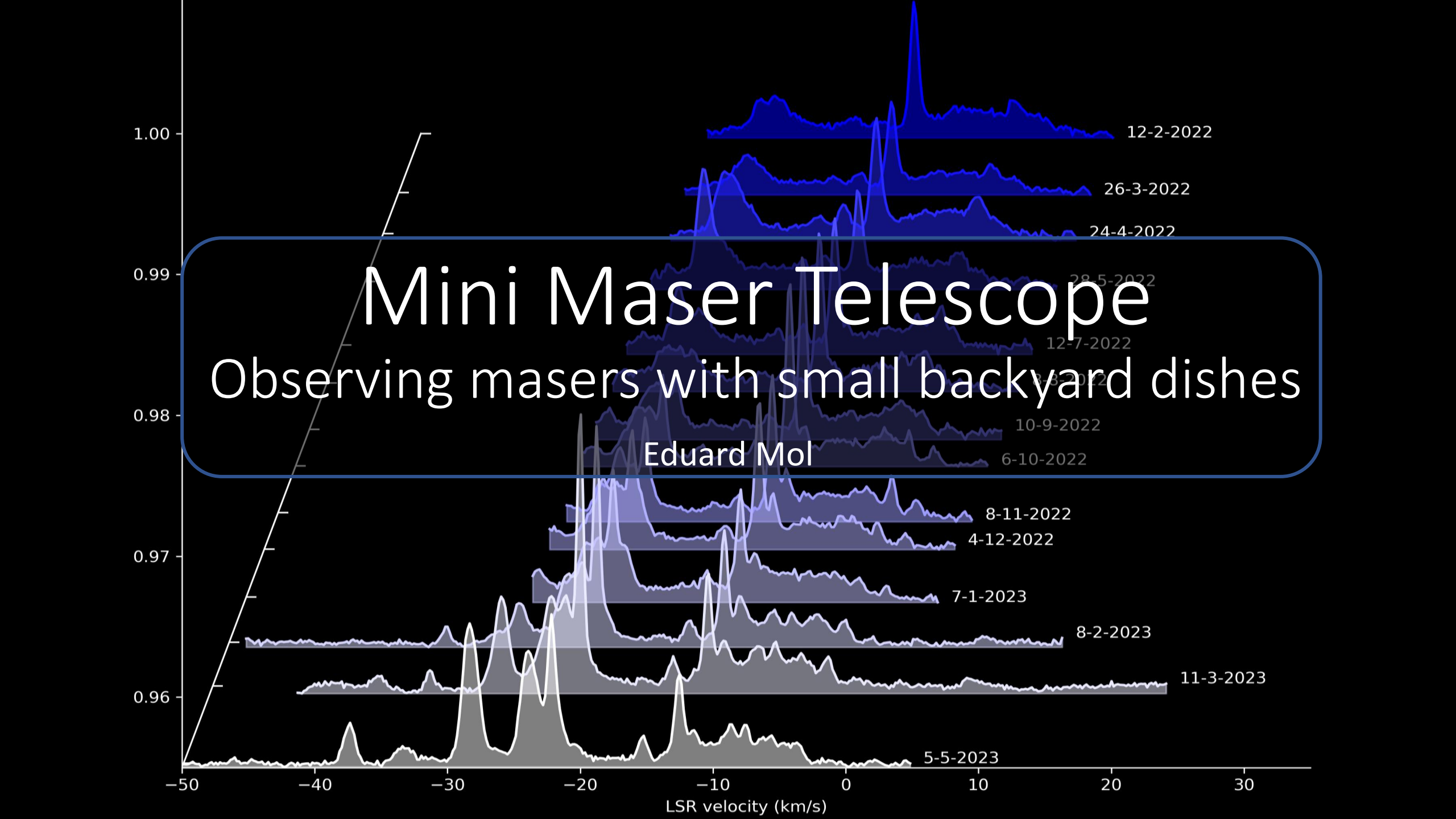


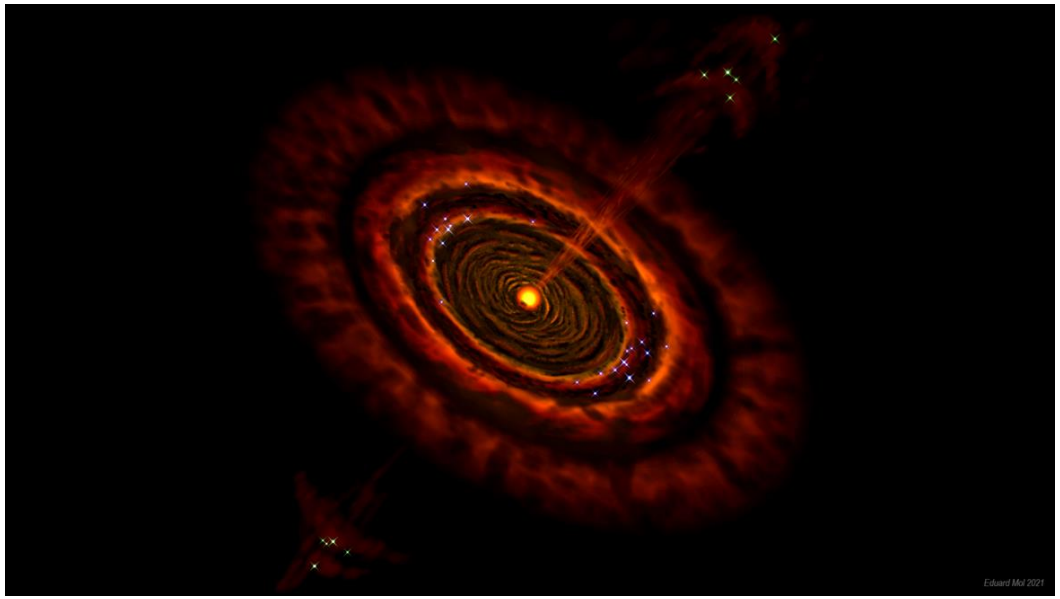

