The hottest gas in massive star forming regions

Observations of HC_3N* in hot cores

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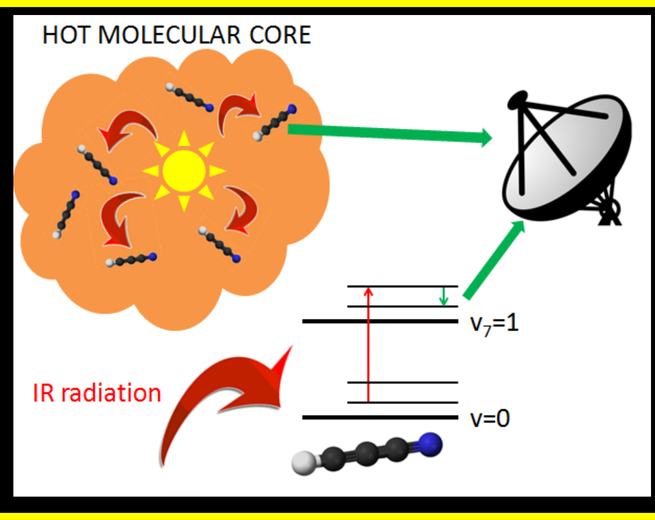
Abstract: Hot (T >150K), dense (n>10^7cm^{-3}) and chemically very rich molecular cores are considered the cradle of massive stars. These regions are hidden behind large extinction (A_v>20 mag), and contain hot dust emitting in the 15-50 μm range. This IR radiation excites the vibrational levels of HC_3N (HC_3N*), whose abundance is enhanced due to evaporation of grain mantles. Therefore, **HC_3N*** is a very well suited molecule to study the kinematics of the dense and hot gas surrounding very young massive stars. Our work calculates the density and excitation conditions of 2 hot cores, and reveals the presence of high excited outflows.



New Observations: We present spectra of HC_3N* J=5-4 toward the Orion Hot Core and G10.47+0.03 carried out with the Green Bank Telescope (USA) in May 2012.

- Spectral coverage= 45-46 GHz (Q band receiver)
- Spectral resolution=2.5 km s^{-1}
- Angular resolution = 16”

Additional interferometric observations

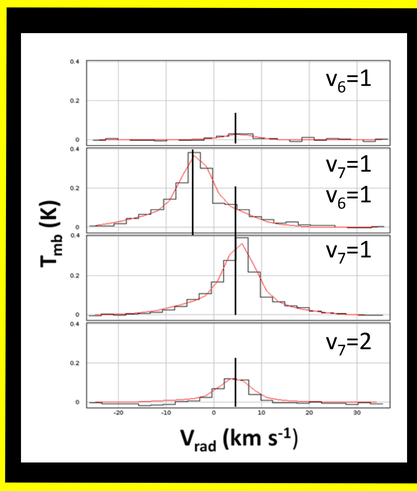
LTE analysis using MADCUBA software

- MADCUBA (Madrid Data Cube Analysis) is a new developed tool for the analysis of cubes and single spectra.
- Spectra simulator ➡ ROTATION DIAGRAM T_{ex} & N (assuming optically thin lines and source size)

HOT CORE

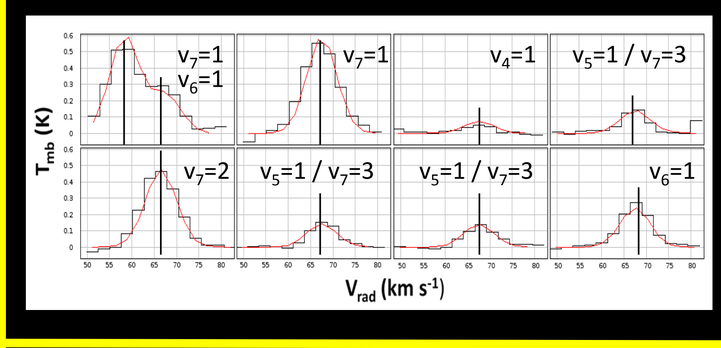
Orion Hot Core	G10.47+0.03

MADCUBA SIMULATION OF GBT DATA

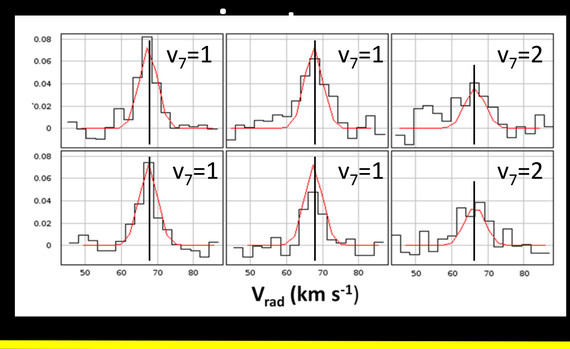


- Narrow component: gas close to the massive stars.
- Broad component: pedestal of high velocity gas.

