Radio Recombination Lines in M82

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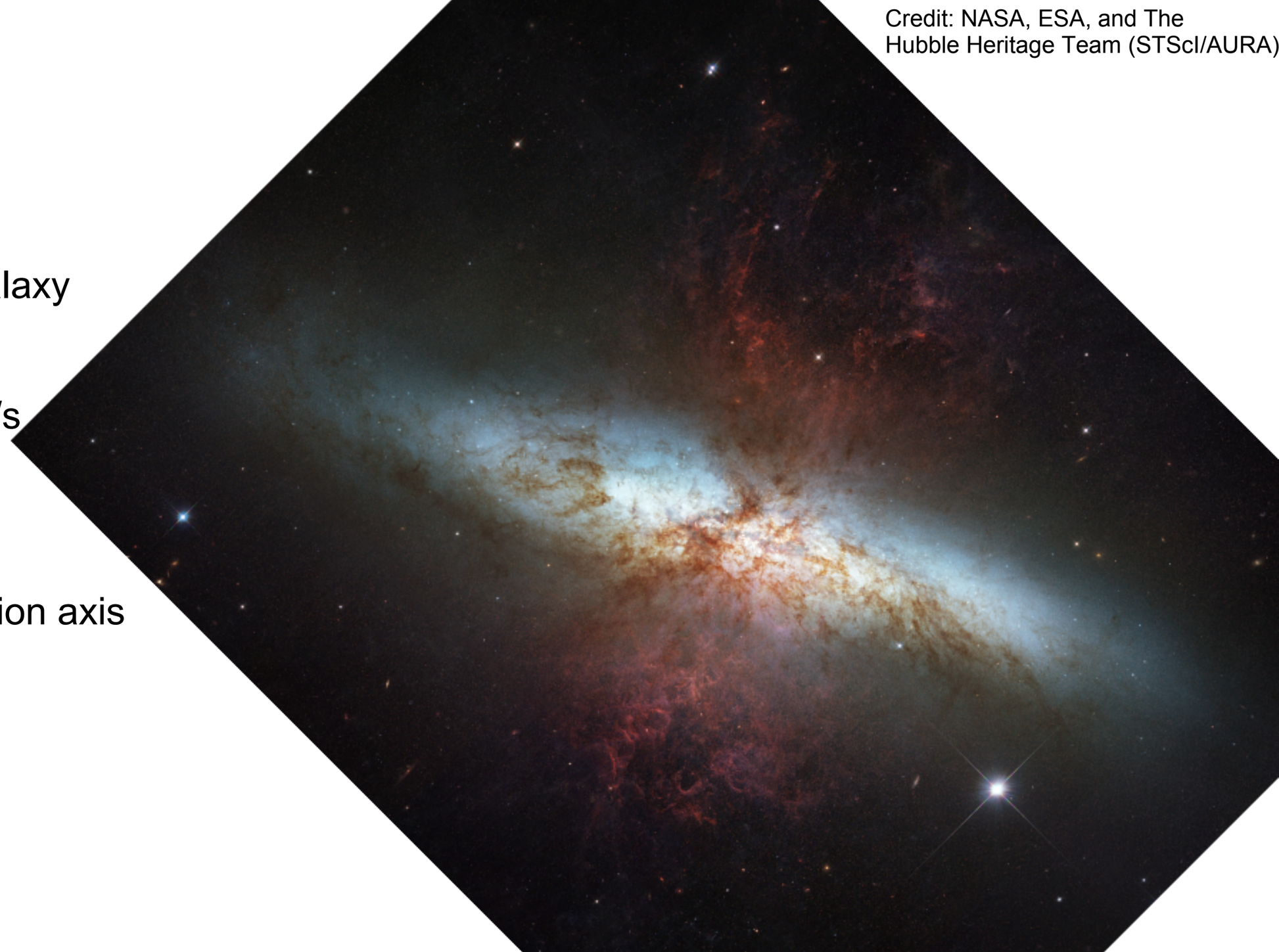
LOFAR Science 2016
Zandvoort aan Zee

M82

- Nuclear starburst galaxy
- Distance 3.7 Mpc
- Velocity 203 ± 4 km/s
- Strong filamentary Hα-streamers in the direction of the rotation axis
- Interacting with M81



Credit: NASA, ESA, and The Hubble Heritage Team (STScI/AURA)

