MHONGOOSE

MeerKAT HI Observations of Nearby Galactic Objects: Observing Southern Emitters

MeerKAT Deep Nearby Galaxies HI Survey

Erwin de Blok

UCT

Kloster Seeon, June 2011

Outline

- MeerKAT and KAT-7
- MHONGOOSE


Canada
United States
Brasil
Cape Town
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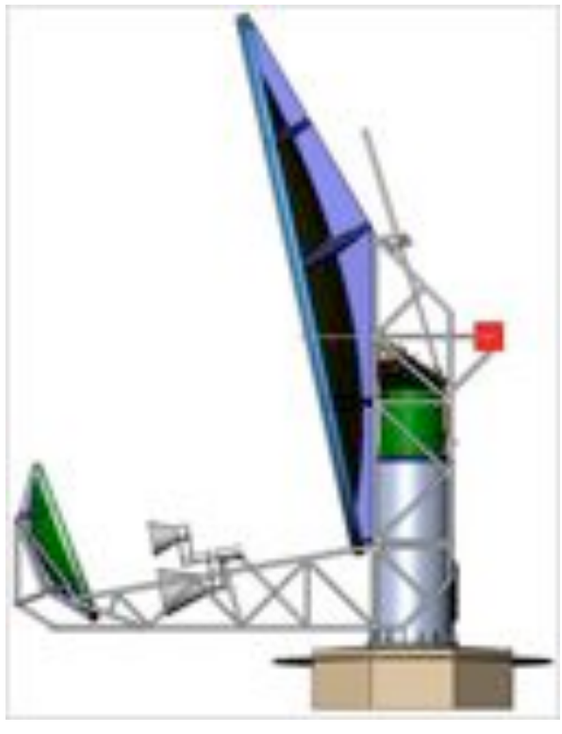
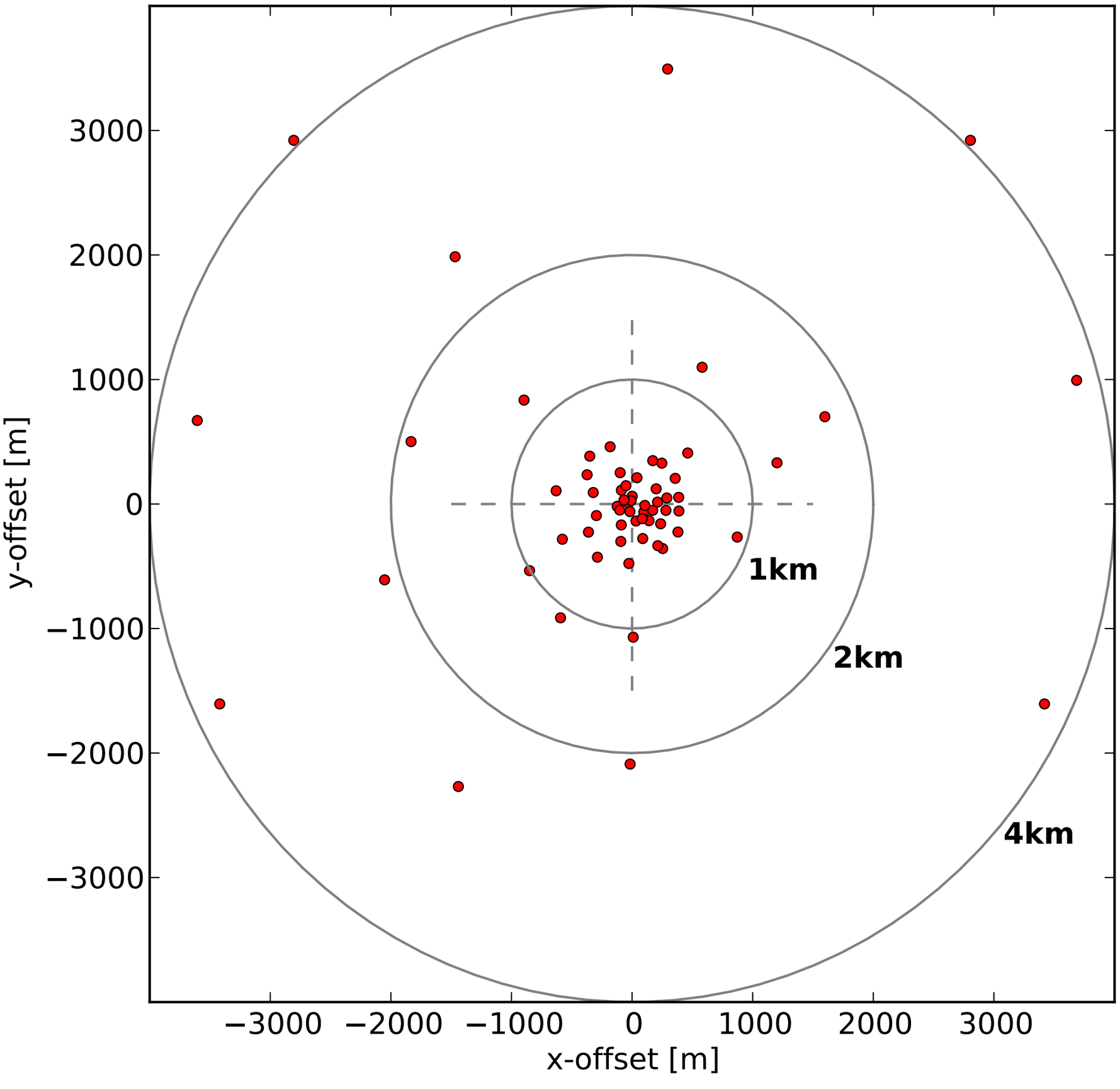
MeerKAT

