

# Resolving Discrepancy in the pPN OH231.8...

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# Outline of the talk



**I. Evolution beyond the AGB for intermediate mass stars**

**Post-AGB: proto / pre - Planetary Nebulae (pPNe)**

**II. The puzzling case of the archetypal pPN OH 231.8+ 4.2**

**III. ALMA Observations**

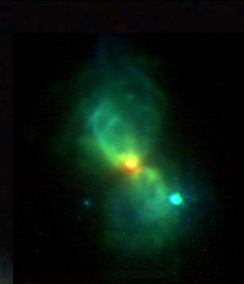
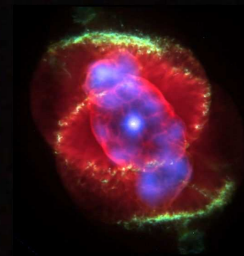
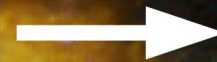
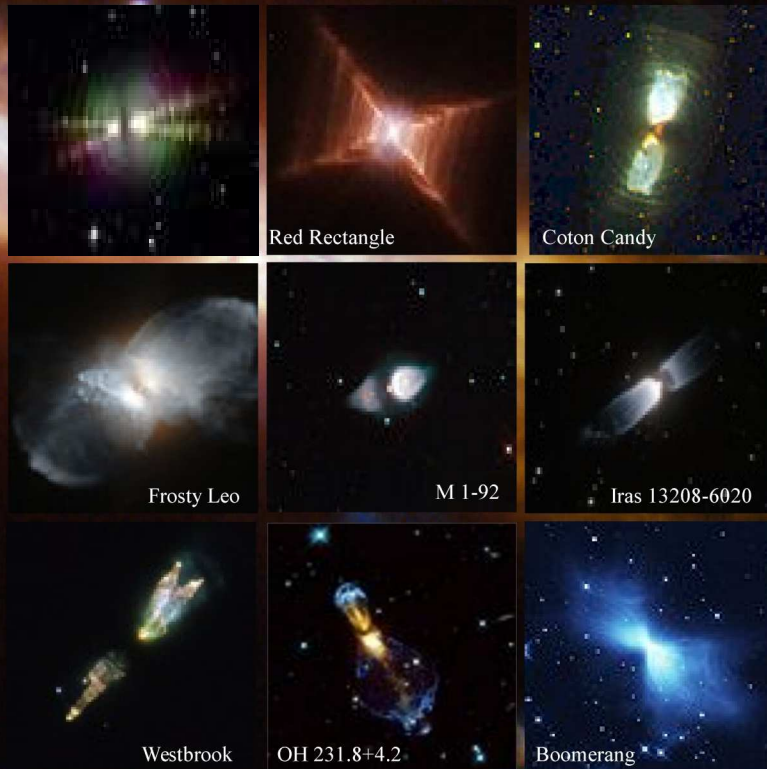
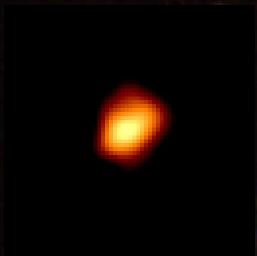
**IV. Conclusions**

In ~10,000 years ...

