Unveiling ALMA Band 2 Workshop 2026

Tuesday 24th - Thursday 26th February 2026
Congress Centre of the CNR Bologna (Italy)
https://arc.ira.inaf.it/events/b2-workshop-2026/

2'-Hydroxyacetophenone:
Lab data and ALMA archive screening

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Free Jet Microwave Spectroscopy Group
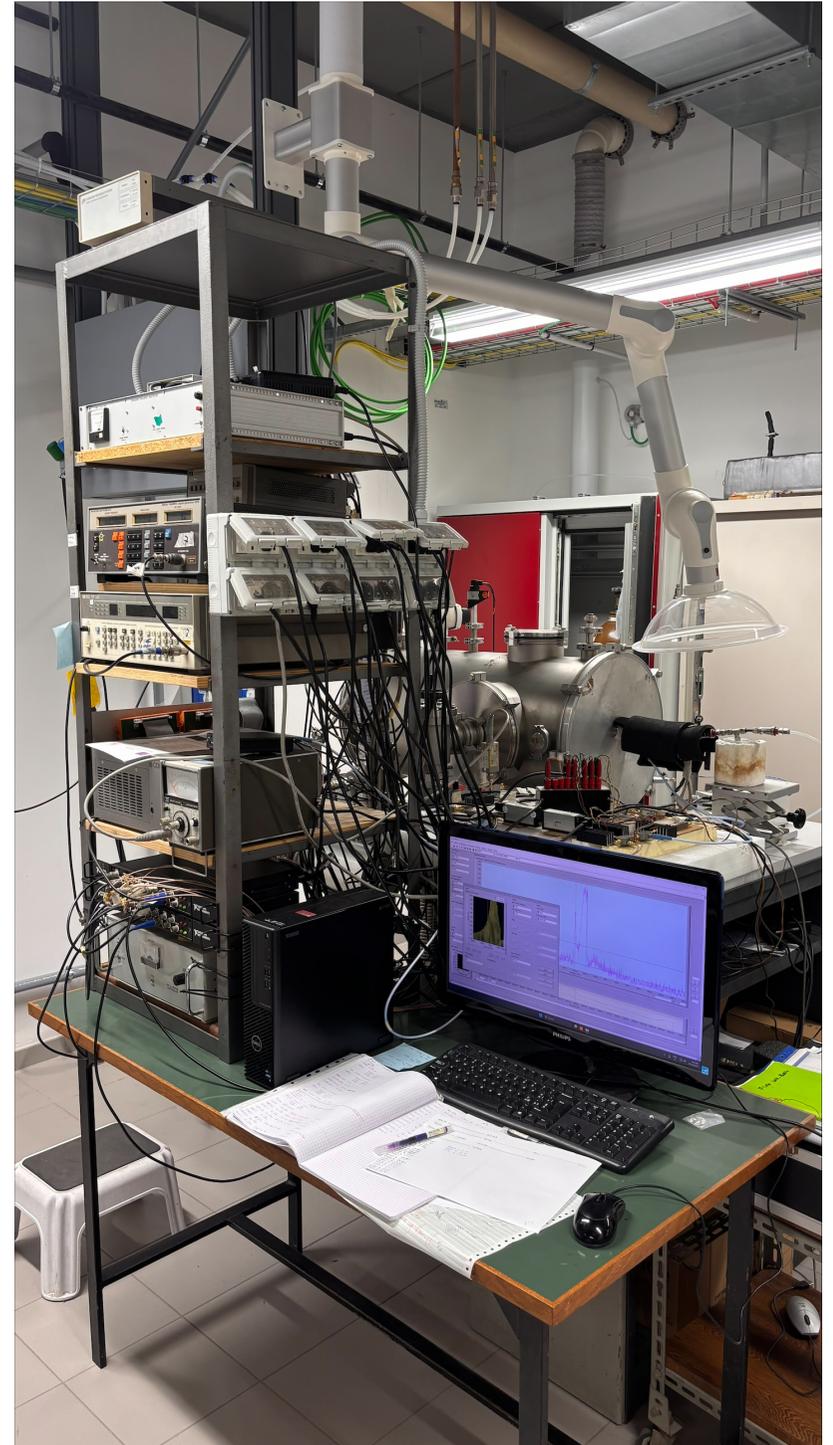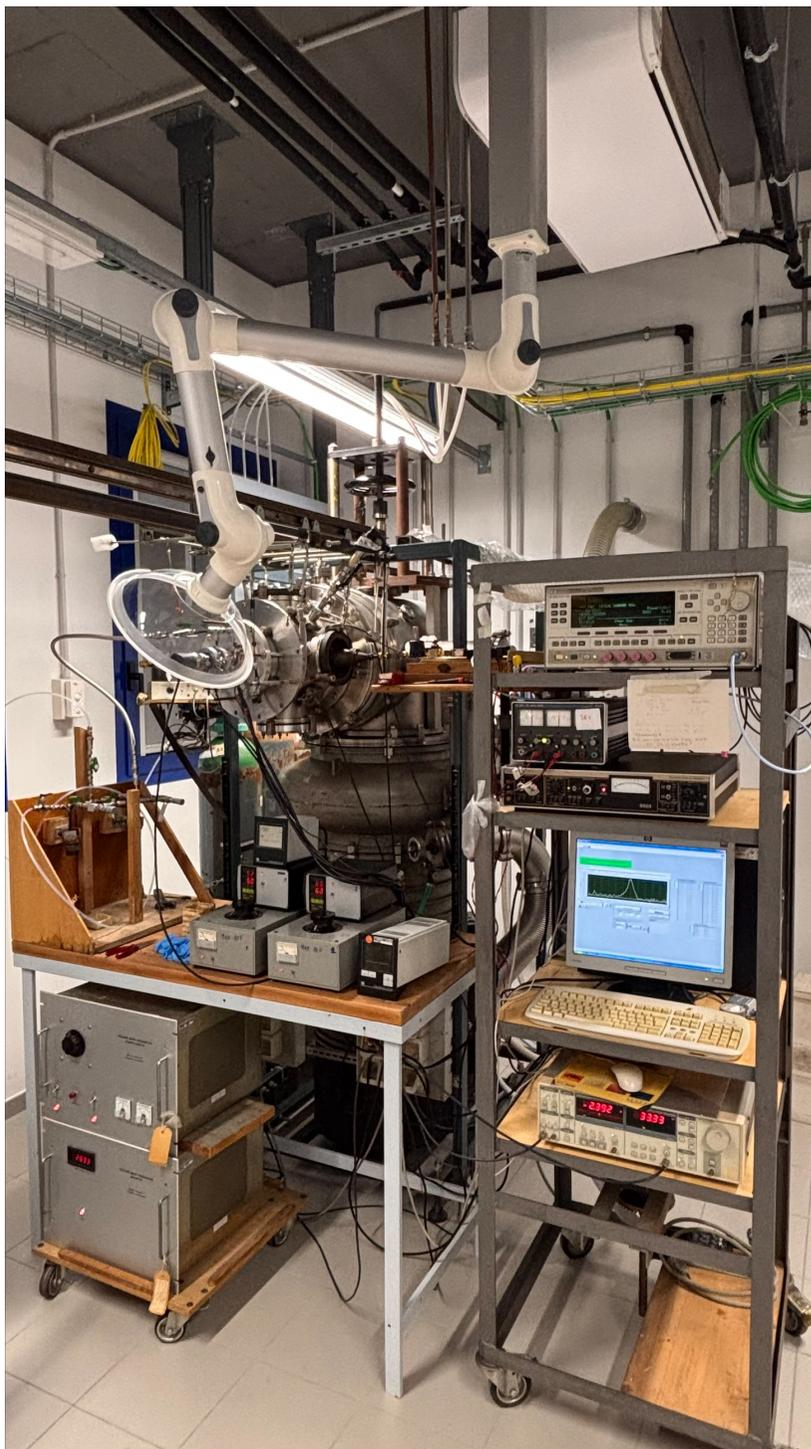Department of Chemistry G. Ciamician
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https://site.unibo.it/freejet/en

