

# JVLA OVERVIEW OF MASER ACTIVITY IN THE BURSTING SOURCE G25.65+1.05\*

*\*Unpublished results - ApJ article in preparation*

METHANOL MASER ACTIVITY DURING A WATER MASER SUPER-BURST IN G25.65+1.05  
(JVLA OVERVIEW OF MASER ACTIVITY IN THE BURSTING SOURCE G25.65+1.05)

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(Received January 1, 2018; Revised January 7, 2018; Accepted April 30, 2018)

Submitted to ApJ

ABSTRACT

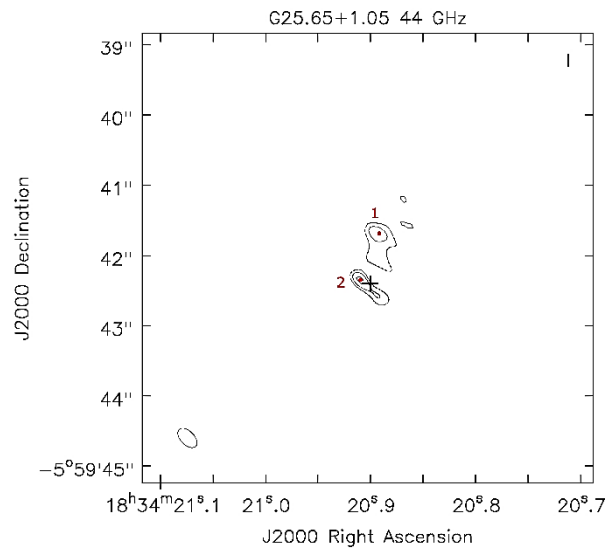
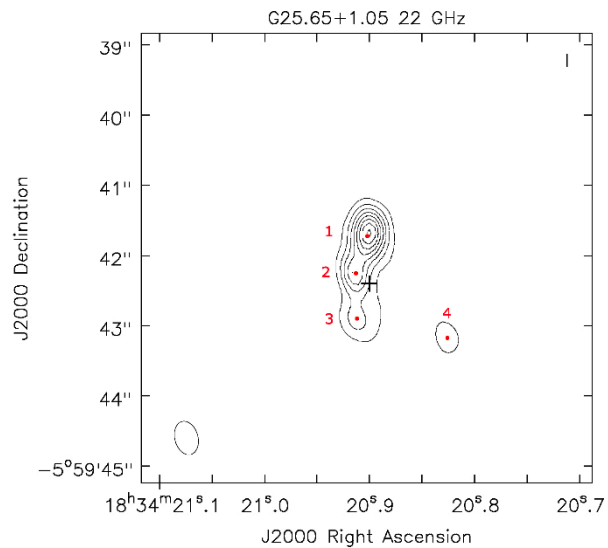
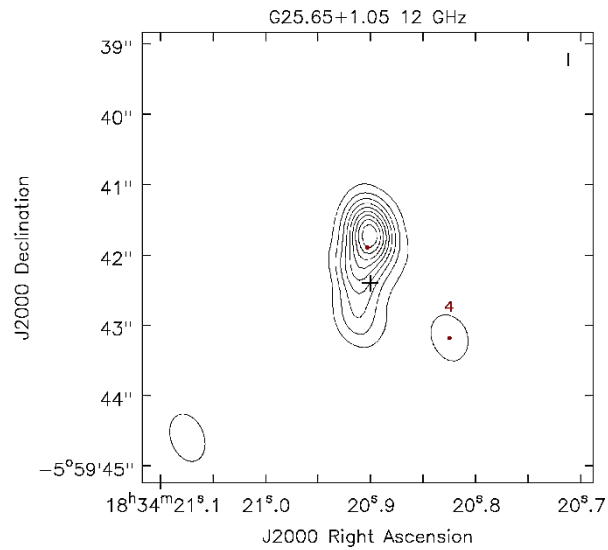
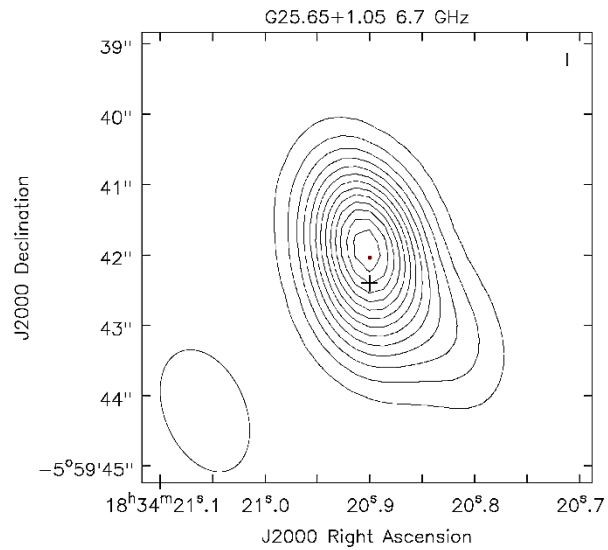
An overview on a maser activity in the source of outstanding H<sub>2</sub>O maser bursts G25.65+1.05 (RAFGL7009S) is presented. Spectral line observations of the water maser at 22 GHz, the methanol maser transitions at 6.7, 12.2 and 44 GHz, and the continuum in all listed frequency bands with The Karl G. Jansky Very Large Array (JVLA) were conducted on the post-burst epoch of 2017. For the first time ever the maps of 22 GHz H<sub>2</sub>O and 44 GHz CH<sub>3</sub>OH maser spots are obtained and the absolute position of the 22 GHz H<sub>2</sub>O bursting feature is determined with a milliarcsecond accuracy. Four continuum sources, unresolved in the previous observations, are detected in the region. It is shown that there are at least two areas in the star-forming region that are at the different stages of evolution. One of them, associated with the known UCHII region, contains a protostellar disk of  $\sim 1000$  AU detected at 6.7 GHz, while another, separated from UCHII region by  $0.7''$  ( $\sim 1500$  AU) and probably more young, contains the bursting H<sub>2</sub>O maser associated with the front of the shock from compact disk of  $\sim 40$  AU detected at 22 GHz. Bursting H<sub>2</sub>O maser components appear to trace a V-shaped structure. Other relationships of detected continuum and maser sources as well as possible models of the H<sub>2</sub>O maser burst are discussed.