## Pre-Planetary Nebulae

## Planetary Nebulae

AGB



AGB wind  
Spherical symmetry



Axial symmetry or point symmetry  
+  
High Velocity Collimated Jets

## II. The puzzling case of the archetypal pPN : OH 231.8+ 4.2



Distance  $\sim 1.54 \text{ kpc} \pm 0.02$

Inclination:  $\sim 36^\circ$

Bipolar – Axial symmetric

Very fast outflow  $\sim 400 \text{ km/s}$

Age :  $\sim 1200$  years

Strong shocks

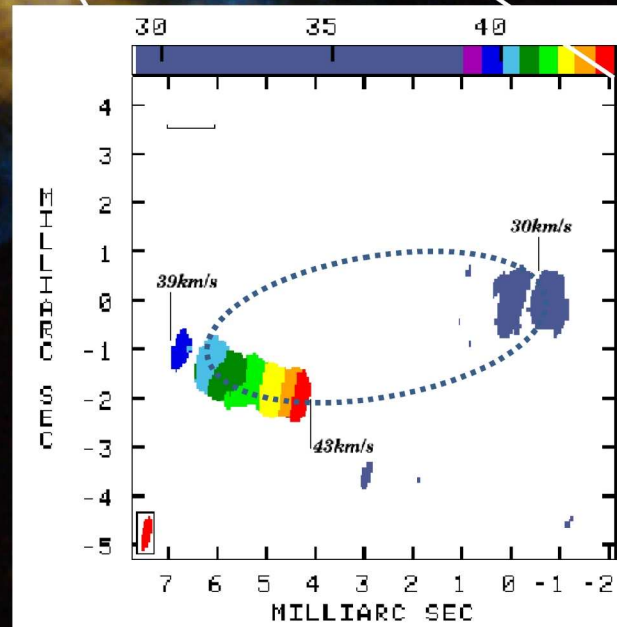
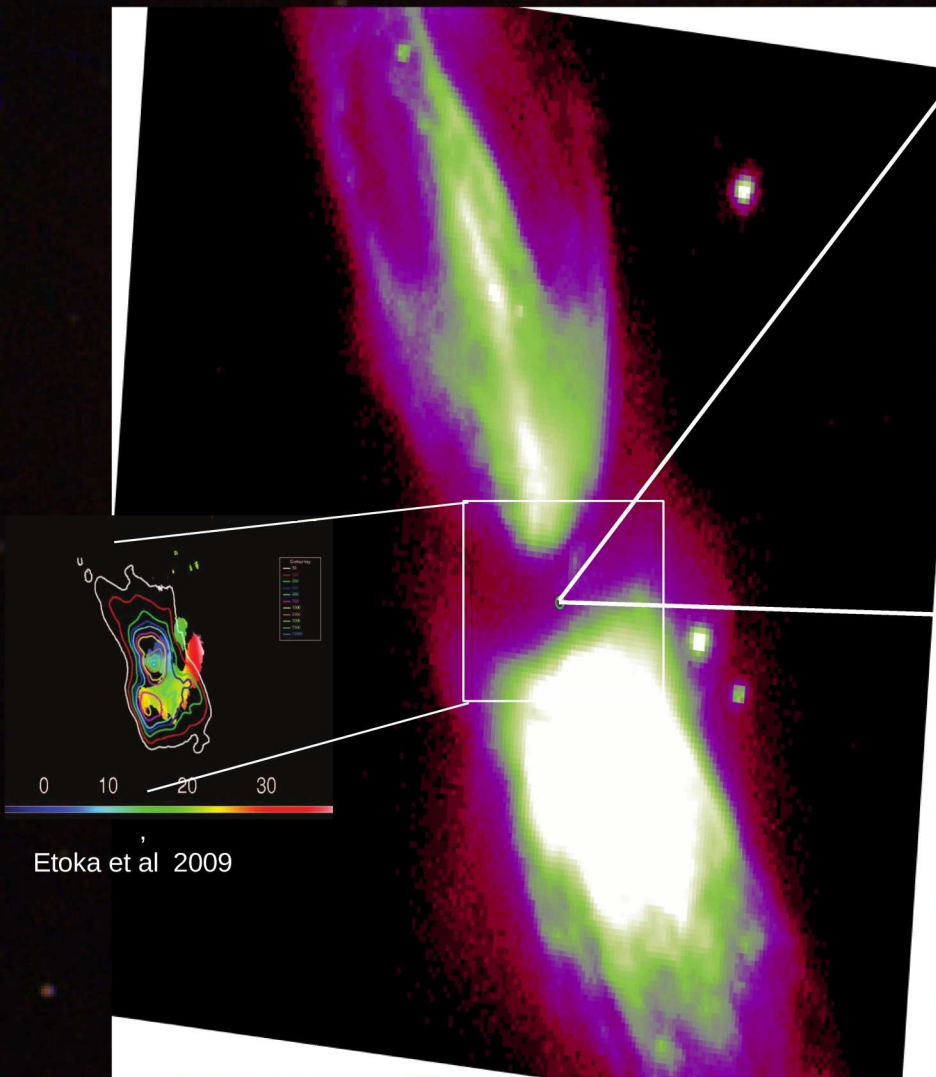
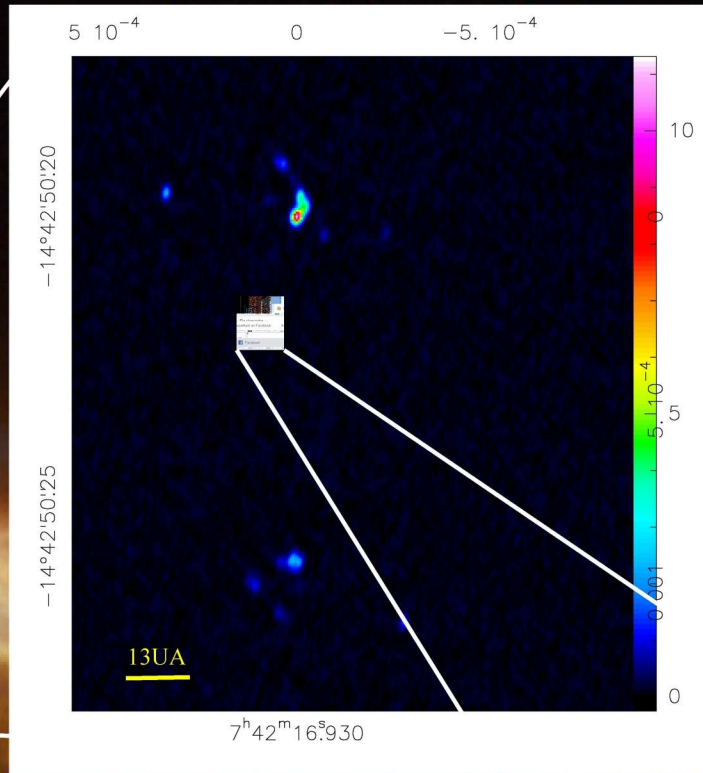
Binary star