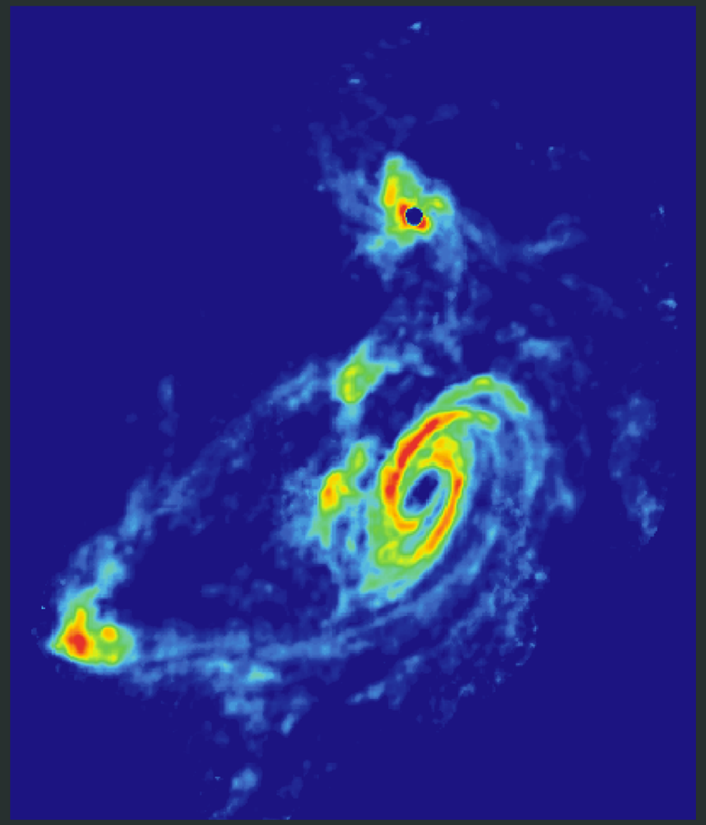
M82

Credit: Yun, Ho and Lo. Image courtesy of NRAO/AUI

TIDAL INTERACTIONS IN M81 GROUP

Stellar Light Distribution

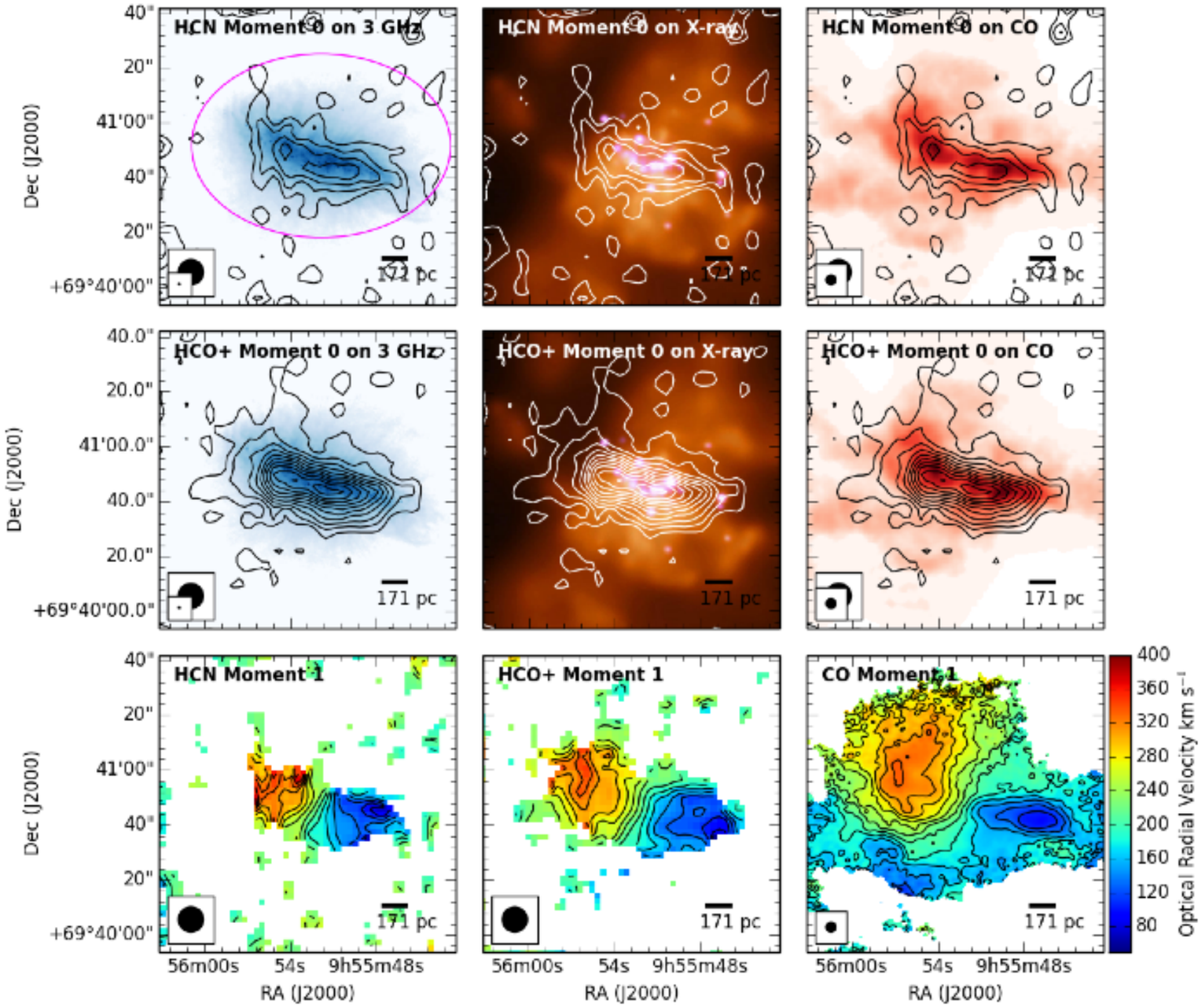
21 cm HI Distribution



Credit: Johannes Schedler (Panther Observatory)

