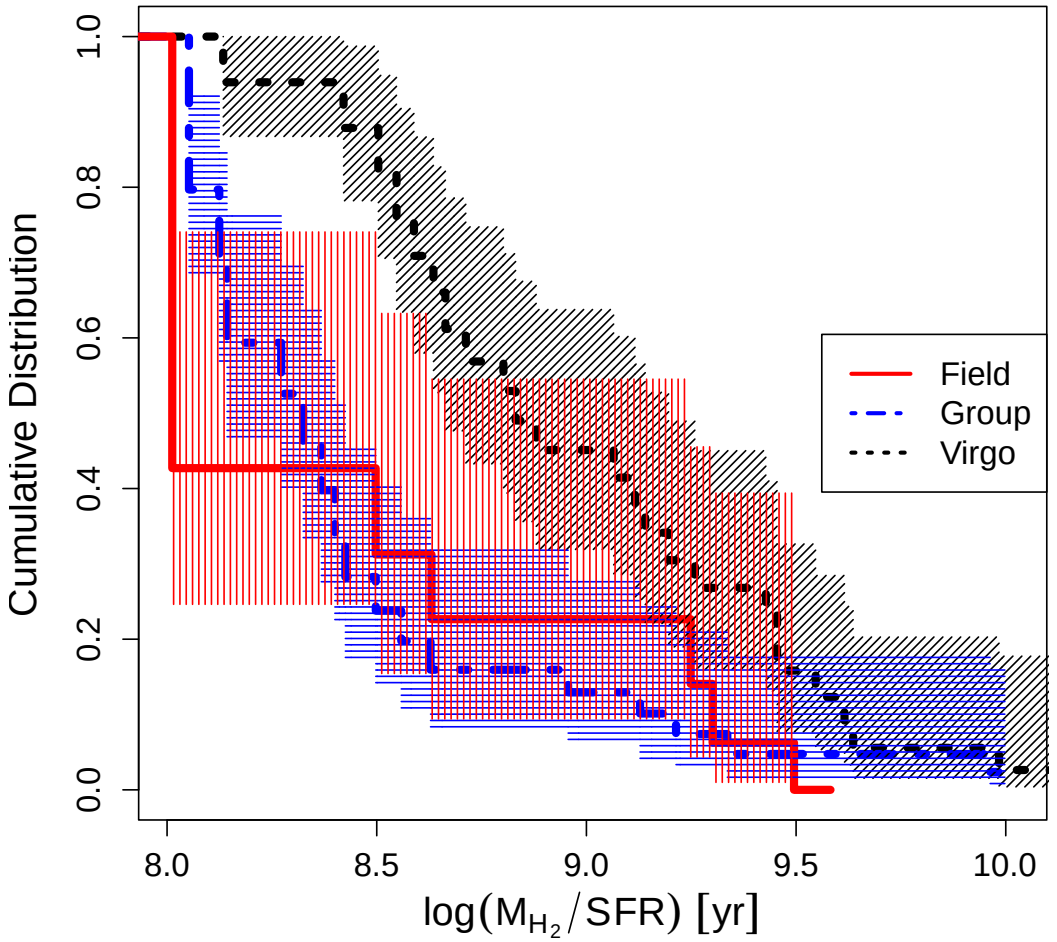


Cumulative distribution functions for the 3 environments (Figure 1 from Mok+ 2016)