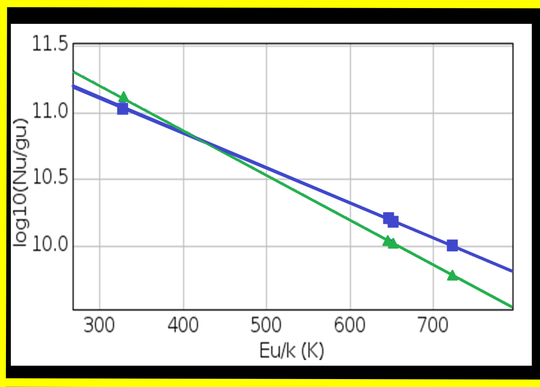
HC_3N*



$HC^{13}CCN$* / $HCC^{13}CN$*



ROTATION DIAGRAMS



Narrow component
T_{ex}=165 K

Broad component
T_{ex}=130 K

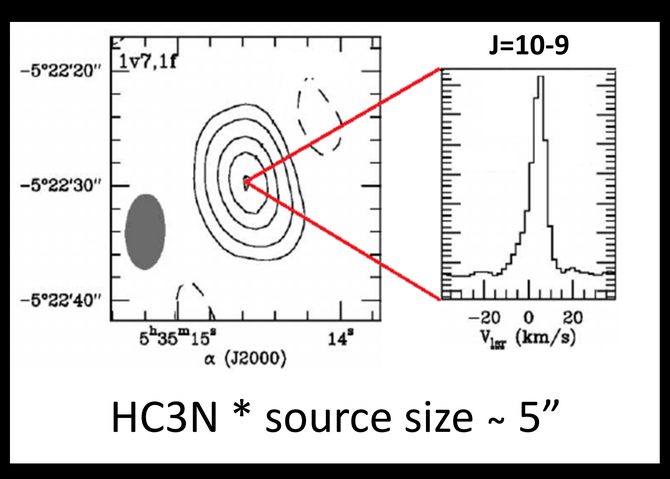
- The detection of HC_3N* ^{13}C isotopes suggests HC_3N* main isotopomer is optically thick. Assuming $^{12}C/^{13}C$ abundance ratio X=40:

τ[v7=1 main isotopomer] ~ 5 (rotational diagram not valid)

- Isotopes are optically thin (rotation diagram valid) ➡ **T_{ex}=270 K**

ADDITIONAL INTERFEROMETRIC DATA

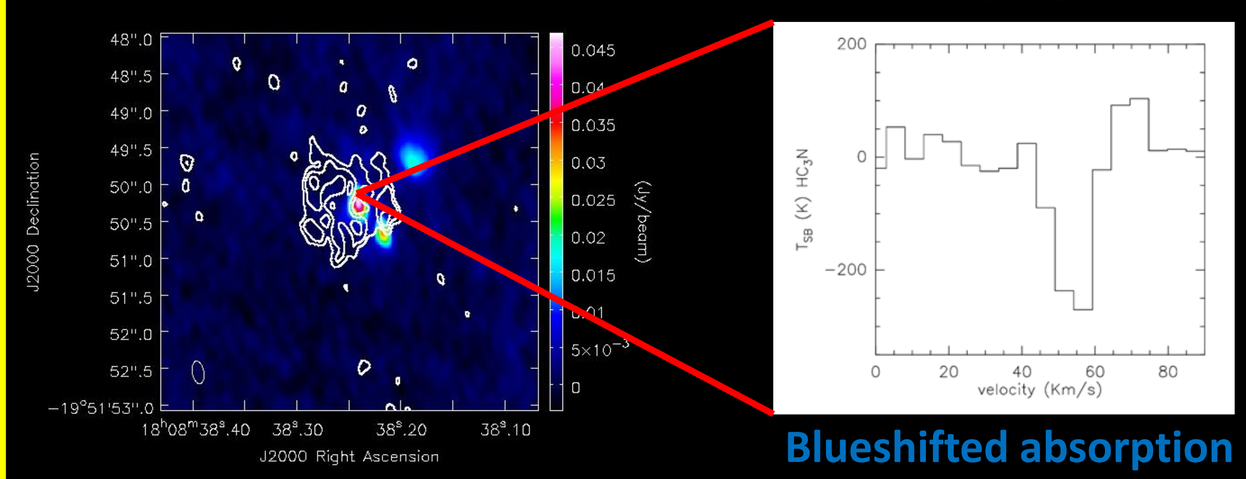
PdB observations from de Vicente et al. (2002)



HC3N * source size ~ 5”

- Both spectral components also detected

VLA observations from Rivilla et al. (in preparation)



HC3N * source size ~ 1”

Blueshifted absorption towards the UC HII region B1

RESULTS

component	logN (cm^{-2})	T_{ex} (K)	v_{lsr} (km s^{-1})	FWHM (km s^{-1})
narrow	15.84	165	5.5	7.0
broad	16.04	130	4.0	22.0

logN (cm^{-2})	T_{ex} (K)	v_{lsr} (km s^{-1})	FWHM (km s^{-1})
18.0	270	67.5	6.0

High excited gas OUTFLOWING from the core

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