Supersonic expansion Fourier transform microwave spectrometer

Frequency range 6-18 GHz
Resolution 10 kHz
Accuracy 5 kHz

Rotational temperature ≈ 1 K

Sample temperature up to 80 °C

Millimeter wave free-jet absorption Stark modulated spectrometer

Frequency range 59.6-74.4 $\rightarrow$ 110 GHz
Resolution 300 kHz
Accuracy 50 kHz

Rotational temperature ≈ 10 K

Sample temperature up to 150 °C

Chirped pulsed supersonic expansion Fourier transform microwave spectrometer
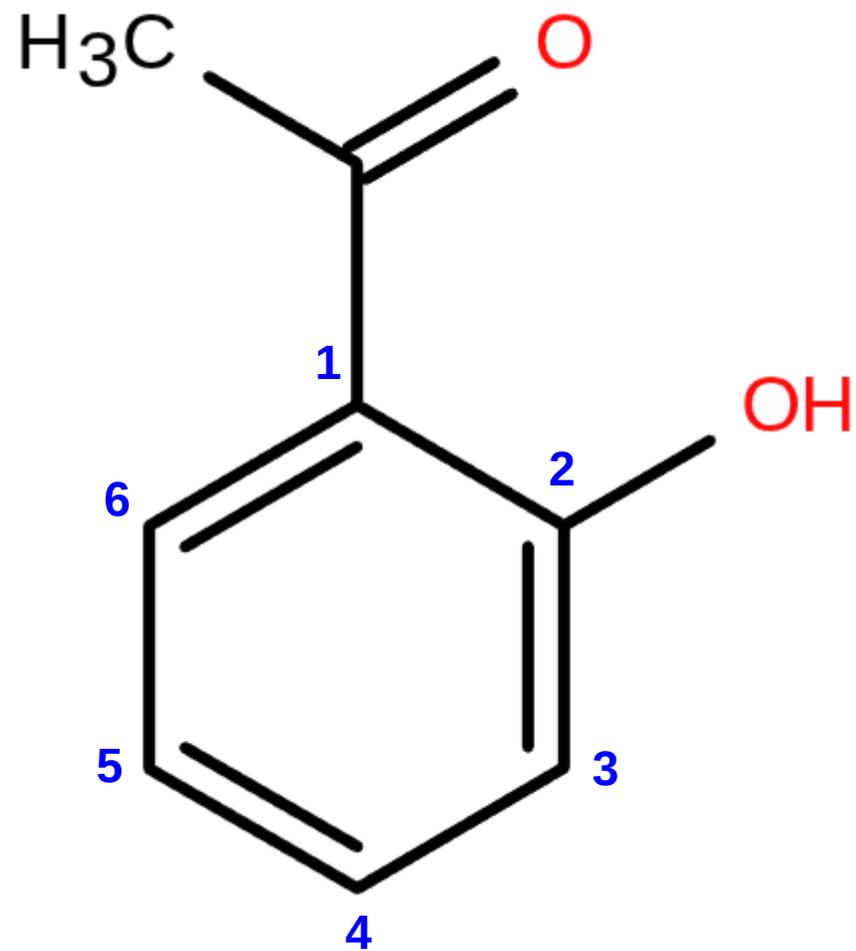
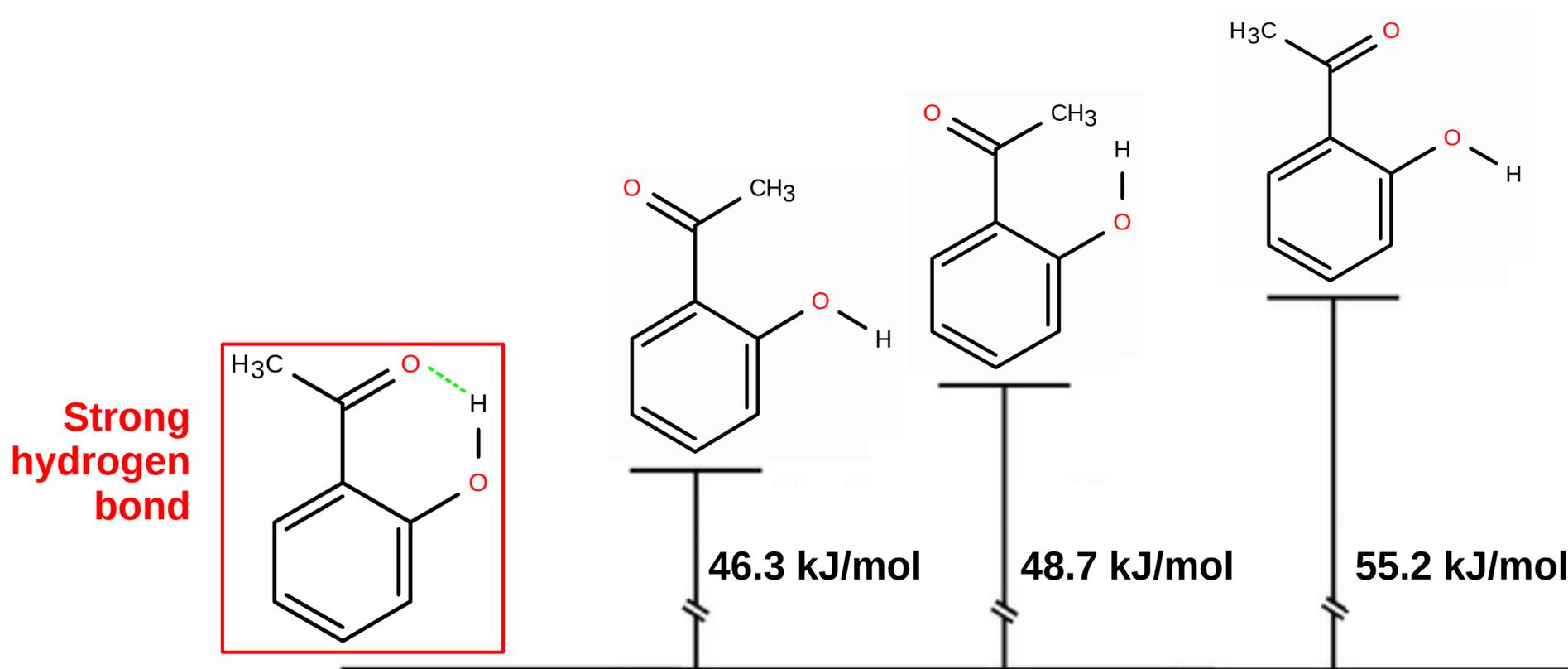**Frequency range 2-8 GHz**
Resolution 30 kHz
Accuracy 10 kHz
Rotational temperature ≈ 7 K

2'-hydroxyacetophenone   C8H8O2

Under equilibrium conditions, up to 1000 K only one conformer is populated

Strong hydrogen bond

46.3 kJ/mol

48.7 kJ/mol

55.2 kJ/mol

B3LYP-D3(BJ)/Def2-TZVP   [Boi+ 2024]

