Interferometric study of the class I methanol masers at 104.3 GHz

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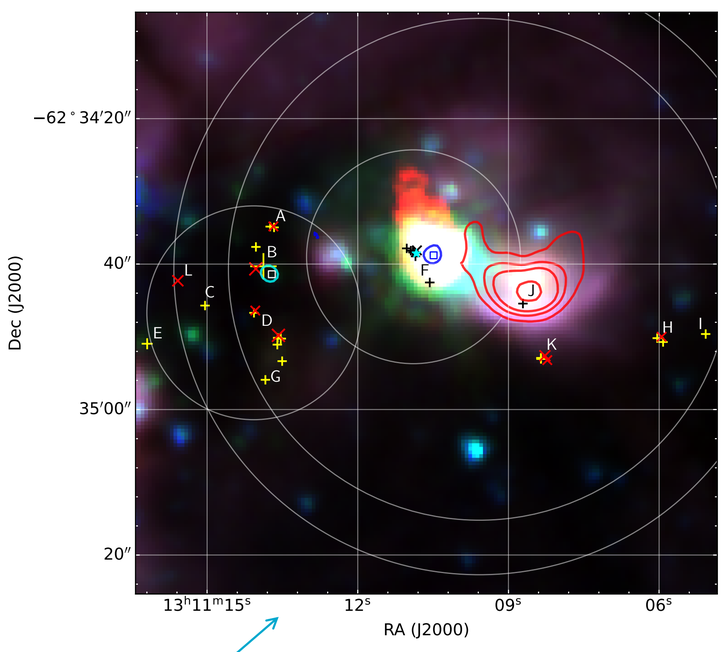
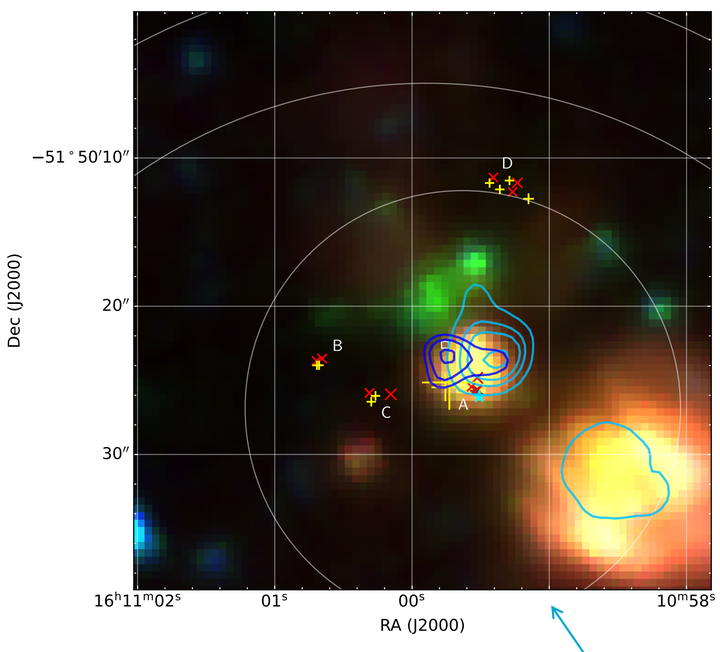
Methanol masers tend to occur in transition series with all members of the series sharing similar properties. However, there is a discrepancy for the rare class I masers in the J_{-1}-$(J-1)_{-2}$ E series. The Australia Telescope Compact Array (ATCA) has been used for high angular resolution study at 104.3 GHz (J=11) of all six known sources where the masers in this series have previously been reported. Combined with existing data on the 9.9 GHz (J=9) masers and cm-wavelength continuum, this led us to conclusion that the likely cause of the apparent discrepancy in maser detection could be due to the seed radiation.

G305.21+0.21



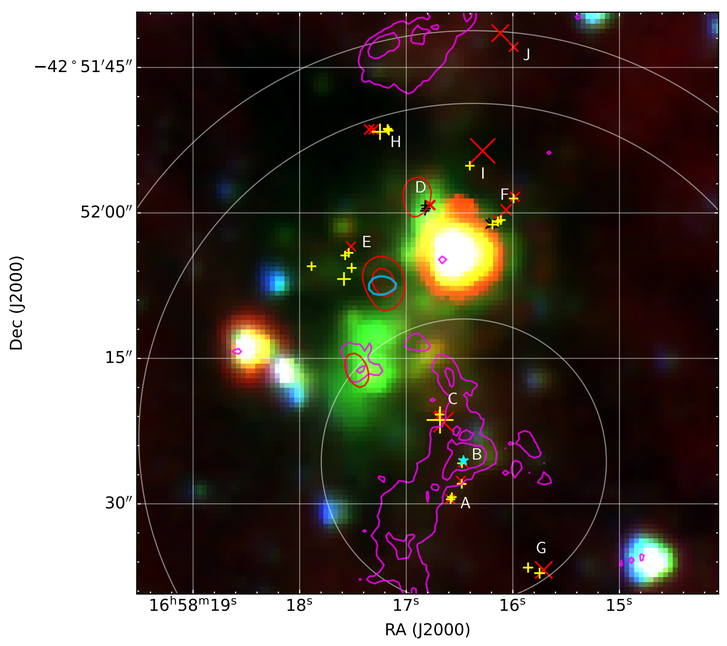
Note that the 104 GHz maser is close to the 3mm continuum source but far from the cm-wavelength continuum emission. Marginal 9.9 GHz detection.