Initial stellar mass  $\sim 3M_{\text{sun}}$

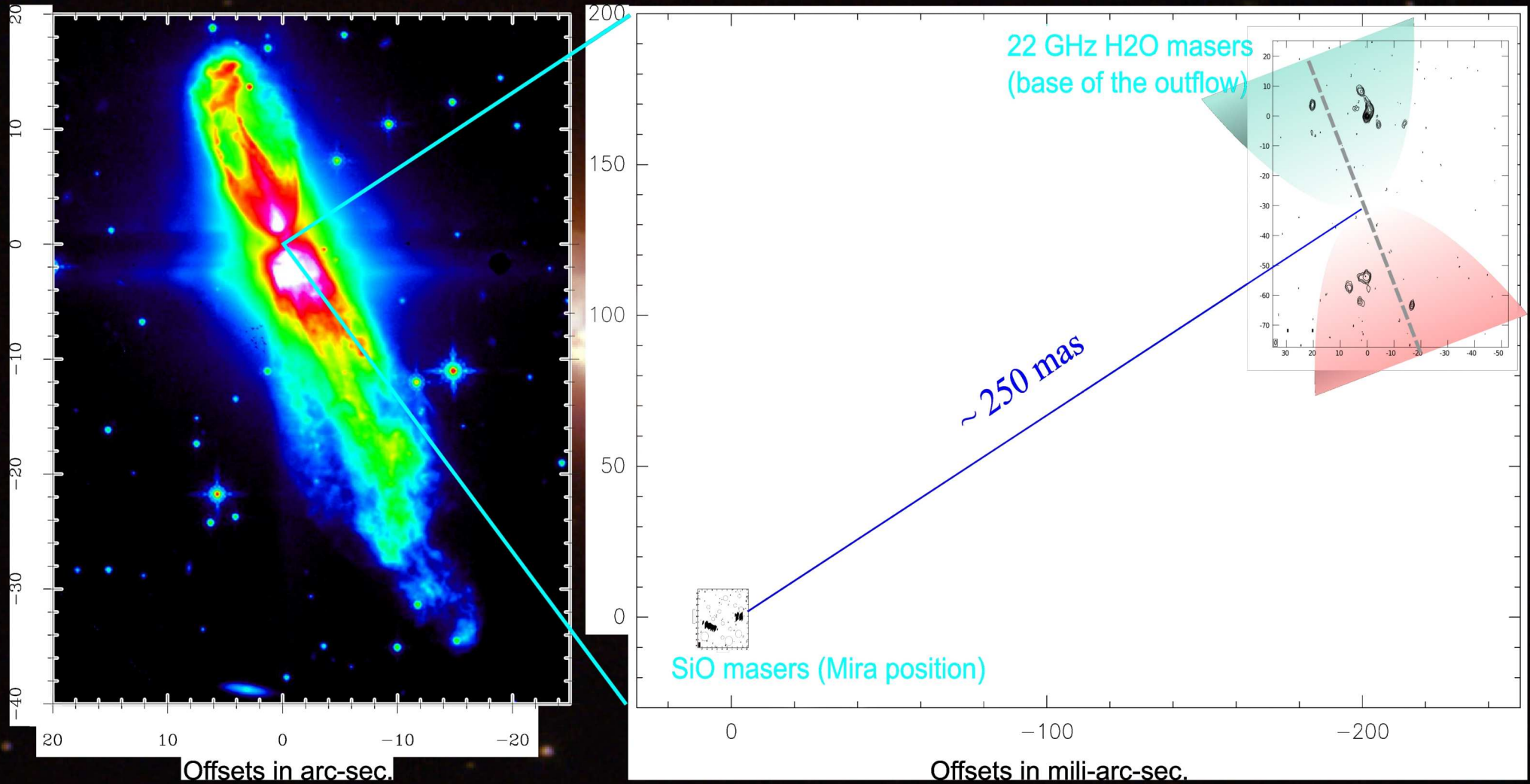
Stellar radius:  $\sim 4.5 \text{ AU}$

Resolution: 50 milli arcsecond  
HST image (credit V Bujarrabal)