Electric dipole moment

μ_{tot}=3.24 D

μ_a=0.77 D

μ_b=3.15 D

MP2/aug-cc-pVTZ
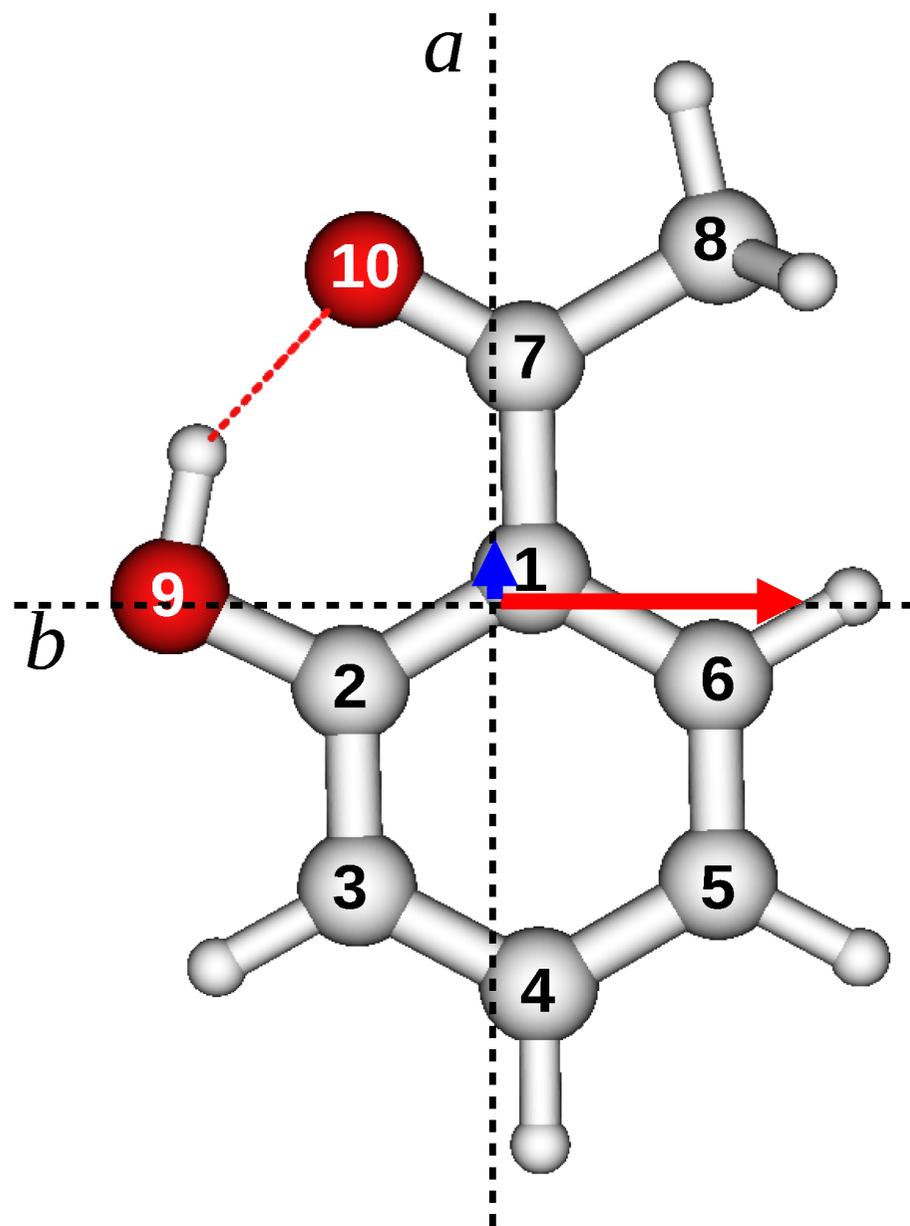
Benzene derivatives in TMC-1
## Yebes 40m and GBT 100m

- **Substituted benzene**
  - ethynylbenzene (c-C6H5CCH) Loru+ 2023
  - indene (C9H8) Cernicharo +2021
 - phenalene (C13H10) Cabezas +2025
- **Cyano-PAHs**
  - benzonitrile (c-C6H5CN) McGuire+ 2018
  - 2-cyanoindene (C9H9CN) Madelyn+ 2022
  - 1- and 2-cyanonaphthalene (C10H7CN) McGuire+ 2021
  - cyanoacenaphthylenes (C12H7CN) Cernicharo+ 2021, Cernicharo+ 2026
  - cyanopyrenes (C16H9CN) Wenzel+ 2024, Wenzel+ 2025
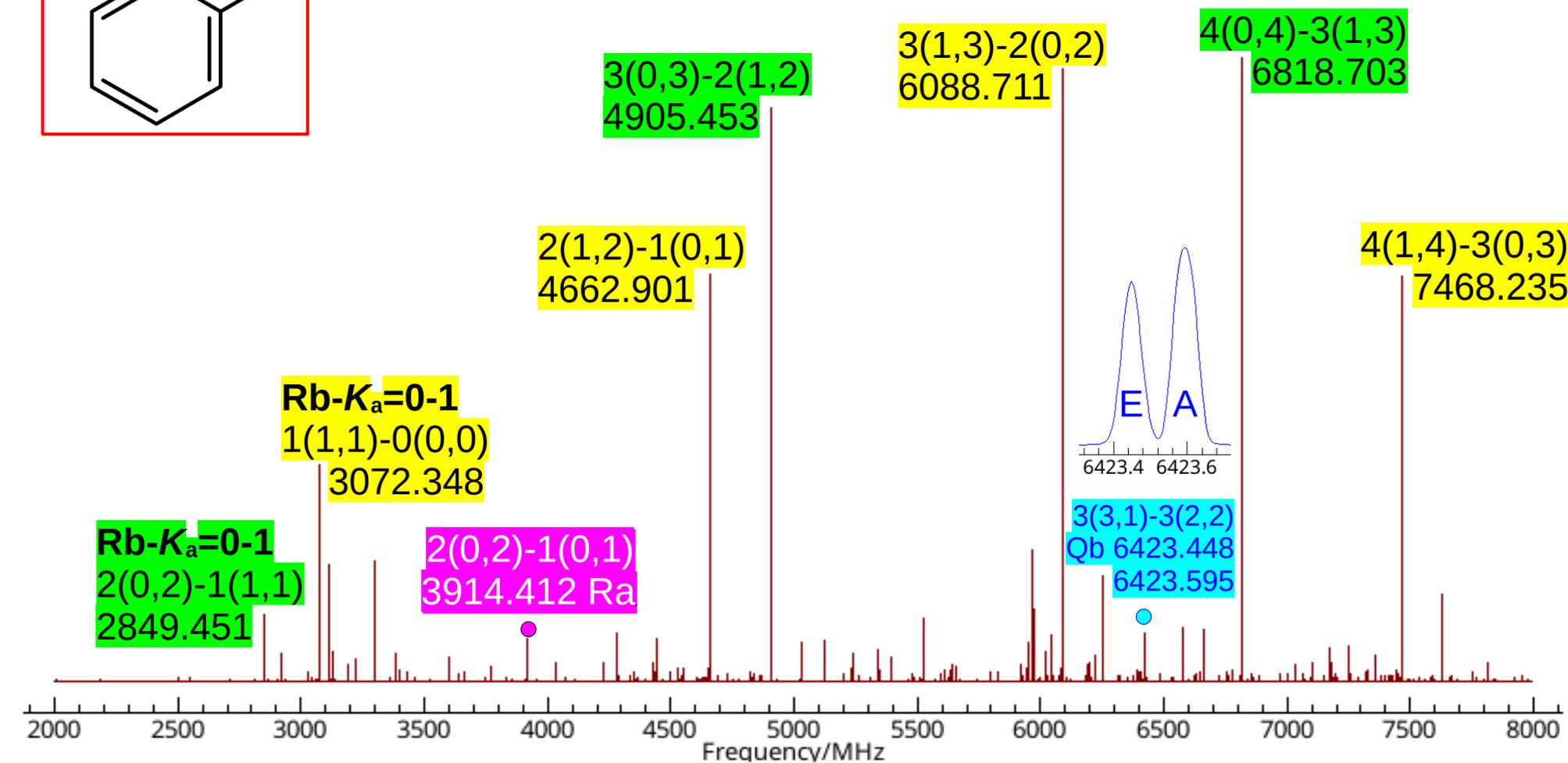 - cyanocoronene (C24H11CN) McGuire+ 2025