- Specifications:
  - 64 dishes of 13.5 meters (equiv)
  - Offset Gregorian
  - 70% in core of ~ 1 km
  - 30% in extended configuration of 8 km
  - Resolution 8”-90”
  - Single pixel cooled receivers
  - 580 MHz - 1.75 GHz and 8 - 15 GHz
  - [Long baseline “spur” (out to 20 km)]
  - Commissioned by late 2015
- KAT-7 proto-type test bed
  - 7 dishes of 12 meters



shortest baseline 27m
longest baseline 8 km



Karoo Radio Astronomy Reserve

Site Complex

KAT-7

- Technology and science test bed for MeerKAT
- 7 dishes of 12 m
- Compact configuration
- Longest baseline 200m

Array Site

KAT-7 Views

MeerKAT Approved Projects

- **Priority Group 1**
  - Radio Pulsar Timing (PI: Bailes): 7860h
  - HI Deep Field (PIs: Blyth, Holwerda, Baker): 5000h
- **Priority Group 2**
  - MESMER: MeerKAT Search for Molecules in the Epoch of Re-ionisation (PI: Heywood): 6500h
  - MeerKAT Absorption Line Survey (PIs: Gupta and Srianand): 4000h
  - MHONGOOSE: MeerKAT HI observations of Nearby Galactic Objects: Observing Southern Emitters (PI: de Blok): 6000h
  - TRAPUM: Transients and Pulsars with MeerKAT (PIs: Stappers and Kramer): 3080h
  - A MeerKAT HI Survey of Fornax (PI: Serra): 2450h
  - MeerGAL: A MeerKAT High Frequency Galactic Plane Survey (PIs: Thompson and Goedhart): 3300h
  - MeerKAT International GigaHertz Tiered Extragalactic Exploration (MIGHTEE) Survey (PIs Van der Heyden and Jarvis): 1950h
  - ThunderKAT: The Hunt for Dynamic and Explosive Radio Transients with MeerKAT (PIs: Woudt and Fender): 3000h
  - (VLBI)

HI: what's left to do

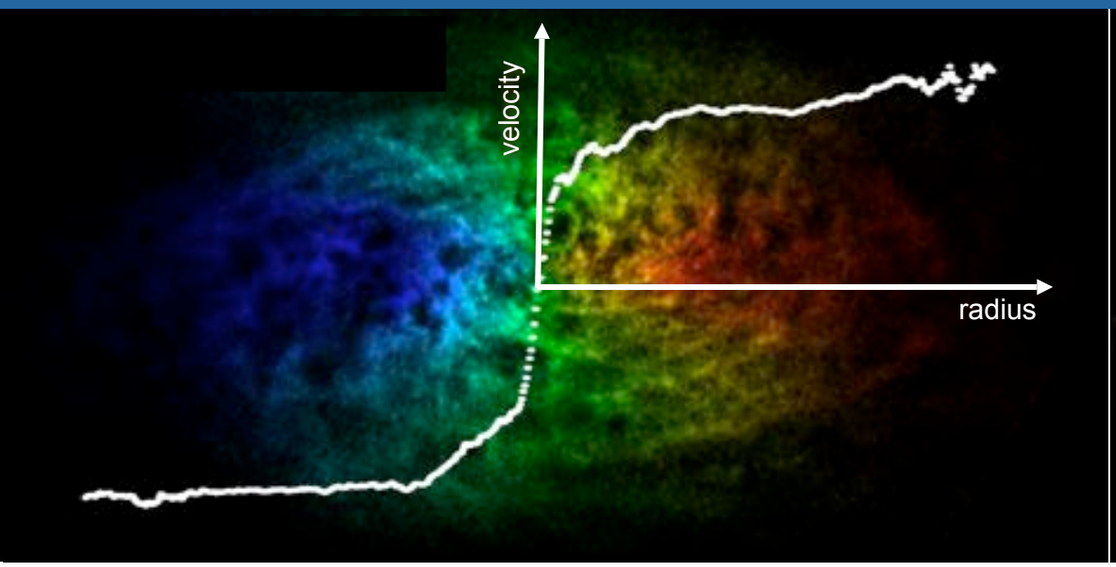
The connection between between **star formation, HI, dynamics** and **accretion**, is one of the main issues to address in the coming years through *large, deep surveys* of the H I in the *local* and *distant* Universe

