



6.7 GHz and 25 GHz methanol masers in OMC-1

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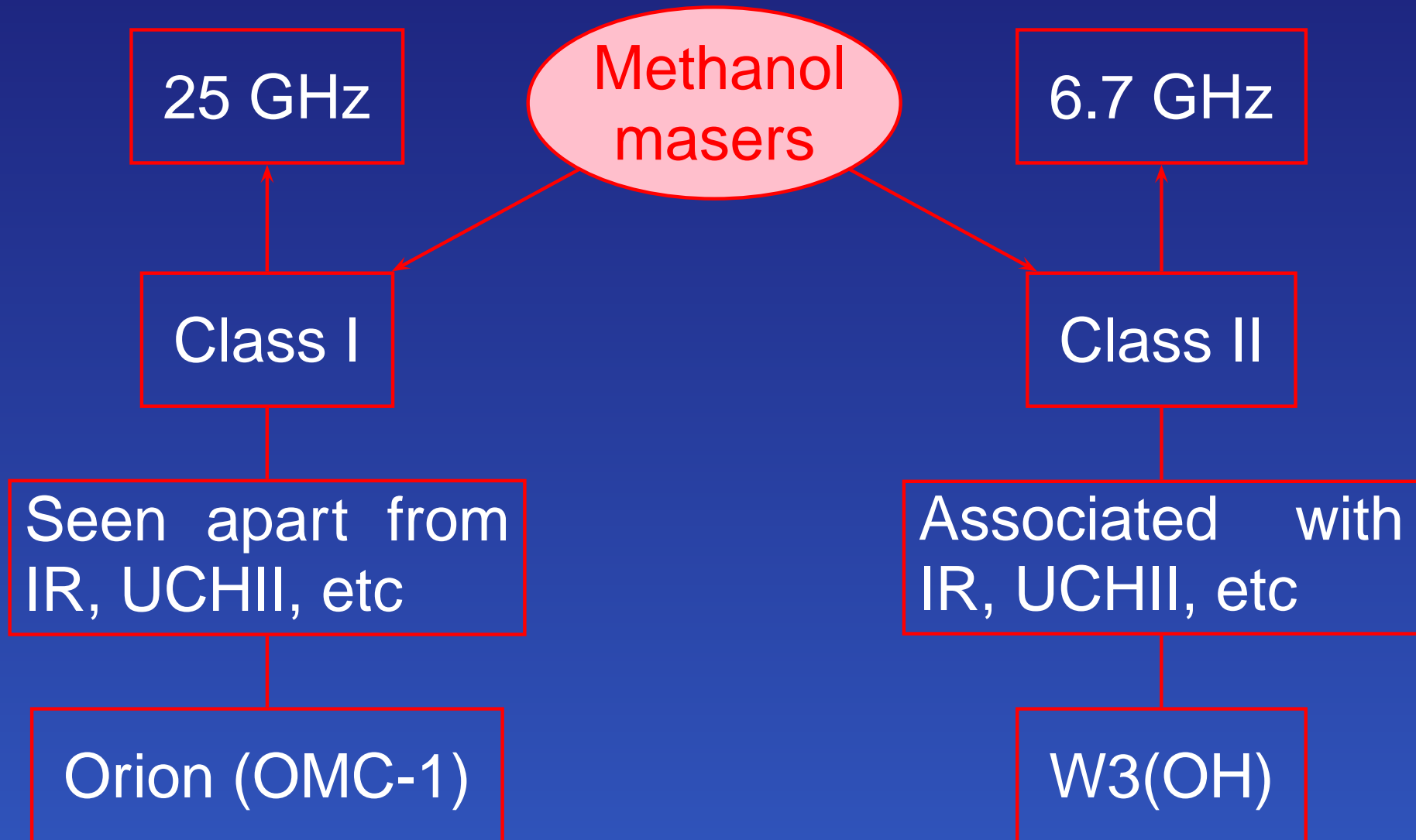
Australia Telescope National Facility

