

Double Maser Super-Burst

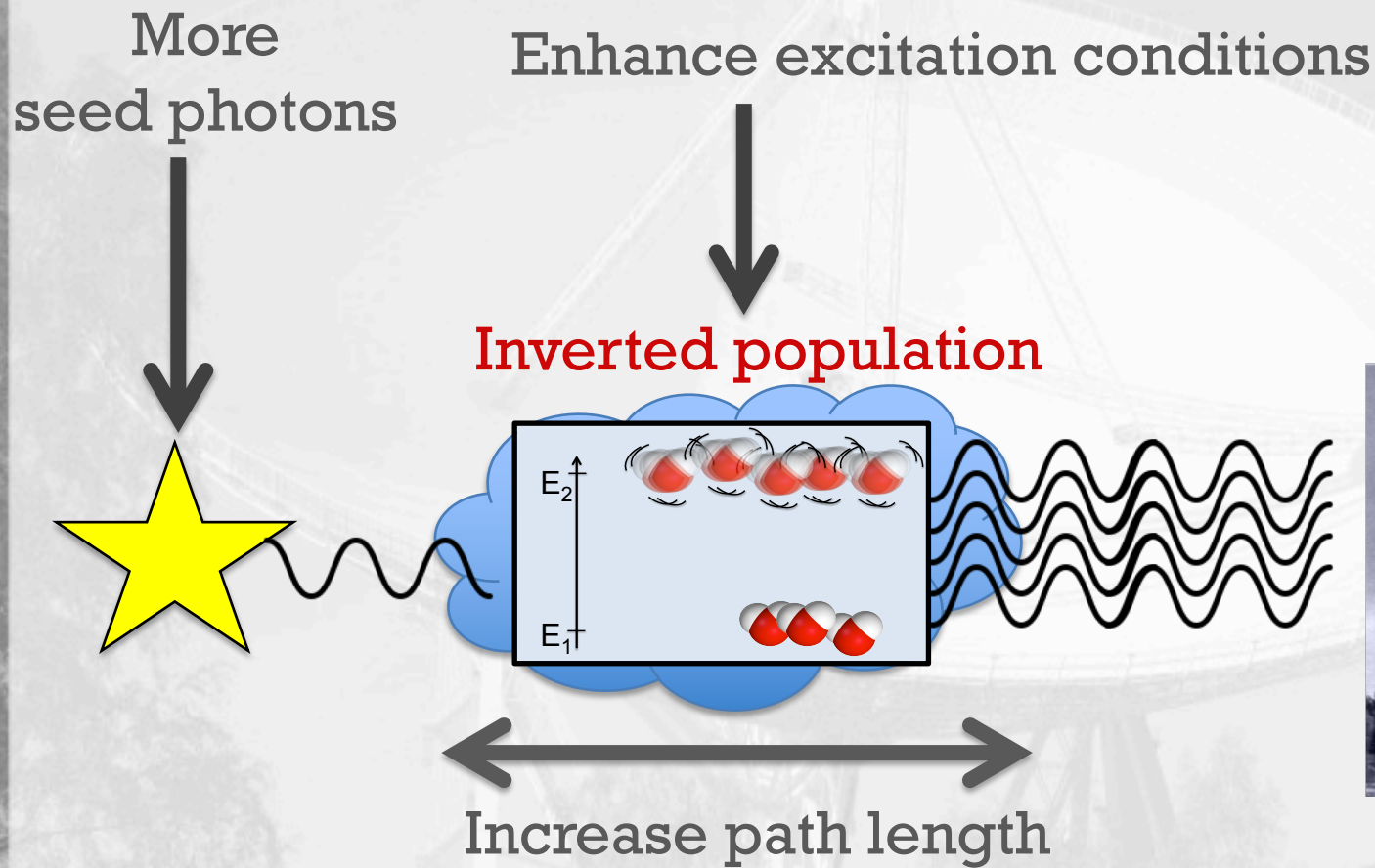
Ross Burns
Joint Institute for VLBI ERIC (JIVE)