M82

Dense gas tracing
SF rotating torus
(Kepley+2014)



Diffuse Radio Recombination Lines (<1GHz)

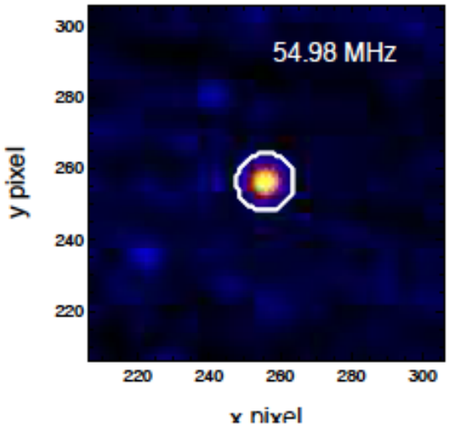
The line profiles are determined by the

- **Thermal properties of RRL gas** (T_e, n_e, EM)
- **Ionization rate of the RRL gas** $(\zeta(H))$
- **Carbon abundance** $([C/H])$
- **Kinematics of the RRL gas** $(v, \Delta v)$

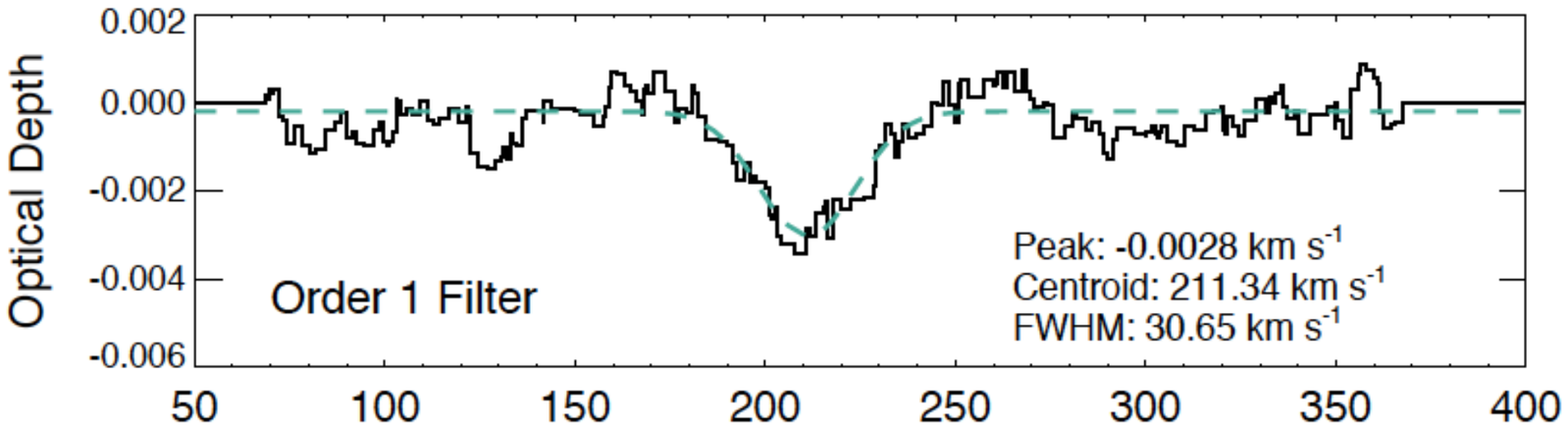
>> Method: Localize the (C)RRL gas & compare with CO, HI and HII in order to probe the properties of the CNM.

LBA measurements (30-78 MHz)