# Mini Maser Telescope

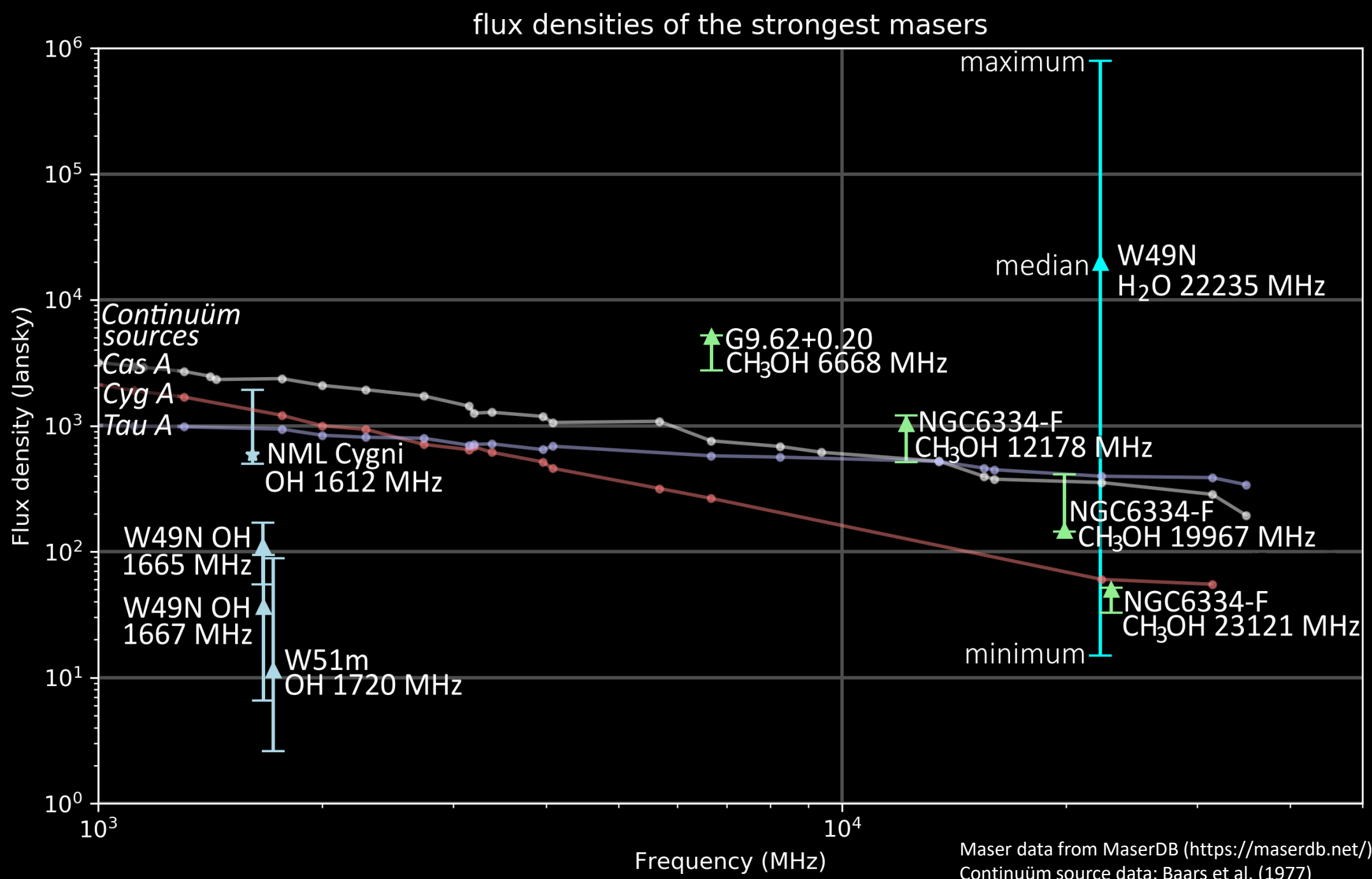
## Observing masers with small backyard dishes