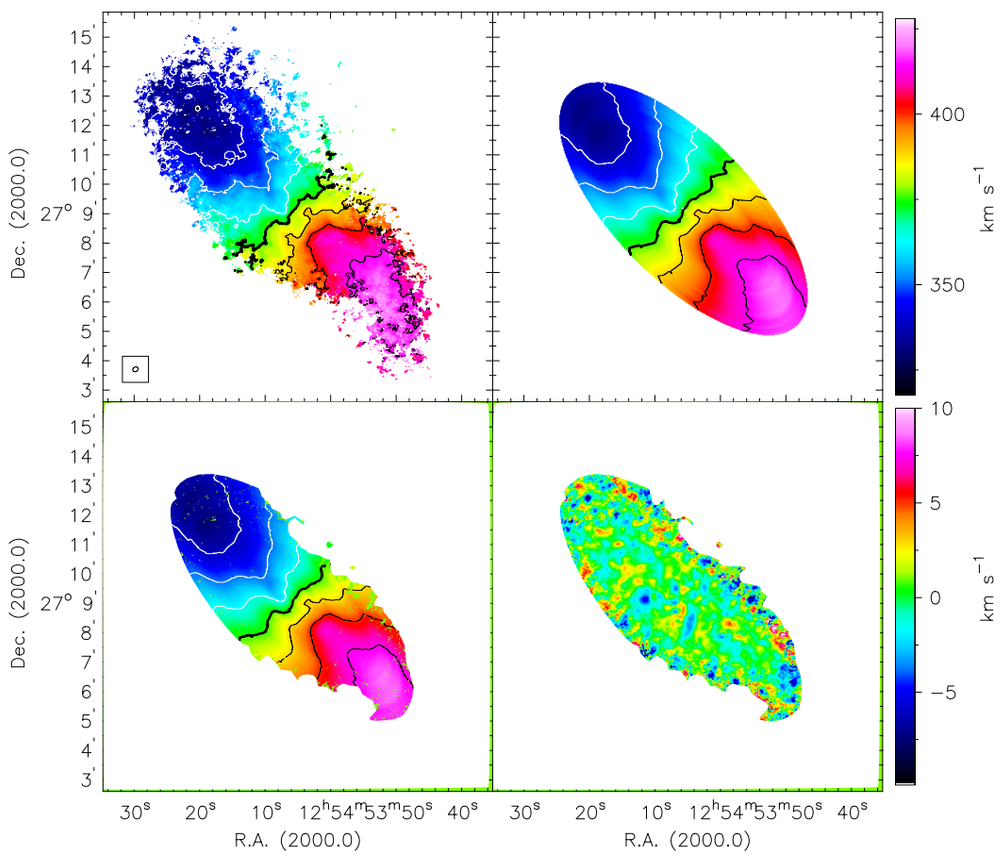
- How do galaxies get their gas?

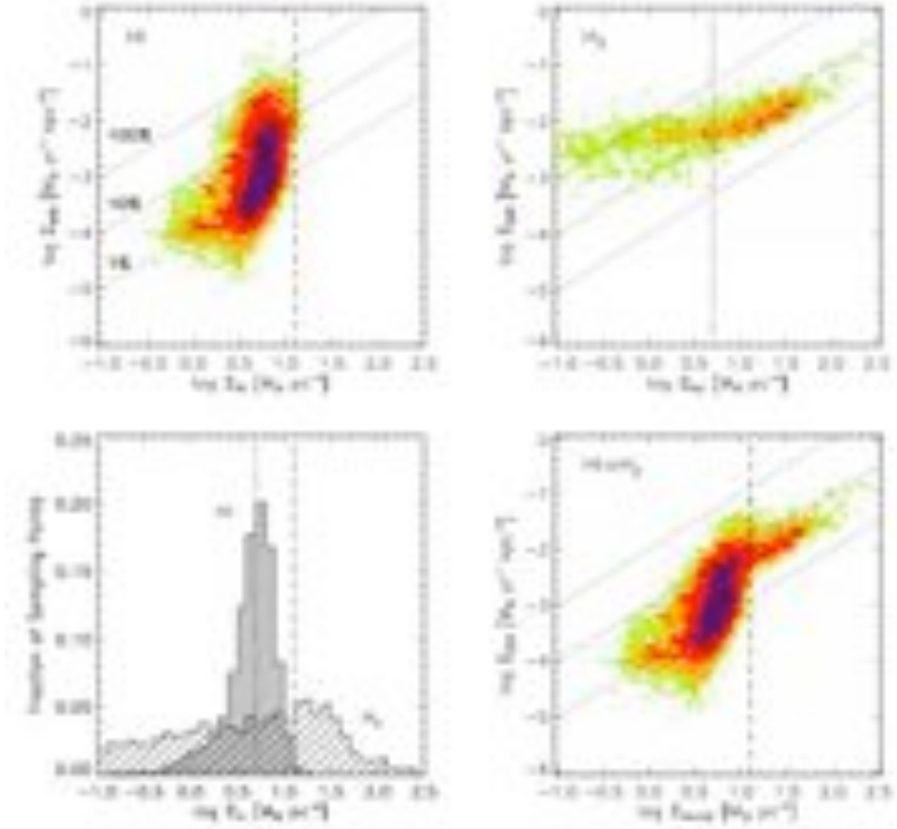
- How is star formation regulated?

- How are outer disks and cosmic web linked?