Gas Depletion Times

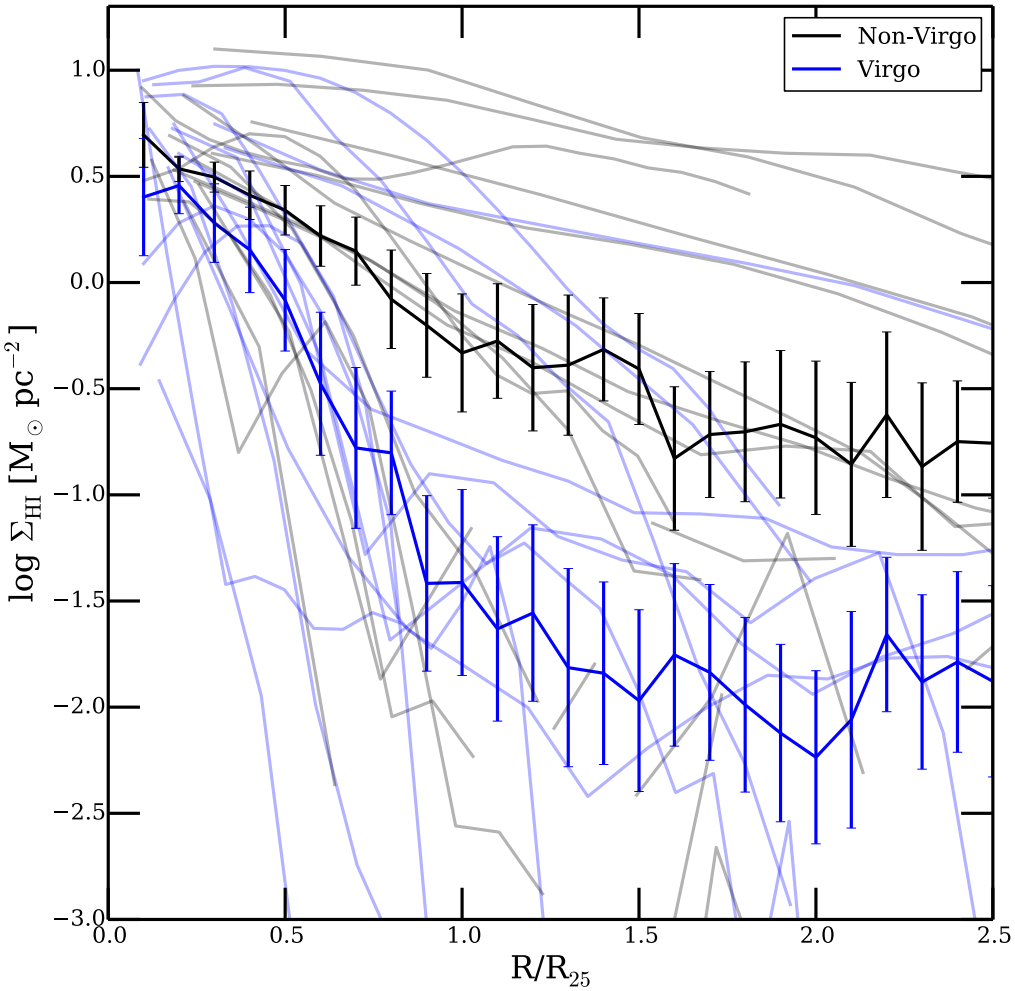
- Combine with Hα star formation rate data (Sánchez-Gallego+ 2012)
- Longer molecular gas depletion times in the Virgo sample
  - Environmental effects (heating process, pressure, stabilization in disk)
  - No differences found in the HI gas depletion times



Cumulative distribution functions for the 3 environments (Figure 2 from Mok+ 2016)