Eduard Mol

# What are masers? (and why are they interesting?)

- Essentially the microwave equivalent of LASERs
- Stimulated emission
- Specific molecules:
  - OH (1612- 1720 MHz),
  - methanol (6.668 and 12.2 GHz)
  - water (22.2 GHz)
- Star formation and red giant stars
- Variable



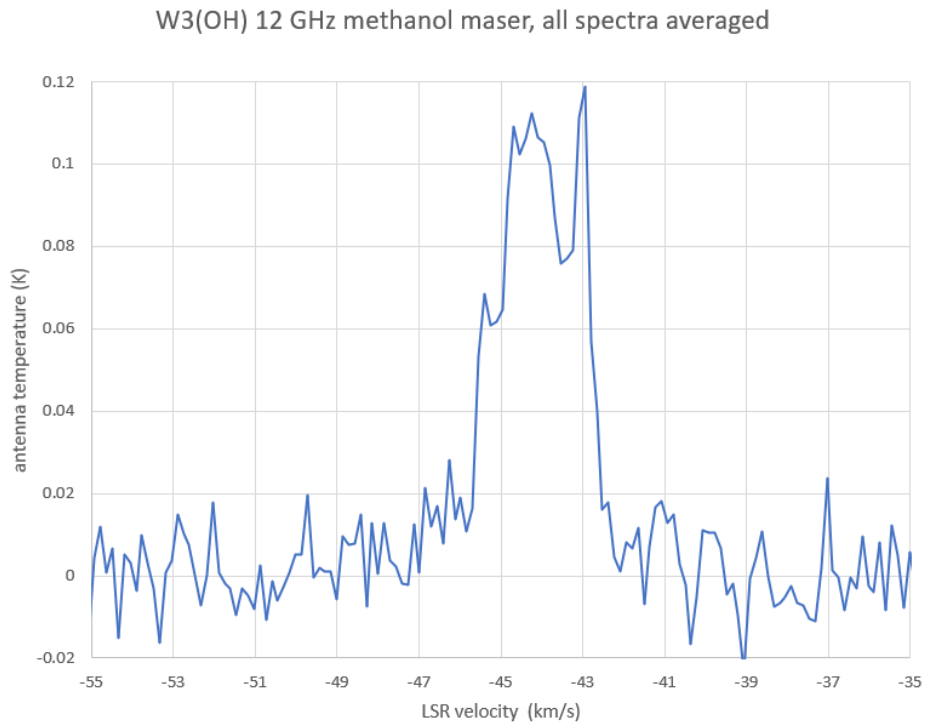

flux densities of the strongest masers
Flux density (Jansky)
Frequency (MHz)
$10^0$
$10^1$
$10^2$
$10^3$
$10^4$
$10^5$
$10^6$
$10^3$
$10^4$
Continuüm sources
Cas A
Cyg A
Tau A
NML Cygni
OH 1612 MHz
W49N OH
1665 MHz
W49N OH
1667 MHz
W51m
OH 1720 MHz
G9.62+0.20
$CH_3OH$ 6668 MHz
NGC6334-F
$CH_3OH$ 12178 MHz
NGC6334-F
$CH_3OH$ 19967 MHz
NGC6334-F
$CH_3OH$ 23121 MHz
maximum
median
minimum
W49N
$H_2O$ 22235 MHz
Maser data from MaserDB (https://maserdb.net/)
Continuüm source data: Baars et al. (1977)

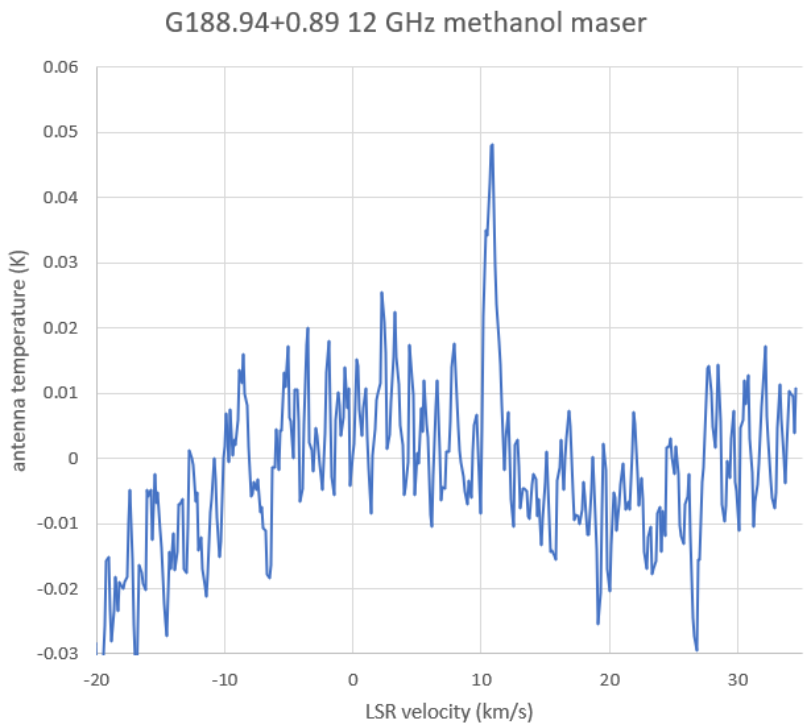
# 12.2 GHz methanol masers- hardware and observation methods

- 1 metre dish on HEQ5 mount
- Inverto Ku band PLL LNB
- 22KHz tone for band switching
- Software: SDR#/ IF average
- Post-processing in python/ excel
- Frequency to LSR velocity

