

Nearby Galaxies Science
with
SKA-1 MID and Survey

Past Progress

- Progress in nearby galaxies research driven by
 - increase in resolution
 - *matched* resolution multi-wavelength obs
 - prototype: THINGS/HERACLES
 - including B-array leap forward enabling sub-kpc for $D < 20$ Mpc

THINGS

The HI Nearby Galaxy Survey

NGC 2841

NGC 3621

NGC 7331

NGC 4826
(M64)

NGC 3198

NGC 6946

NGC 3184

NGC 925

NGC 3351
(M95)

NGC 5194
(M51)

NGC 3521

NGC 4214

NGC 2976

DDO 53

NGC 1569

M81dwB

M81dwA

NGC 5236
(M83)

NGC 2366

Our Galaxy
HI stars

IC 2574

NGC 4449

NGC 3627
(M66)

Holmberg II

NGC 7793

DDO 154

NGC 4736
(M94)

NGC 3077

Holmberg I

NGC 2903

NGC 5055

NGC 628
(M74)

NGC 5457
(M101)

NGC 3031
(M81)

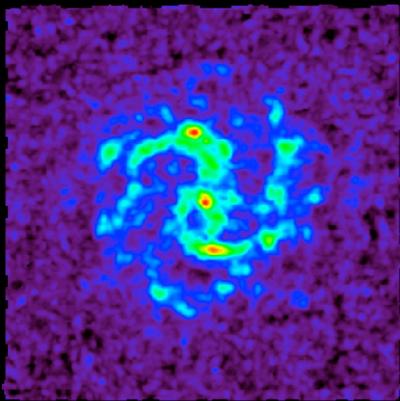
NGC 2403

↔
10 kpc

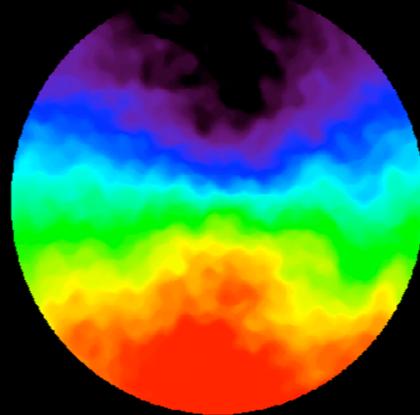
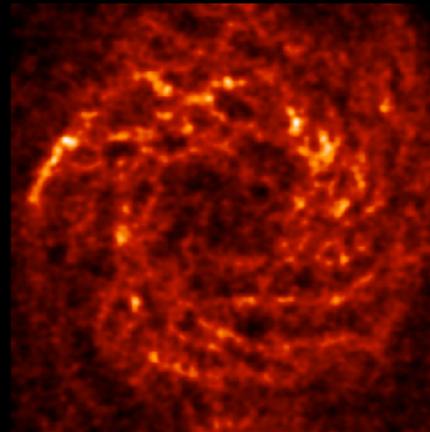


Data: Walter et al 2008
Milky Way HI map: Oort et al (1958)
Milky Way art: NASA/JPL, R. Hurt (SSC)

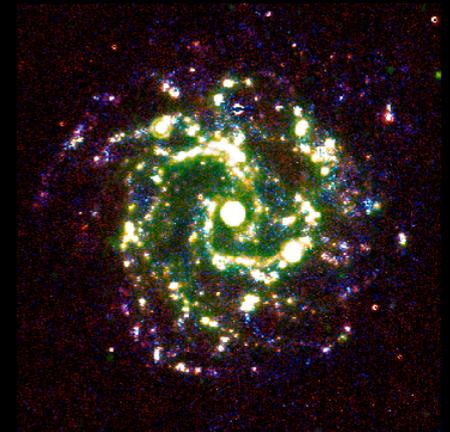
Molecular Gas
Peak CO intensity
From HERACLES



Kinematics
Here from HI line
Also from CO



Recent Star Formation
Composite of **FUV** (GALEX),
mid-IR (SINGS/LVL),
and **H α** (SINGS/LVL)

