Resolved [CII] (158μm) spectroscopy of M33 @ 50pc with HIFI

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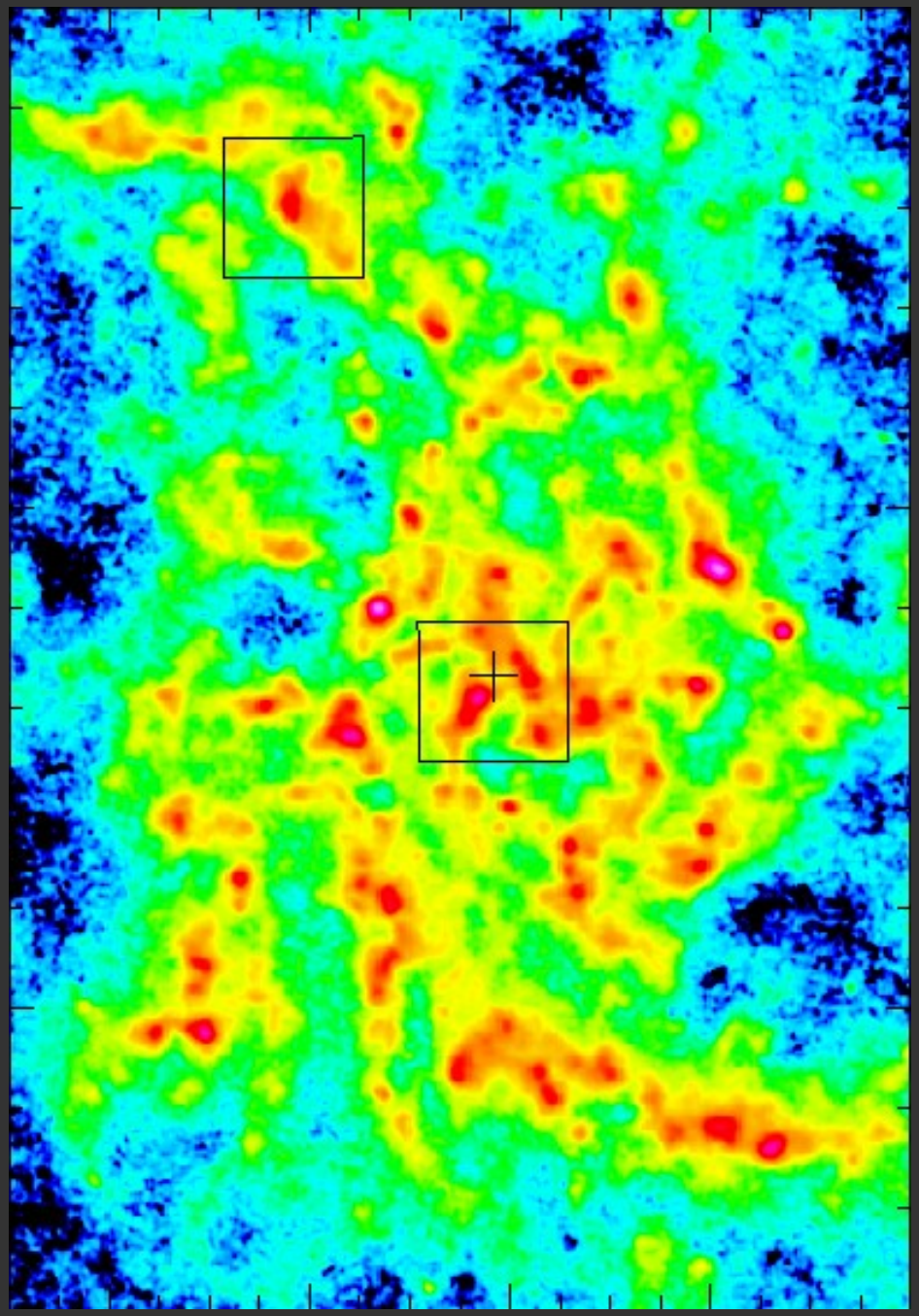
M33: At a resolution (12") 50 pc