Tracing the Flow
5th July 2018

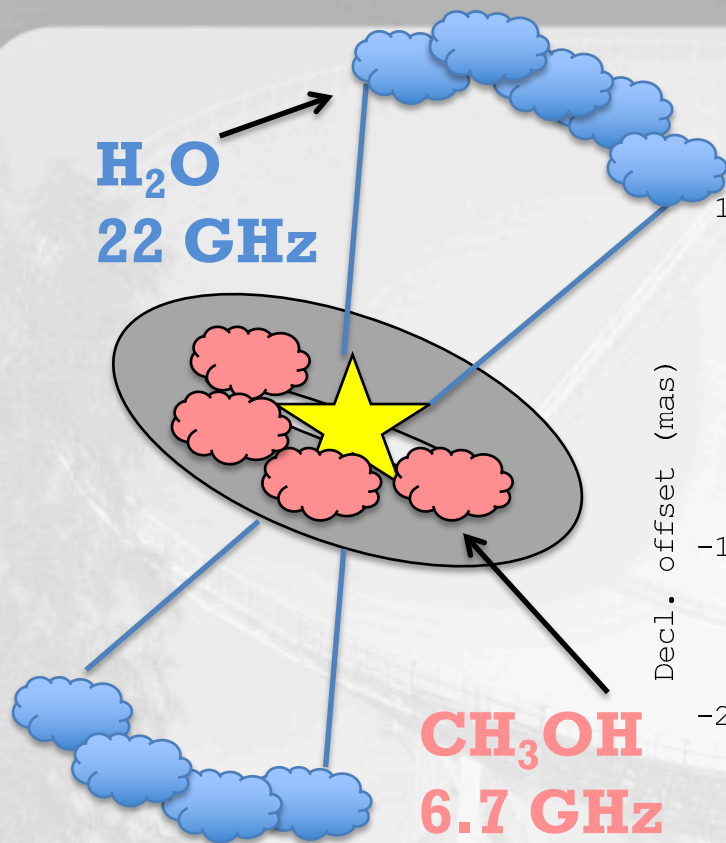
IAUS 336: Astrophysical Masers: Unlocking the Mysteries of the Universe



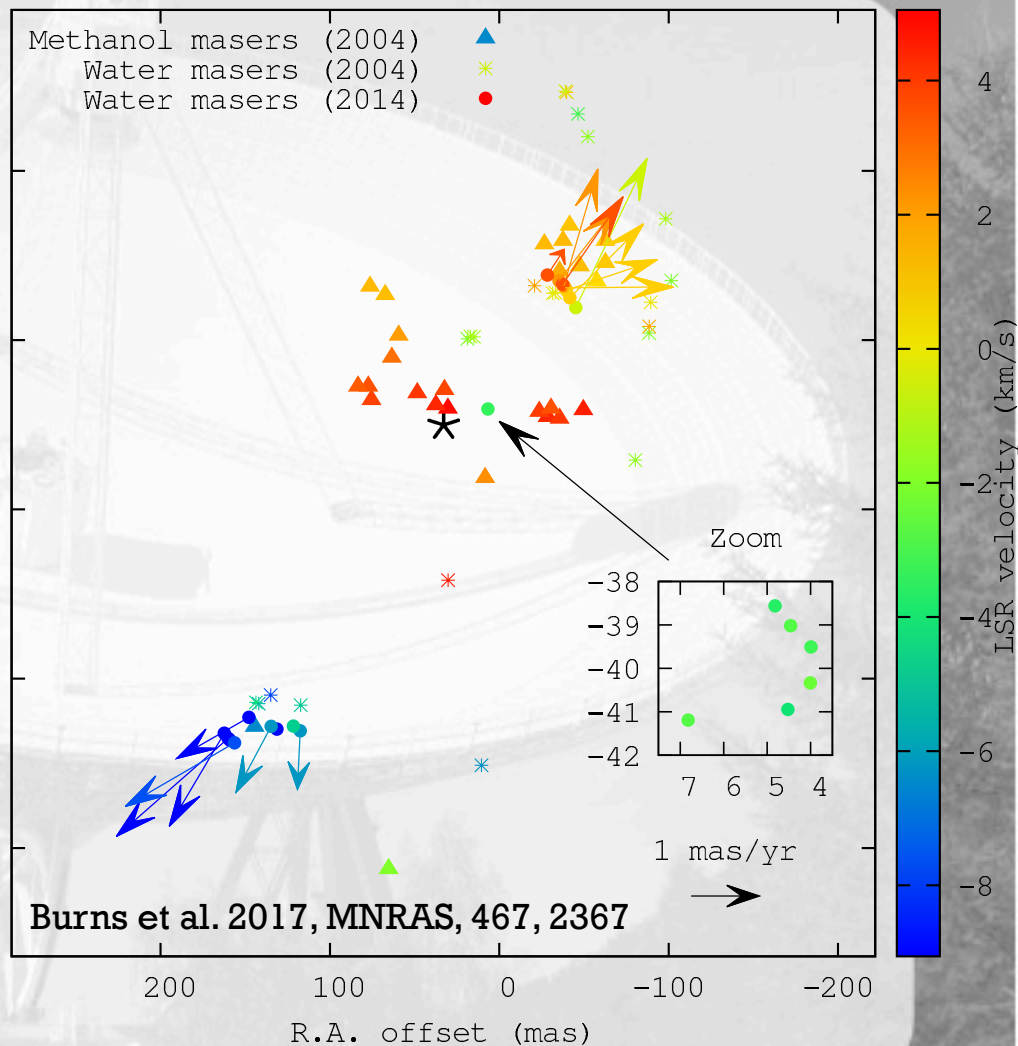
How masers work



Maser environments



Protostars
(High-mass)

