

The Resolved Vertical Structure of Molecular Gas in Edge-on Disk Galaxies

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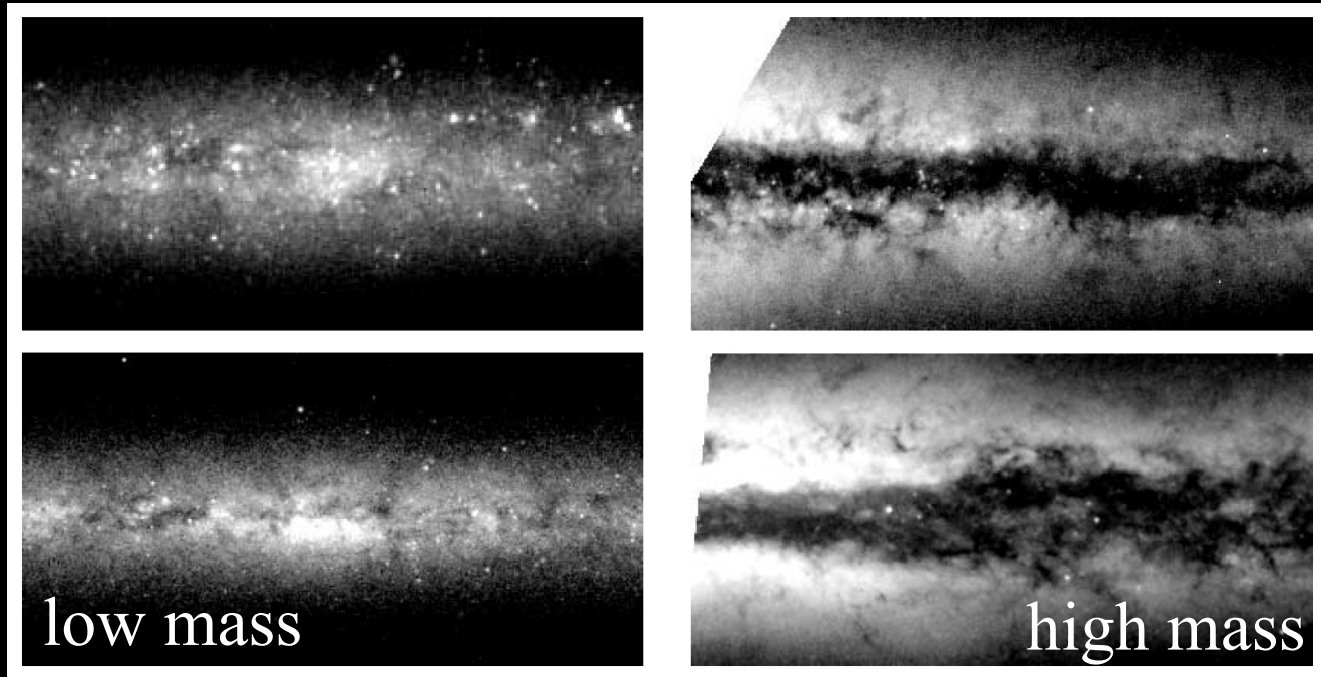
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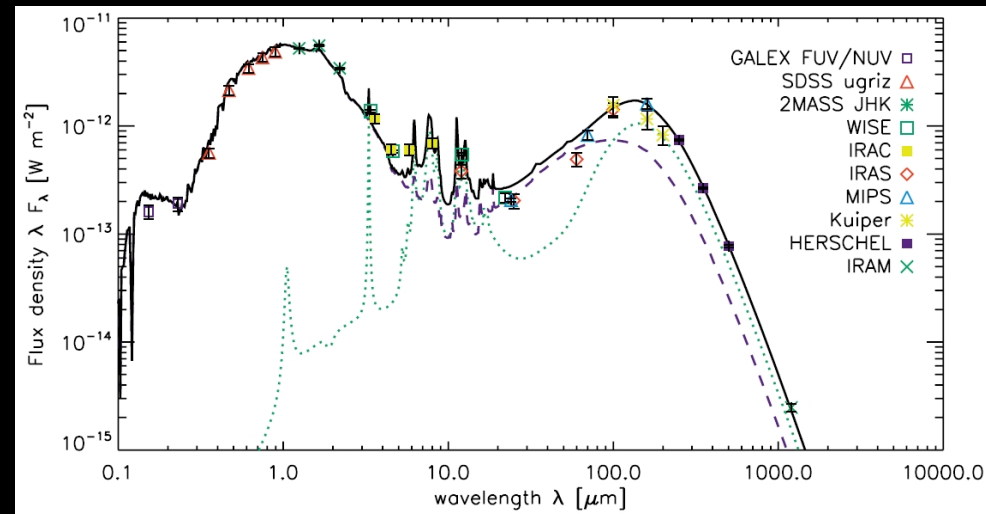
Background: Dalcanton et al. (2004)