Star Formation; Dynamics

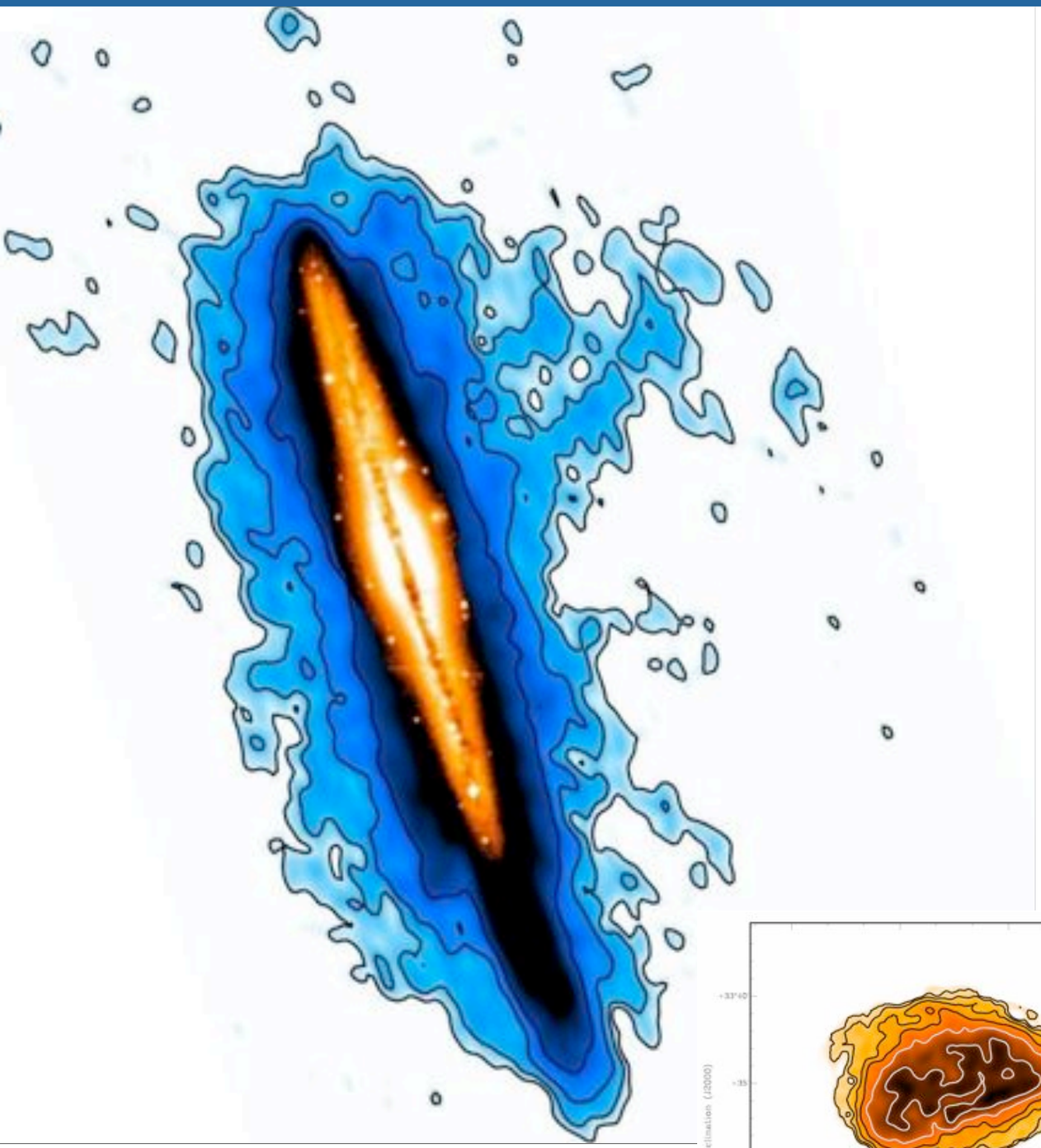




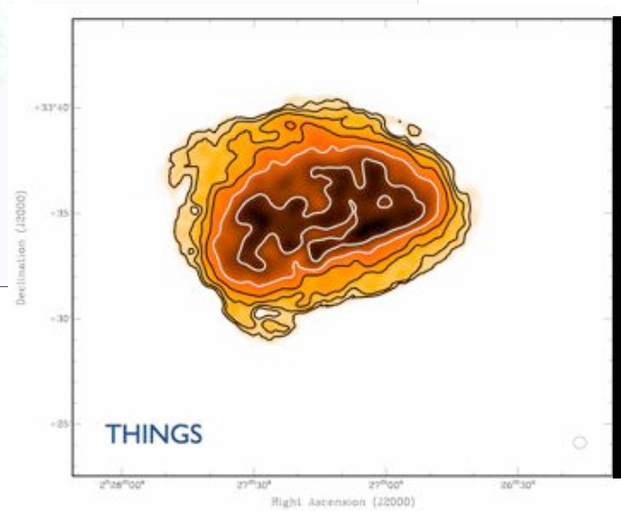


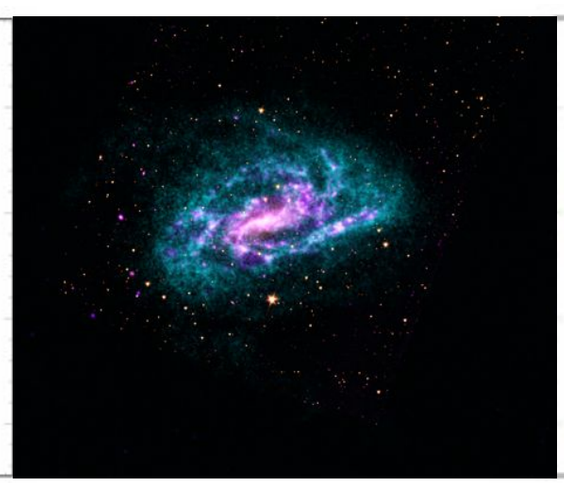
Walter, de Blok, Brinks, Bigiel, Leroy, Kennicutt, Oh, Trachternach et al 2008, AJ 136