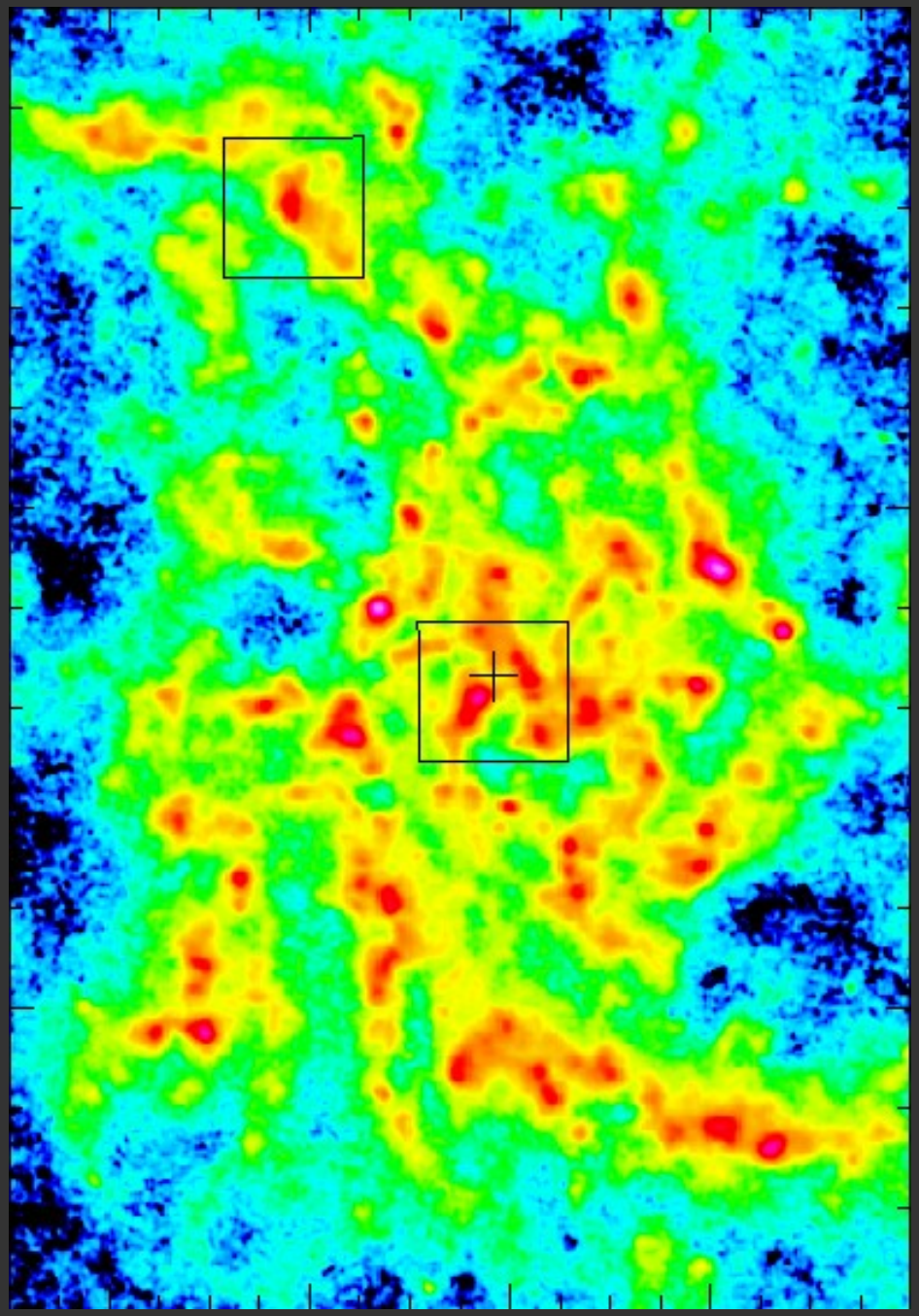


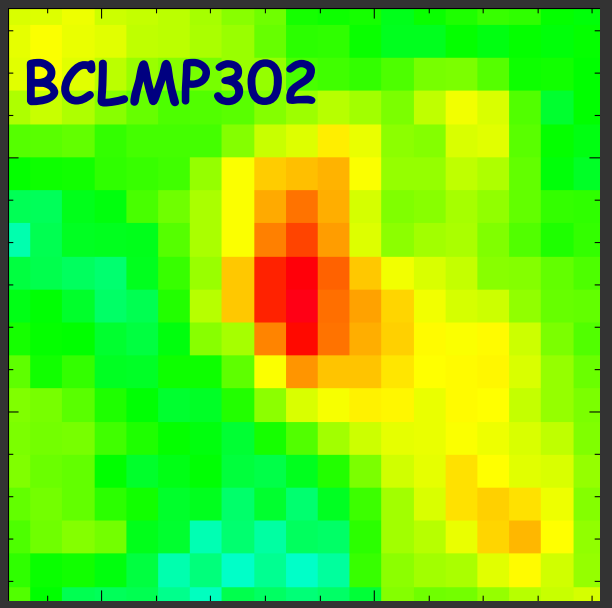
- Distance = 840 kpc
- Inclination = 56 deg
- Individual molecular clouds
- Metalicity ~ 0.5 Solar

- [CII] from individual regions along the major axis
- Origin of [CII] --- atomic, molecular, ionized
- Small maps of [CII] & [OI (63)], with PACS
- [CII] cuts with HIFI

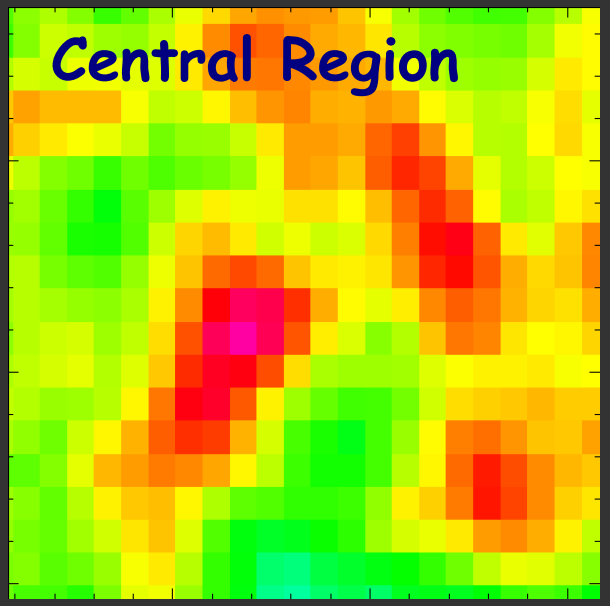
PACS 160 μm ; Boquien et al. (2011)