- Study of 49 edge-on, late-type disk galaxies
- Objects with $v_{\text{circ}} > 120$ km/s (high mass) show well-defined dust lanes
- Objects with $v_{\text{circ}} < 120$ km/s (low mass) show no dust lanes

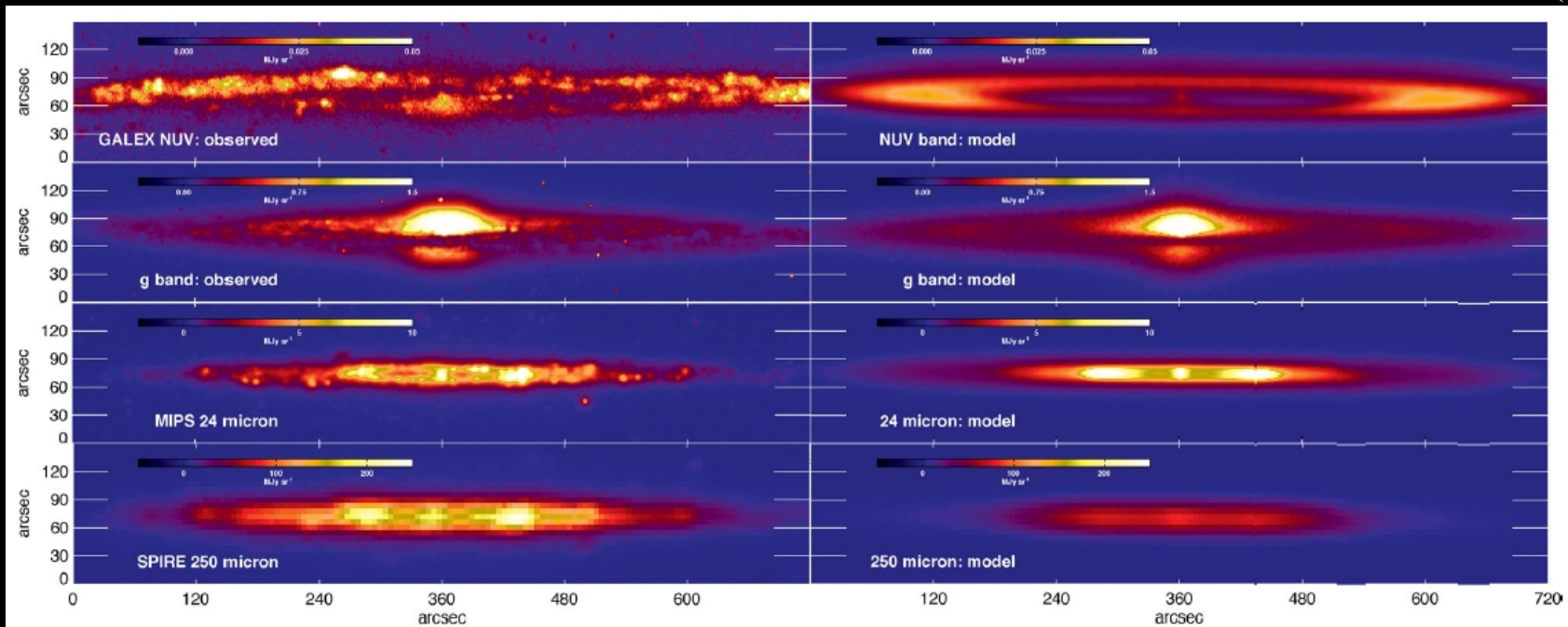


Predictions from Radiative Transfer Models

- Fit the optical appearance of the galaxy and the dust SED (e.g. MacLachlan et al. 2011; De Looze et al. 2012)
- High-mass galaxies: $z_d \sim 0.5 z_*$