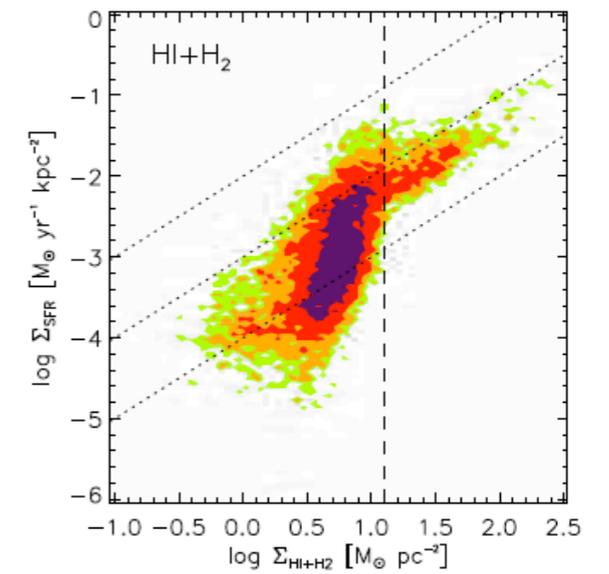
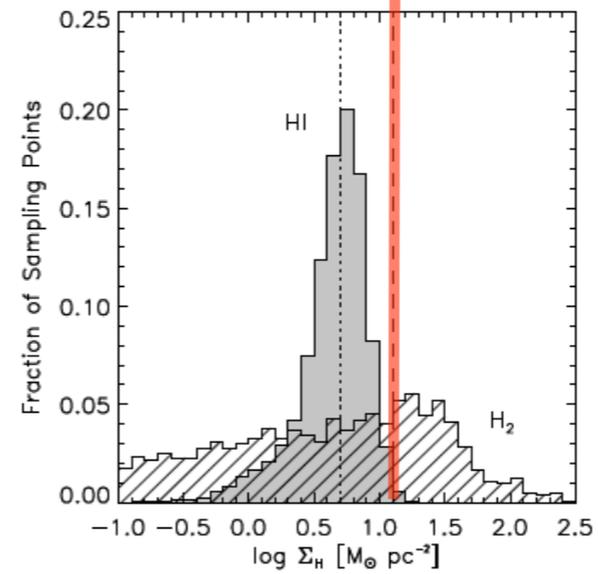
