Spectroscopy in the 3mm Band: Nearby "Normal" Galaxies

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NRAO-GB

Interesting Extragalactic Molecular Lines (80-116 GHz)

^{12}CO	115.27 GHz
^{13}CO	110.20
CS	97.98
HNC	90.66
HCN	88.63
HCO^+	89.19
SiO	86.8, 86.24, 85.64 (thermal and maser)
$H^{13}CO^+$	86.75

...

(all of these are imperfect tracers of H_2)

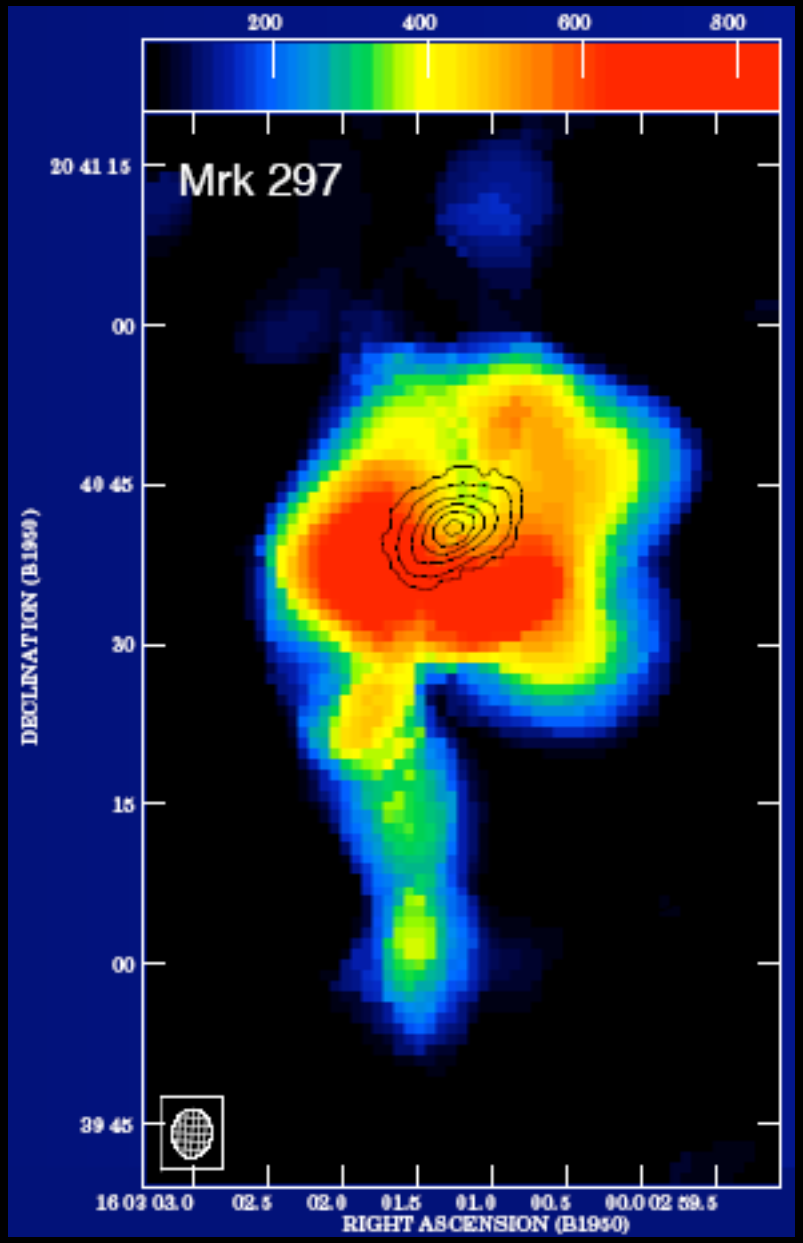
Examples of GBT 3mm Science

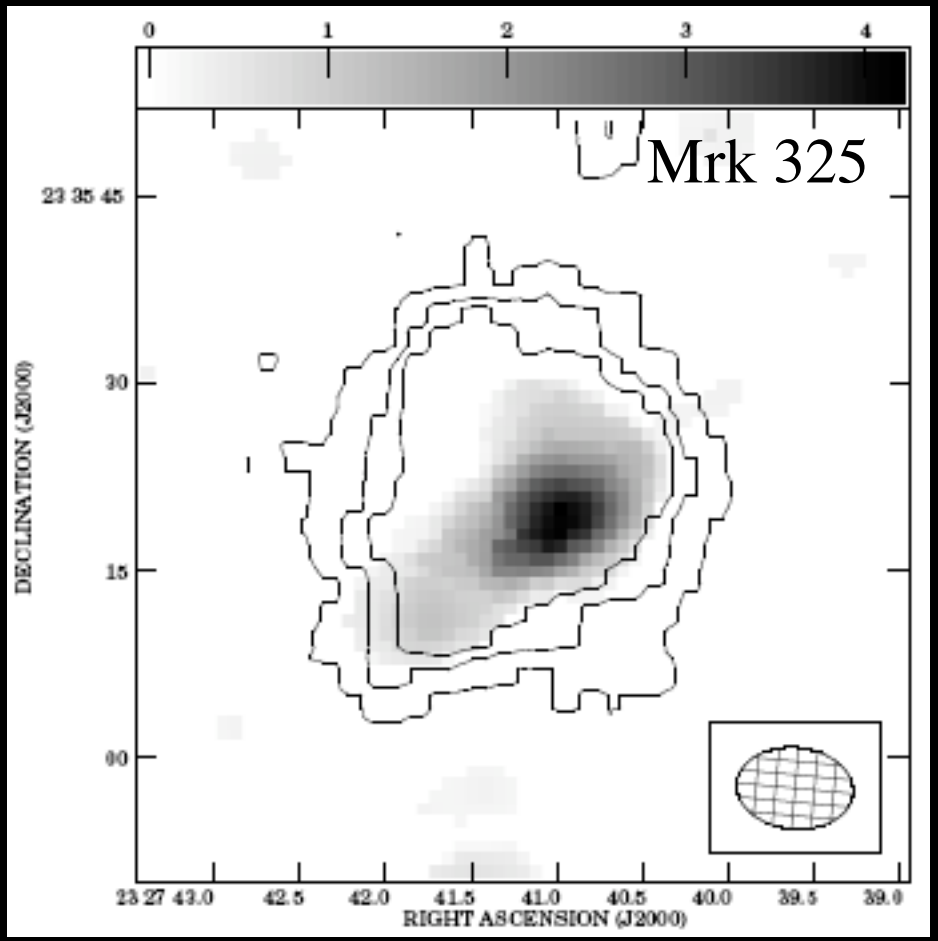
- Resolved studies of the molecular phase of the ISM in nearby galaxies.
- Better studies of GMCs in other galaxies
- Correlation of molecular gas with star formation.