- Low-mass galaxies: $z_d \sim z_*$



De Looze et al. (2012)



Motivation

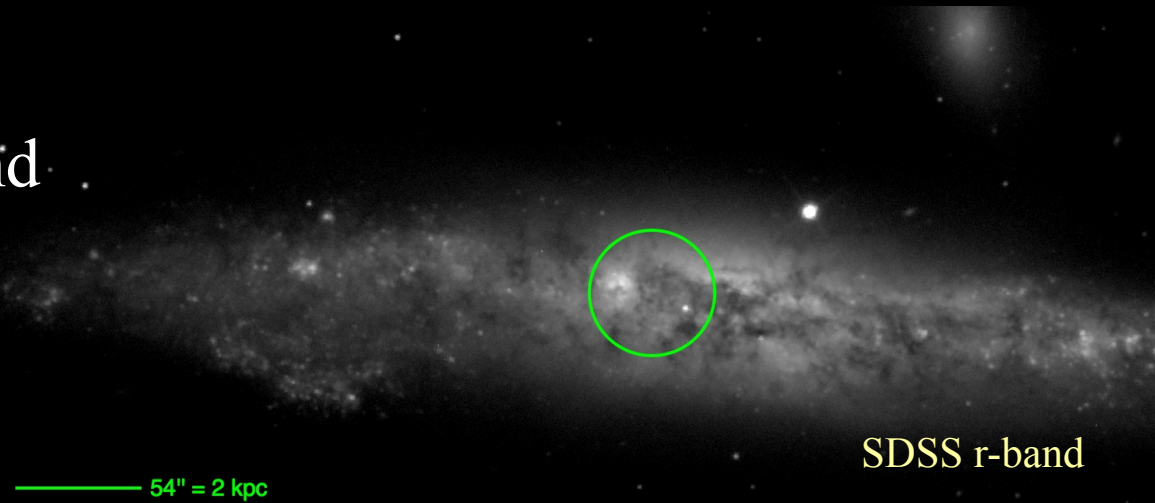
- Is there a transition in the scale height of the cold ISM at $v_{\text{circ}} \sim 120 \text{ km/s}$?
- If there is a transition in scale height, what physical processes are most important for causing the transition?
- Compare molecular gas scale height to predictions of the dust scale height from radiative transfer modeling