in collaboration with

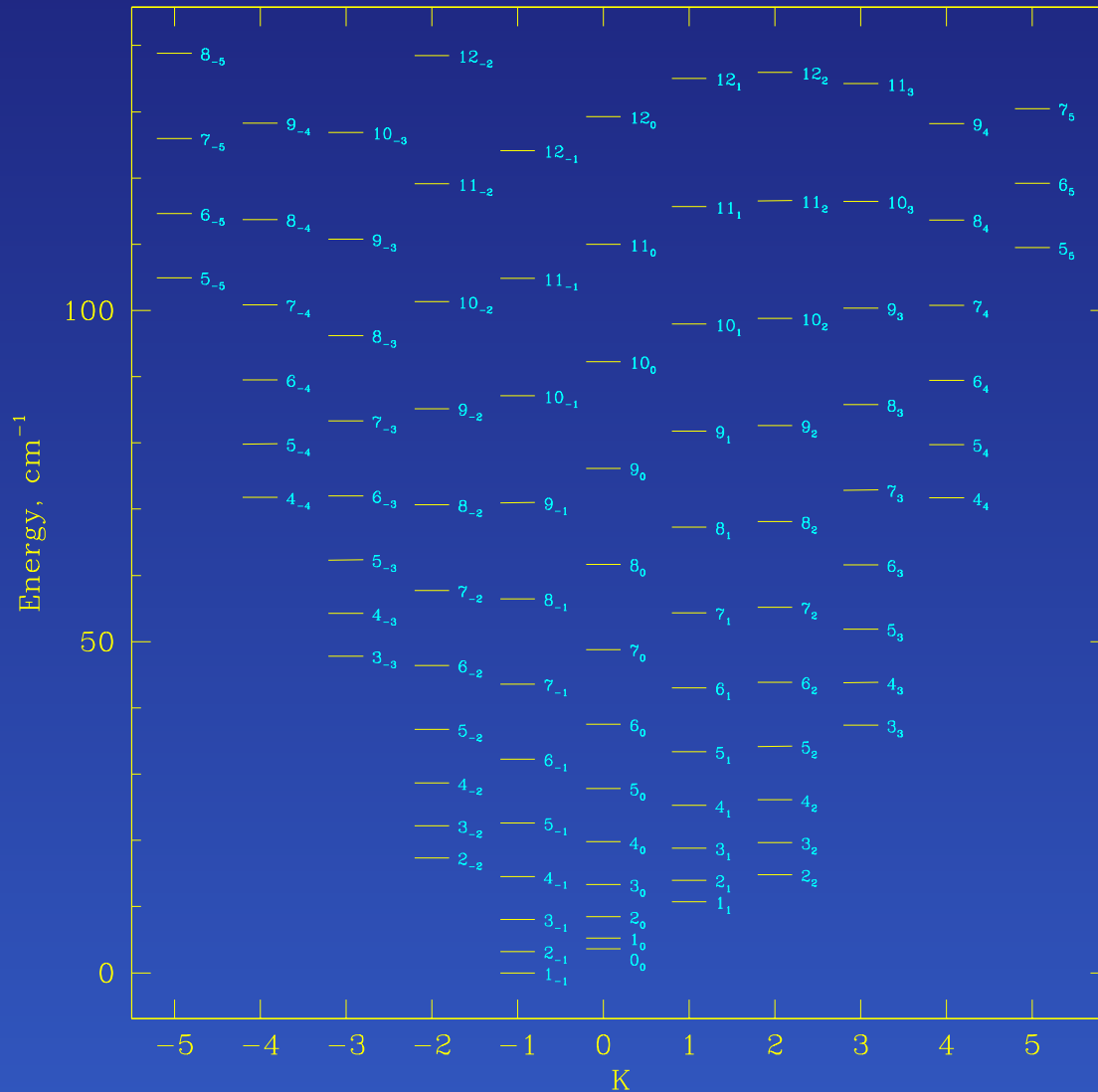
Andrej Sobolev (USU), Simon Ellingsen (UTas), Andrei Ostrovskii (USU) (6.7 and 25 GHz)