*Keywords:* ISM: evolution, masers

Table 1. Observation parameters

Frequency (GHz)	Obs. Date	Integ. Time (min)	Continuum			Spectral Line			
			Synth. Beam (arcsec)	PA ( $^{\circ}$ )	$\sigma$ (mJy/beam)	Vel. res. (km/s)	Synth. Beam (arcsec)	PA ( $^{\circ}$ )	$\sigma$ (mJy/beam)
6.7	2017-Dec-09	10	$1.82 \times 1.15$	23.01	8	0.04	$1.24 \times 0.86$	19.78	35
12	2017-Dec-09	12	$0.70 \times 0.47$	20.51	10	0.05	$0.62 \times 0.44$	19.16	53
22	2017-Dec-09	12	$0.48 \times 0.33$	15.43	15	0.11	$0.35 \times 0.25$	11.25	60
44	2017-Nov-02	10	$0.33 \times 0.19$	44.27	41	0.05	$0.24 \times 0.14$	33.08	36

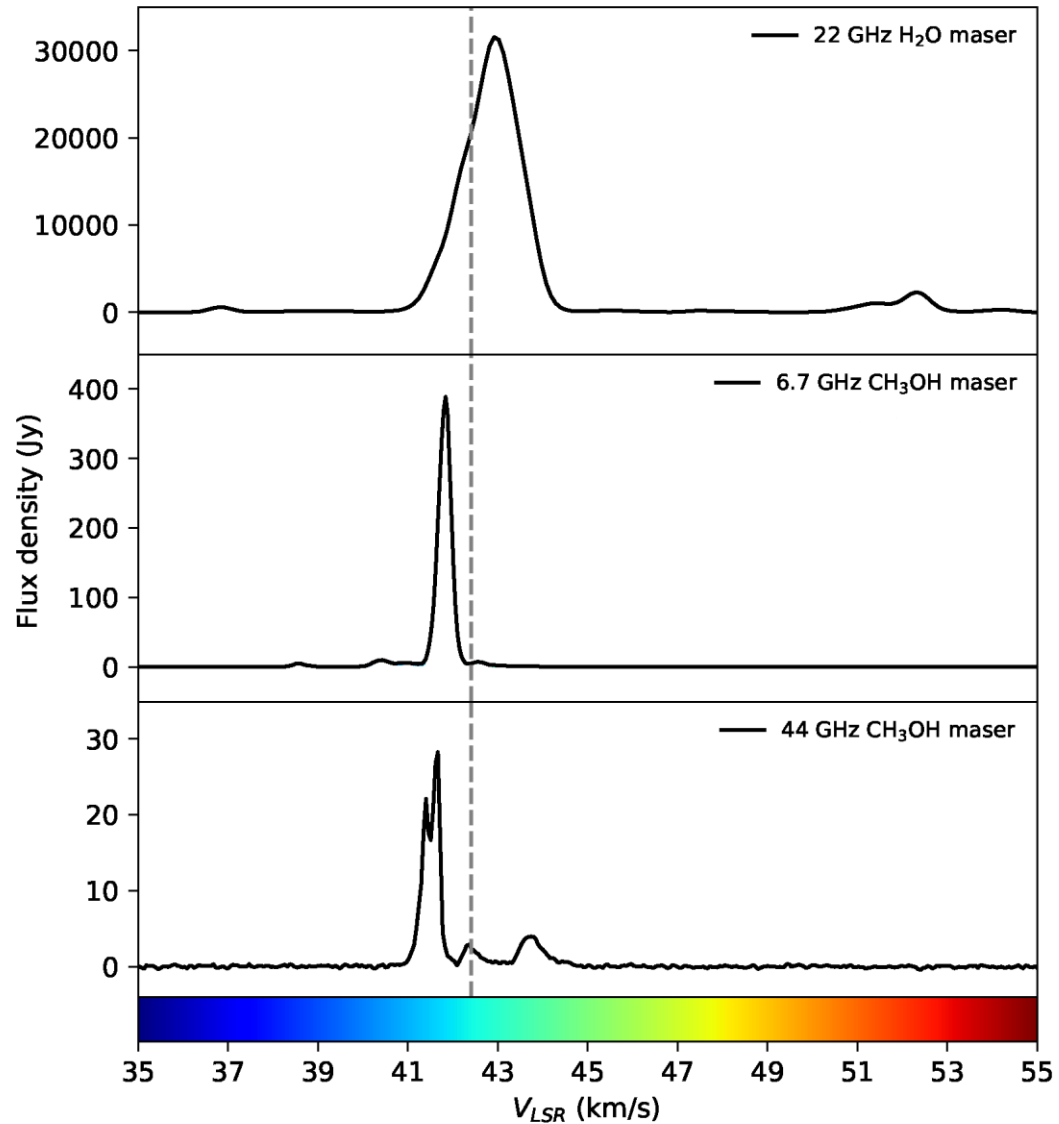
# Continuum images of G25.65+1.05 at 6.7, 12, 22, and 44 GHz