Submillimeter Array Observations of NGC 4631



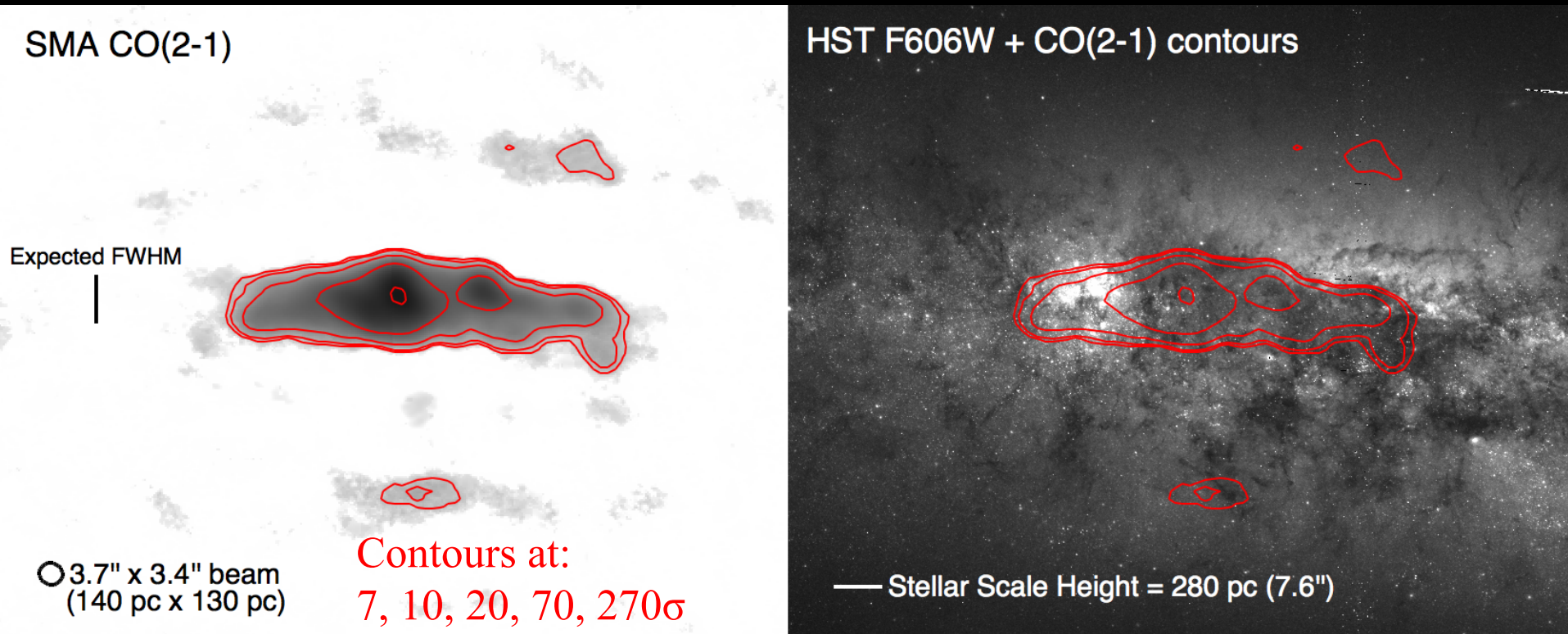
Image credit: Nimesh Patel

- NGC 4631 at CO(2-1):
 - Observed with subcompact, compact, and extended configurations
 - Sensitive to scales between 140 pc and 2 kpc