Alexei Alakoz (ASC) (104.3 GHz)

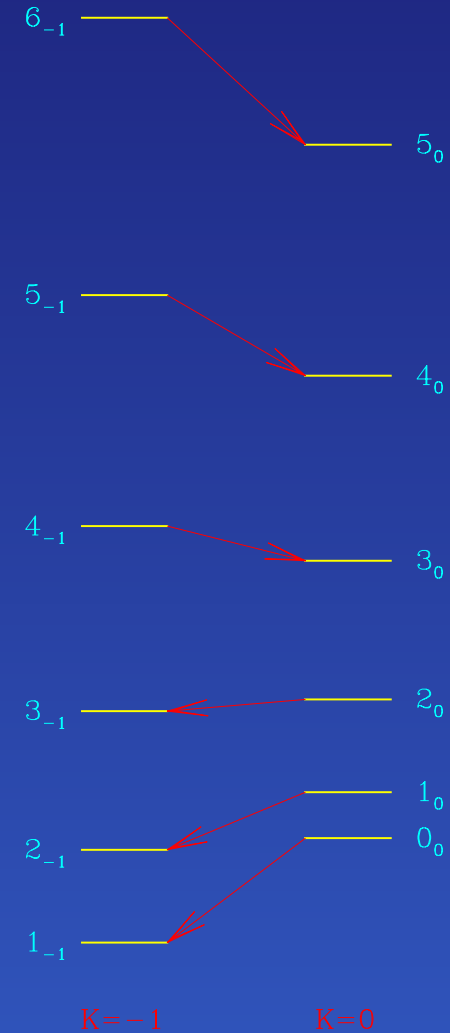
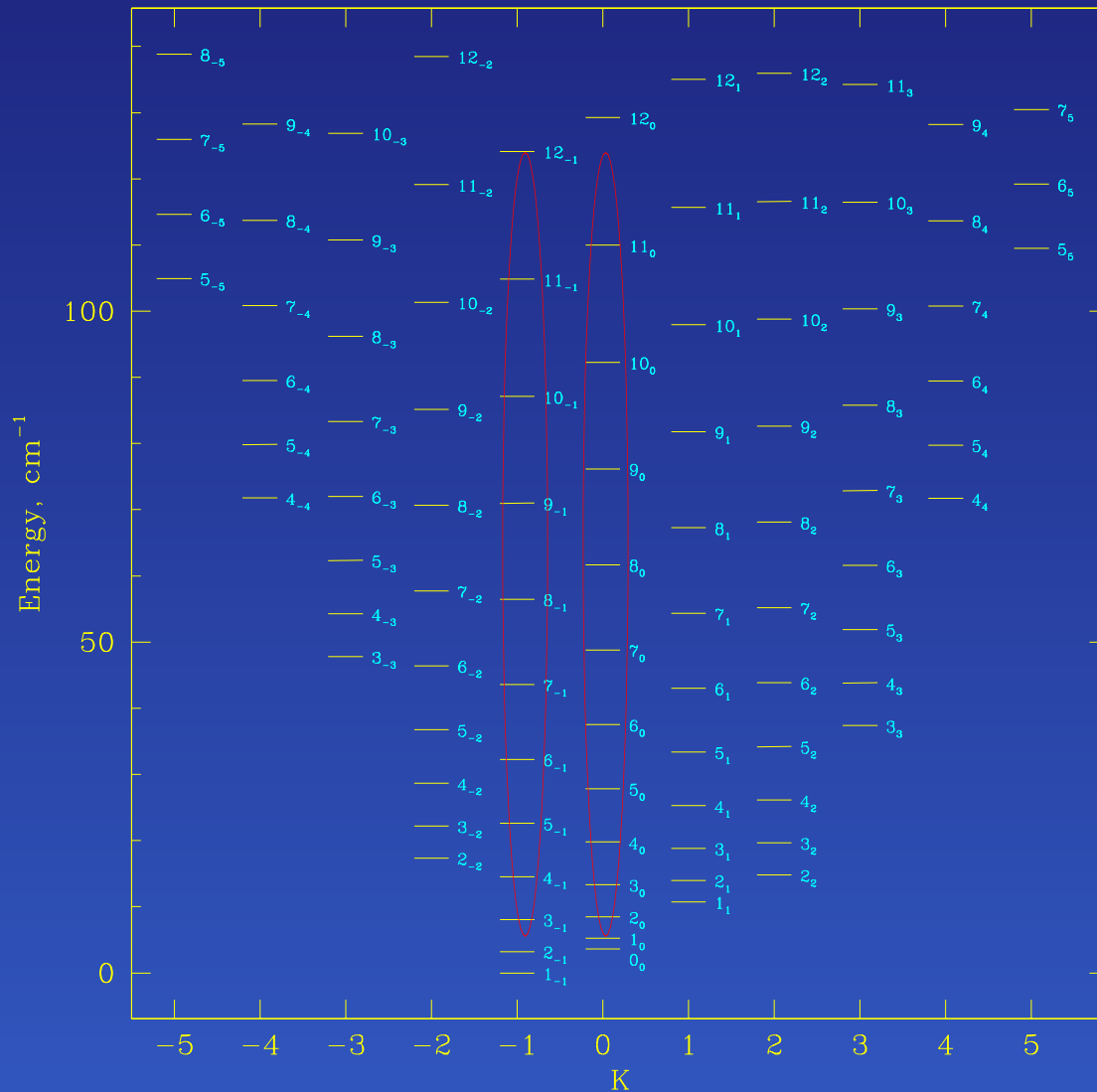
Two classes of methanol masers