M33: Center & Northern HII region BCLMP302



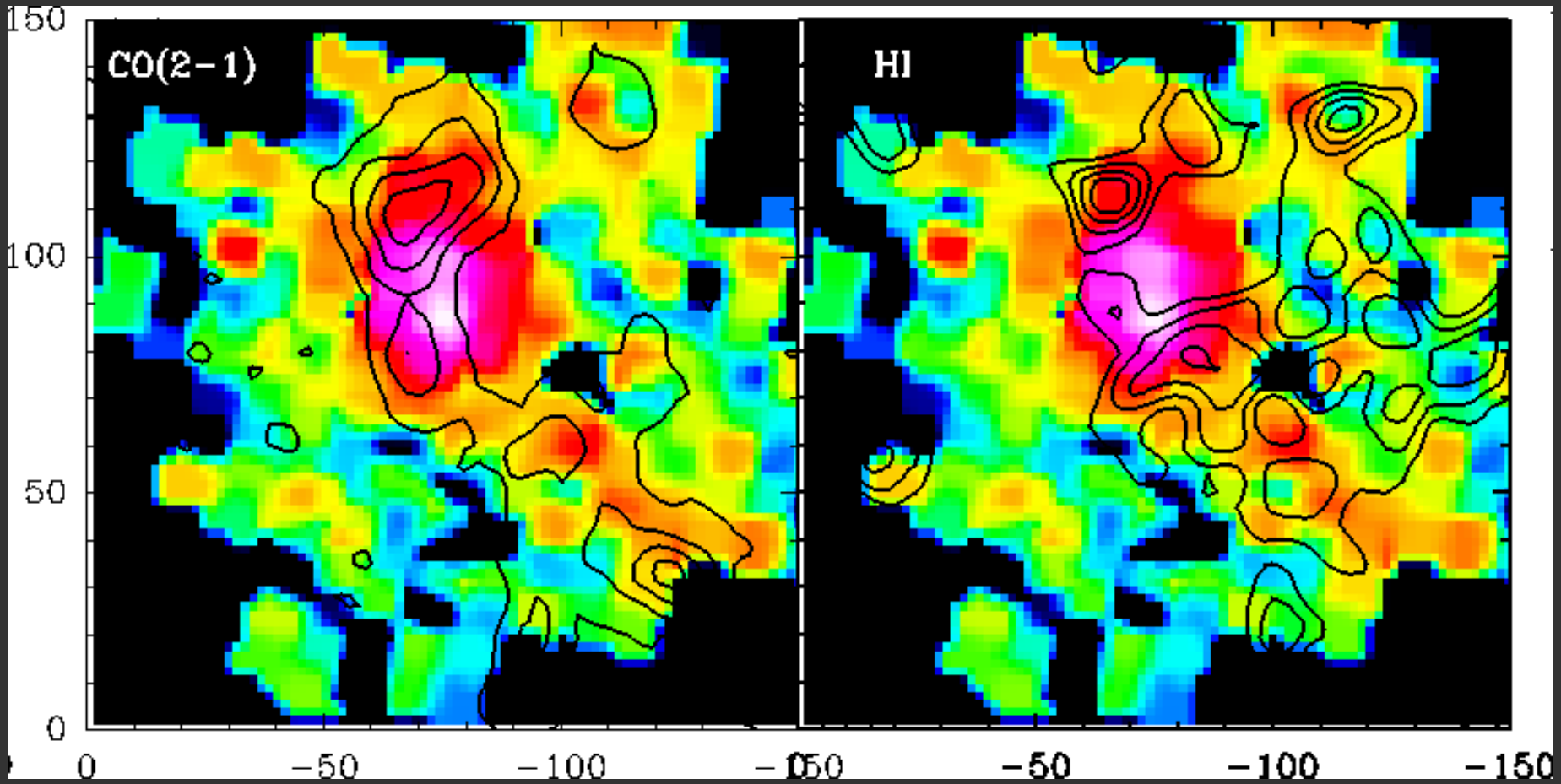


R_G = 2 kpc



PACS 160 µm ; Boquien et al. (2011)

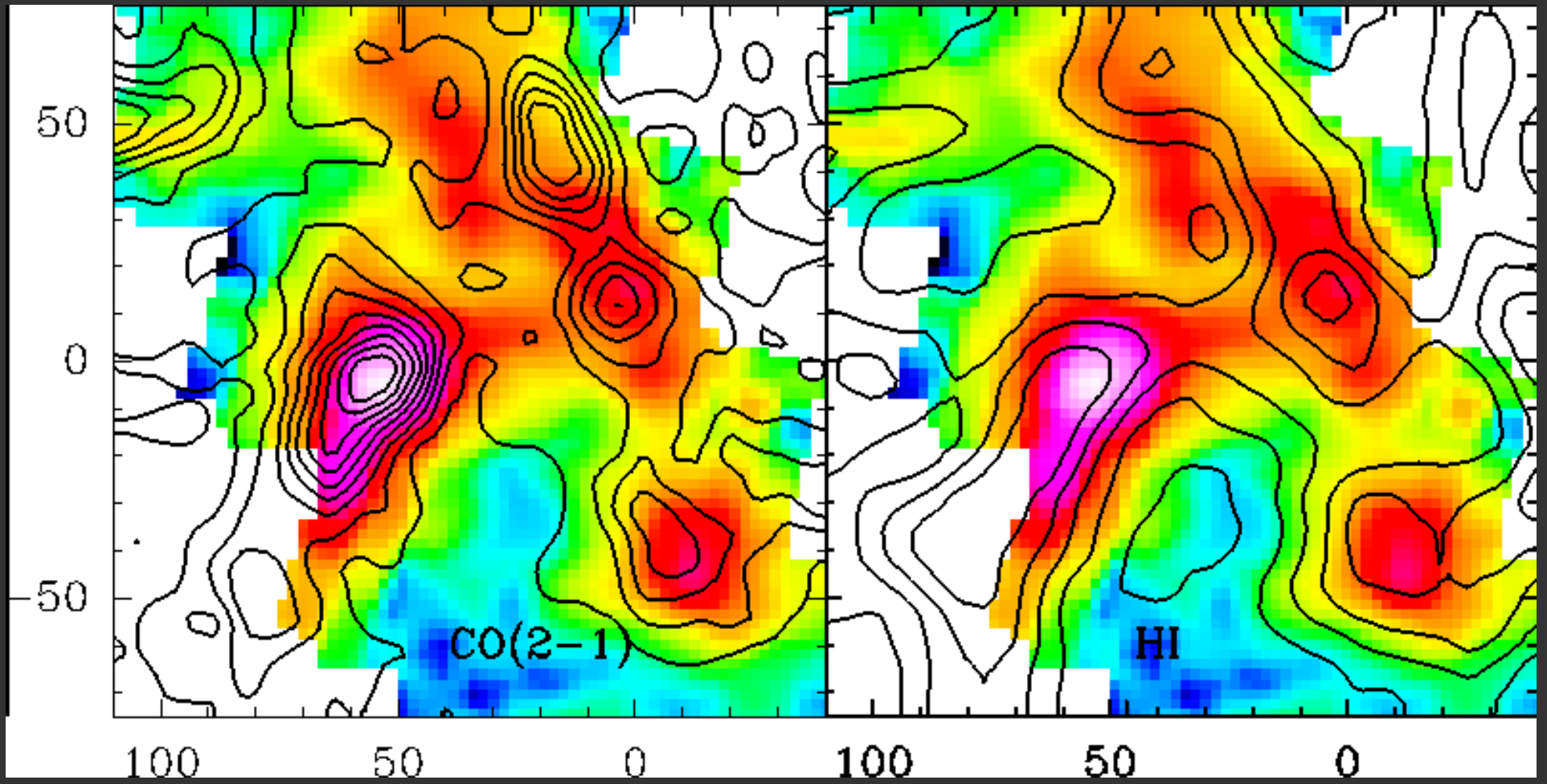
PACS [CII] Spectroscopy, CO(2-1) & HI distribution BCLMP302