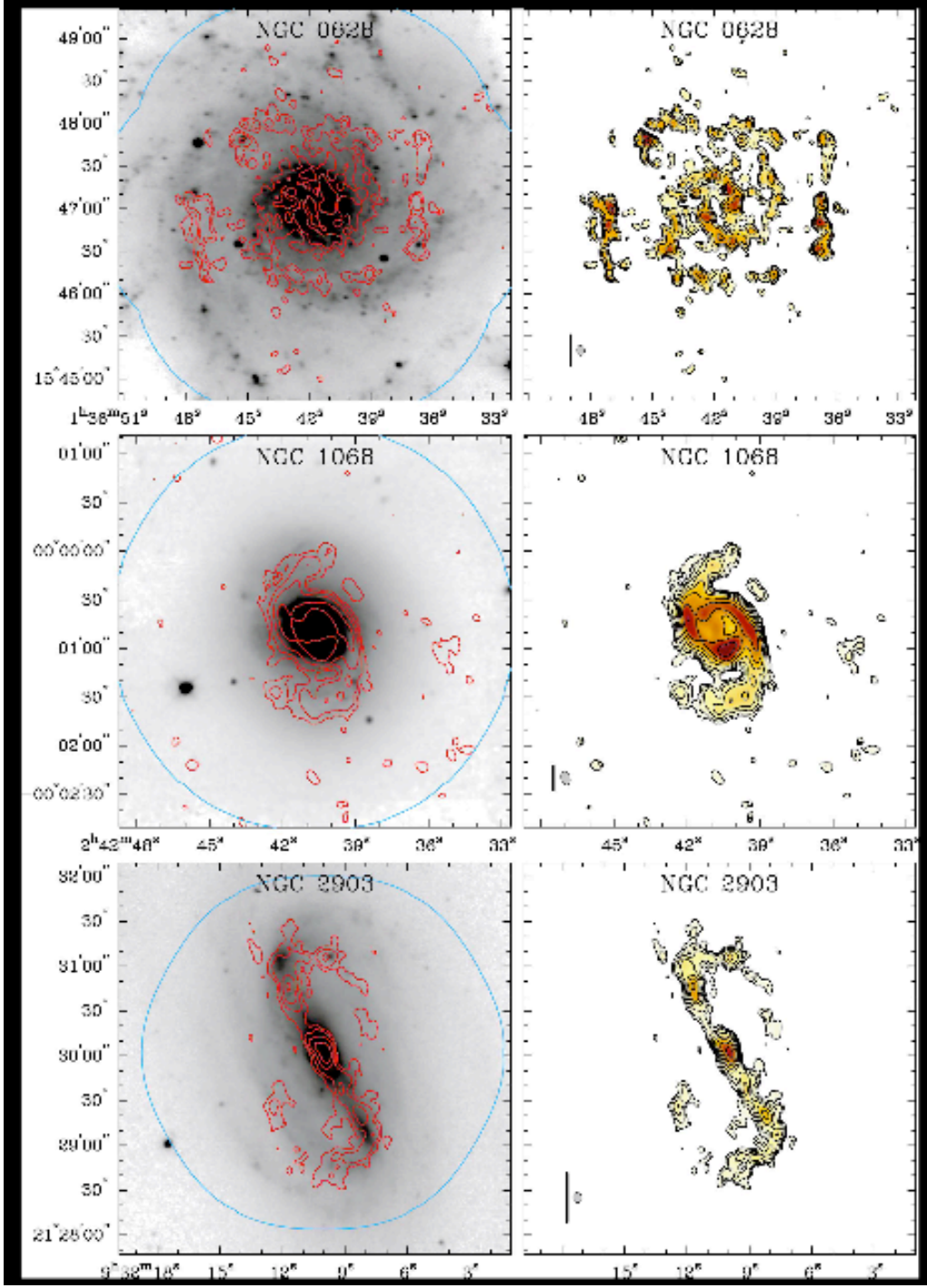
Can study SF process under different physical conditions (metallicity, excitation, etc.)

OVRO CO Maps of LCBGs

(Garland et al. 2006)







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(Regan et al. 2001)