## Levels:

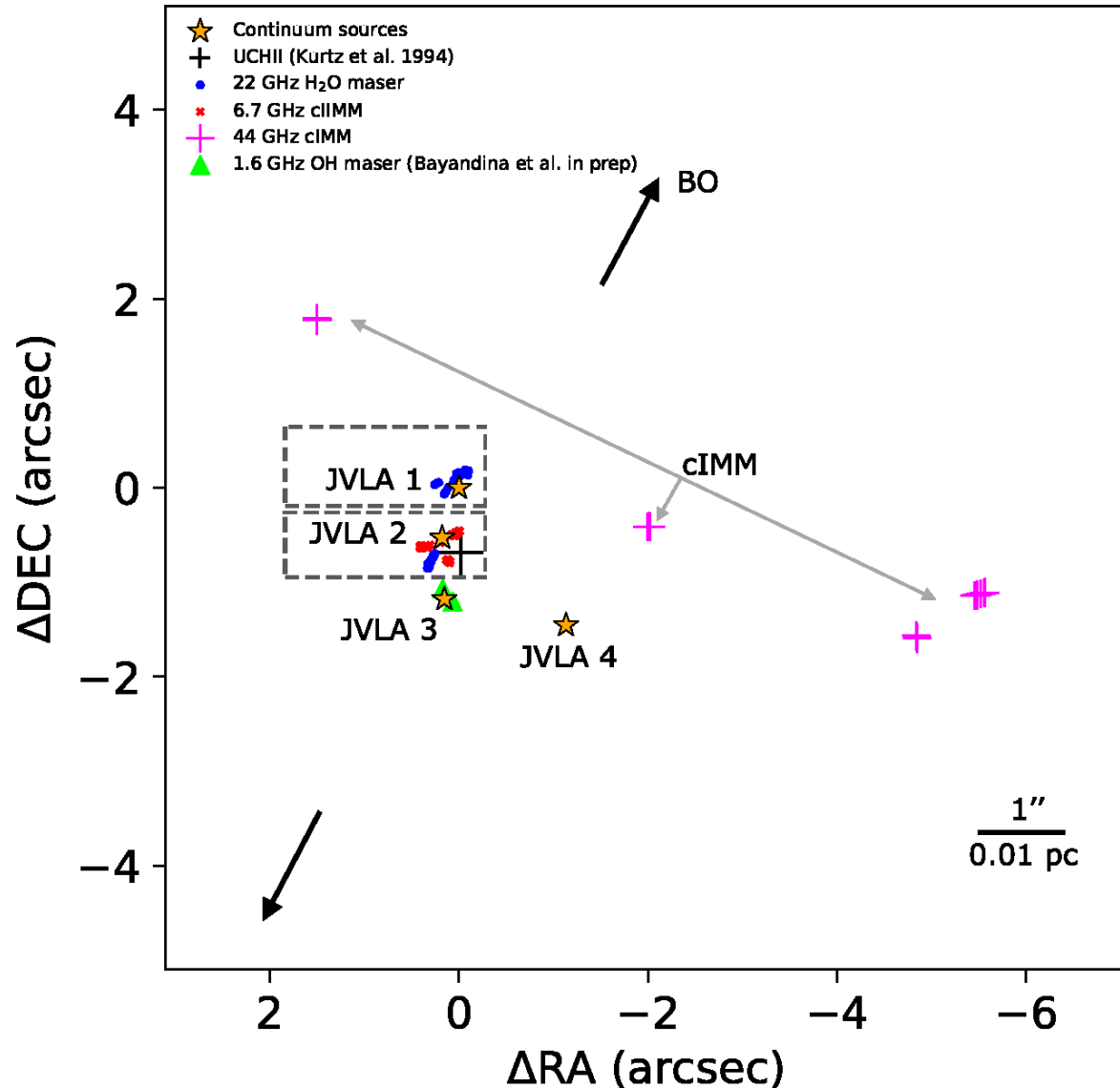
- 6.7 GHz  
0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0, 2.2, 2.4, 2.6 mJy/beam,
- 12 GHz  
0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8 mJy/beam),
- 22 GHz  
0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6 mJy/beam),
- 44 GHz  
0.2, 0.4, 0.6 mJy/beam

# Detection of spectral maser line emission



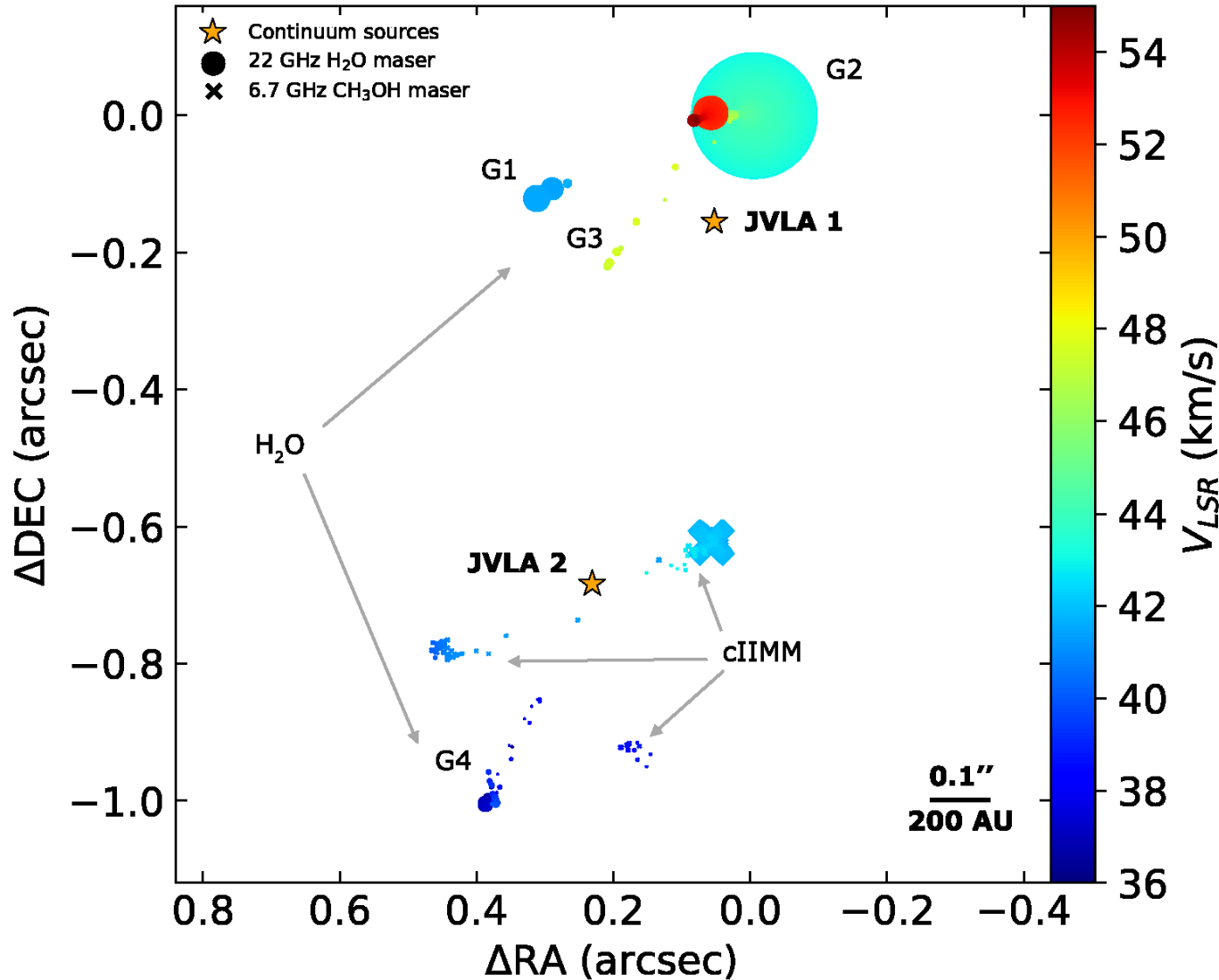
Spectral line emission is detected in all frequency bands except Ku-band (15 GHz) - no 12 GHz class II  $CH_3OH$  maser emission is found above 5 level.