E-Methanol energy level diagram

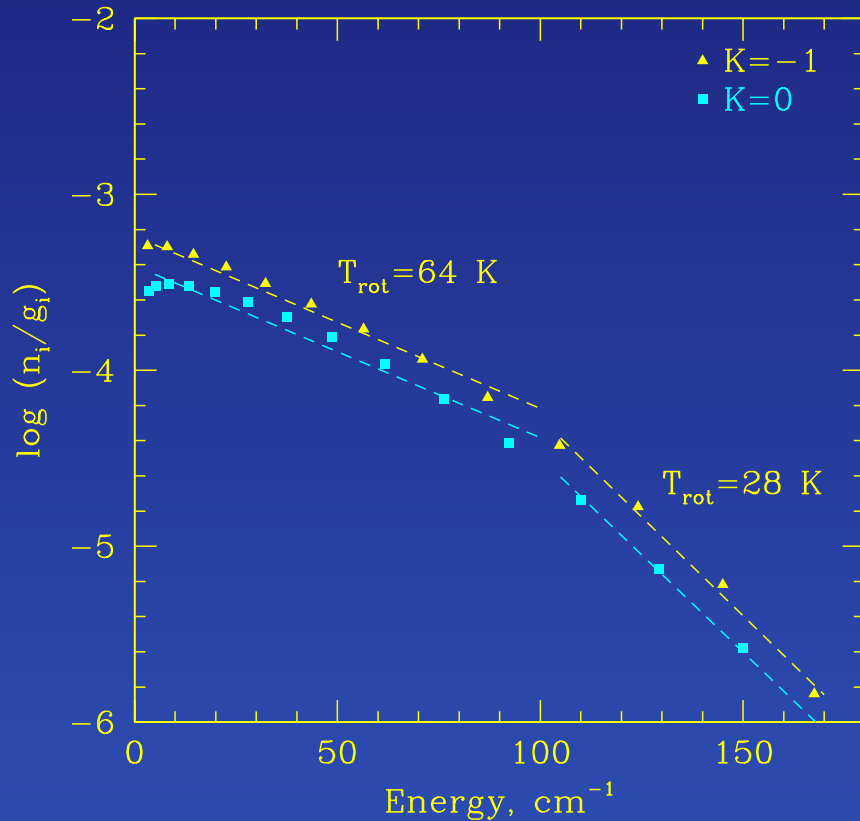


E-Methanol energy level diagram



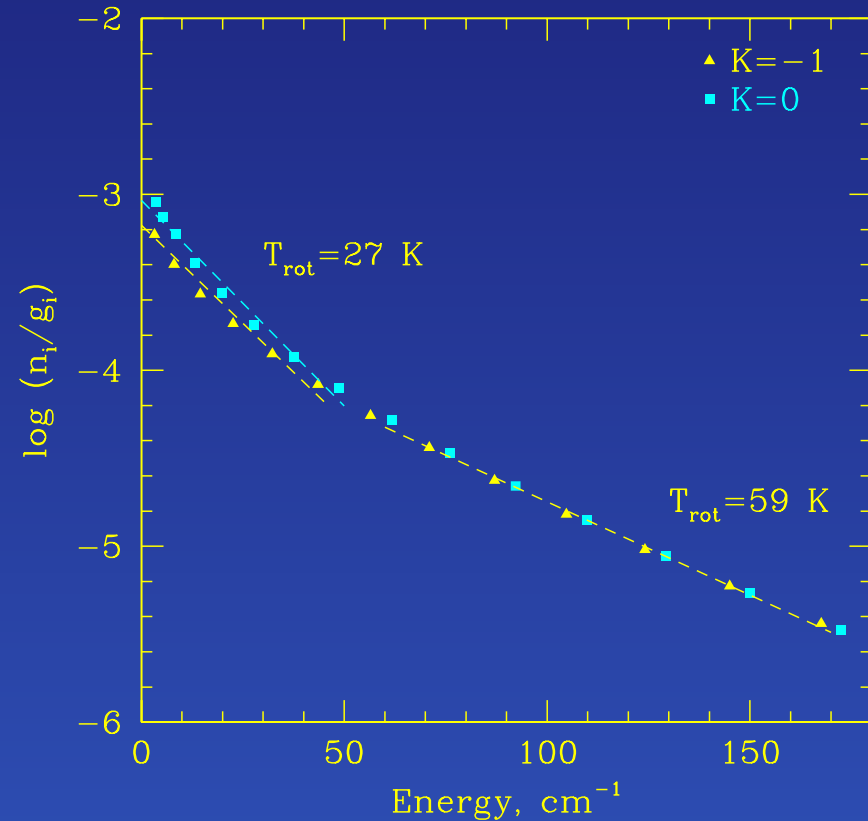
Two classes: different pumping

$$T_{rad} = 2.7 \text{ K}, T_{kin} = 70 \text{ K}$$



Class I, e.g. $4_{-1} - 3_0 \text{ E}$
at 36 GHz

$$T_{rad} = 70 \text{ K}, T_{kin} = 20 \text{ K}$$

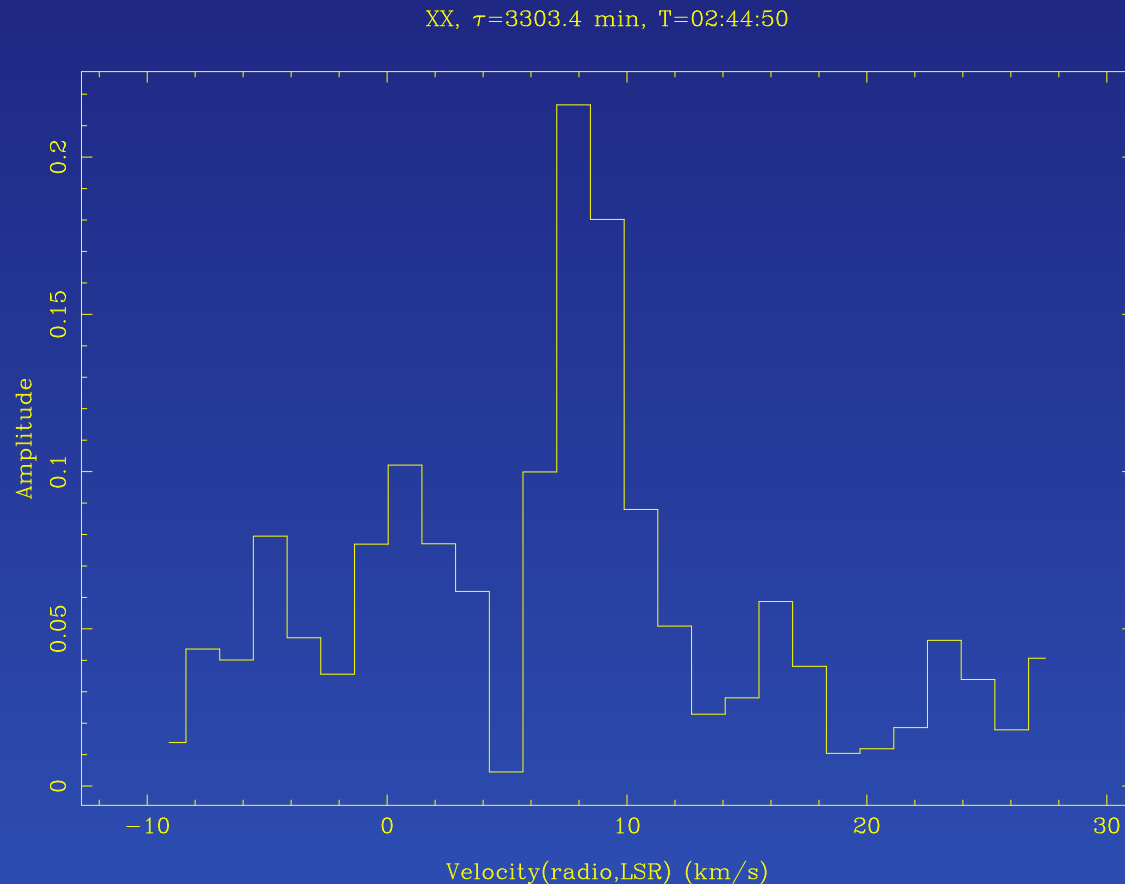


Class II, e.g. $2_0 - 3_{-1} \text{ E}$
at 12 GHz

Theory: they may coexist

- Masers of different classes are often seen in the same sources, but apart from each other. This is not an interesting case.
- Modern models of the methanol maser pumping predict a weak 6.7 GHz maser (Class II) under the same conditions when the 25 GHz transition (Class I) becomes a maser.
- The OMC-1 has the brightest known 25 GHz methanol maser. It is worth to search a 6.7 GHz emission in this source.