# 12.2 GHz methanol masers: results

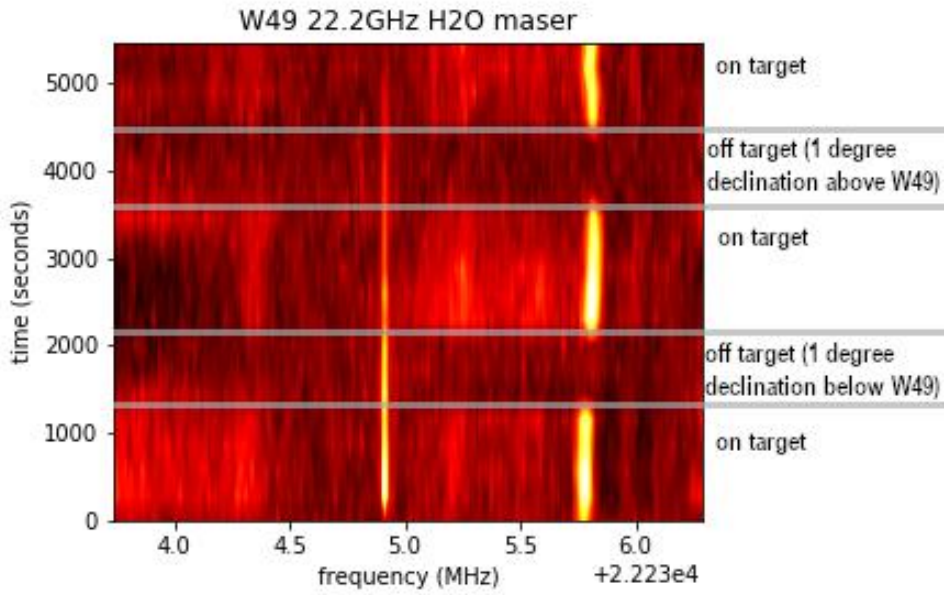
- W3(OH)
- G188.94+0.89



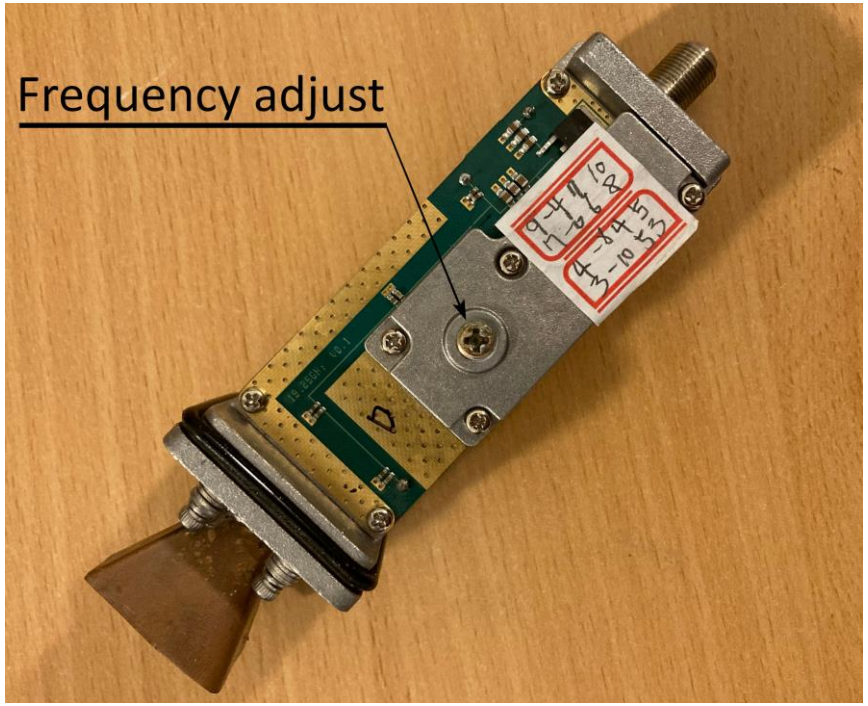
# Water masers at 22.2 GHz

- First attempts with modified Triax Ka band LNB: no success
- Later attempts with Norsat 9000LD Ka band LNB
- More expensive, but atleast it worked!




# 22.2 GHz setup technical info

- DRO LNB: output frequency unstable!
- Solved by recording (weak) pilot signal during observing
- IF at 2 GHz was unpractical (need for special SDR receiver)
- Frequency tuning screw was used to adjust ouput frequency