# Objects detected toward G25.65+1.05 with the JVLA



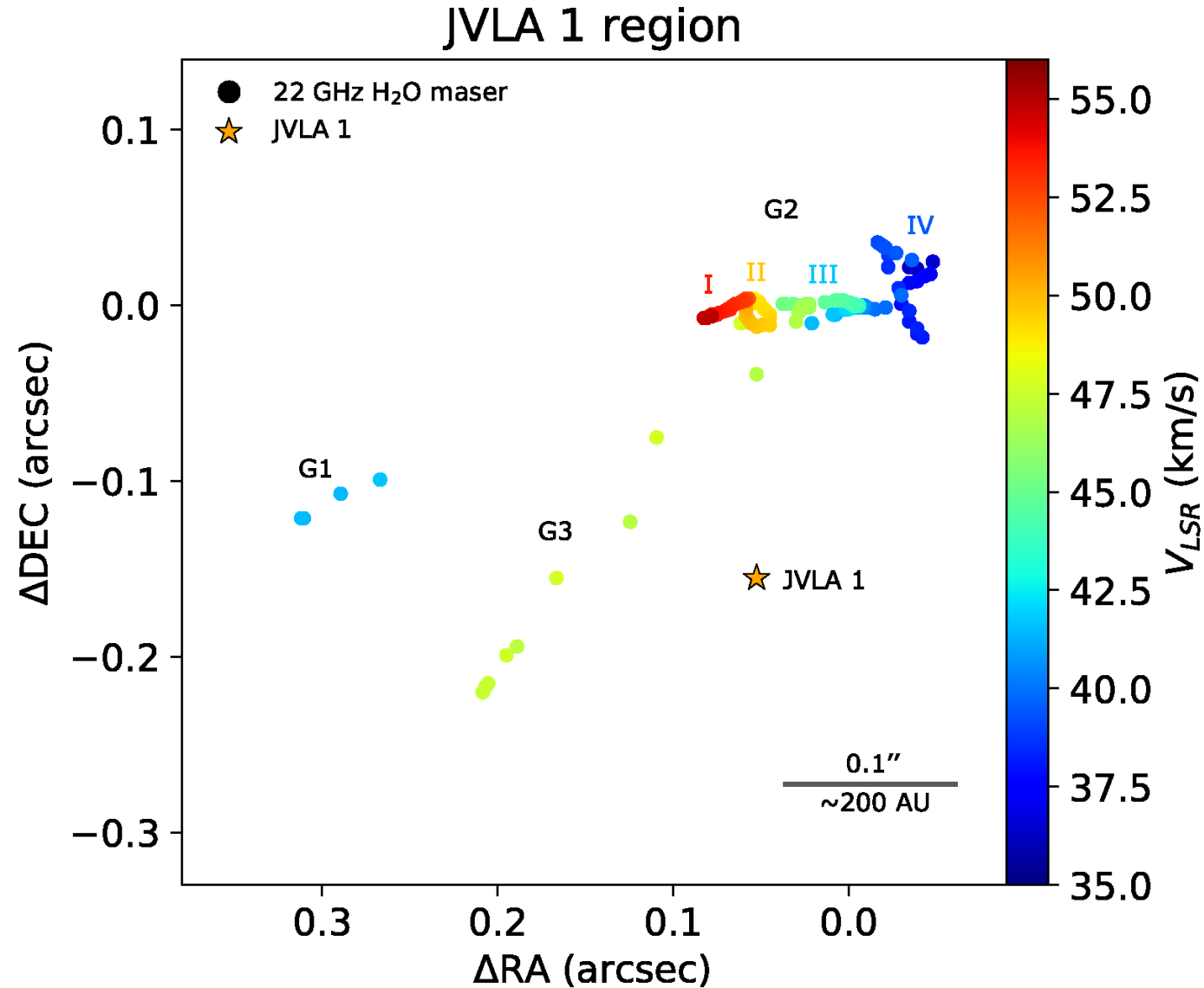
- *Black arrows represent the direction and the position angle (but not the actual position) of bipolar outflow from Sanchez-Monge et al. (2013).*
- *Positional offsets are relative to the JVLA 1 continuum source.*
- *The physical scale label (in pc) assumes the distance to the source of 2.08 kpc (the BeSSeL Survey Bayesian Distance Calculator).*

# Distribution of 22 GHz H<sub>2</sub>O and 6.7 GHz CH<sub>3</sub>OH maser spots detected in vicinity of JVL A 1 and 2 sources