G331.13-0.24

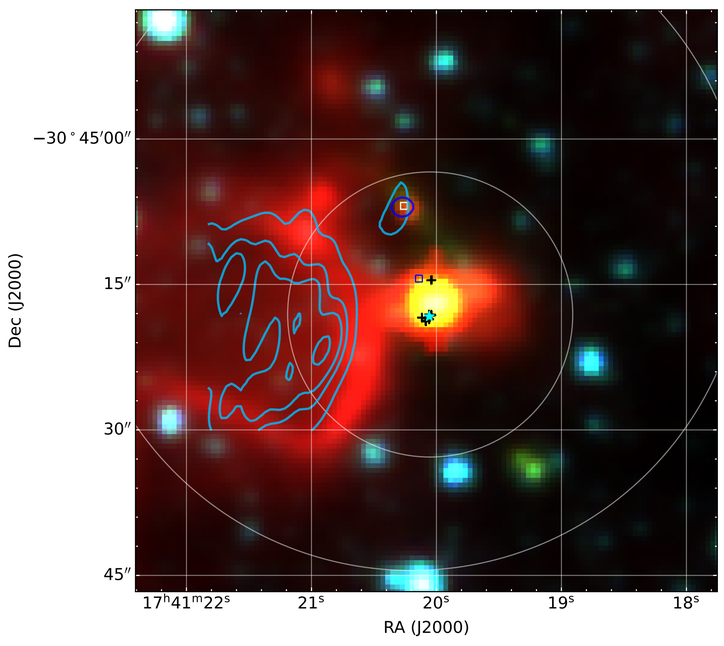


Note that the 9.9 GHz maser is projected at the 3cm continuum source and offset from the 3mm continuum source. Non-detection at 104.3 GHz.

G343.12-0.06



G357.97-0.16



Some tension still exists for this source as it is very strong at 9.9 GHz (see Table 1) but has the flux density comparable to other sources at 104.3 GHz (and in all other observed sources the 104.3 GHz maser is actually stronger than the 9.9 GHz one).

Need more sensitive continuum SEDs or at least more sensitive 3cm data for G357.97-0.16!

Figure 1: Selected sources from the project. The background is the 3-colour GLIMPSE images (8.0-, 4.5- and 3.6-μm bands are shown as red, green and blue, respectively). The masers in J_{-1}-$(J-1)_{-2}$ E series (position is the same for both 9.9 and 104 GHz masers where both transitions are detected) are shown with the star symbol. Larger contours represent cm-wavelength continuum emission. Smaller (blue/cyan) contours show 3mm continuum. Squares depict the position of the 6.7 GHz masers. Other symbols show the class I maser emission at 36 (crosses) and 44 GHz (pluses) from [4] or unpublished data. Large circles represent FWHM of the ATCA primary beams at 104.3 (smallest), 44 and 36 GHz (largest) indicating the effective field of view. The pink contours for G343.12–0.06 represent H_2 2.12-μm emission tracing molecular outflow [2].

Table 1: The only six known masers in the J_{-1}-$(J-1)_{-2}$ E series and the results of their observations at 104.3 GHz (J=11). Uncertainties are given in the brackets and expressed in the units of the least significant figure. For the two sources marked with (*), this result is the first measurement of the absolute position with an arcsecond accuracy. The last column lists fluxes for the 9.9 GHz (J=9) masers from the published data.

SOURCE	POSITION (J2000)		PEAK V_{LSR}	PEAK FLUX	9.9 GHZ FLUX
	RA	DEC	KM S^{-1}	JY	JY
G305.21+0.21(*)	13:11:10.83 (7)	–62:34:38.5 (5)	–42.3 (1)	21.3 (6)	≤ 0.2[1]
G331.13–0.24	Non-detection at 104.3 GHz, single channel rms noise is 0.84 Jy				~ 3[next poster]
G343.12–0.06	16:58:16.46 (5)	–42:52:25.5 (5)	–31.7 (1)	14.9 (7)	9.5 (3)[2]
G357.97–0.16(*)	17:41:20.06 (4)	–30:45:18.3 (5)	–5.0 (1)	15.8 (9)	69 (2)[3]
G012.80–0.19	18:14:10.90 (4)	–17:55:58.8 (5)	+32.9 (1)	10 (2)	4.3 (1) [1]
G019.61–0.23	18:27:37.49 (4)	–11:56:38.6 (5)	+41.3 (1)	9 (1)	3.3 (1) [1]

FOR FURTHER INFORMATION

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REFERENCES

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[2] Voronkov et al., 2006, MNRAS, 373, 411
[3] Voronkov et al., 2011, MNRAS, 413, 2339
[4] Voronkov et al., 2014, MNRAS, 439, 2584