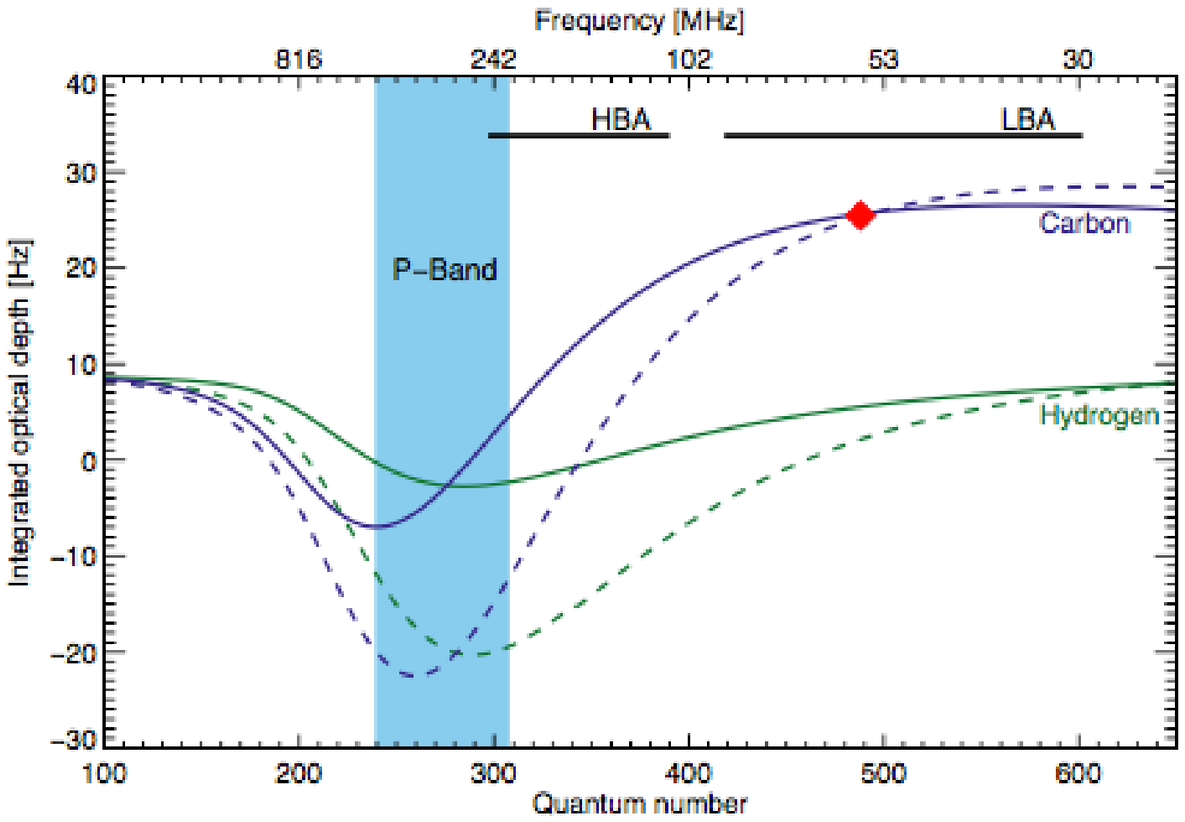
Morabito et al. 2014:



First detection of CRRLs from an extragalactic source



(32channels/subband, stacking 22 subbands)