OMC-1: The 6.7 GHz spectrum



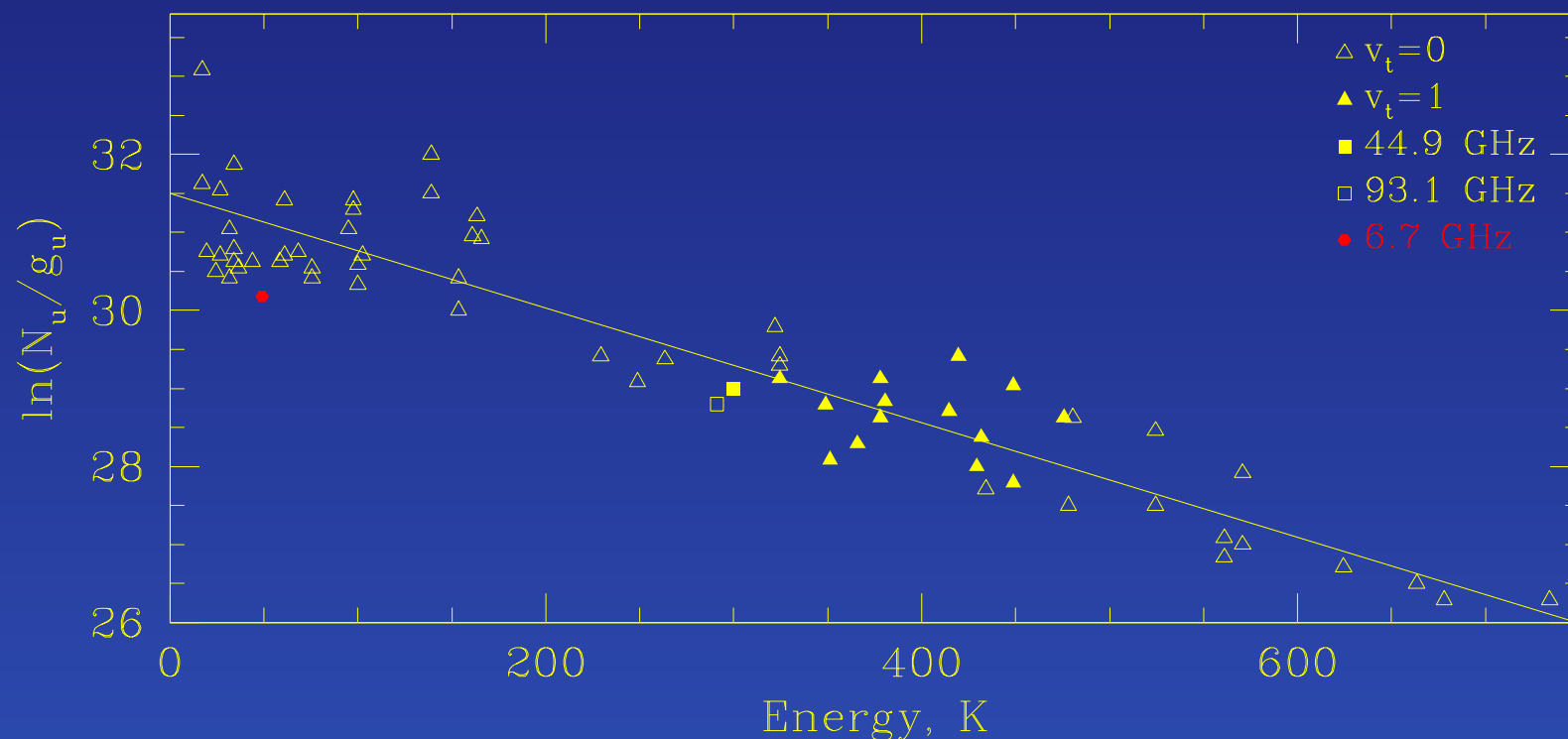
The 6.7 GHz spectrum. All baselines of the short configuration (H75) have been averaged together.

No line has been detected with the 6km configuration

No signal at long baselines. Why?

- The line may be thermal
- The phase stability might be worse because the long configuration observations were done in summer. The phase stability is more important for long configurations than for small ones.
- The source at 6.7 GHz may be an "extended maser". Several spots may be responsible for the emission.
- The source may be variable.

OMC-1: Rotational diagram



The rotational diagram does not contradict with the hypothesis of the thermal nature of the 6.7 GHz emission in OMC-1

ATCA upgrade: 12mm

- All 6 antennas are available. Frequency range is from 16 GHz to 26 GHz.
- Two polarizations at each of two frequencies
- Both frequencies must be either below 22.4 GHz with a separation of less than 2.7 GHz or above 20.0 GHz with a separation of less than 2.3 GHz.
- Either of both frequencies can have bandwidth of 64 or 128 MHz. One frequency can have bandwidths of 4, 8, 16 or 32 MHz.