μ_a = 5.67 D
μ_b = 0.59 D

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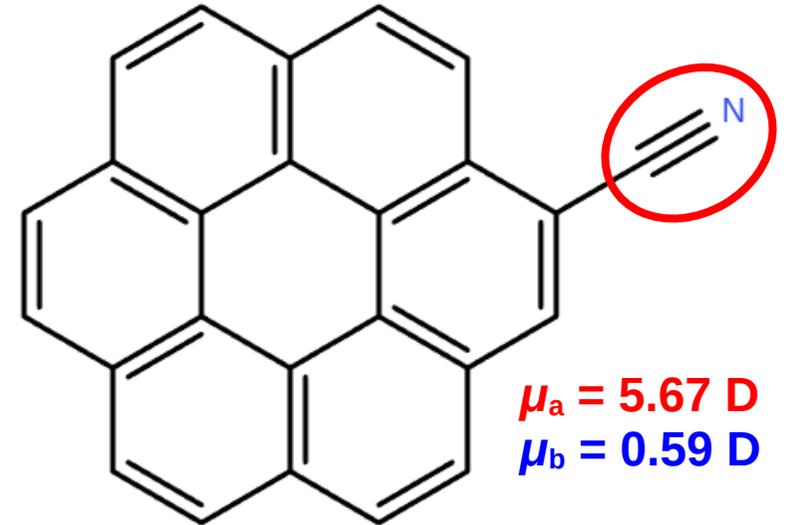
Other ring molecules toward the Galactic Center molecular cloud G+0.693-0.027

$\mu_a = 4.73$ D
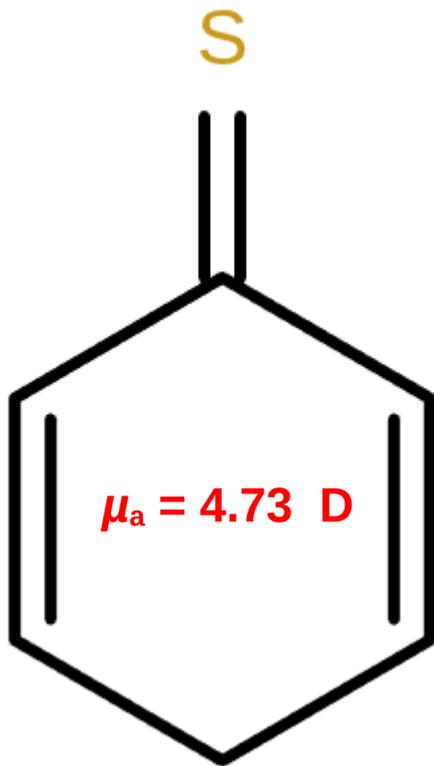
- 2,5-cyclohexadien-1-thione
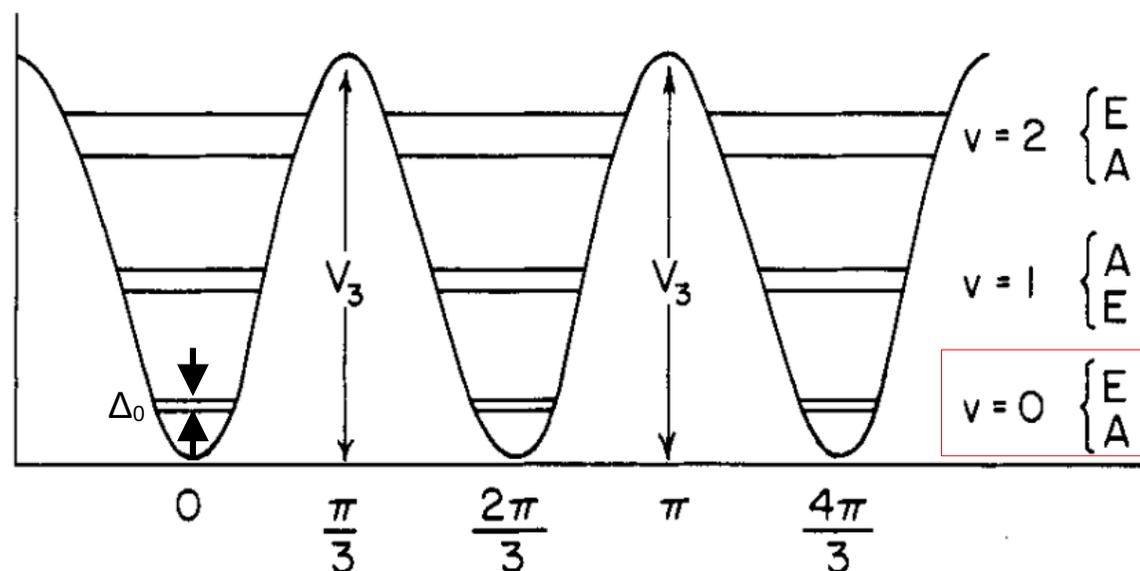- c-C6H6S
- IRAM 30-m and Yebes 40-m
- Araki+ 2026
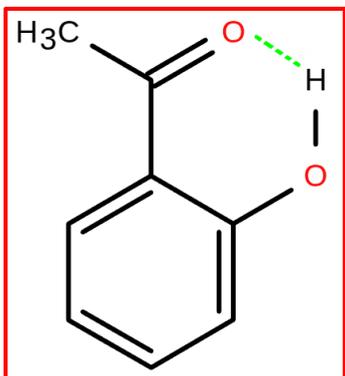
Why not?