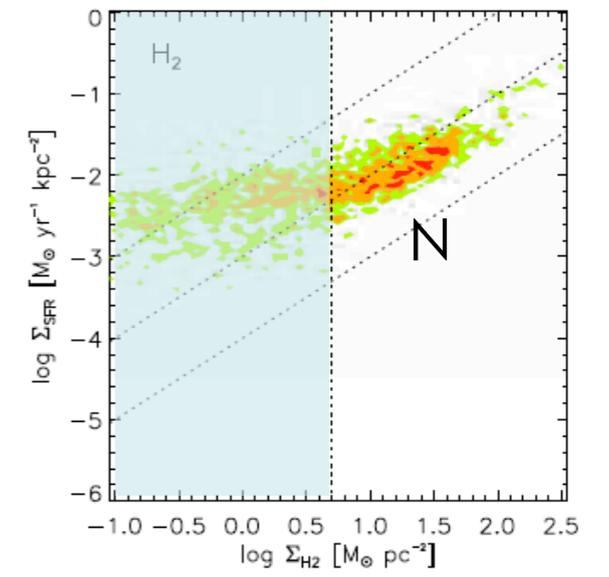
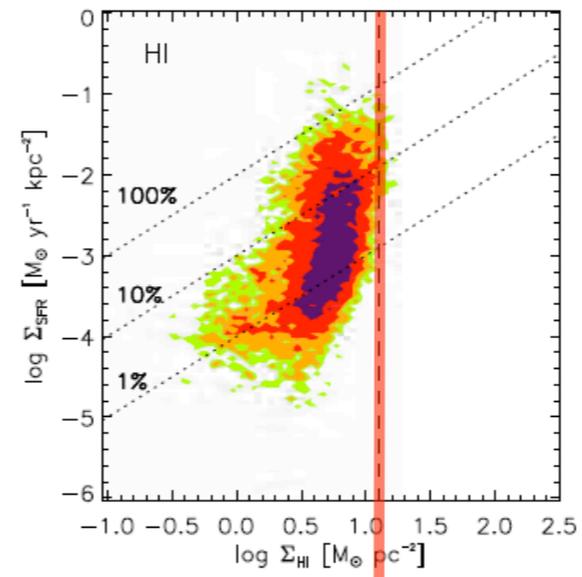
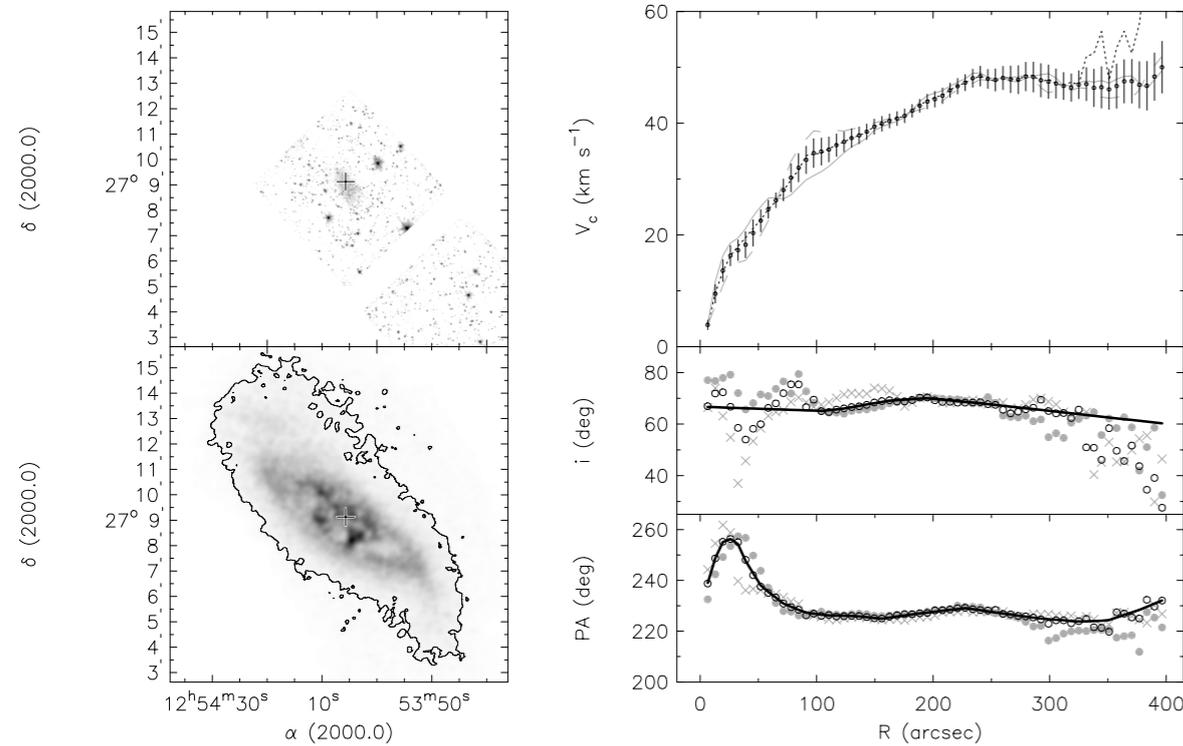