ATCA upgrade: 3mm

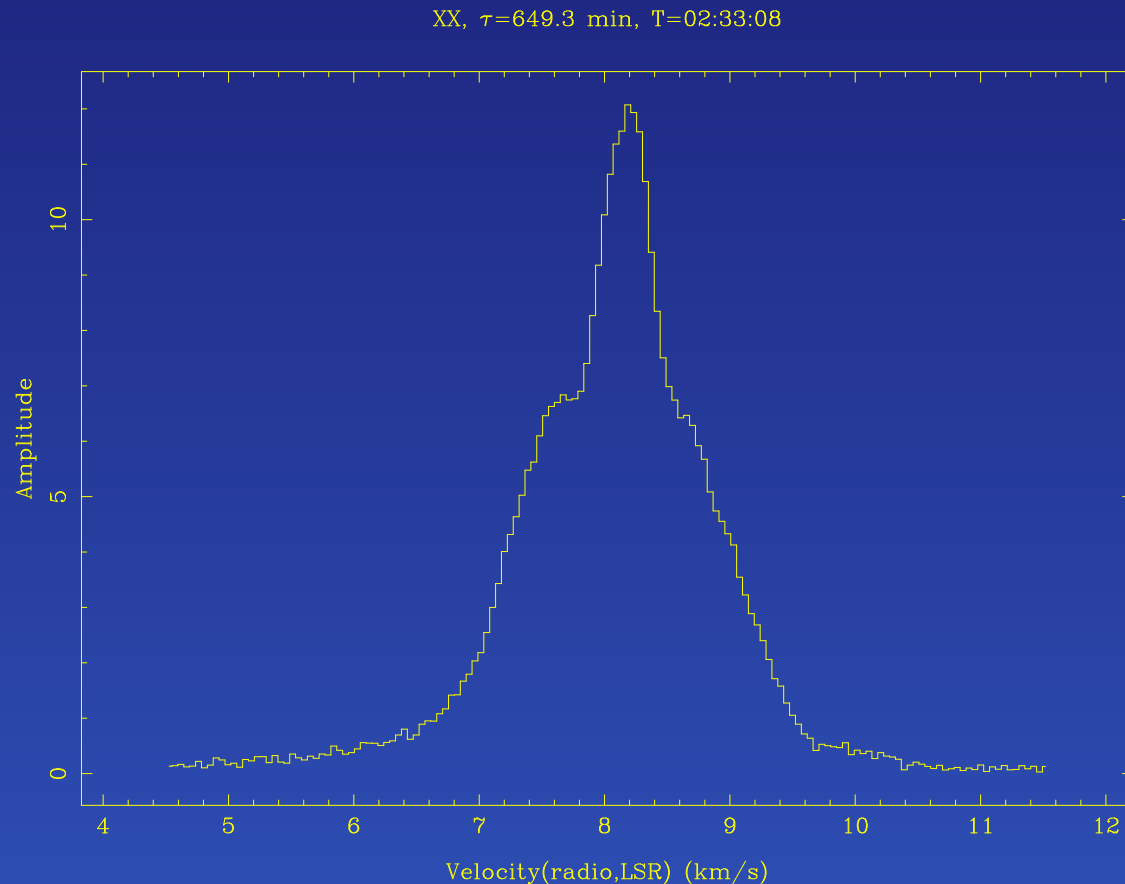
Now

- 3 antennas are available. Frequency range is from 84.906 GHz to 87.305 GHz and from 88.506 to 91.305 GHz
- Two polarizations at each of two frequencies
- Either of both frequencies can have bandwidth of 64 or 128 MHz. One frequency can have bandwidths of 4, 8, 16 or 32 MHz.

From June 2004

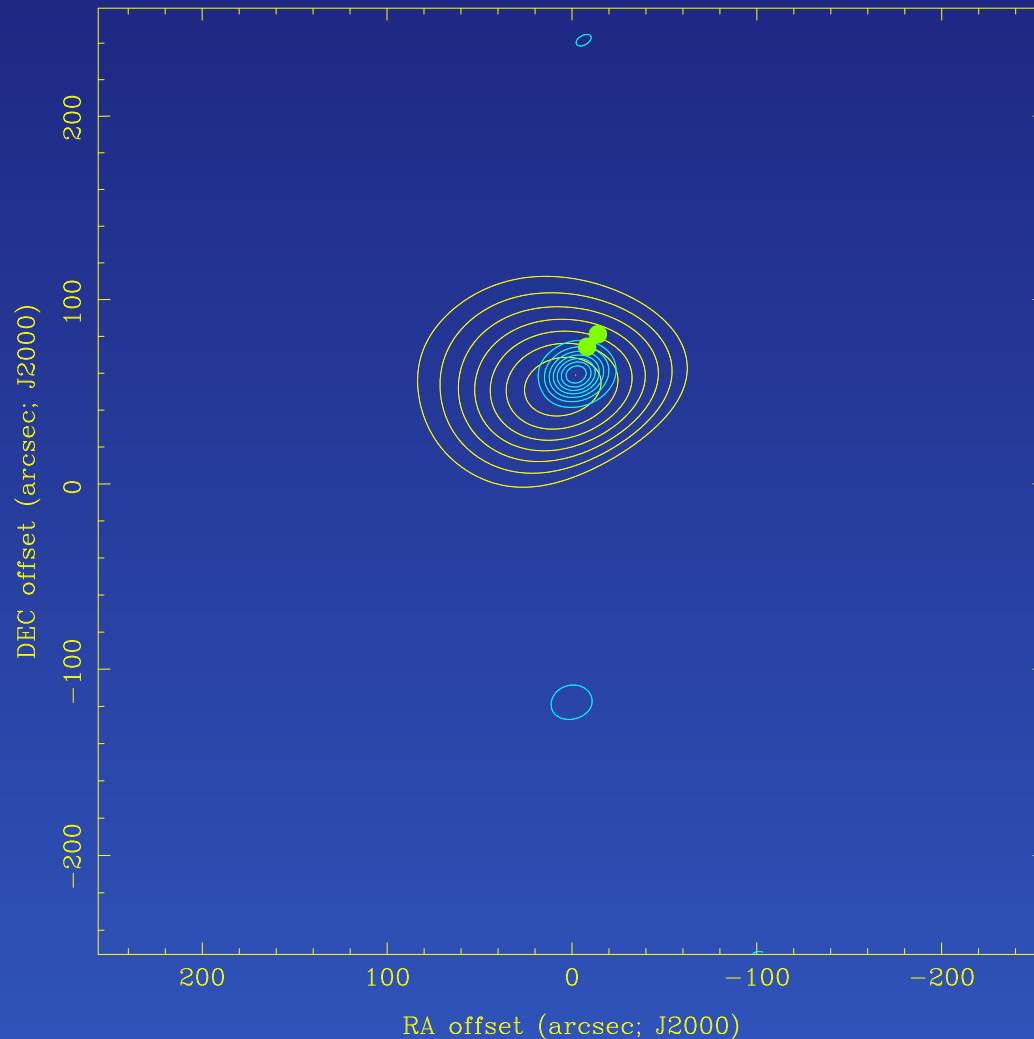
- 5 antennas will be available. Frequency range is from 85 GHz to 105 GHz.