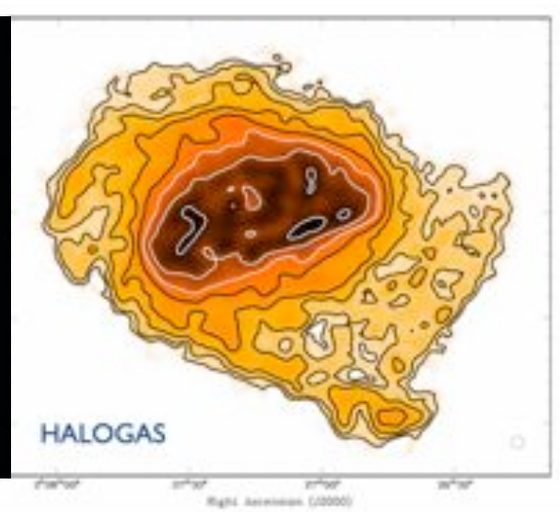
Galaxy halo-IGM connection



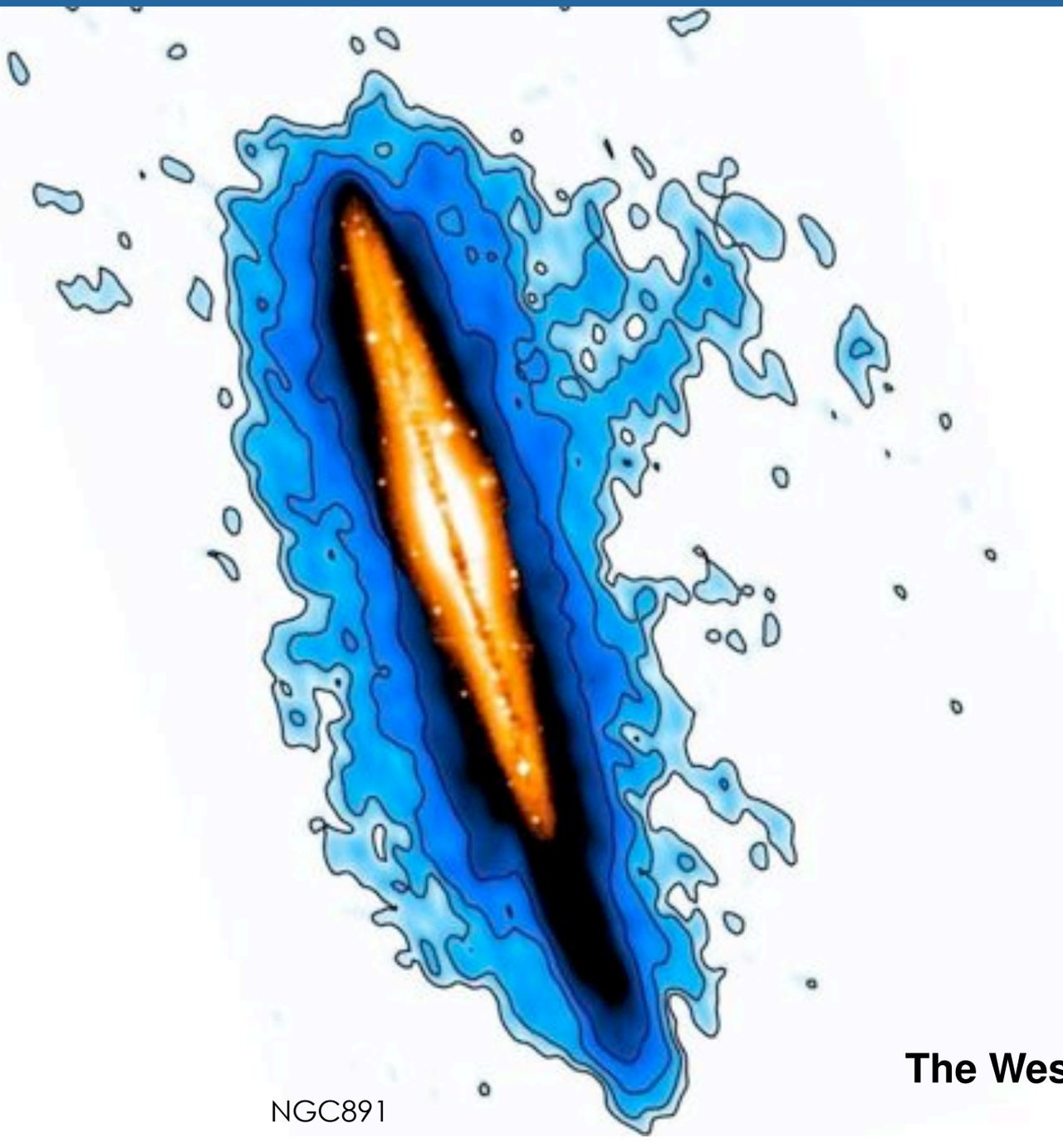
- Deep H I observations of nearby spirals may help to understand the relation with IGM
- Study the low column density H I in nearby Universe to see how this connects to IGM