- CO(2-1) from IRAM 30m & HI from VLA both at 12" resolution
- BCLMP302 CO(2-1) "similar" but HI completely different

Mookerjea et al. (2011)

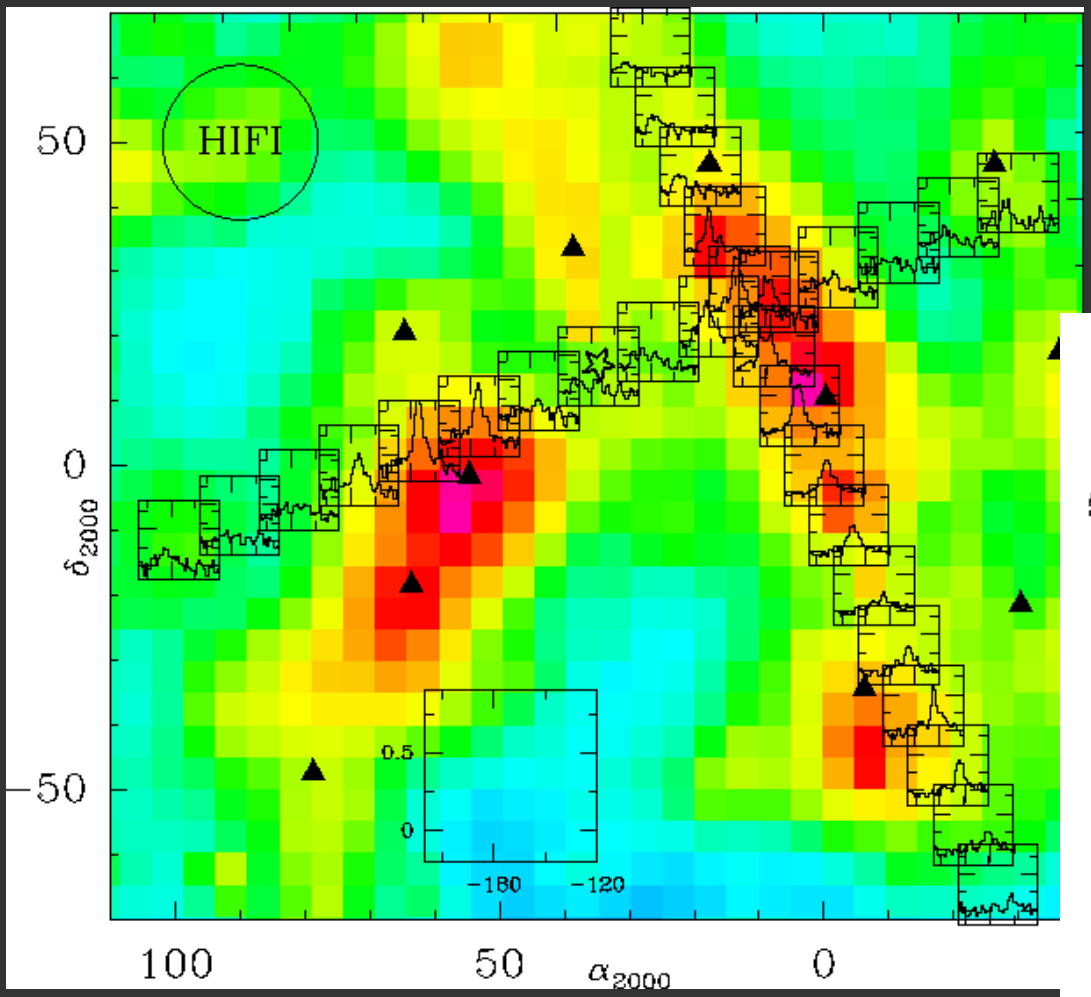
PACS Spectroscopy [CII], CO(2-1) & HI distribution
Central Region