OMC-1: 25 GHz spectrum



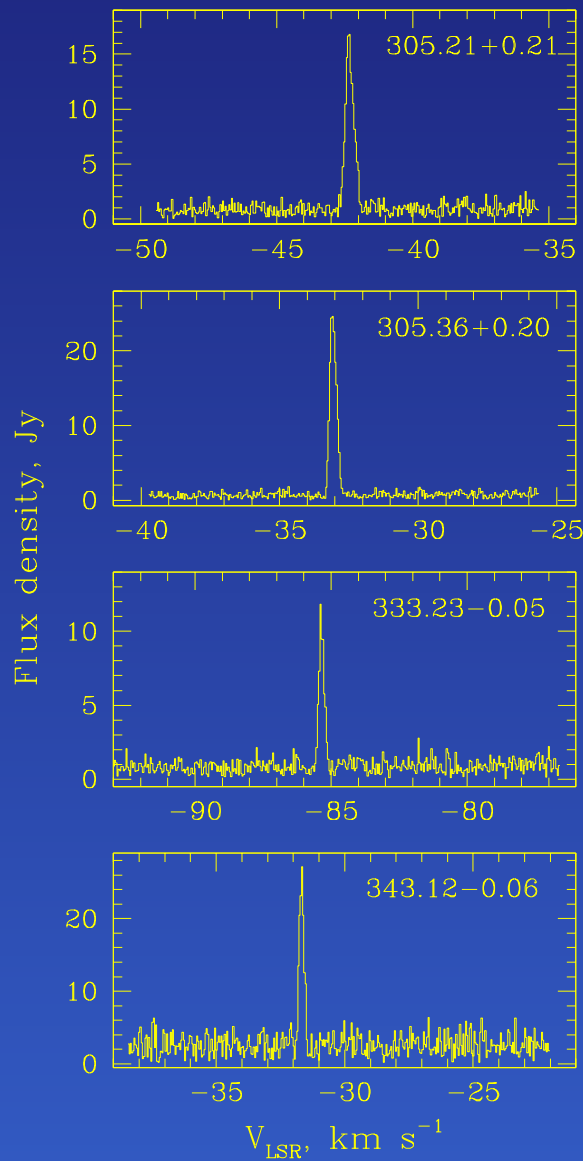
The 25 GHz spectrum (observed the first time with the ATCA). All baselines have been averaged together.

OMC-1: 6.7 GHz and 25 GHz



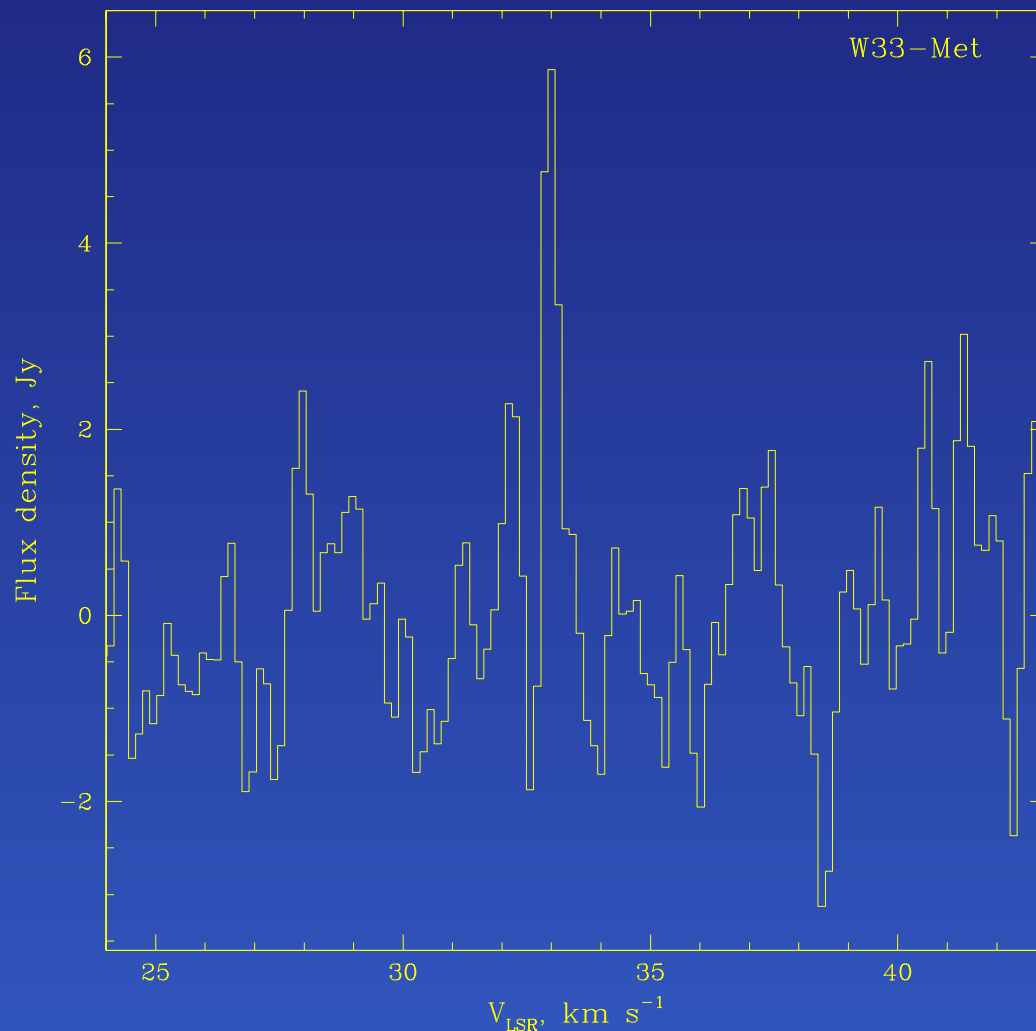
The 6.7 GHz emission may originate from the same place, where the 25 GHz maser spots were found.