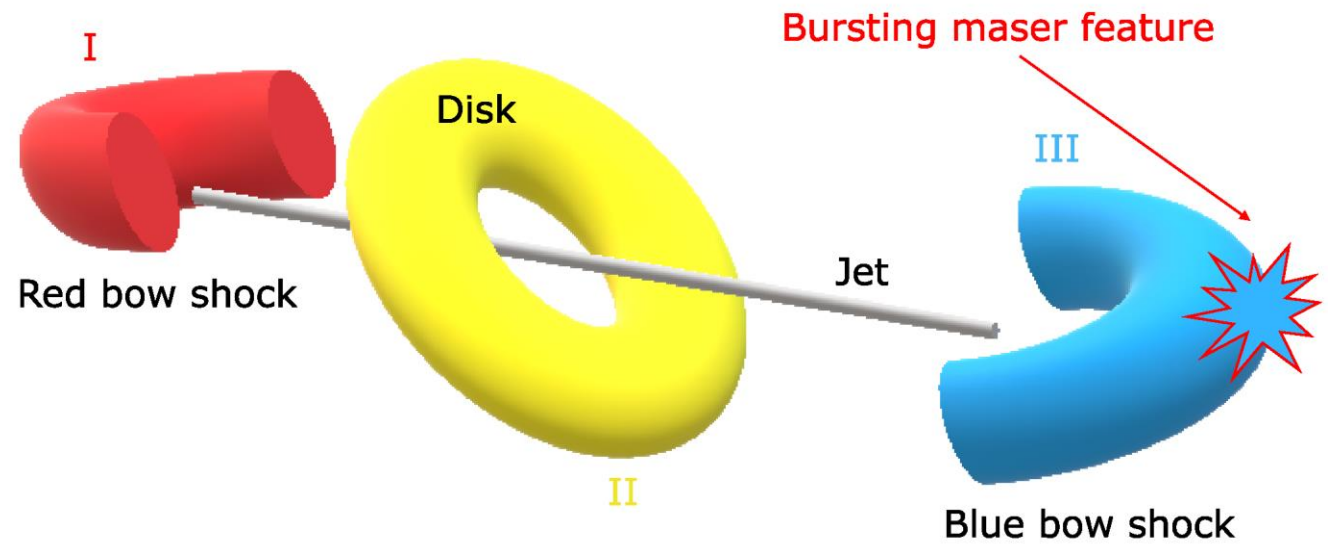
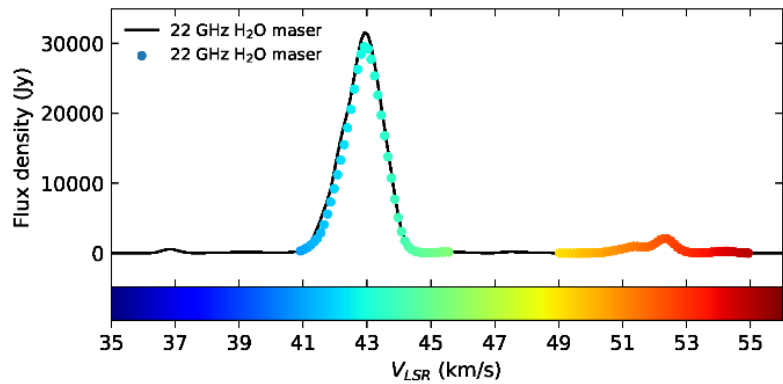
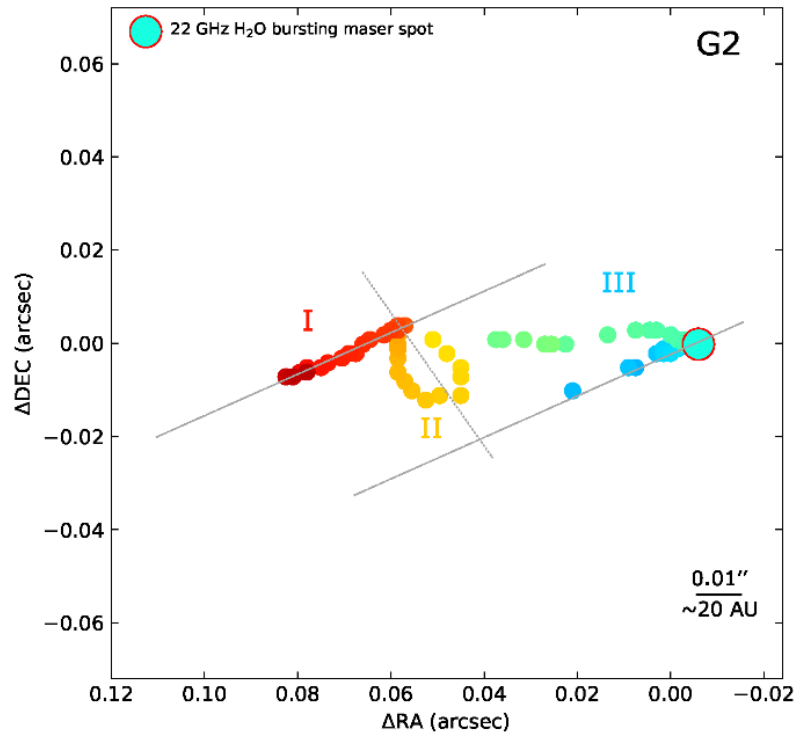
- The diameter of each spot is proportional to the flux.
- Plot is color-coded by radial velocity.