Radial Trends

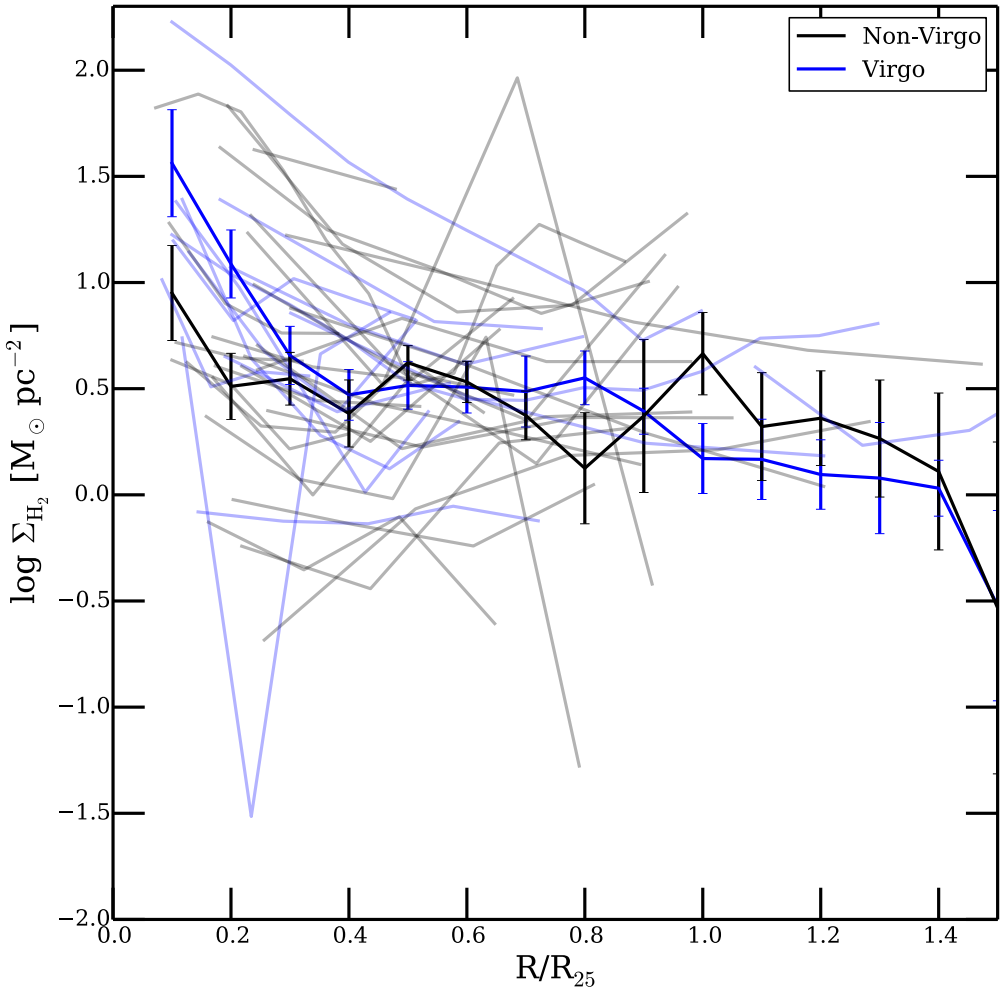
- Create radial annuli around the center of each galaxy
- From the HI data, disk size appears to be smaller for Virgo galaxies after normalization by R_{25}



HI radial averages for the galaxies in our sample, normalized by R_{25} and subdivided by environment

Radial Trends (CO)

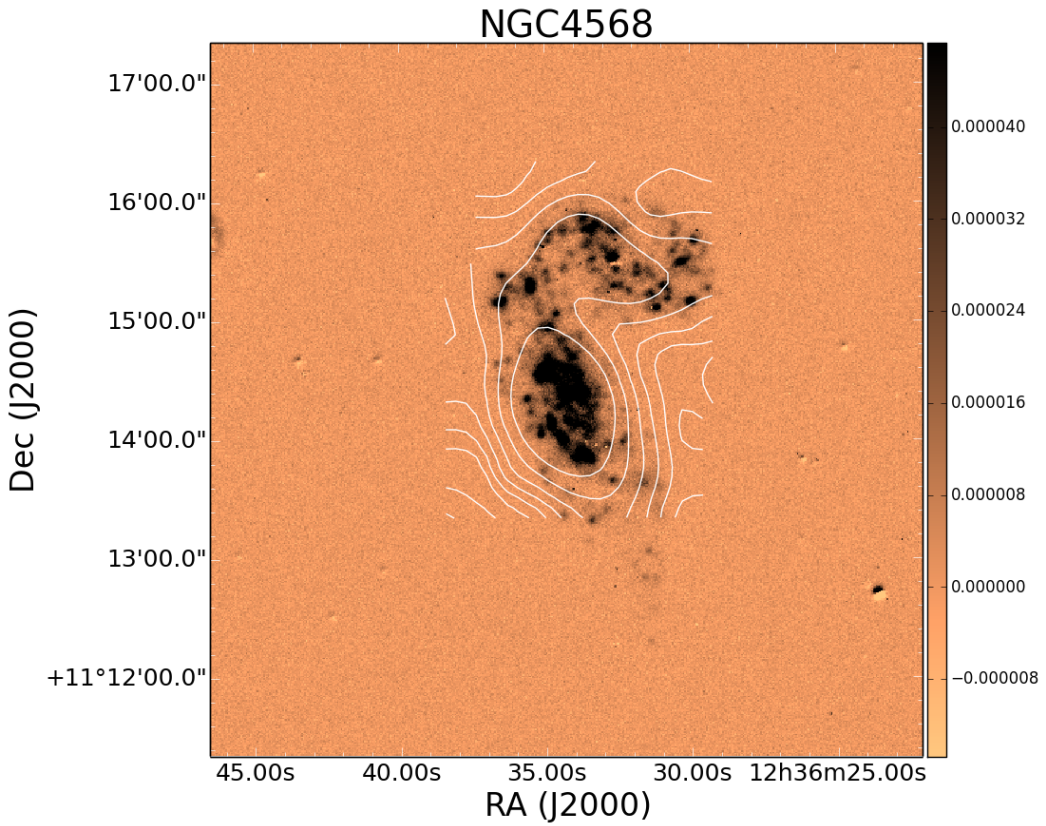
- Applied the same process to CO data, including normalization by R_{25}
- No signs of a truncation in the H_2 disks of Virgo galaxies