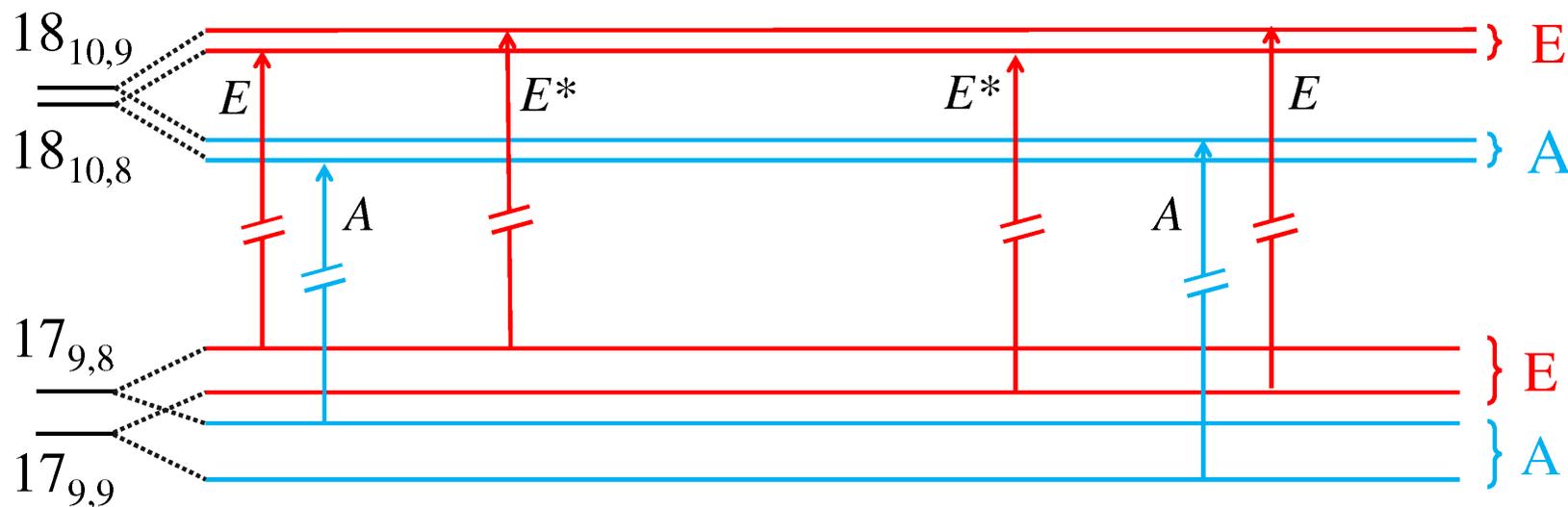CP-FTMW spectrum
23/09/2024   P₂O₅   P₀(Ne)=2 bar   680 kAv

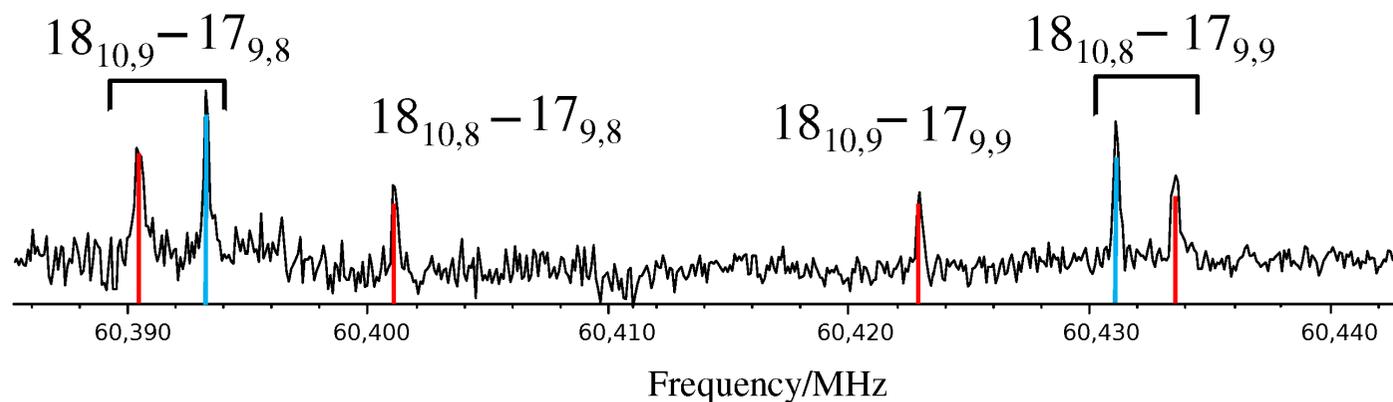# Fit: S-reduction, Iʳ representation

B_J	1.0036926(2)	GHz
B_K	1.2733804(3)	GHz
B_-	0.2084173(1)	GHz
D_J	24.2(7)	Hz
D_{JK}	24(2)	Hz
D_K	118(2)	Hz
d_1	-7(2)	Hz
d_2	-3.1(8)	Hz
V_3	16946(12)	GHz
F_0	[161.74]	GHz
δ	[31°]	
RMS	20	kHz
N	216	
k	-0.43739	
s	46.135985	
$w^{(1)}$	-0.000094	
F	163.248547	GHz
Δ_0	0.052	GHz

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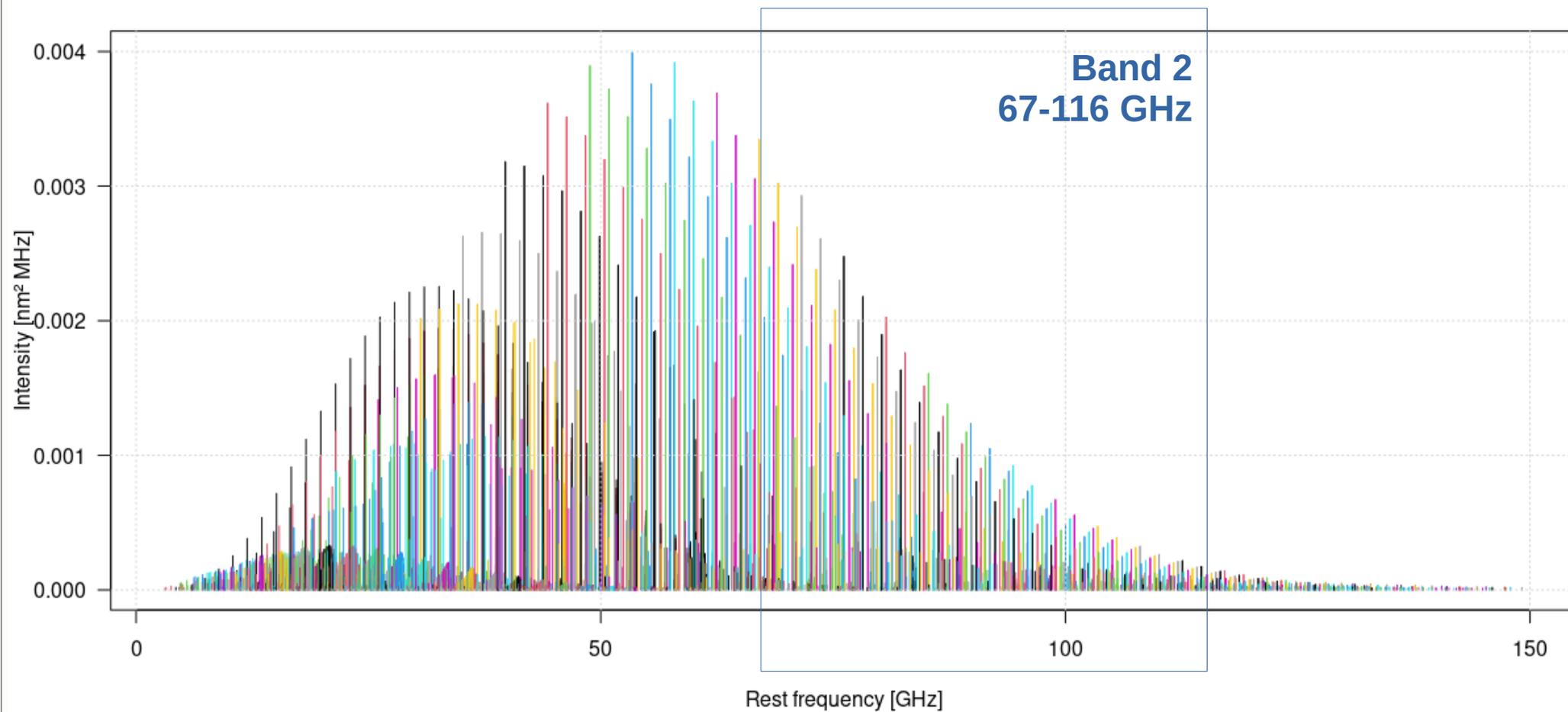**XIAM**: Hartwig & Dreizler 1996; Hansen, Mader & Bruhn 1999; Herbers & Nguyen 2020; Herbers 2020; Herbers+ 2025