look at CO distribution

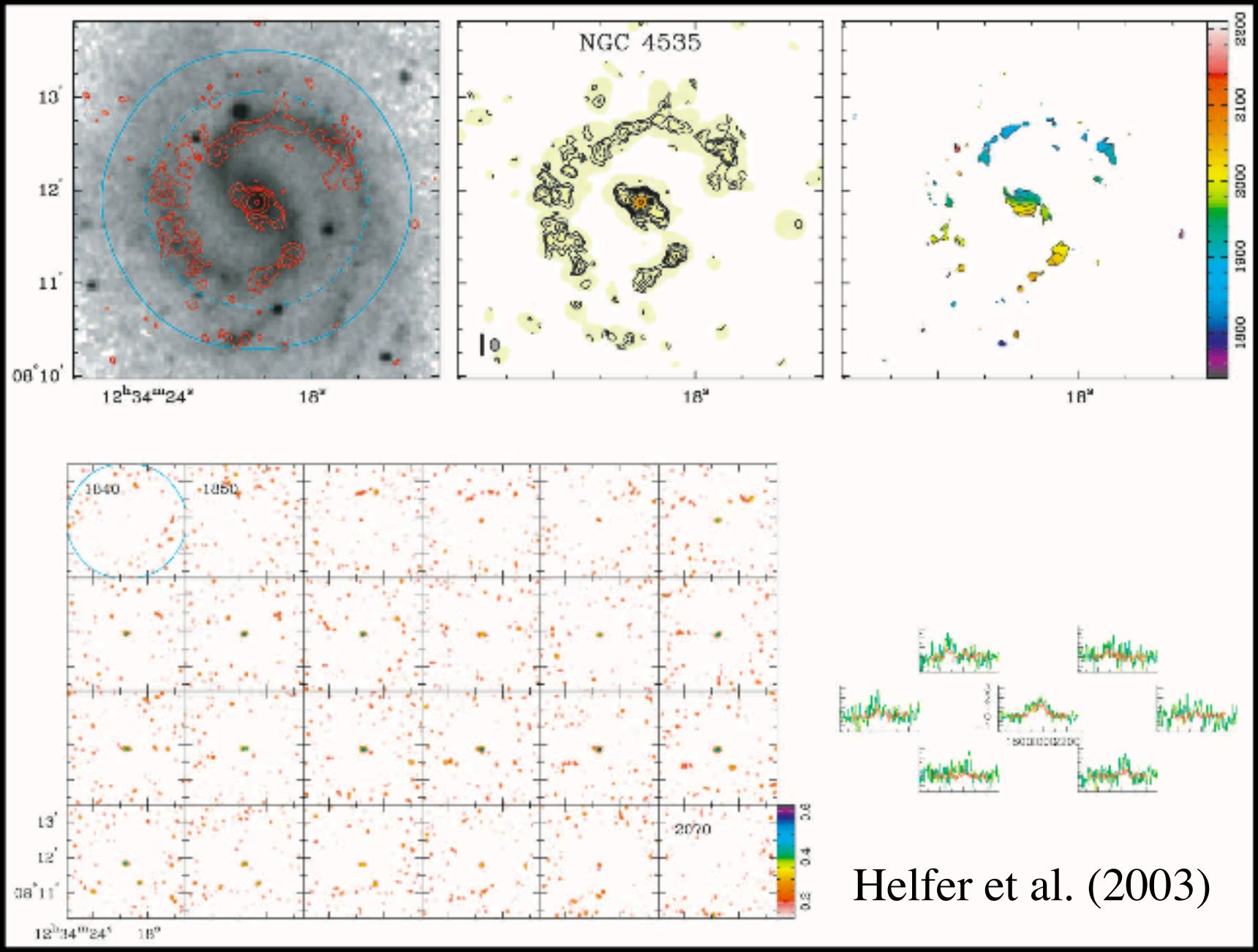
correlate with star formation tracers

study dynamics