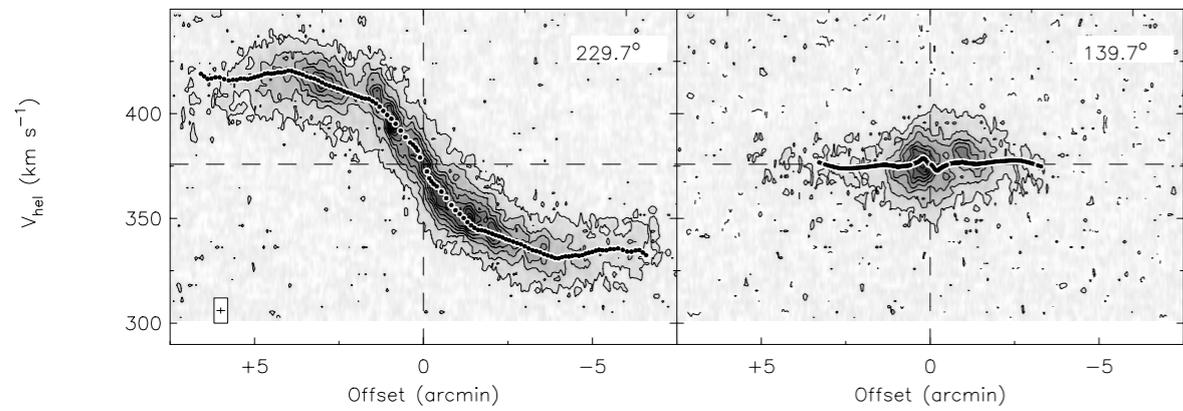
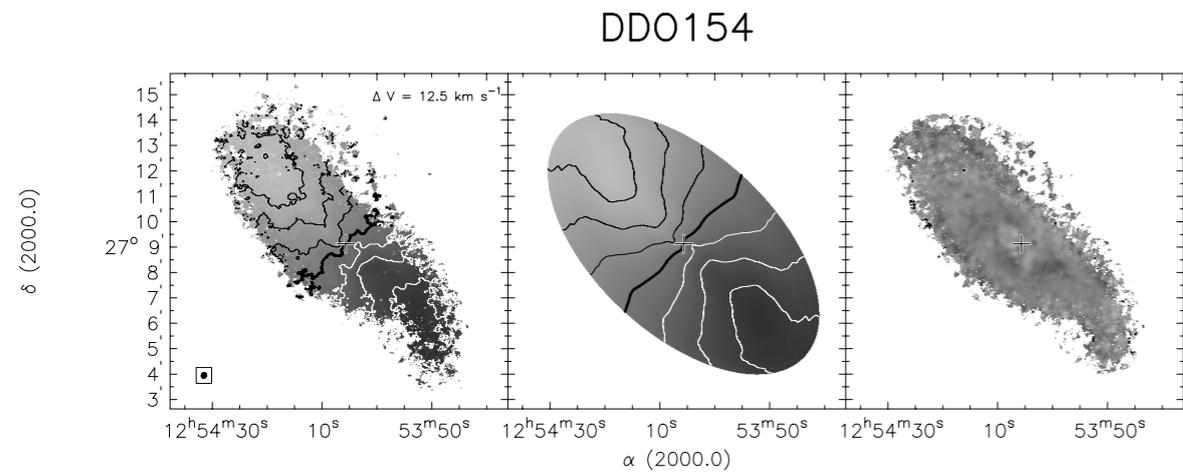