Methyl internal rotation
An issue or a boost?
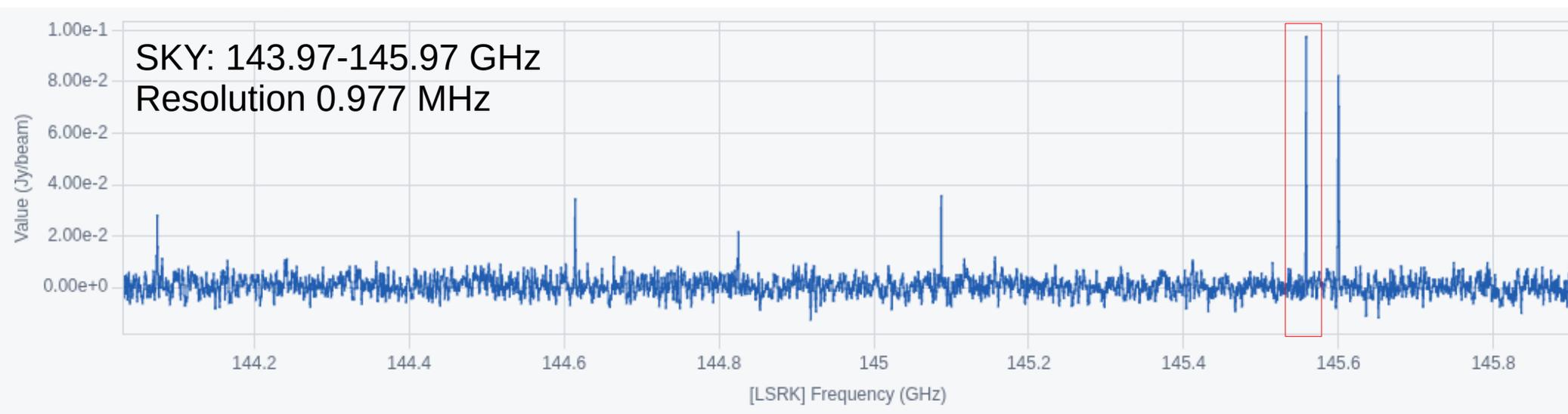
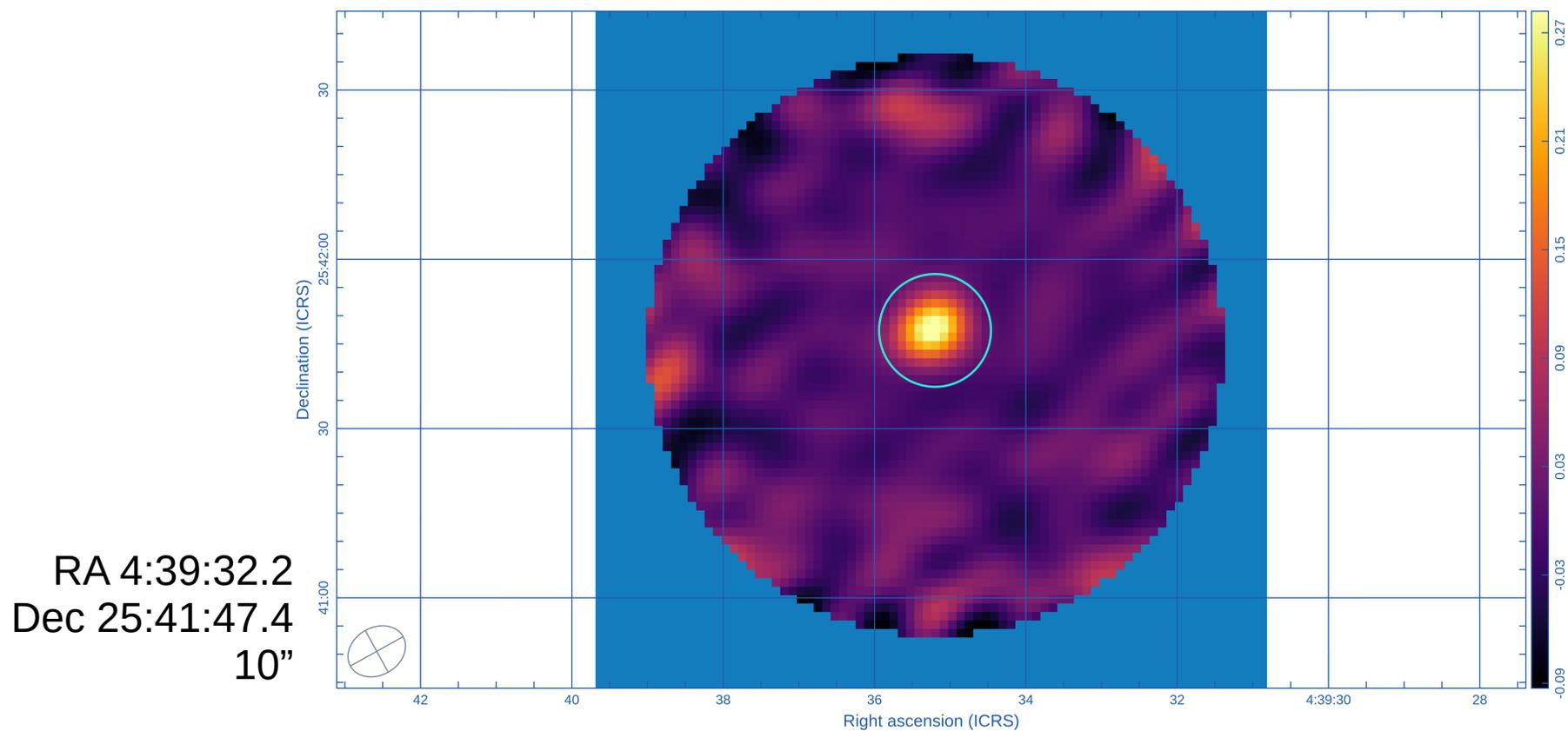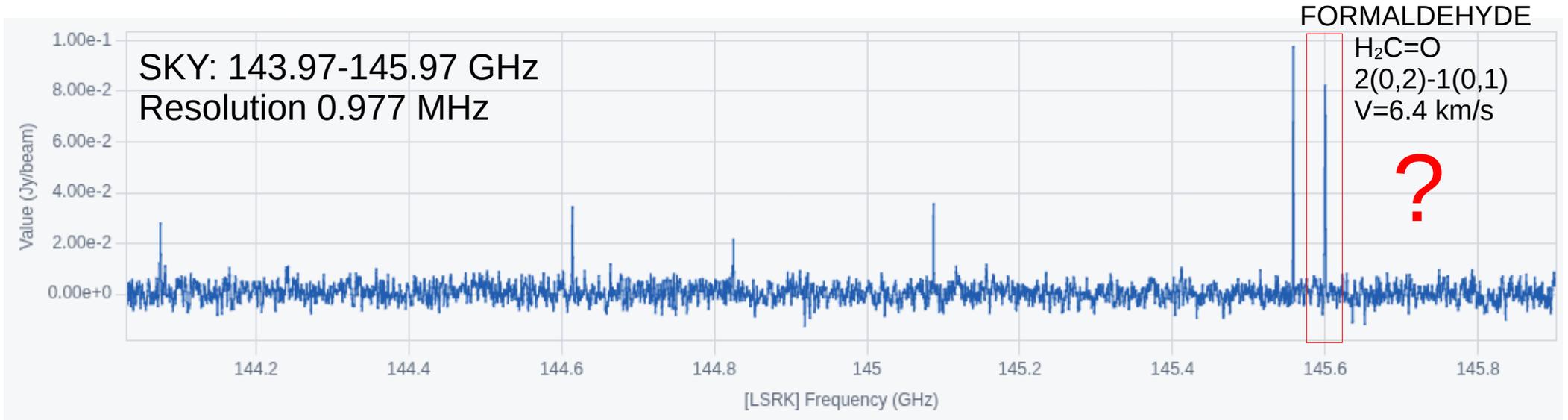2'-hydroxyacetophenone / simulated absorption spectrum / b-type / T=10 K