Can measure CO-H_2 ratio using GMCs:

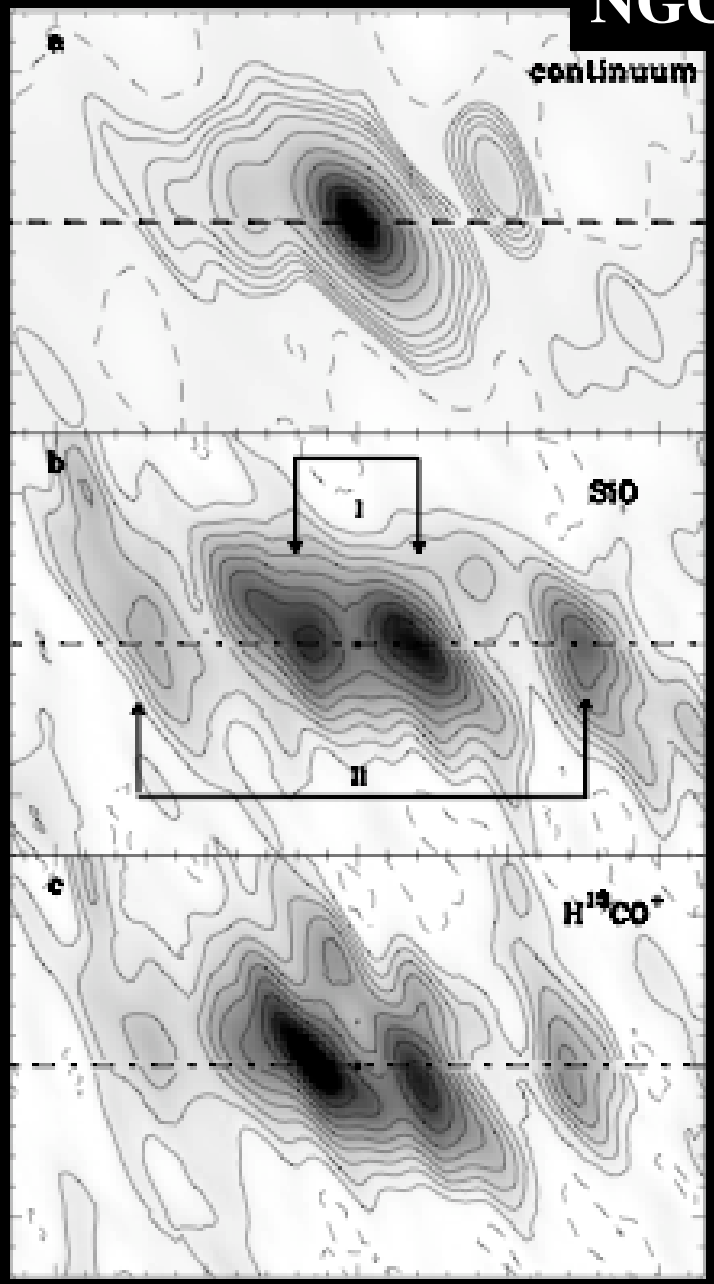
$M_{mol} \approx M_{vir} \sim \sigma^2 R/G$