# Distribution of 22 GHz H<sub>2</sub>O maser spots detected in JVLA 1 region

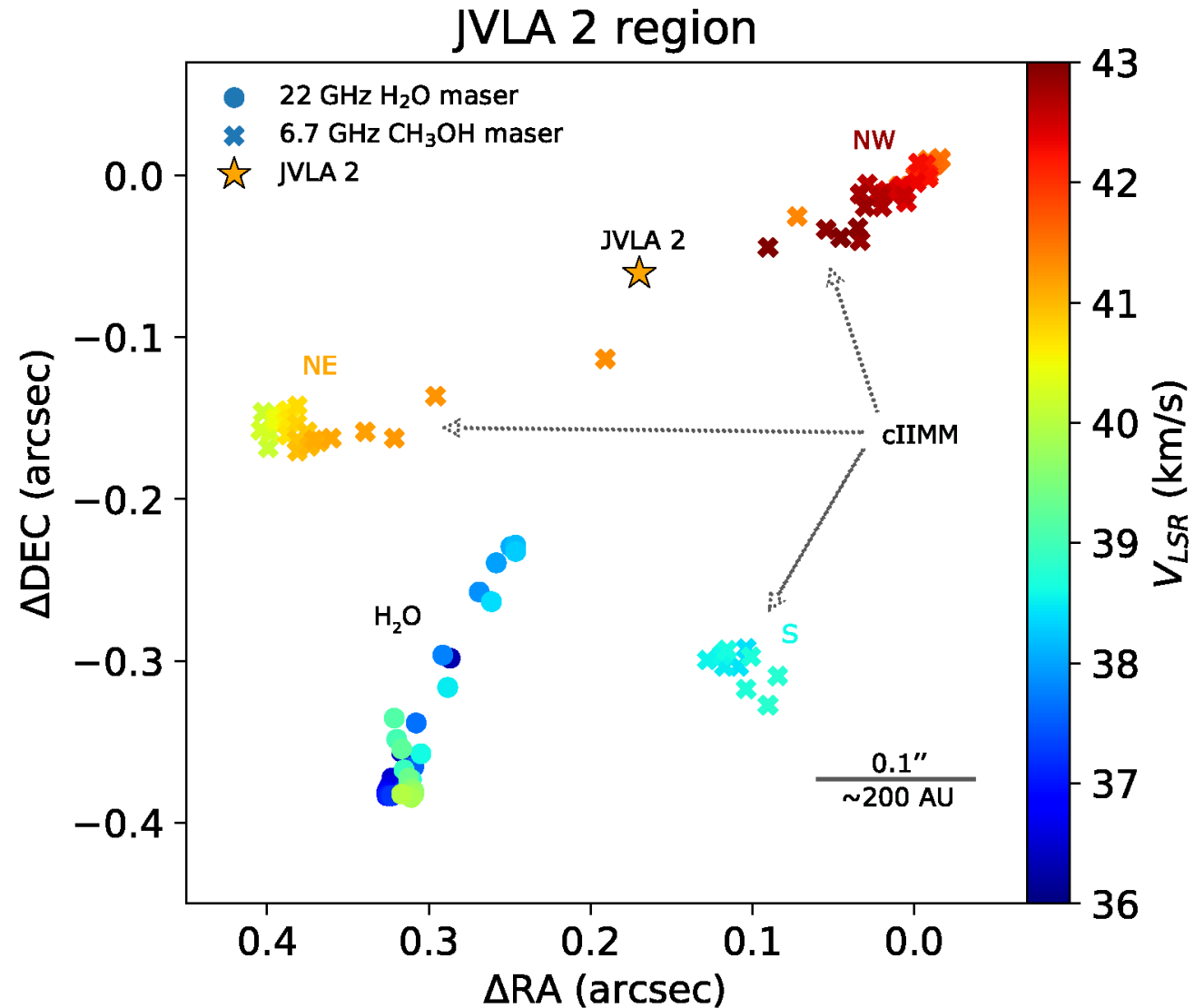




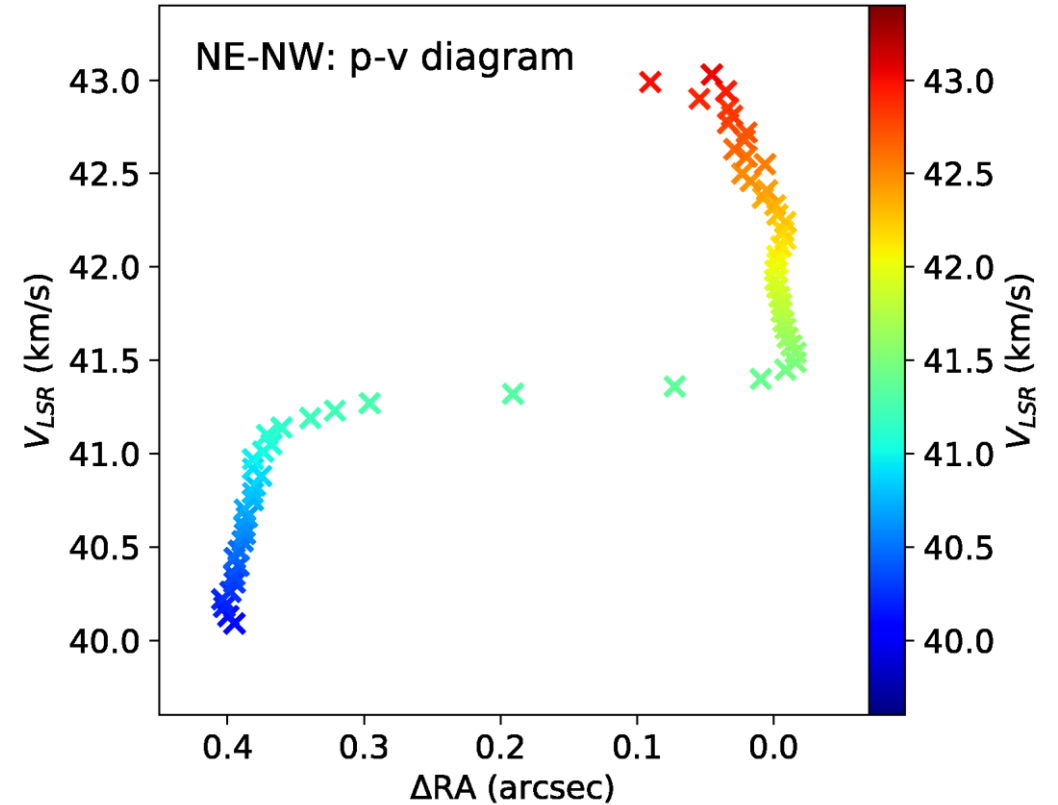
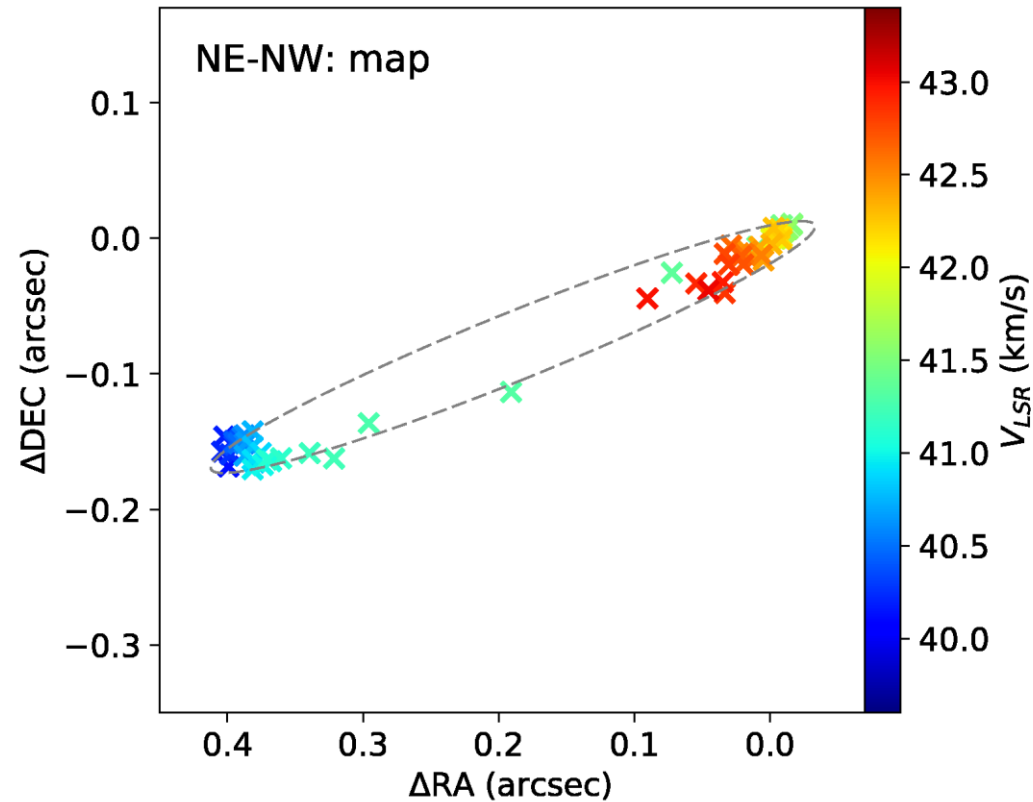
# Possible model of the bursting source