Band 2
67-116 GHz

ALMA Archive
https://almascience.eso.org/aq/

		Project code	ALMA source name	RA (h:m:s)	Dec (d:m:s)	Band	Cont.sens. (mJy/beam)	Frequency support	↑ Release date
	⊕ ↔		tmc			3|4			
⊕ ↔ ∿ ⬇ 🖾		2017.1.00765.S	TMC1	04:41:45.900	+25:41:27.000	4	0.3263	143.967..158.01 GHz	2019-11-25
⊕ ↔ ∿ ⬇ 🖾		2017.1.00765.S	TMC1A	04:39:35.194	+25:41:44.730	4	0.3263	143.967..158.01 GHz	2019-11-25
⊕ ↔ ∿ ⬇ 🖾		2021.1.01099.S	TMC1	04:41:41.900	+25:41:27.094	3	0.4597	93.142..96.769 GHz	2023-03-30
⊕ ↔ ∿ ⬇ 🖾		2021.1.01099.S	TMC1	04:41:41.900	+25:41:27.100	3	1.6755	93.14..96.771 GHz	2023-12-13
⊕ ↔ ∿ ⬇ 🖾		2021.1.01099.S	TMC1_OFF_0	04:42:31.000	+23:32:33.468	3	2.2899	93.141..96.771 GHz	2023-12-13
⊕ ↔ ∿ ⬇ 🖾		2021.1.01099.S	TMC1	04:41:42.021	+25:41:28.469	3	3.7832	93.14..96.771 GHz	2023-12-20
⊕ ↔ ∿ ⬇ 🖾		2022.1.00131.S	TMC-1A	04:39:35.000	+25:41:45.000	3	0.0934	99.969..115.591 GHz	2024-05-03
⊕ ↔ ∿ ⬇ 🖾		2022.1.01357.S	TMC1A	04:39:35.200	+25:41:44.230	3	0.0241	89.581..105.413 GHz	2024-08-29
⊕ ↔ ∿ ⬇ 🖾		2022.1.00131.S	TMC_1A	04:39:34.806	+25:41:44.199	3	0.8006	99.965..115.593 GHz	2025-01-25
⊕ ↔ ∿ ⬇ 🖾		2024.1.00117.S	tmc1a	04:39:35.200	+25:41:44.230	3	0.7838	99.065..113.722 GHz	2026-01-05

- 2017.1.00765.S TMC-1   Band 4 CARTA WINDOW DOES NOT OPEN
- 2021.1.01099.S TMC-1   Band 3 SMALL RANGE
- 2022.1.00131.S TMC-1A Band 3 SMALL RANGE
- 2022.1.01357.S TMC-1A Band 3 NO IMAGE
- 2024.1.00117.S TMC-1A Band 3 NO CARTA

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RA 4:39:32.2
Dec 25:41:47.4
10"

SKY: 143.97-145.97 GHz
Resolution 0.977 MHz

RA 4:39:32.2
Dec 25:41:47.4
10"

SKY: 143.97-145.97 GHz
Resolution 0.977 MHz

FORMALDEHYDE
$H_2C=O$
2(0,2)-1(0,1)
V=6.4 km/s

?

RA 4:39:32.2
Dec 25:41:47.4
10"