# Expected relative distribution of maser emission



# But published positions ...



Many frustrated projects until 2016 to measure

# III. Alma Observations

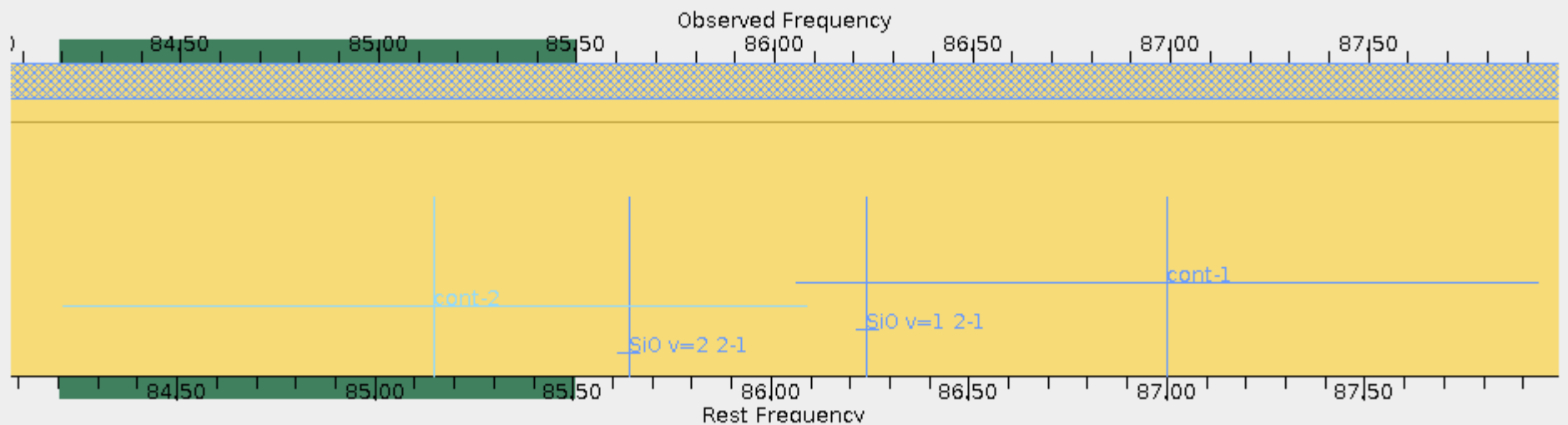
Total time : 70min → 22 min on source! (SNR > 5)

Total aggregate bandwidth : 3.6 GHz

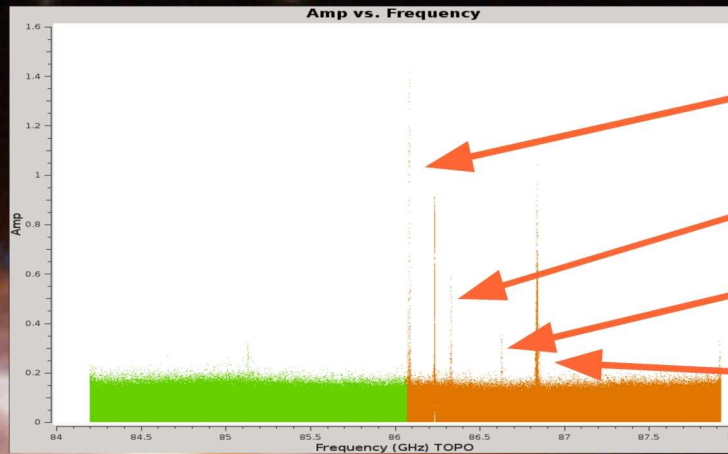
Resolution : 0.4km/s

Sensitivity 5mJy / channel

Beam resolution ~80x50mas (extended conf., 15km)