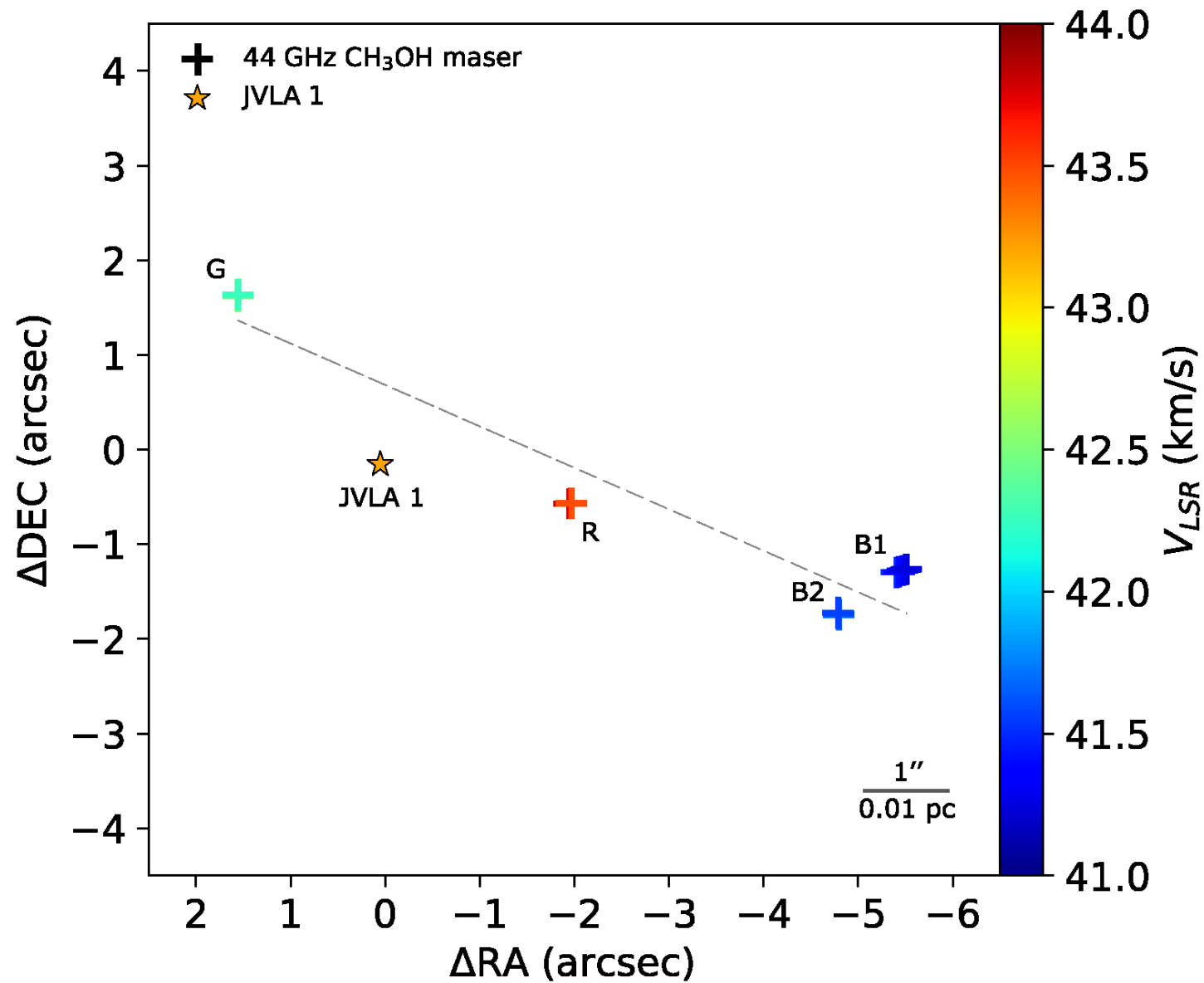
# Distribution of 6.7 GHz CH<sub>3</sub>OH and 22 GHz H<sub>2</sub>O maser spots detected in JVLA 2 region



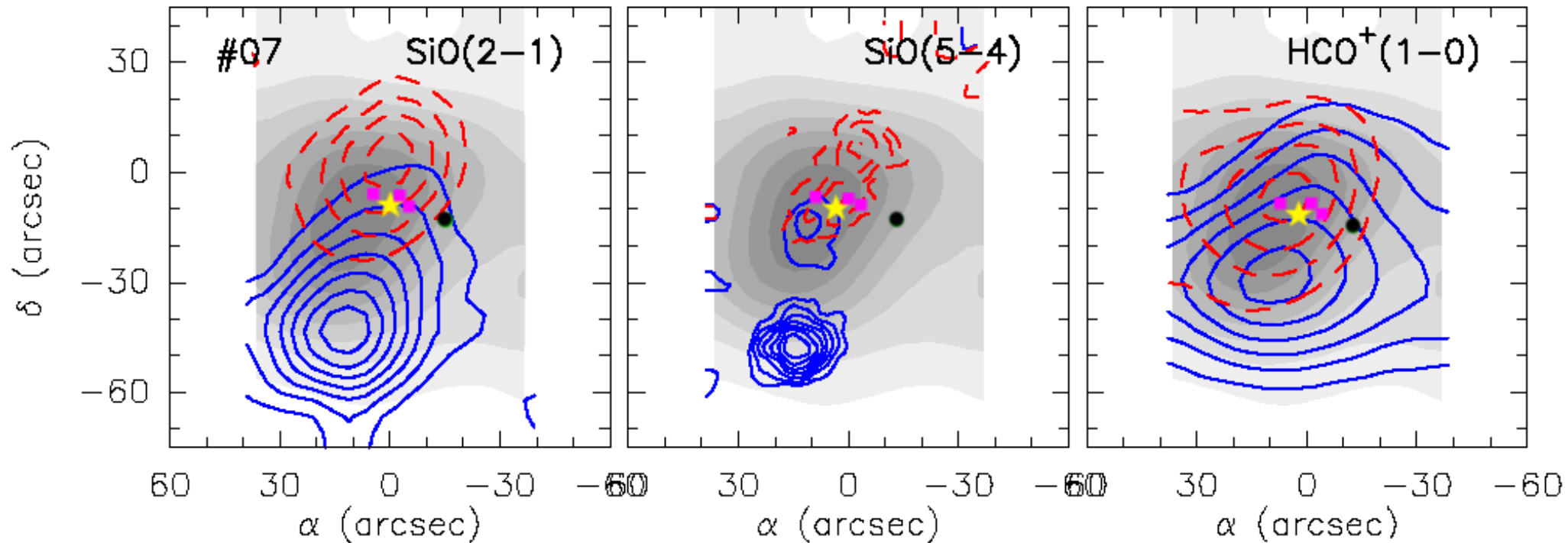
# 6.7 GHz CH<sub>3</sub>OH maser cluster: map with a least squares fitting of ellipse and p-v diagram