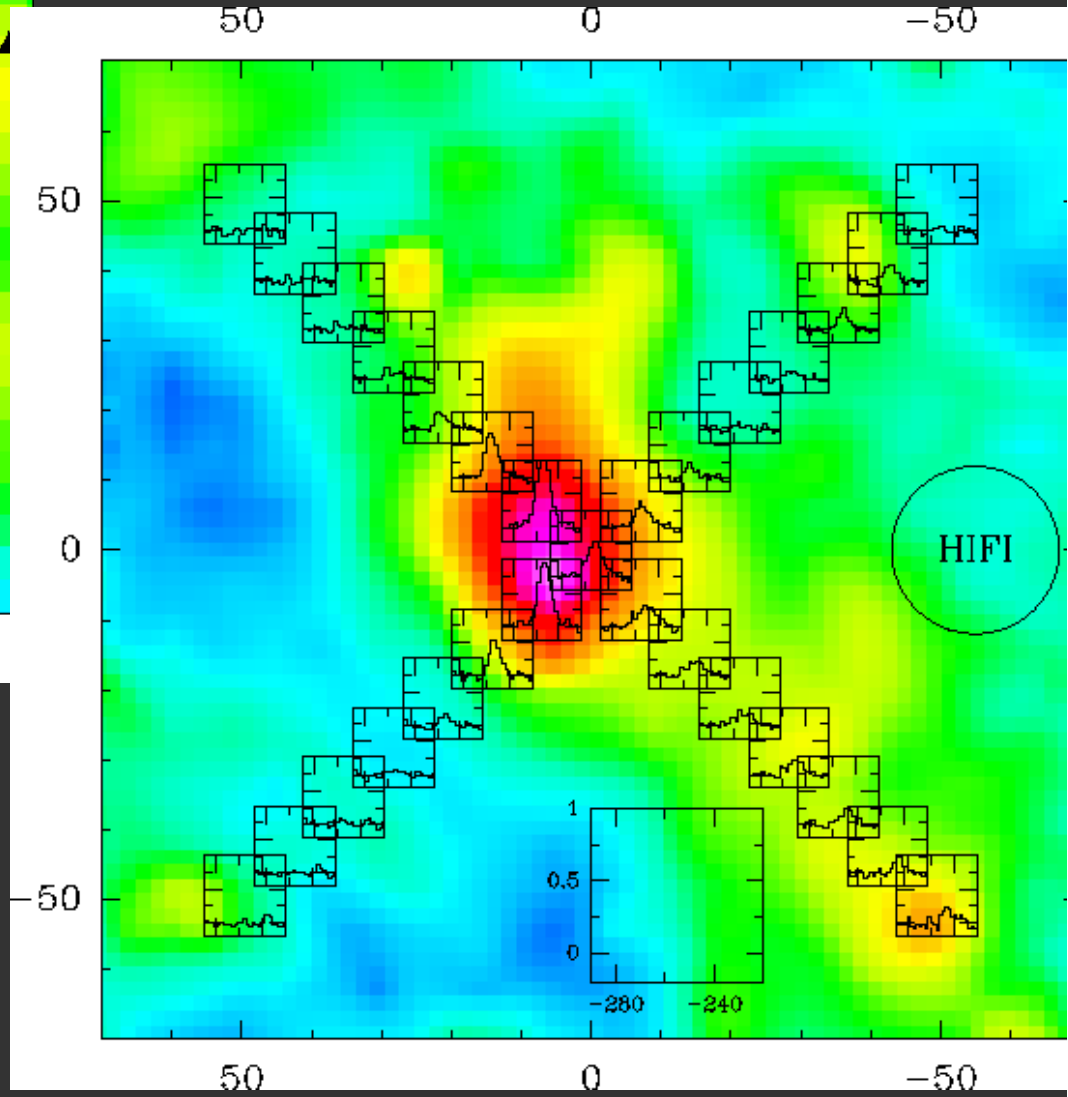


- [CII], CO(2-1) & HI appear to match well in the centre

Nikola et al. (in preparation)

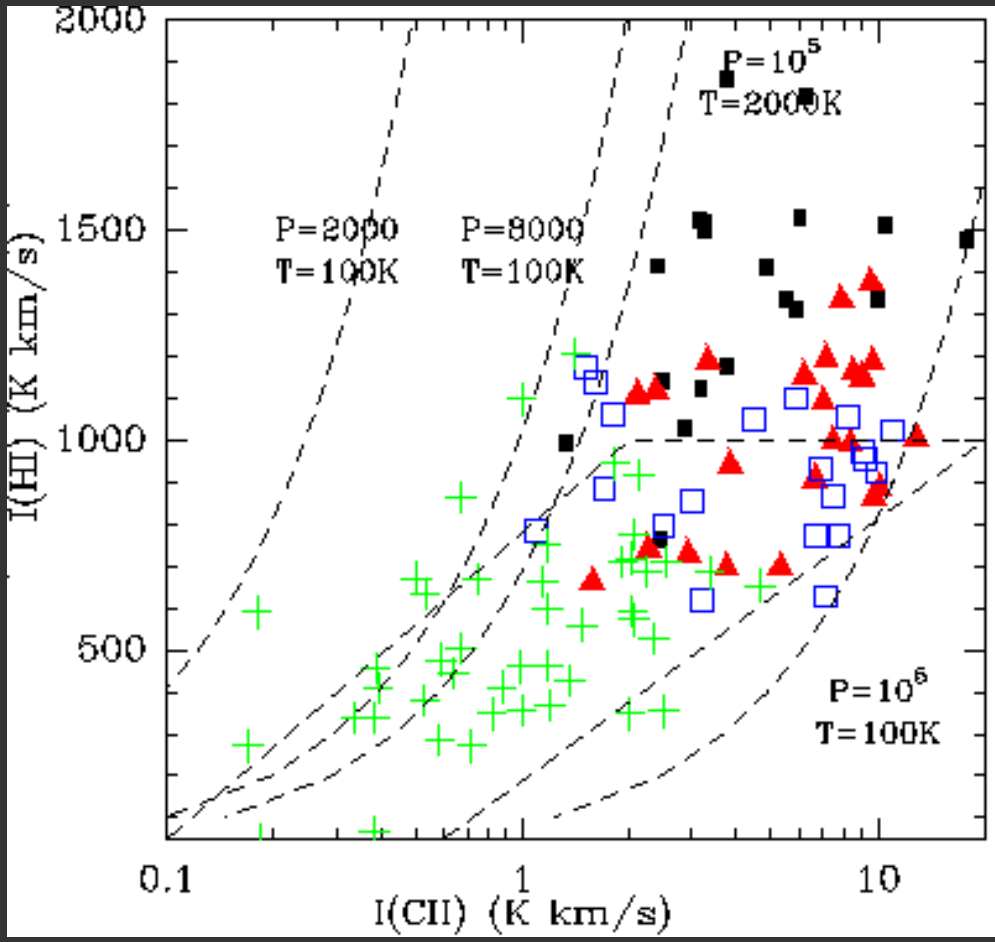
HIFI Spectroscopy of the central & BCLMP302 region