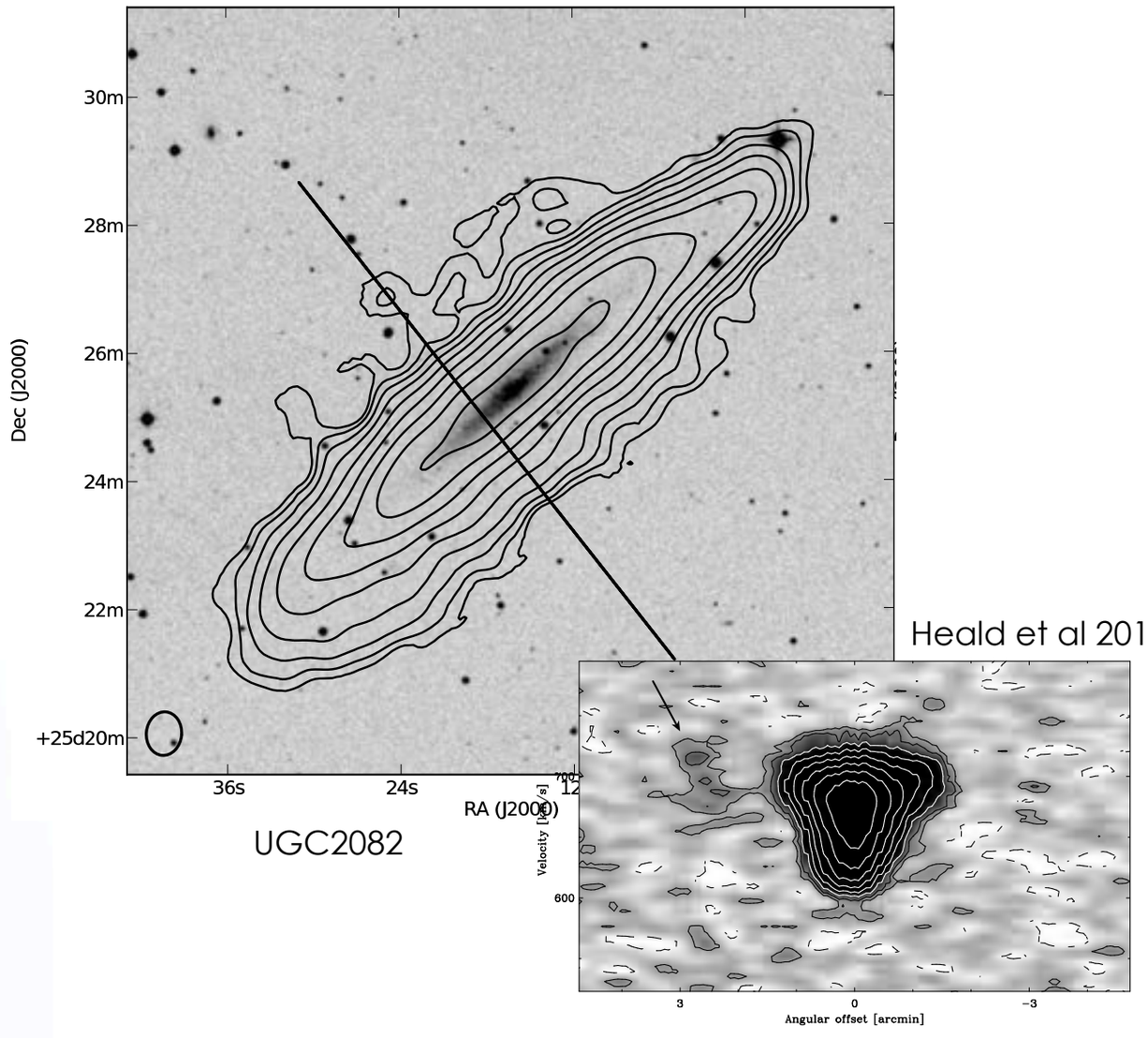


Accretion



NGC891

Oosterloo et al (2007)



UGC2082

Heald et al 2011

The Westerbork Hydrogen Accretion in Local Galaxies (HALOGAS) Survey

A&A 526, 2011

I. Survey Description and Pilot Observations

George Heald[1], Gyula Józsa[1], Paolo Serra[1], Laura Zschaechner[2], Richard Rand[2], Filippo Fraternali[3], Tom Oosterloo[1,4], Rene Walterbos[5], Eva Jütte[6], and Gianfranco Gentile[7]