SKY: 143.97-145.97 GHz
Resolution 0.977 MHz

CARBON MONOSULFIDE S-34
C=^{34}S
J=3-2
V=5.7 km/s
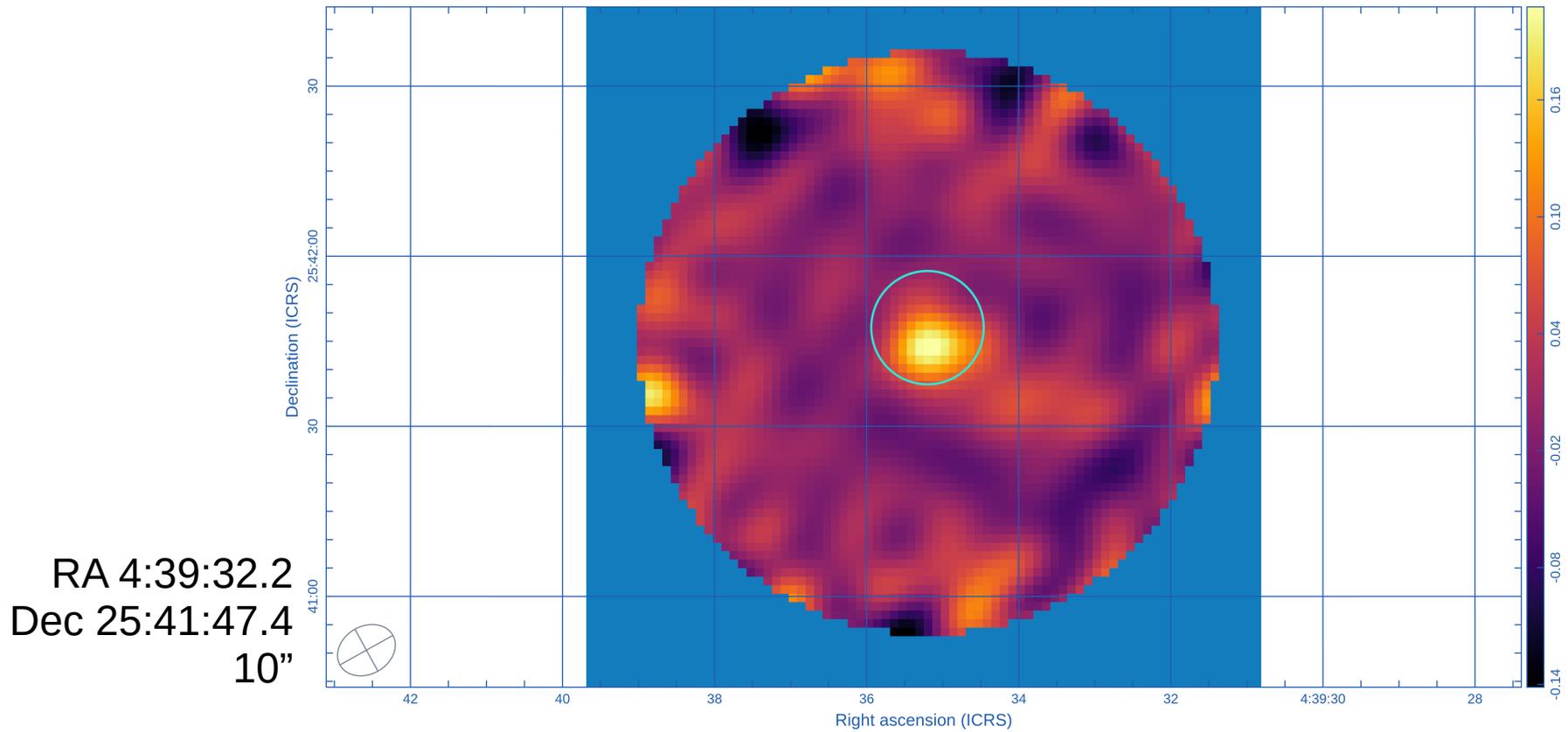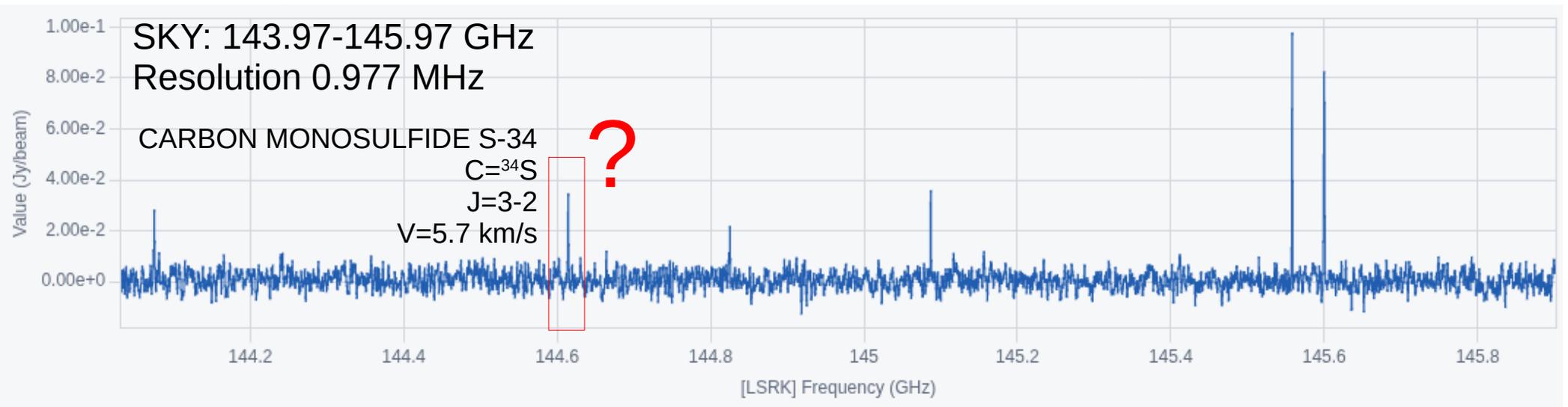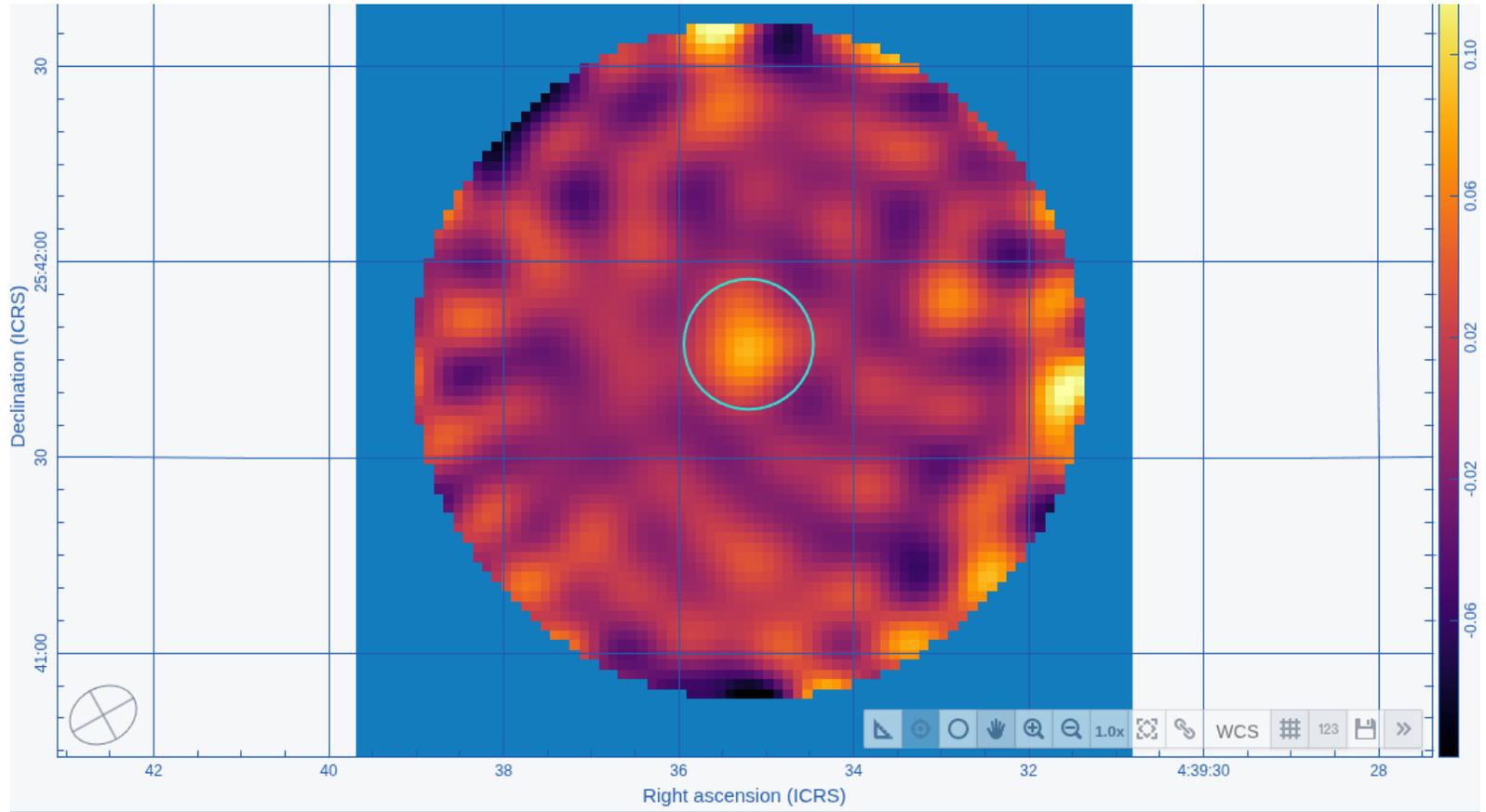
In conclusion, we have not found 2'-hydroxyacetophenone yet, but I am sure we could…

…with your expertise!

Acknowledgments

- Riccardo Stanganini (BSc thesis)

- Filippo Baroncelli
(poster on methylurea)

- Martino Napoli
(working on automatic fit methods)

- Andrea Maggio & Jinxi Huang
(working on sulfur compounds)

… and thank you for your attention