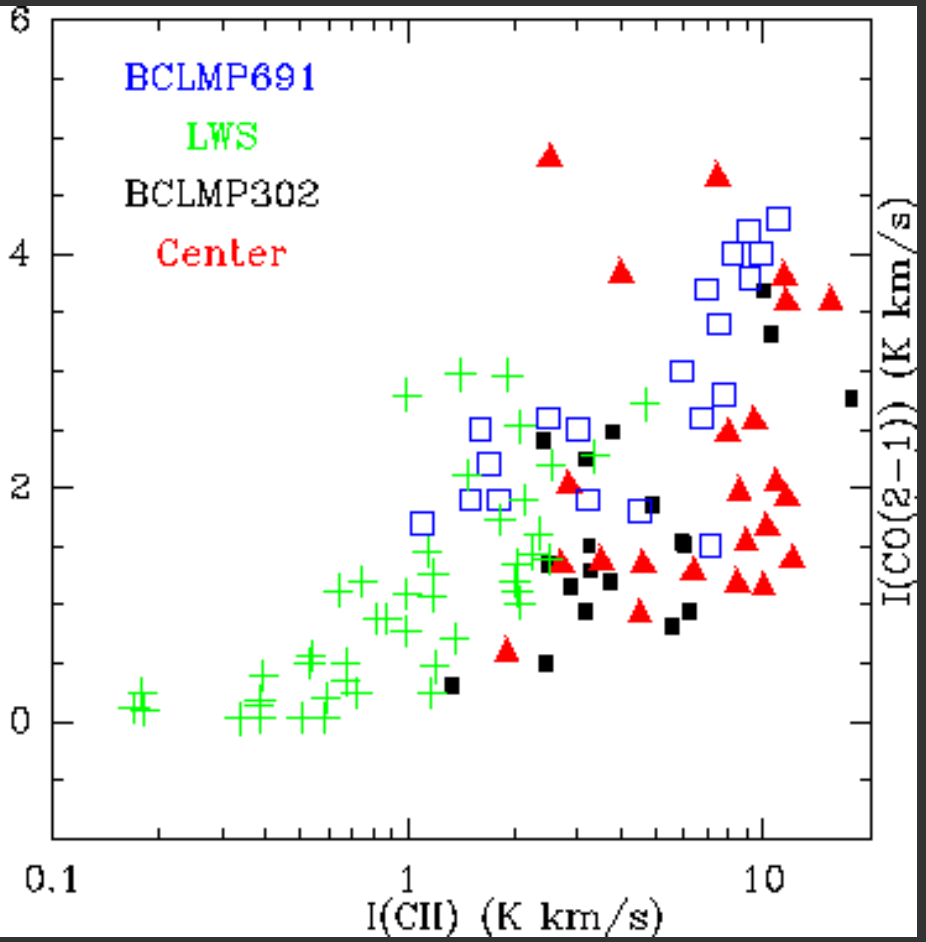




- Load chopped OTF scans perpendicular to each other

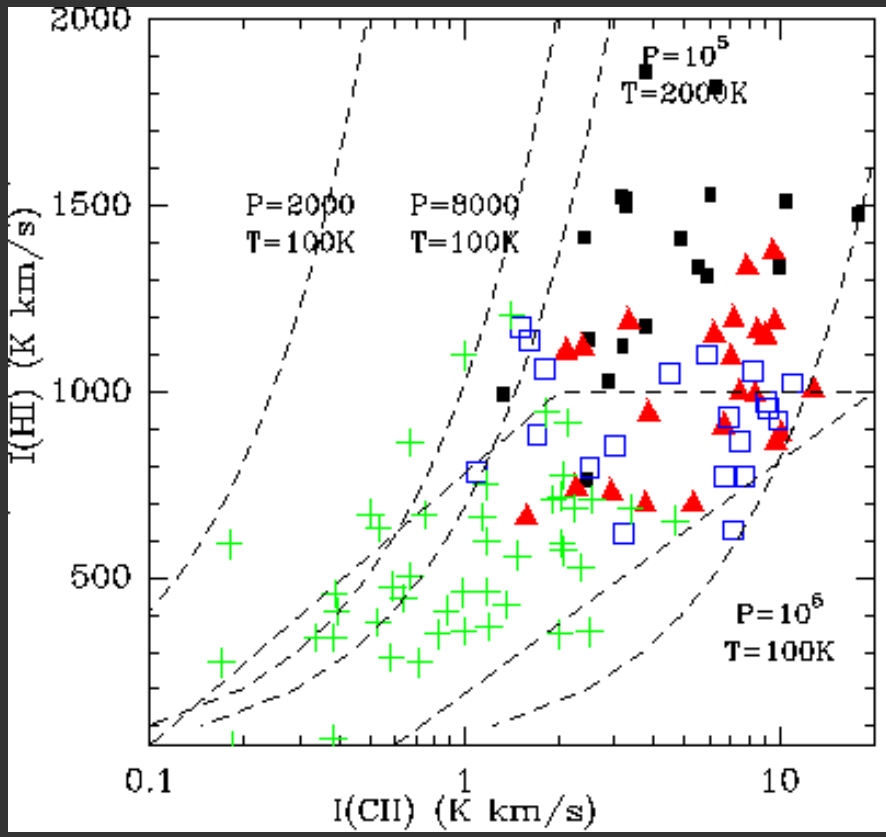
Comparison of [CII] with CO and HI

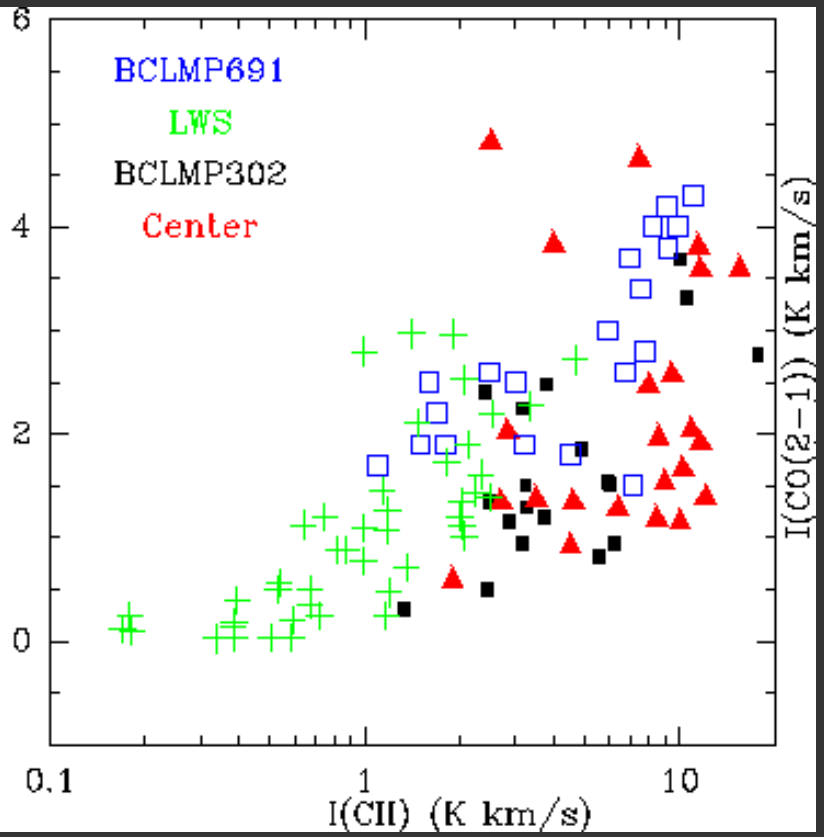




- N(HI) lies between 9.0×10^{20} to 2.7×10^{21} cm^{-2}
- Typical N(HI) diffuse atomic clouds < few$\times 10^{20}$ cm^{-2}
- N(HI) for atomic envelopes of dense molecular clouds (1-7)$\times 10^{20}$ cm^{-2}
- Multiple diffuse clouds