Team

MHONGOOSE

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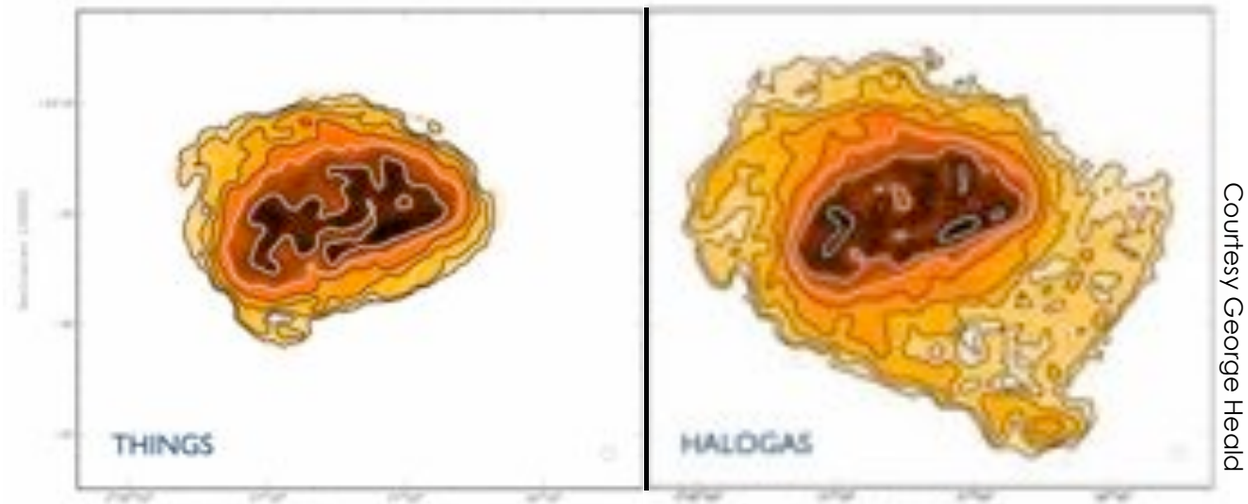
MeerKAT HI Observations of Nearby Galactic Objects: Observing Southern Emitters

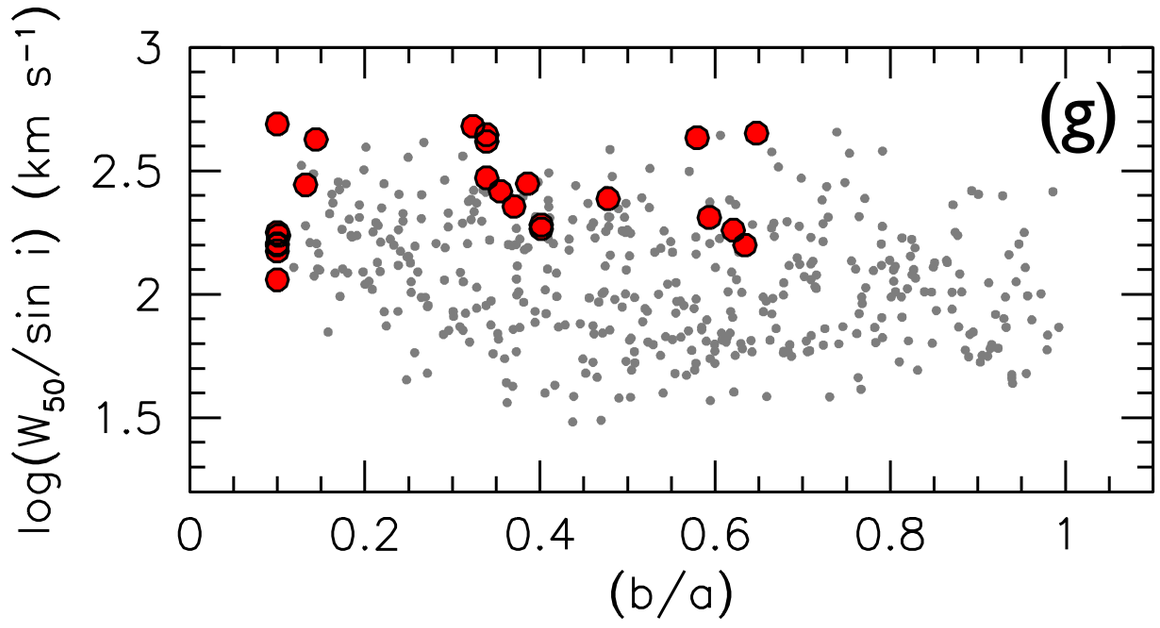
- MHONGOOSE project:
  - 30 nearby galaxies ultra-deep for 200h each ⇒ 6000h (“deep”), uniform over log(M_{HI})

Deep

- 200h per galaxy - cf. THINGS 8h
- Accretion, cosmic web, dynamics beyond disk
- Equivalent to HALOGAS but different parameter range
- $5\sigma = 1.2 \cdot 10^{19}$ cm^{-2} at 30" for 16 km s^{-1} FWHM HI line at 5 km s^{-1} channel spacing or 5.10^{17}-10^{18} cm^{-2} at 90"