# Detected lines : Only one observing run

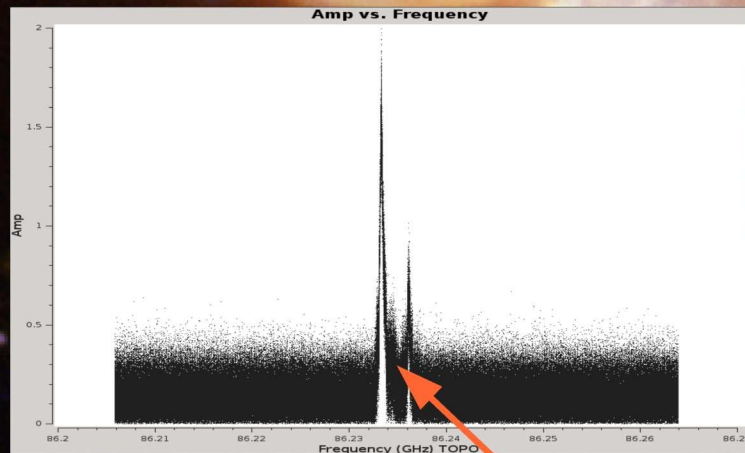


SO  $v=0$

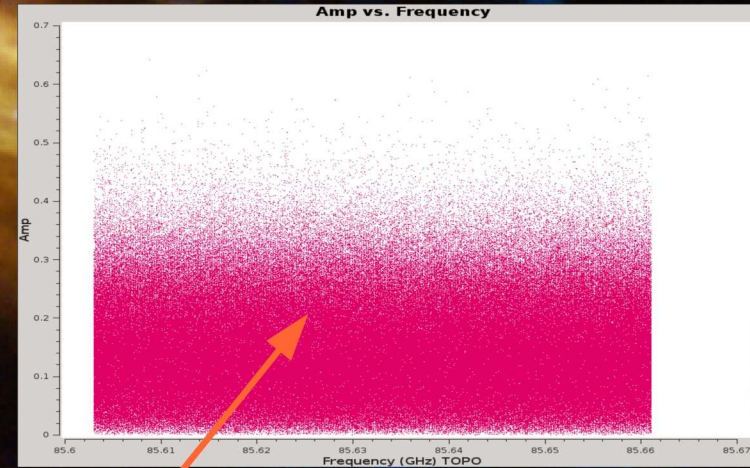
$H_{13}CN$   $v=0$

$SO_2$   $v=0$

SiO J 2-1,  $v=0$



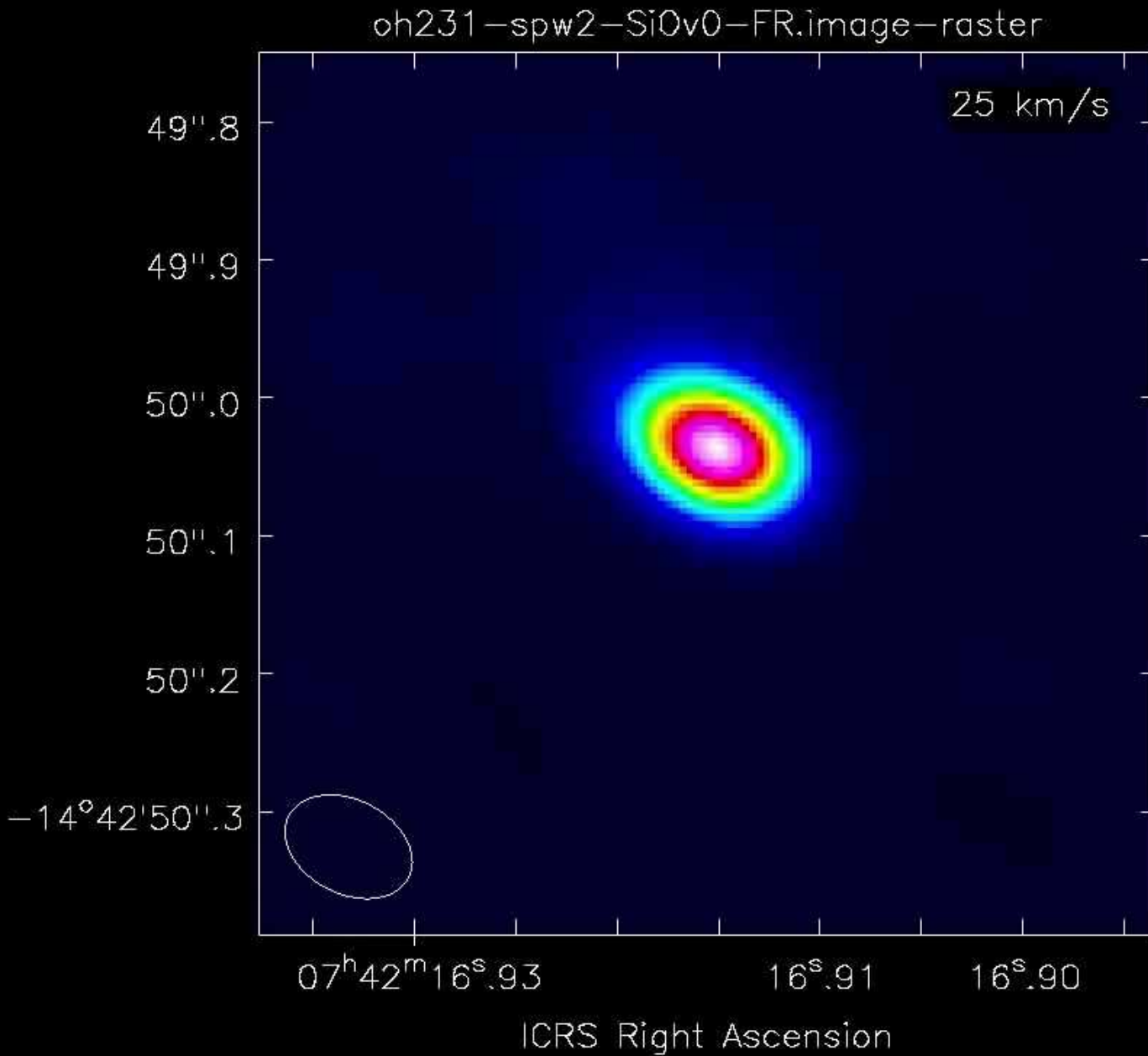
SiO J 2-1,  $v=1$  but not  $v=2$ !