SDSS r-band

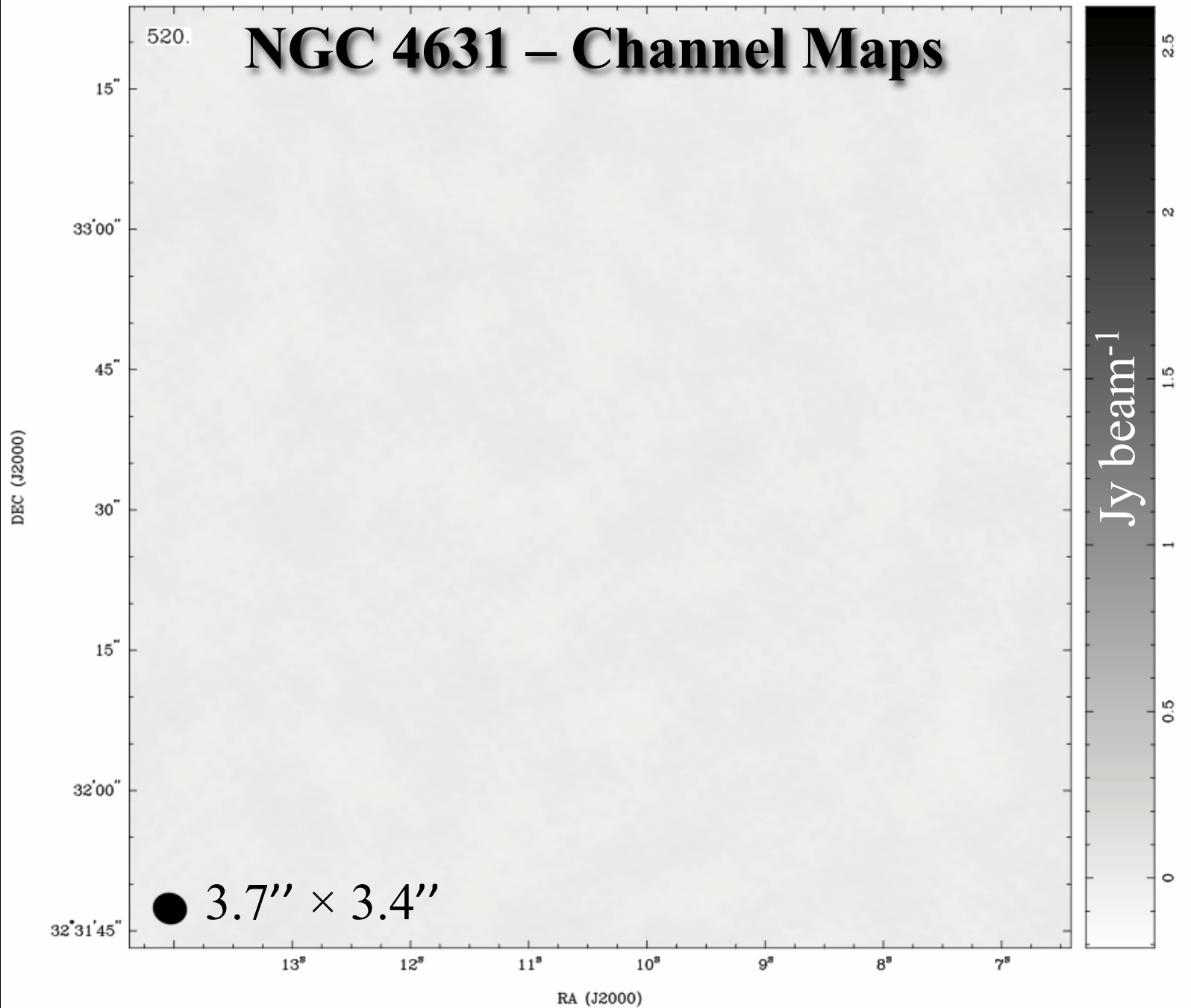
NGC 4631 ($v_{\text{circ}} = 132 \text{ km/s}$) – Integrated Intensity



HST image credit: GHOSTS; de Jong et al. (2007)