BIMA SONG



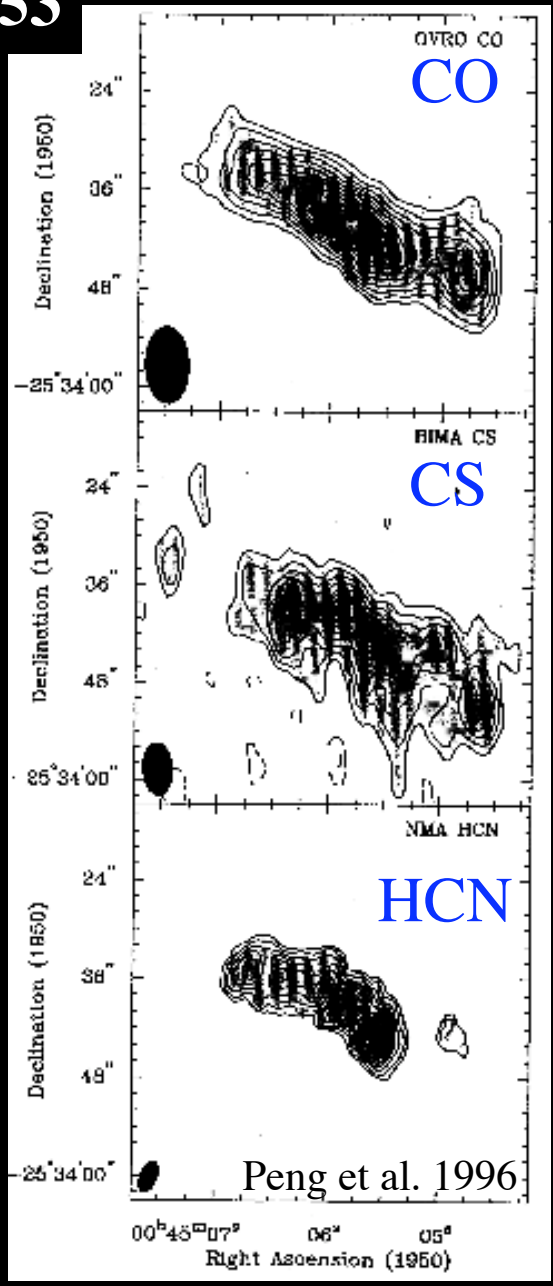
Helfer et al. (2003)

NGC 253



20”

Garcia-Burillo et al. 2000



Peng et al. 1996

A GBT 3mm FPA Specification

T_{sys} = 200 K

η = 10 %

Gain ~ 0.28 K/Jy

From GBT sensitivity calculator:

10 mK in 1 minute over 10 km/s

ν = 86 - 115 GHz

θ = 8″ - 6″

16 beams (SEQUOIA-like)

FOV = 50″ x 50″

100 beams (future FPA?)

FOV = 120″ x 120″

Other 3mm Telescopes

To get 10 mK sensitivity:

CARMA (E configuration):

FOV ~ 3', 9" resolution, 10 hr

LMT (w/ SEQUOIA):

FOV ~ 90", 12" resolution, ~ 3 min

ALMA (compact configuration):

FOV ~ 50", 4" resolution, ~ 1 min

With a FPA, the GBT will be competitive in mapping speed and resolution to these instruments.

Advantages of GBT

- Short-spacing data is free. For example, this allows more accurate comparison of M_{virial} and M_{mol} for GMCs.
- Very sensitive. With an FPA, GBT can map large galaxies quickly.
- Biggest Advantage comes with combining GBT+interferometer for better image fidelity.
- With the right spectrometer, could map multiple transitions simultaneously.
- Same beam size at all sky positions.
- Should be the most stable single-dish system.