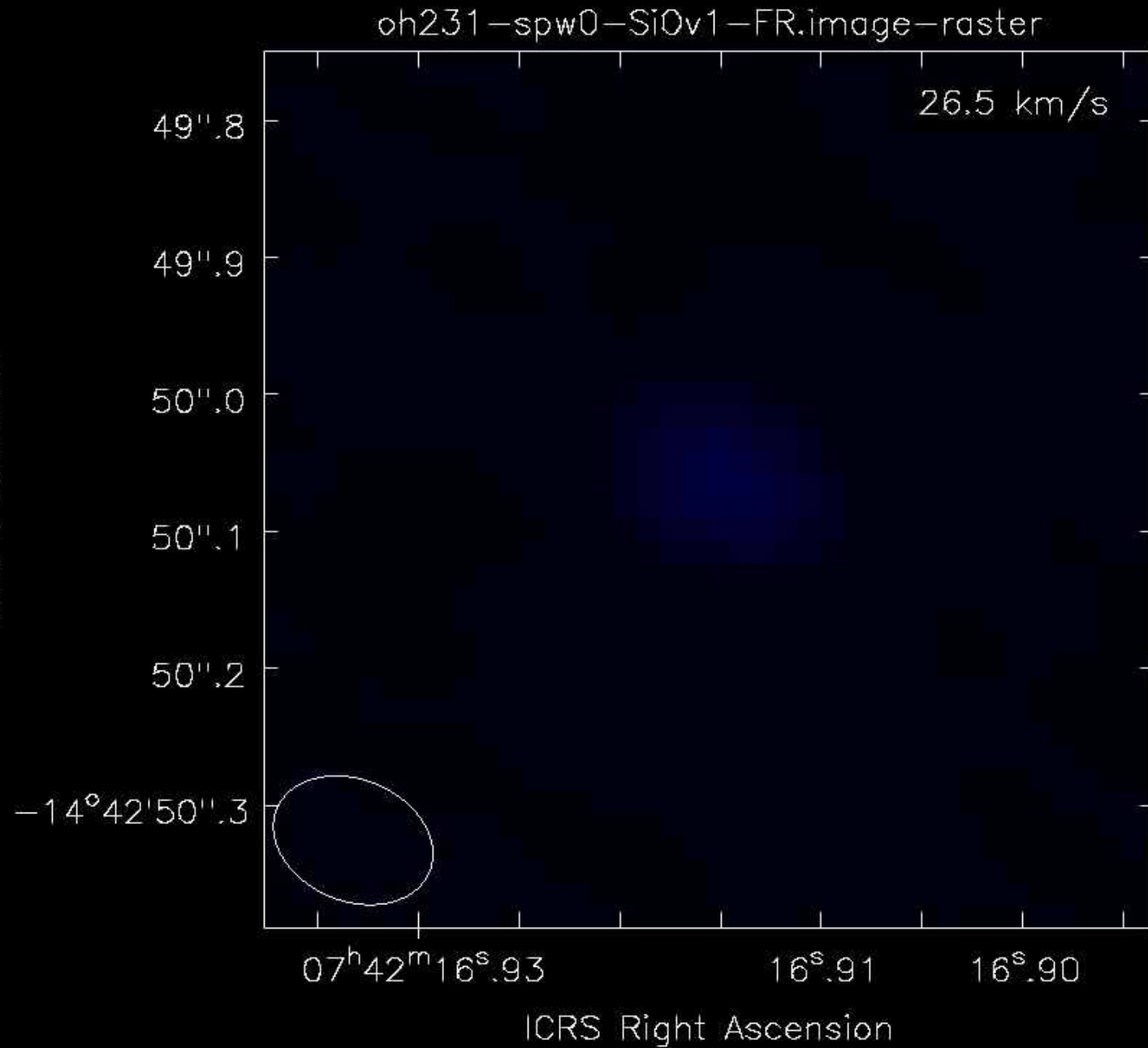
And the continuum !