# Distribution of 44 GHz CH<sub>3</sub>OH maser spots

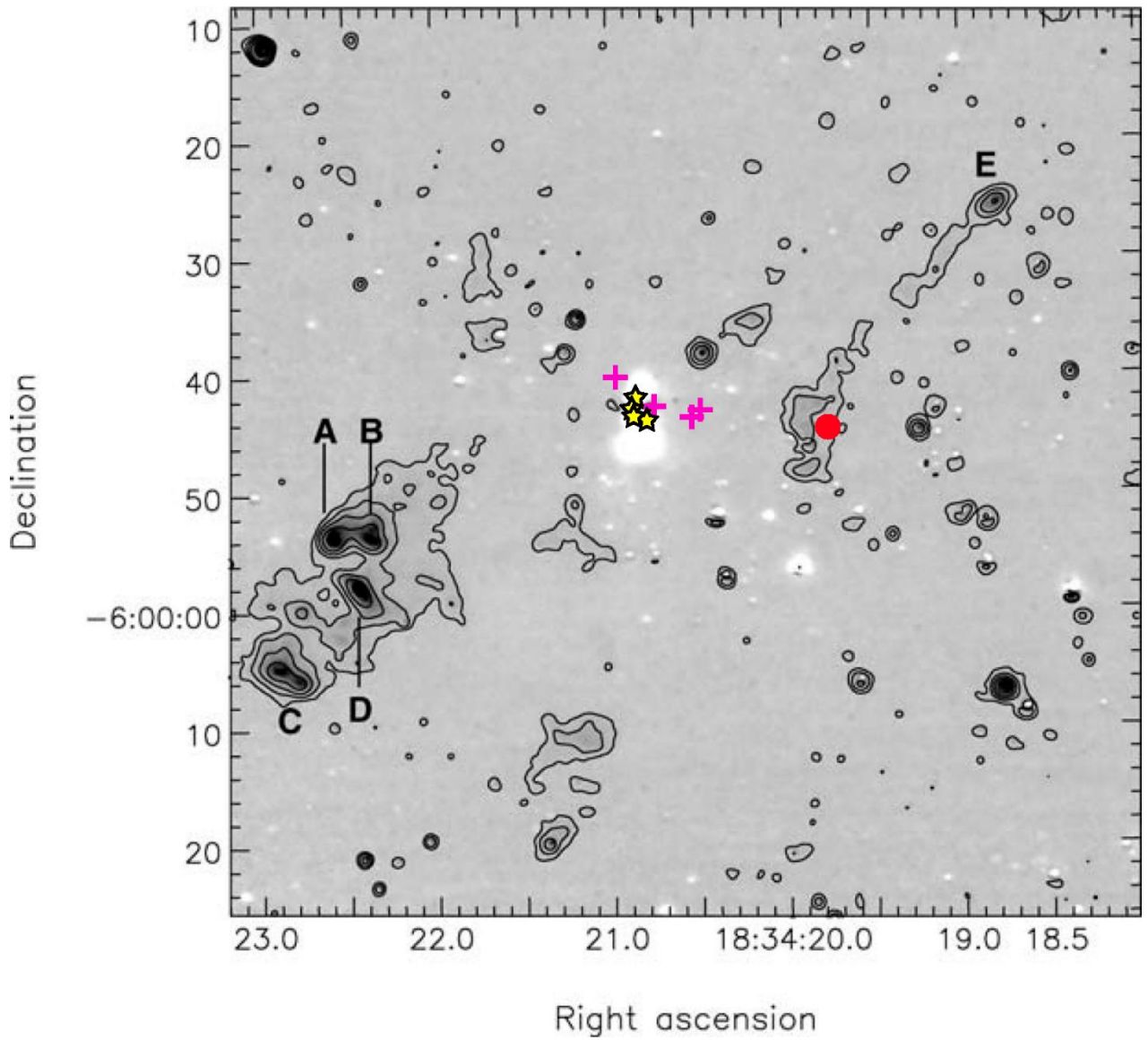


Objects detected toward G25.65+1.05 with the JVL A are overplotted on SiO(2-1), SiO(5-4), and HCO<sup>+</sup>(1-0) outflow maps from Fig.2 in Sanchez-Monge et al. (2013)



- average position of continuum sources - yellow star,
- 44 GHz clMMs - magenta squares,
- position of IRAS 18316-0602 is indicated by black circle,
- gray scale corresponds to the N<sub>2</sub>H<sup>+</sup> integrated emission,
- blue-solid and red-dashed contours represent blue- and red-shifted integrated wing emission, respectively.

Objects detected toward G25.65+1.05 with the JVL A are overplotted on continuum-subtracted = 1-0 S(1) H<sub>2</sub> image from Fig.2 in Todd & Howat (2006)



- continuum sources - yellow stars,
- 44 GHz cIMMs - magenta crosses,
- position of IRAS 18316-0602 is indicated by red circle.