H_2 radial averages for the galaxies in our sample, normalized by R_{25} and subdivided by environment

Next Steps

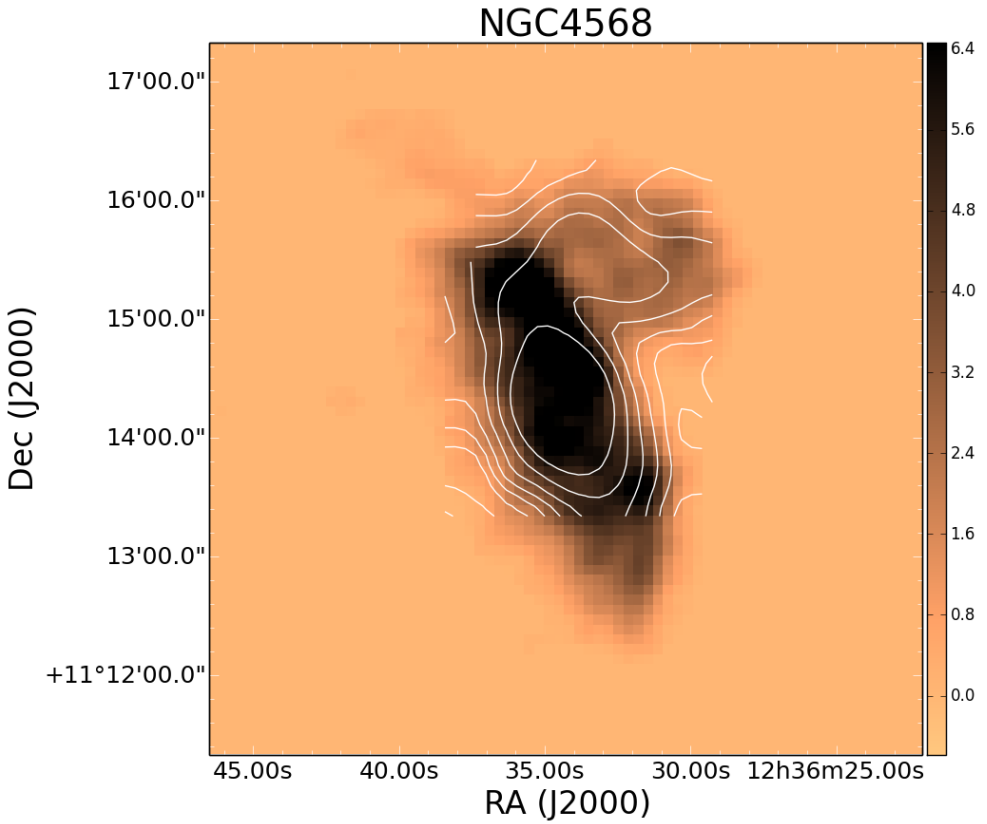
- Combine H_2 and HI data
  - Create ratio maps to distinguish between different scenarios
- Incorporate available Hα SFR maps
  - Determine resolved star formation rates and gas depletion times in radial bins
  - Pixel by pixel analysis (KS laws, gas depletion times)



Hα map of NGC 4567 and NGC 4568 with CO(3-2) contours overlaid

Conclusion

- Created a large sample of gas-rich nearby spiral galaxies in different environments
- Enhancement in the molecular gas content and molecular gas depletion times for Virgo galaxies
- No signs of a truncation in the H_2 disks for the Virgo galaxies, compared to their HI disks



HI moment map of NGC 4567 and NGC 4568 with CO (3-2) contours overlaid