Comparison of [CII] with CO and HI

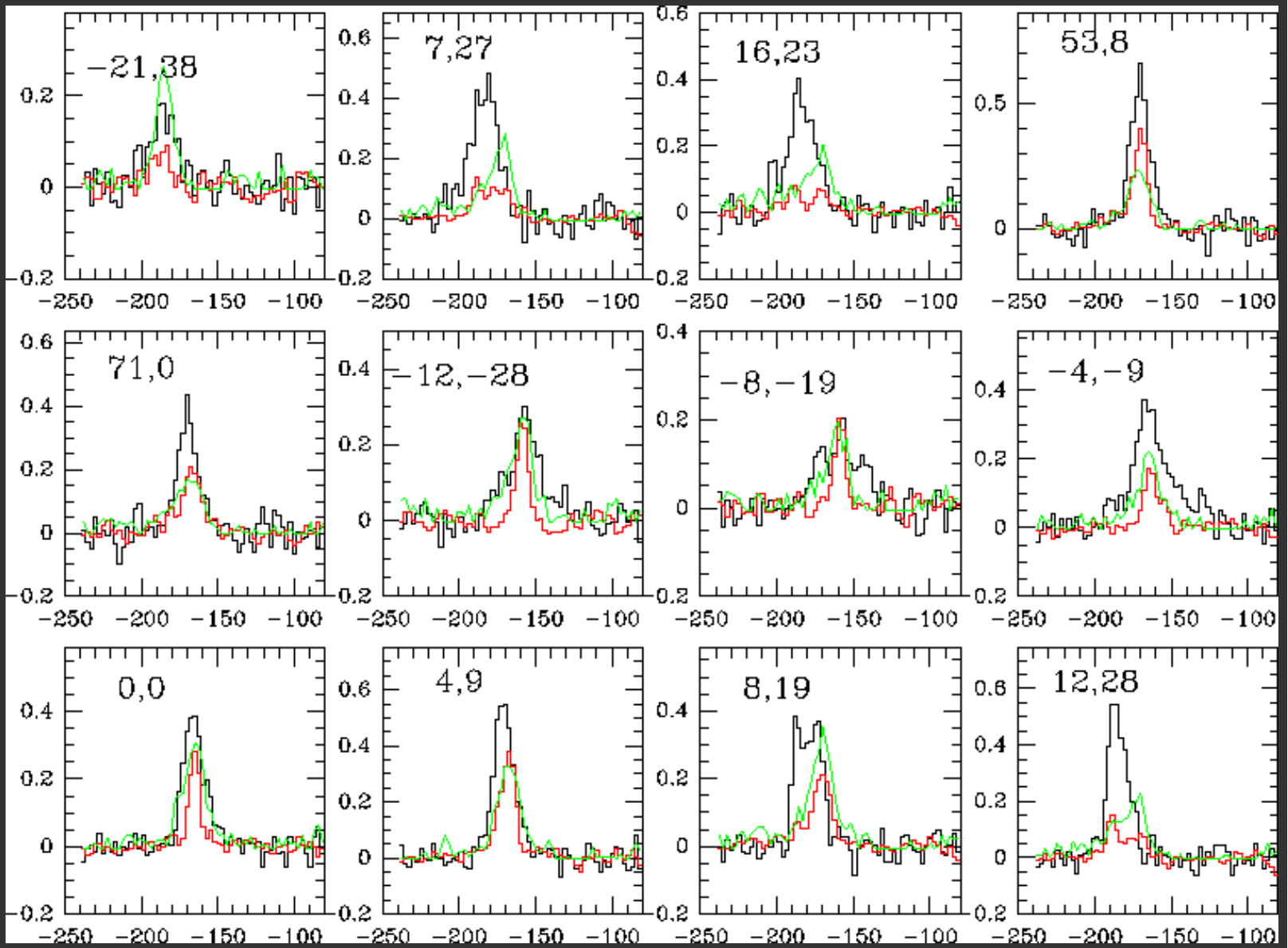




- I(CII) >> emission expected from atomic gas traced by HI ---> molecular gas contribution
- No significant correlation between [CII] and CO @ 50 pc
- CII/CO: Center: 2500-22000 ; BCLMP302: 2500-17000

[CII] spectra in the central region of M33

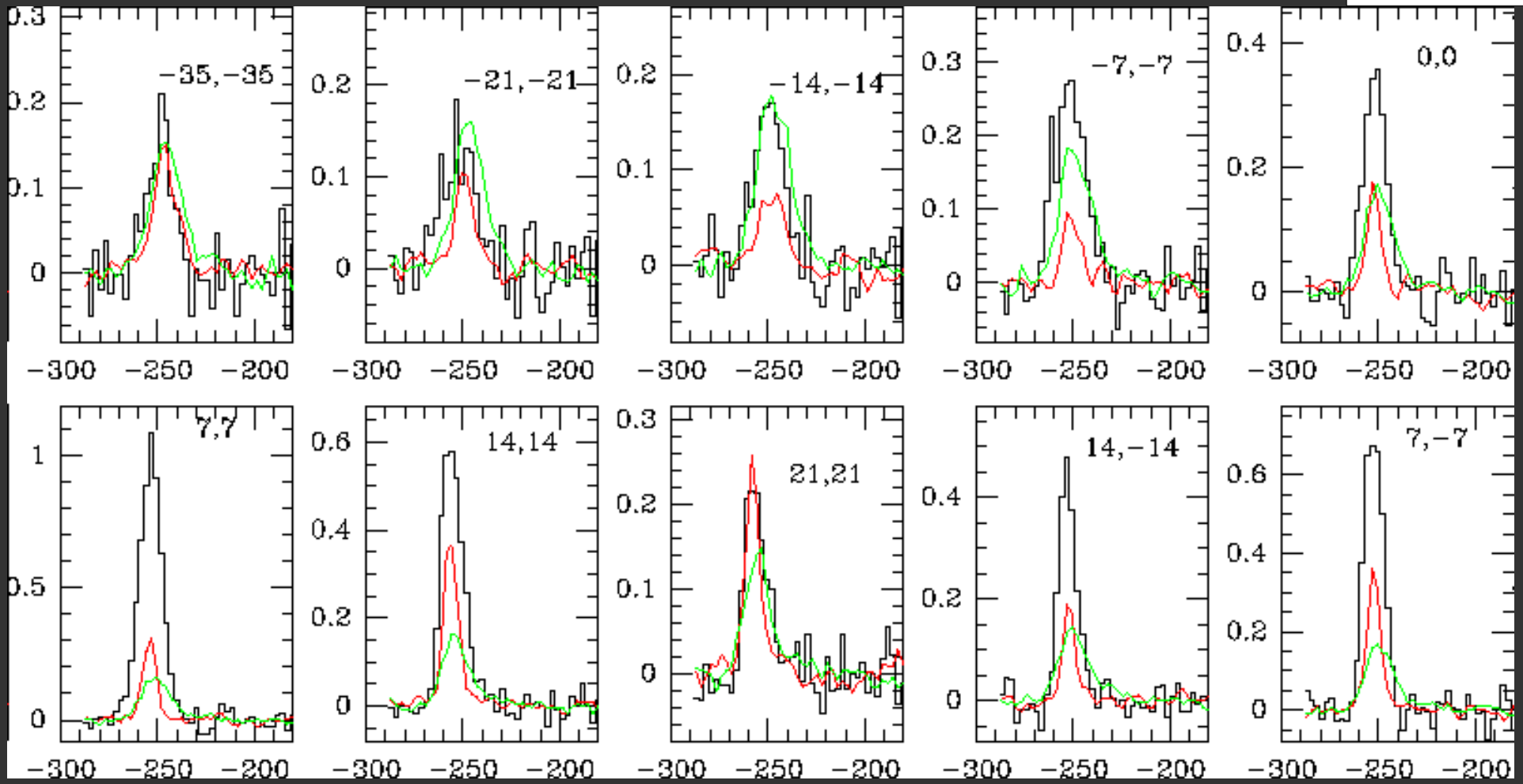
[CII]
CO(2-1)
HI



- [CII] emission broad and peak shifted relative to CO and HI
- Detected at velocities with low or no HI and/or CO

[CII] spectra in BCLMP302 region

[CII]
CO(2-1)
HI



- [CII] has linewidths intermediate between HI and CO
- Slight shift in line centers but still similar profiles

Summary

- Integrated intensity [CII] map more consistent with HI and CO(2-1) in the center than in BCLMP302

- Velocity-resolved [CII] can be explained almost completely with estimated contributions of atomic and CO-bright H_2 in BCLMP302

- In the central region the contribution of ionized+CO-dark molecular gas to the observed [CII] intensity varies between 40-70%

- Velocity resolution changes the entire perspective