Atomic Gas
VLA 21cm data THINGS + new
& archival



Old Stars
Near infrared intensity
From SINGS and LVL



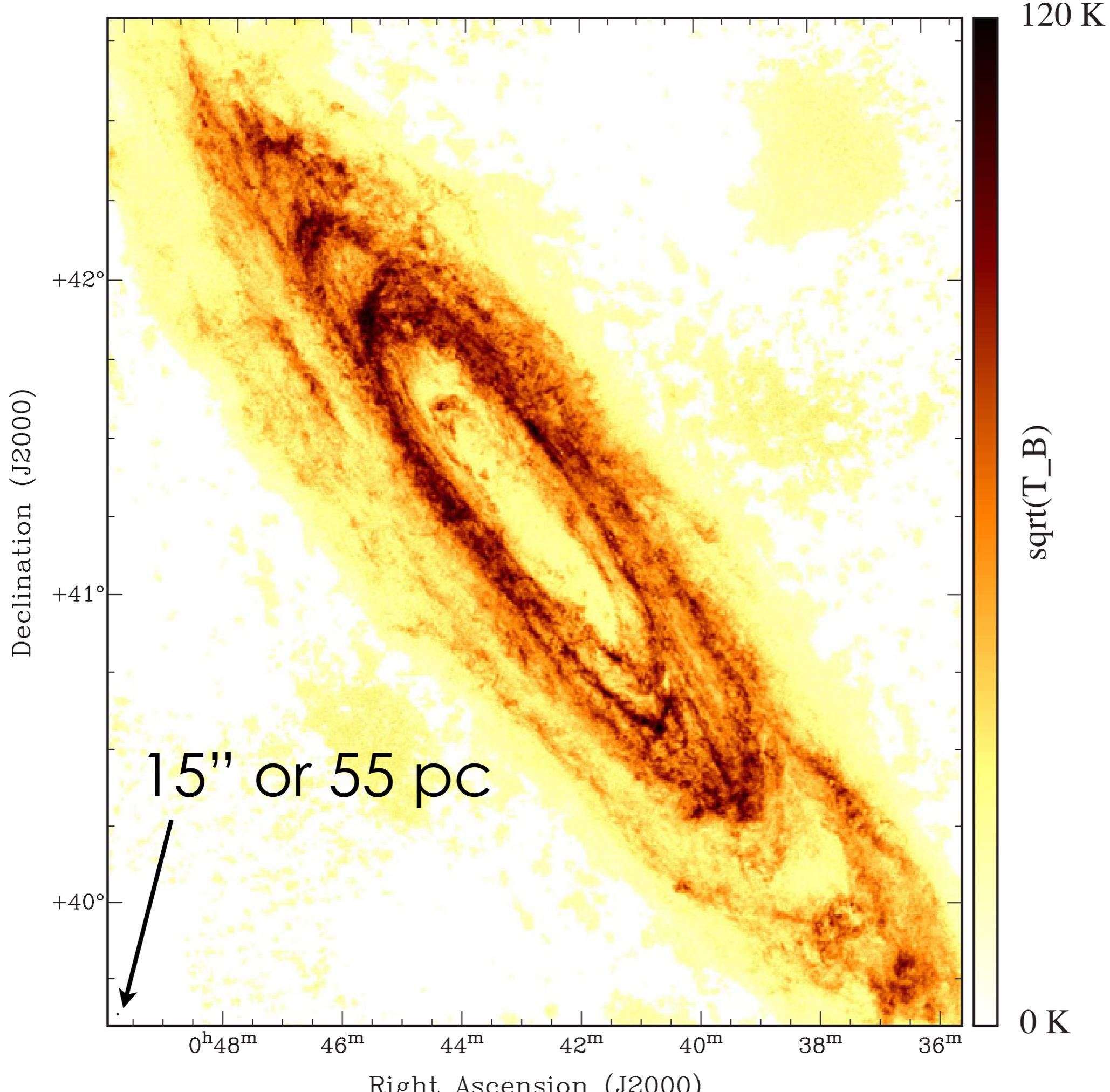


Bigiel et al (2008) and Leroy et al (2008):
two highest cited observational HI papers
2003-2013

Future Progress

- Use increased sensitivity to go beyond THINGS in distance and resolution
- Assume full sensitivity: MID ~ 6 VLA
 - 6 arcsec B-VLA → 2.5 arcsec MID
 - THINGS at 50 Mpc
 - tens of pc at original THINGS
 - multi- λ (ALMA!)

K-Sch Law breaks
down < 300 pc



BD design MID

- Imaging down to 10^{20} cm^{-2} at $2.5''$ with BD or 2nd design
- 20 km/s line at 5σ needs 126^{h} at full sensitivity
- but noise factor ~ 2.3 to 3.1 , so need ~ 650 to 1200^{h}
- ~ 8 galaxies in one year

BD Design SUR

- Such an experiment unfeasible for SUR (2200h at full sensitivity)
- THINGS at SUR: 10^{20} cm⁻² at 5σ , 6'' and 20 km/s HI: 68^h
- noise factor ~ 2.0 , so 270^h
- FoV enables probing full halo volume

Velocity resolution

- With sub-kpc resolution, SF will form large part of science case; especially if linked with ALMA
- Need to separate cold/warm medium in spectra
- CNM can have dispersions $\sim 1 \text{ km s}^{-1}$
- Need $\ll 1 \text{ km s}^{-1}$ channels (~ 0.1)

Summary

- Move beyond VLA-like studies, but current MID design cannot make full use of the “raw” sensitivity
- SUR could do THINGS-like surveys in different environments with census of halo volumes, but no higher resolution
- Need high velocity resolution to resolve ISM phases