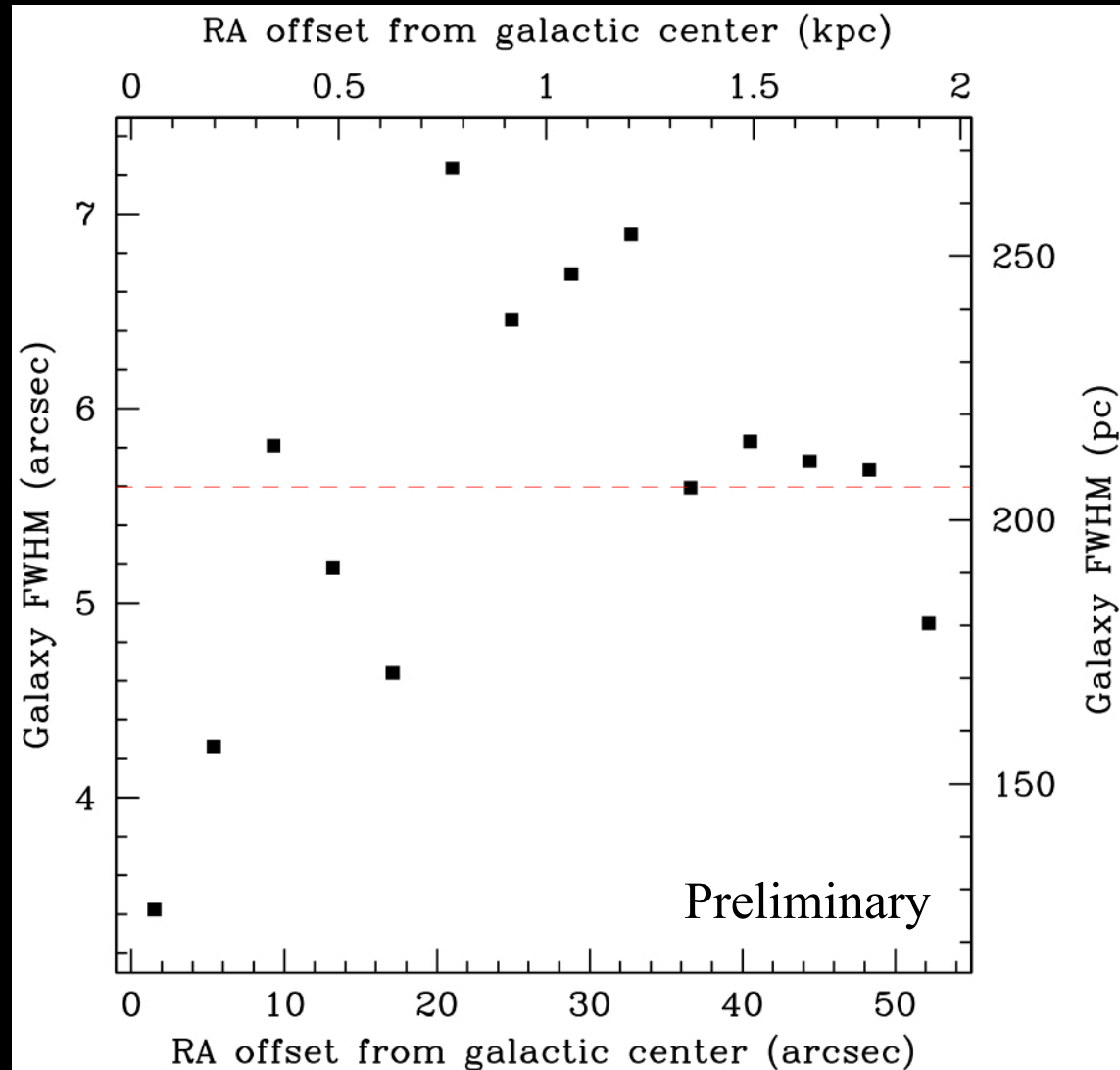
- Resolved the vertical CO distribution
- Stellar scale height from Seth et al. (2005)
- Expected CO FWHM based on assuming $z_{\text{CO}} \sim z_d \sim 0.5 z_*$

NGC 4631 – Channel Maps



FWHM of the Vertical CO(2-1) Distribution

- Average galaxy
 $\text{FWHM} = 5.6'' \pm 1.1''$
 $= 200 \pm 40 \text{ pc}$
- If $z_{\text{CO}} \sim z_d \sim 0.5 z_*$,
expect $\text{FWHM} \sim 280 \text{ pc}$
- Small measurement
error on FWHM ($\sim 0.3''$)
- FWHM results are
sensitive to parameter
choices in imaging



Summary

- The SMA data resolve the vertical distribution of CO(2-1) in NGC 4631
- Preliminary measurement of the FWHM of the vertical CO(2-1) distribution in NGC 4631 is consistent with expectations from radiative transfer models

NGC 4565 ($v_{\text{circ}} = 245 \text{ km/s}$) – Integrated Intensity

SMA CO(2-1)

CO FWHM

Contours at: 2σ and 5σ

○ 2.8" x 2.6" beam
(160 pc x 150 pc)

r-band + CO(2-1) contours

Stellar Scale Height = 480 pc (8.2")

- Additional compact + subcompact data to be processed soon
- Expected CO FWHM from De Looze et al. (2012)