♦LOFAR LBA

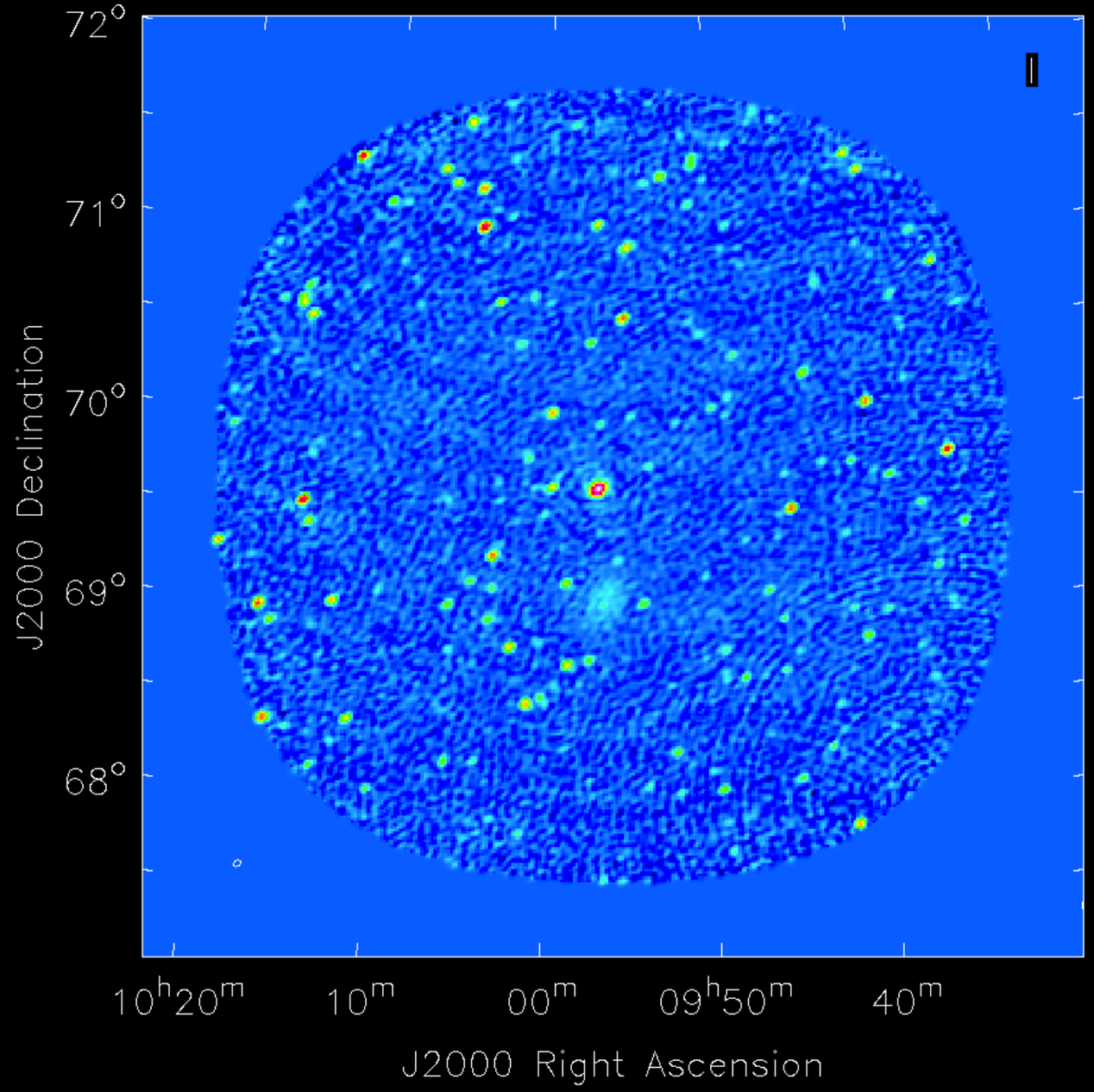
n_e=0.05 cm^{-3}

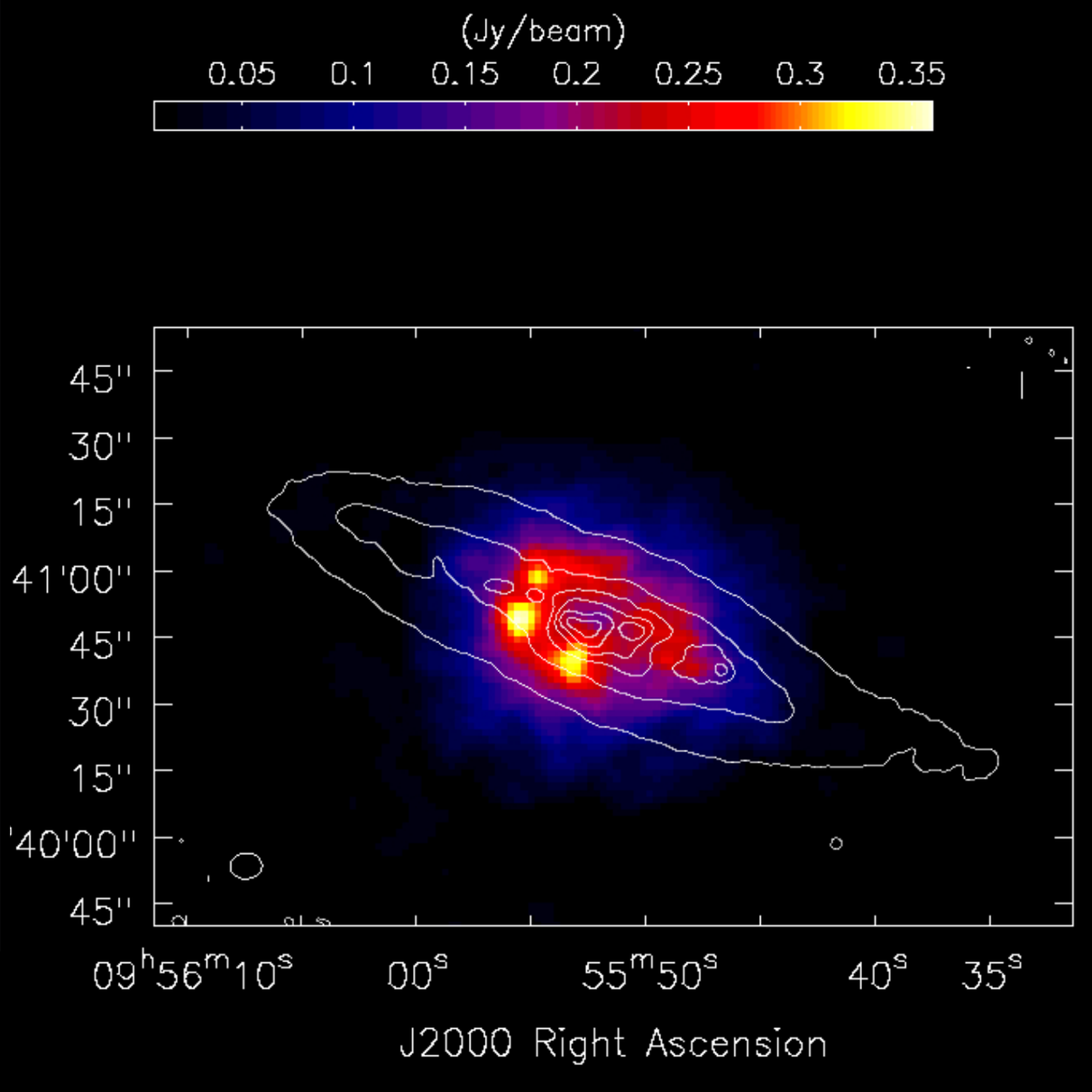
--- T_e=50K

__ T_e=100K

Expand the frequency range to break the degeneracy among the models.