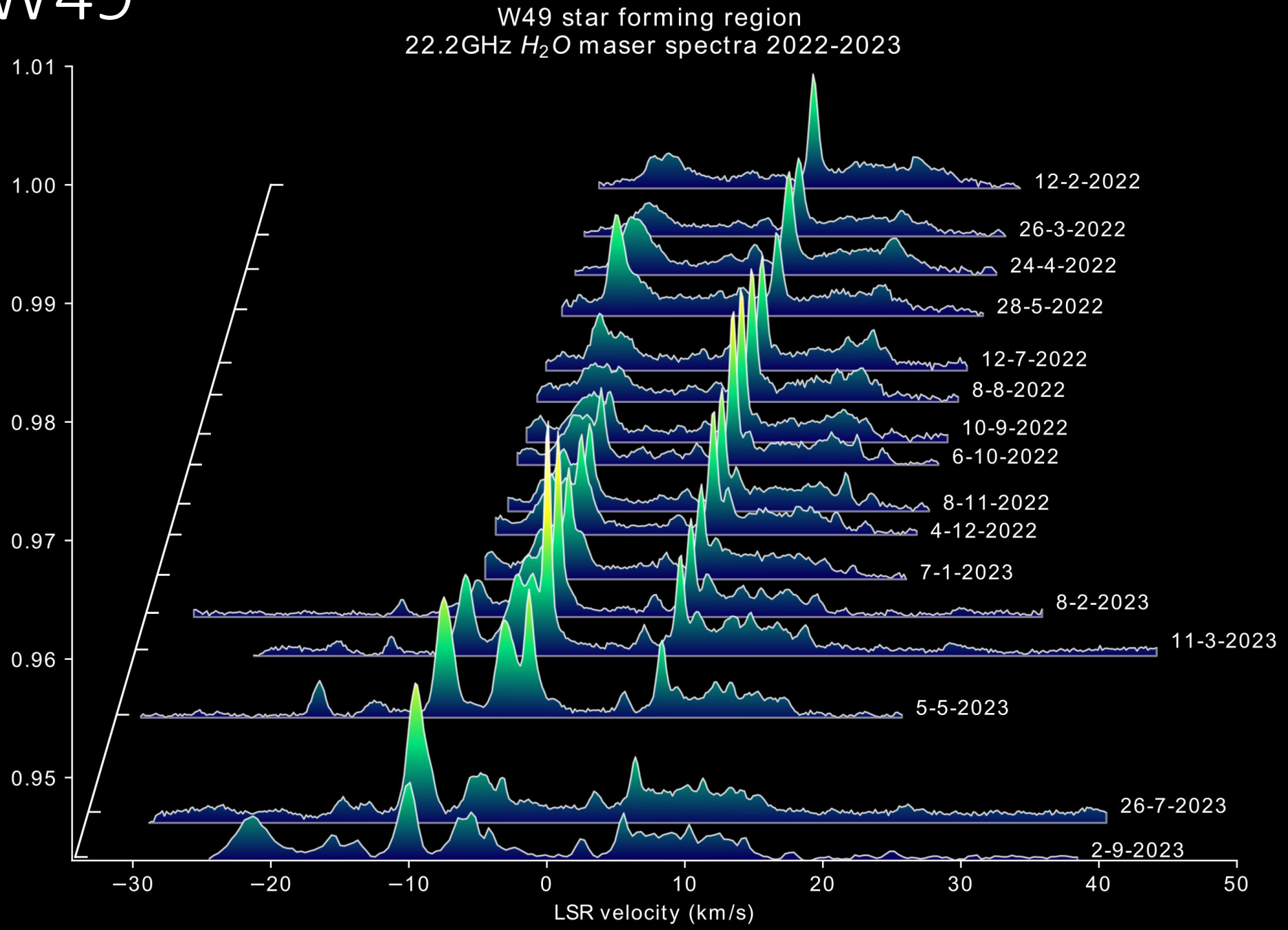



# Water masers: The results so far

- Several sources were detected:

1. W49
2. W51
3. W3(OH)/ W3(2)
4. Orion KL
5. W75
6. G34.403+0.232
7. Cepheus A
8. NML Cygni
9. G25.624+1.050

# W49


W49 star forming region
22.2GHz $H_2O$ maser spectra 2022-2023
1.01
1.00
0.99
0.98
0.97
0.96
0.95
12-2-2022
26-3-2022
24-4-2022
28-5-2022
12-7-2022
8-8-2022
10-9-2022
6-10-2022
8-11-2022
4-12-2022
7-1-2023
8-2-2023
11-3-2023
5-5-2023
26-7-2023
2-9-2023
−30
−20
−10
0
10
20
30
40
50
LSR velocity (km/s)

# Conclusion and outlook

- 12.2 GHz Methanol masers:

+ Relatively easy and cheap to set up

- 12.2 GHz masers are challenging to detect

- 22.2 GHz Water masers

+ several sources can be detected

+ Tracking variability is possible

- equipment is more expensive/ more difficult to obtain