Courtesy George Heald

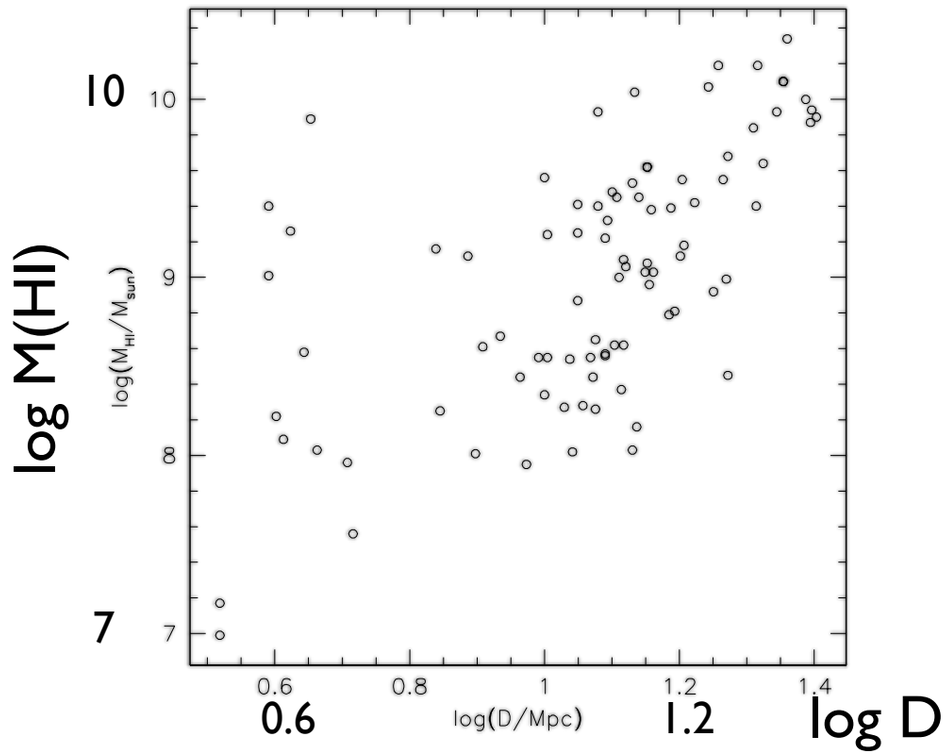


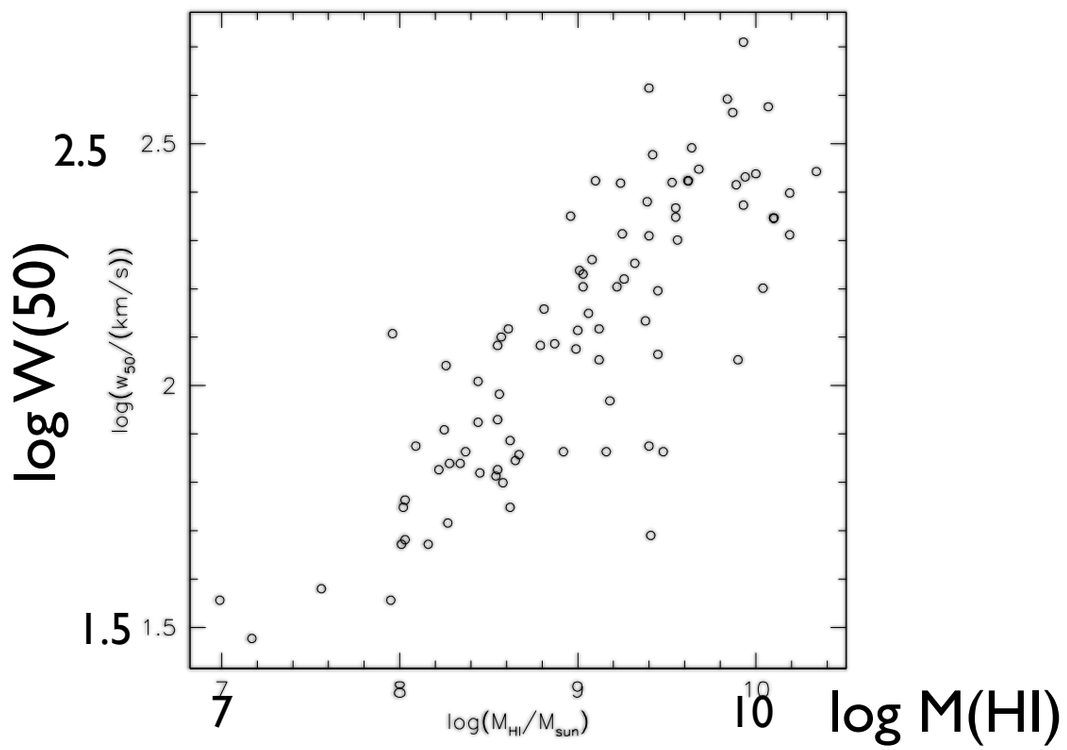
Selecting a shallow sample

- Southern galaxies less often imaged in HI
- Define shallow sample
- Criteria for the MHONGOOSE shallow sample
  - HI detection
  - Extended
  - Resolution sub-kpc
  - Ensure log(M_{HI}) coverage
  - Little foreground extinction
  - Multi-wavelength for characterization

Shallow Sample

- Overlap between HIPASS (4315) and SINGG (331) and SUNGG (200) (Meurer et al)
- Already chosen with uniform log (M_{HI}) coverage **151**
- declination < -10 deg
- D < 30 Mpc **88**
- HI masses ~10^6 to ~10^{10} $M_\odot$
- Luminosity M_R ~ –12 to M_R ~ –22.
- Samples comprehensive range of conditions found in local galaxies
- Bins of 0.5 dex in log(M_{HI})
- Final sample 4-5 galaxies per bin





Also

- 200 hours makes possible a 5σ peak flux detection of a 250 km/s M_{HI}* galaxy at z=0.09
- high-resolution, high S/N inner disk

Next...

- soon: fix and prune shallow sample
- later in 2011: first proposals + archival data
- 2012-13: collect new shallow sample data, observation simulations
- 2014: MeerKAT commissioning
- late 2015: full observations start