New 25 GHz masers



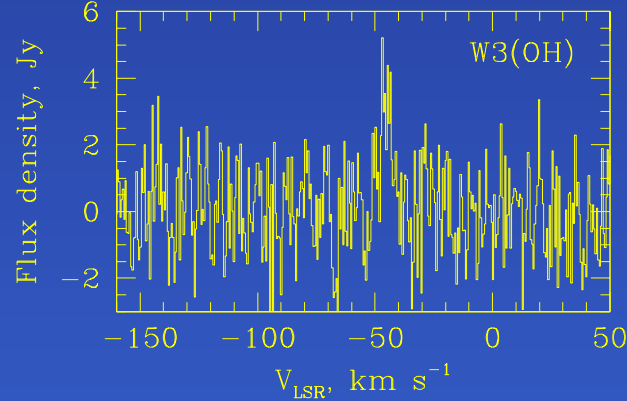
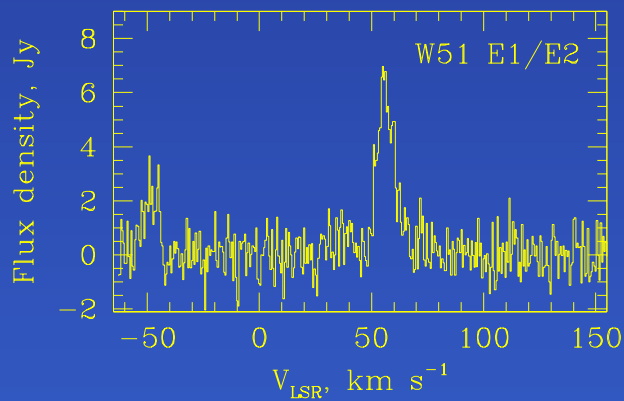
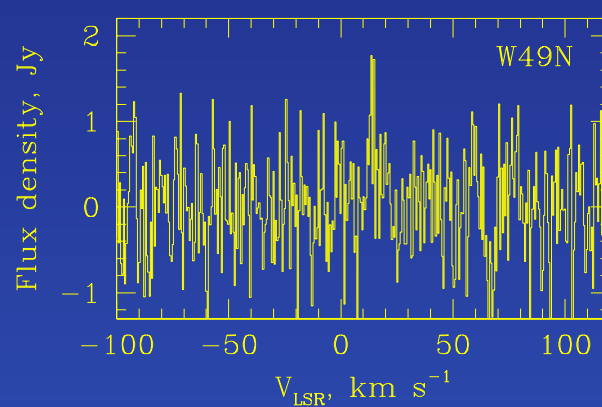
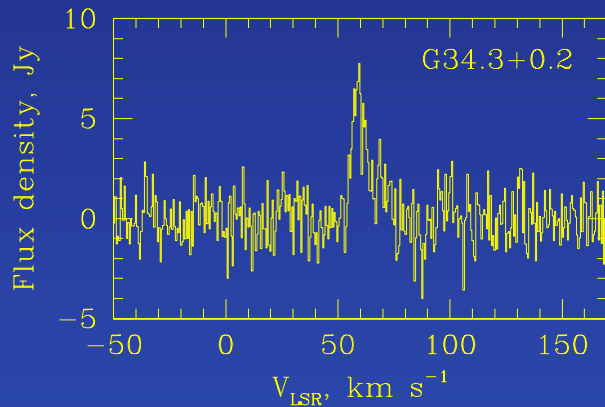
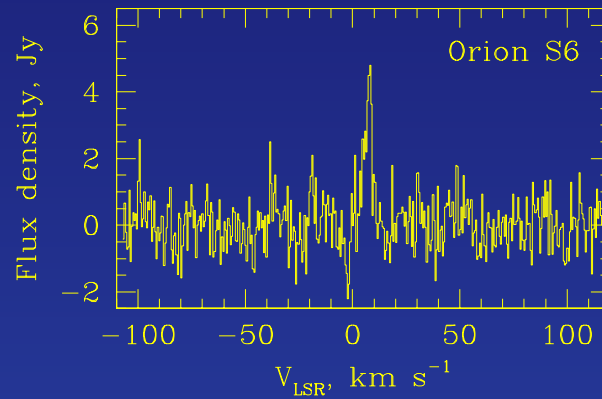
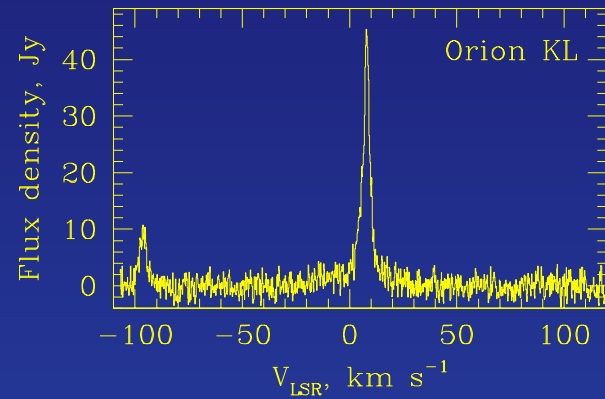
A search for new 25 GHz masers is performed. Targets are known 44 GHz masers (the most widespread Class I methanol maser line).

A new methanol maser at 104.3 GHz



A new maser in the $11_1 - 10_2$ E methanol transition at 104.3 GHz was found towards W33-Met. No masers in this transition were observed before.

Other detections at 104.3 GHz



Conclusions

- A 6.7 GHz emission has been detected towards OMC-1.
- The 6.7 GHz emission may be associated with the 25 GHz maser spots.
- No line has been detected at long baselines.
- New 25 GHz methanol masers were discovered in $305.21+0.21$, $305.36+0.20$, $333.23-0.05$, $343.12-0.06$.
- The 104.3 GHz emission has been detected towards Orion KL, Orion S6, G34.3+0.2, W49N, W51 E1/E2, W3(OH) and W33-Met. In the last source the line is a maser.