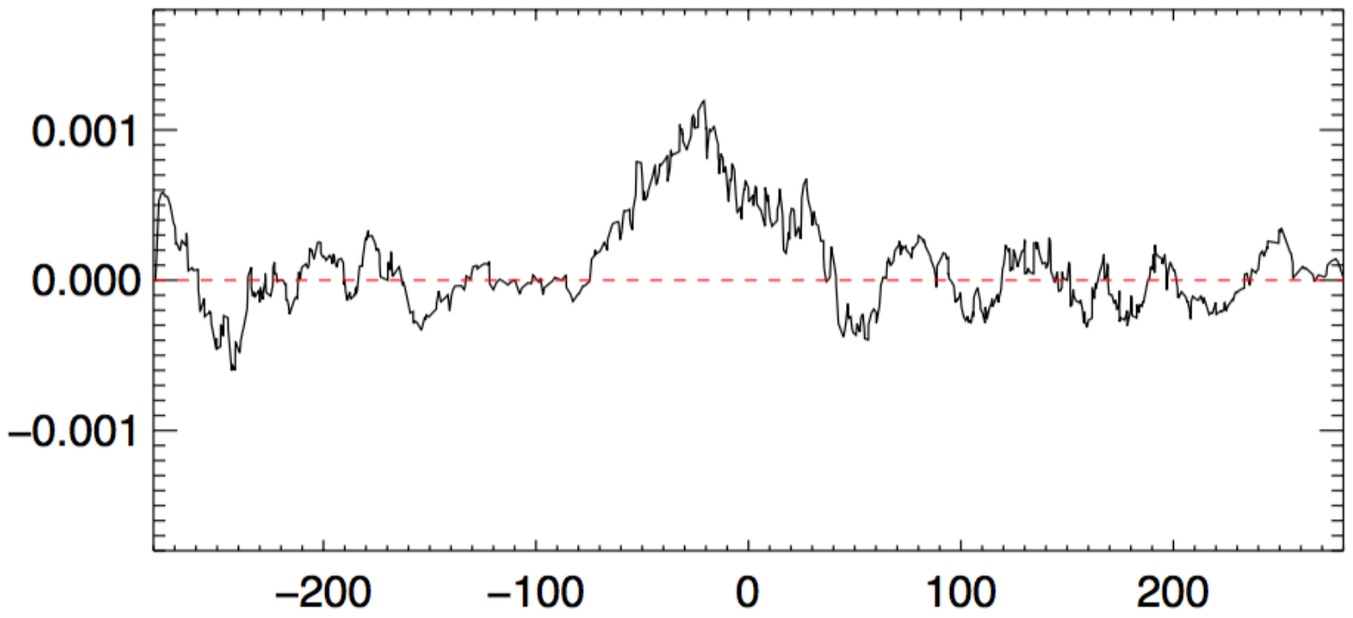
HBA measurements (110-190 MHz)





HBA measurements (152-174 MHz)

Stacking 30 subbands at the same z(=0.0073) as the LBA detection



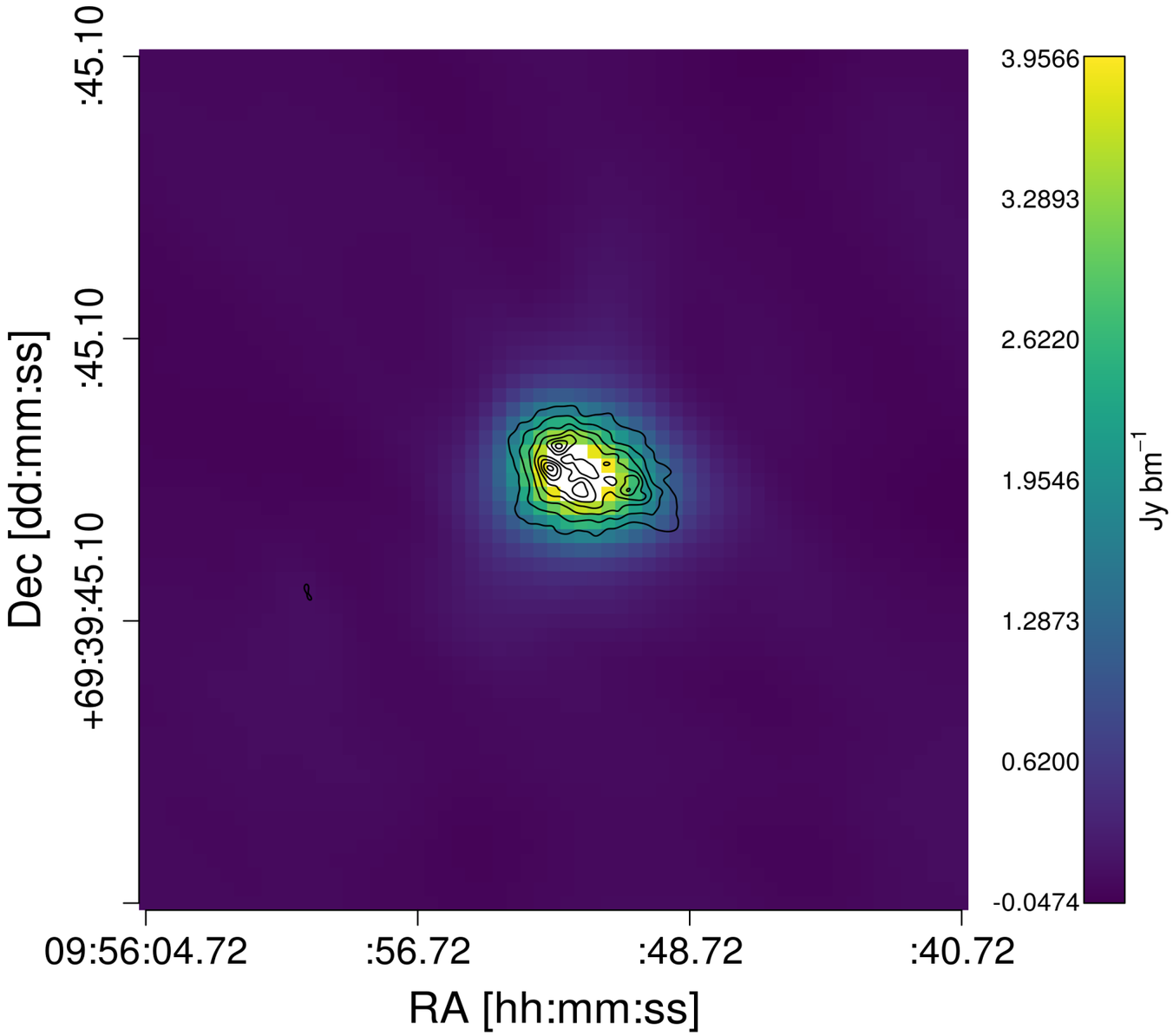
Ongoing:

- Cross-correlation to fine-tune the redshift of the HBA detection
- LBA+HBA+JVLA P-band to constrain the properties of the gas

Future:

- Analyze HBA CS+RS spectra

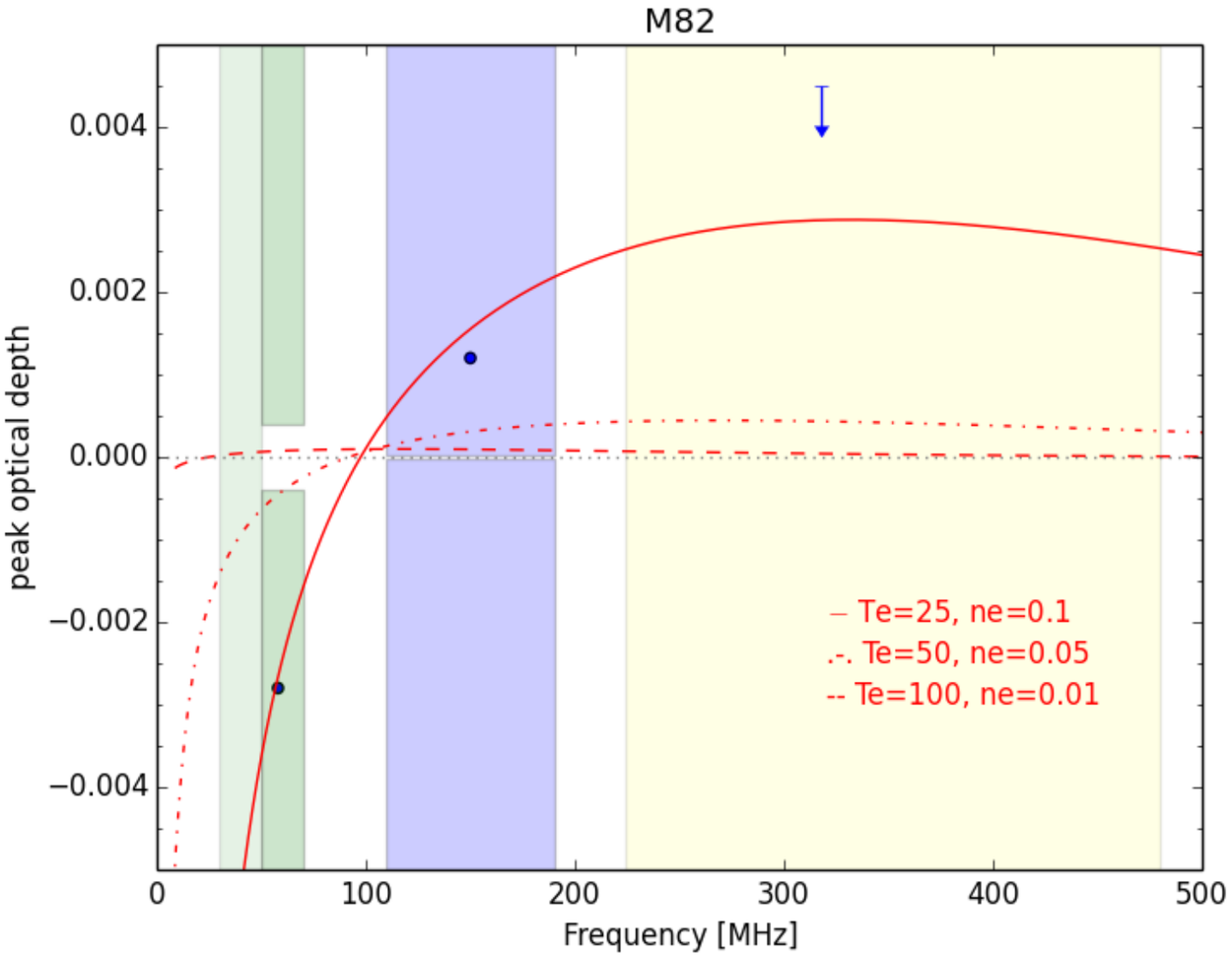
JVLA P-band image

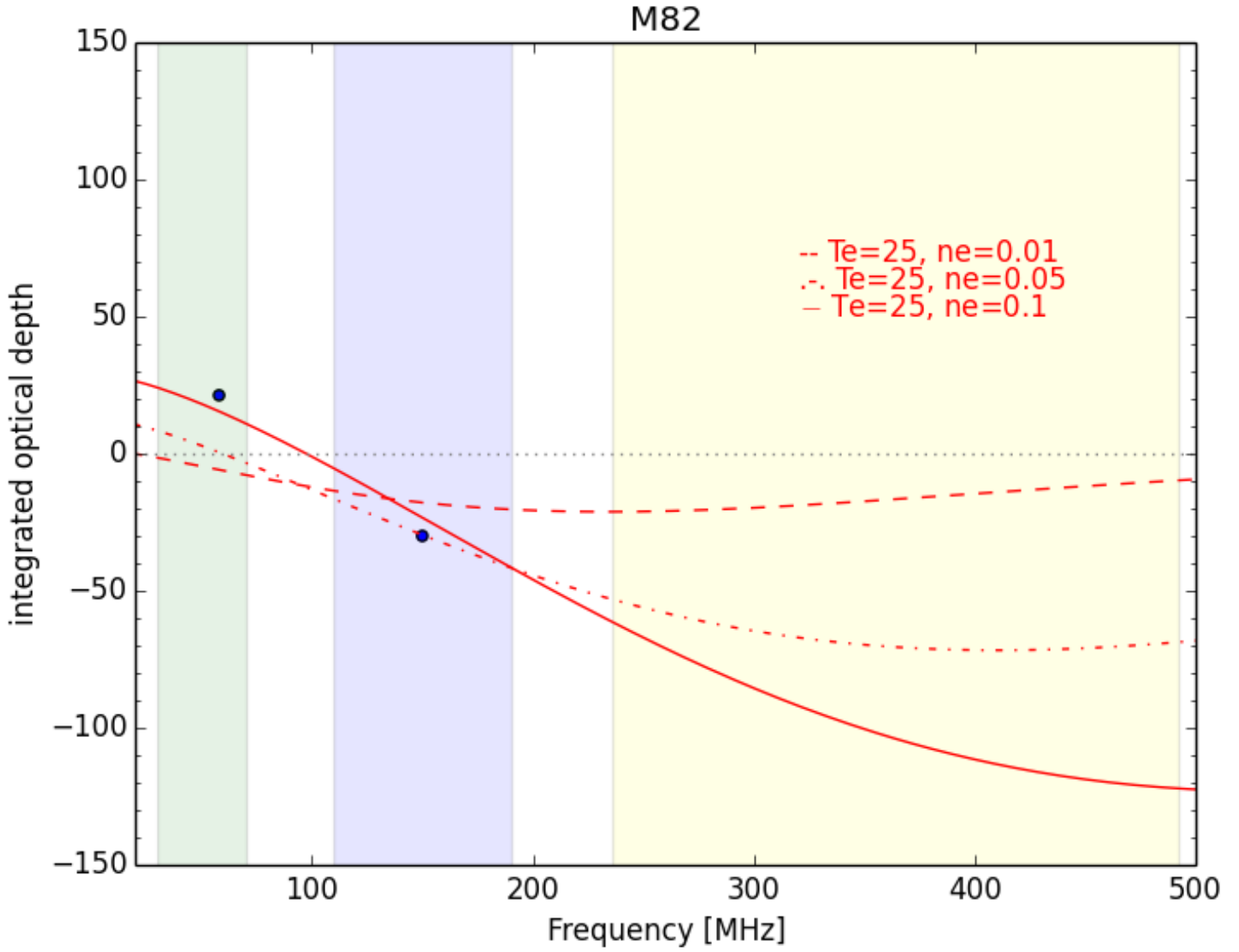


- MFS image of 1 spectral window: 291 MHz (32 MHz bandwidth)
- 1 hour on target
- Contours from LOFAR HBA CS+RS
- RMS 14 mJy
- Biggest challenge: RFI

Credit: S.L. Zoutendijk

Model LOFAR LBA+HBA+JVLA P-band





What can we say about the properties of the gas?