# OH231.8+4.2: SiO J 2-1, $v=0$ (Thermal line)

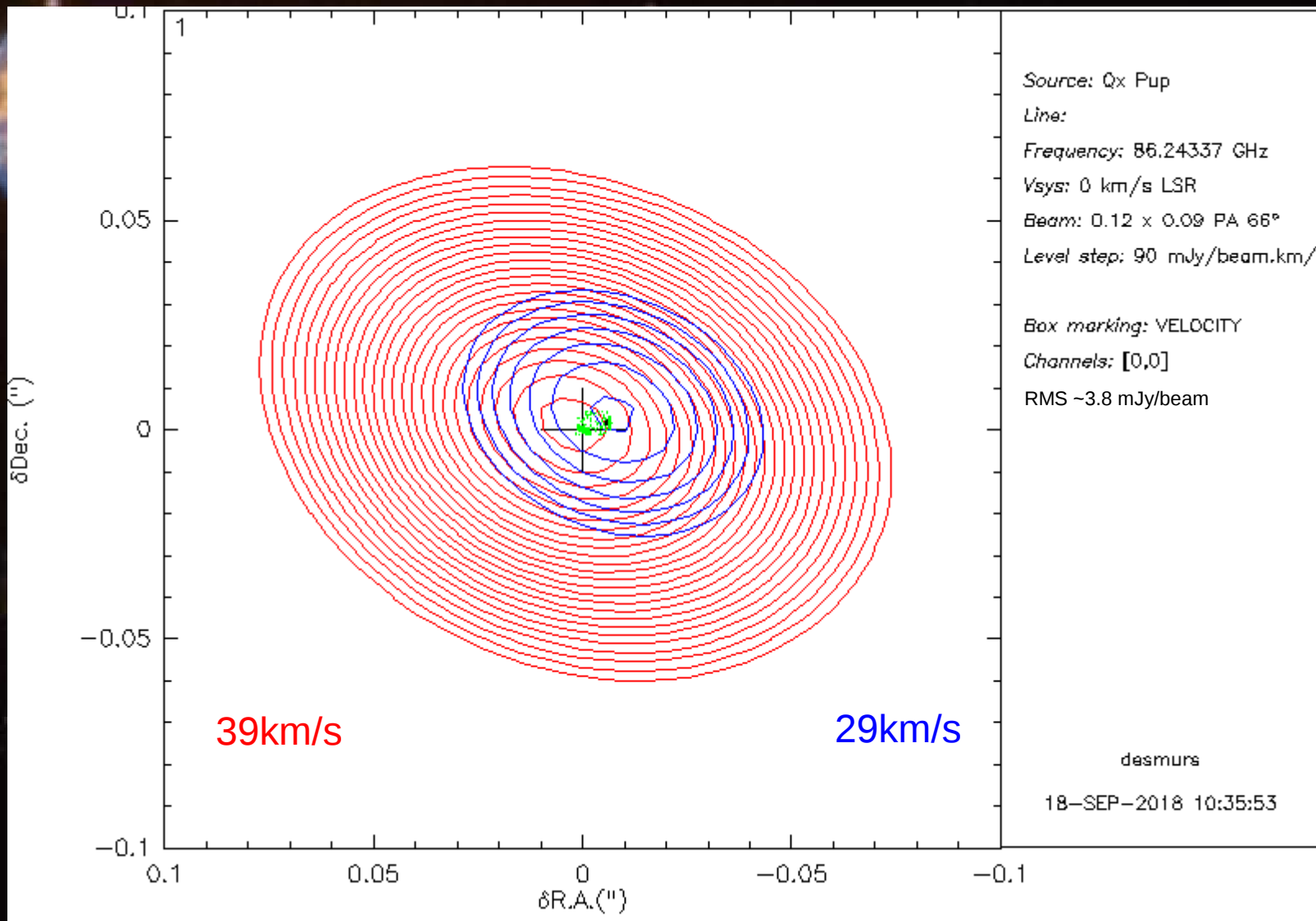


# OH231.8+4.2: SiO J 2-1, $v=1$ (maser line)

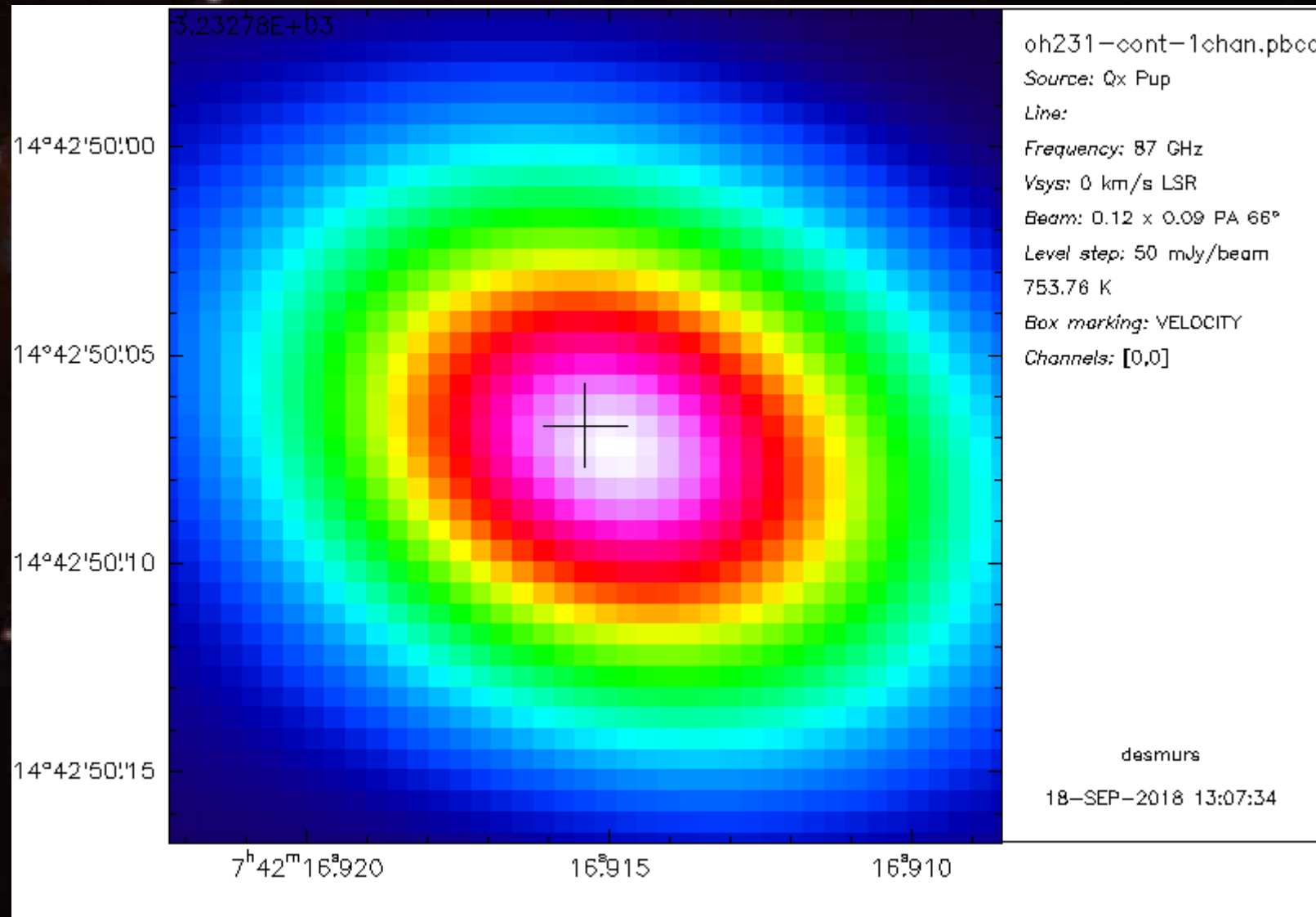


# OH231.8+4.2: SiO J 2-1, v=1 (maser)

## ALMA / VLBA Observations

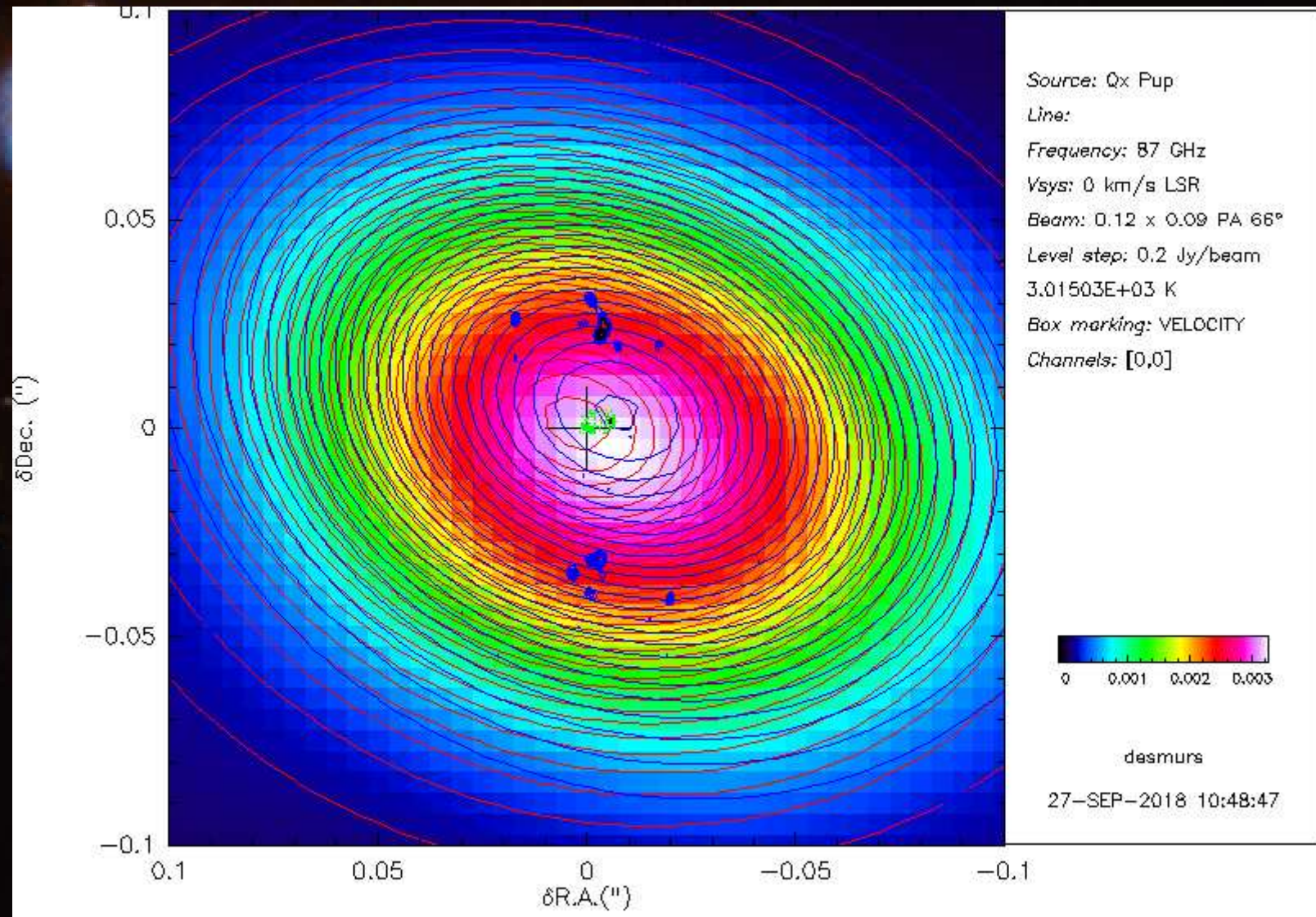


# OH231.8+4.2: Continuum !



Position continuum : 07d42m16.915s -14h42m50.072

# Relative position of masers emission and continuum



# Conclusions

- We detected and measured the SiO maser J 2-1,  $v=1$  and the thermal line (SiO J 2-1,  $v=0$ )
- We detected continuum for first time  $\rightarrow$  trace binary system
- We confirmed SiO position measured by Desmurs et al. 2007 and with KVN by Dodson et al., 2018

We solved the discrepancy and we now have a coherent picture of the source, with the Mira at the center surrounded by SiO emission and, further on, H<sub>2</sub>O masers tracing the base of the outflows.

**THANK YOU !!!**