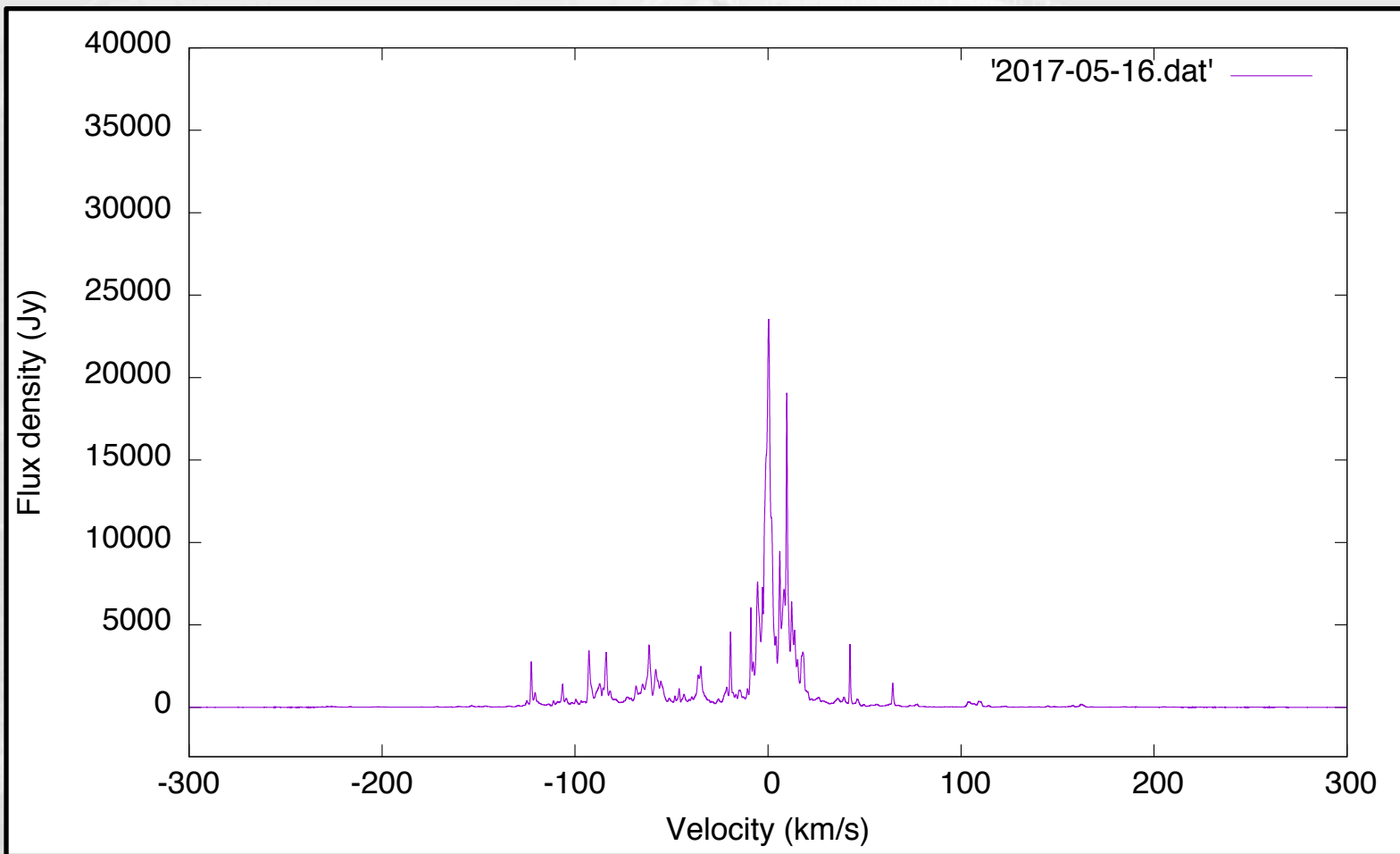


IAUS 336: Astrophysical Masers: Unlocking the Mysteries of the Universe



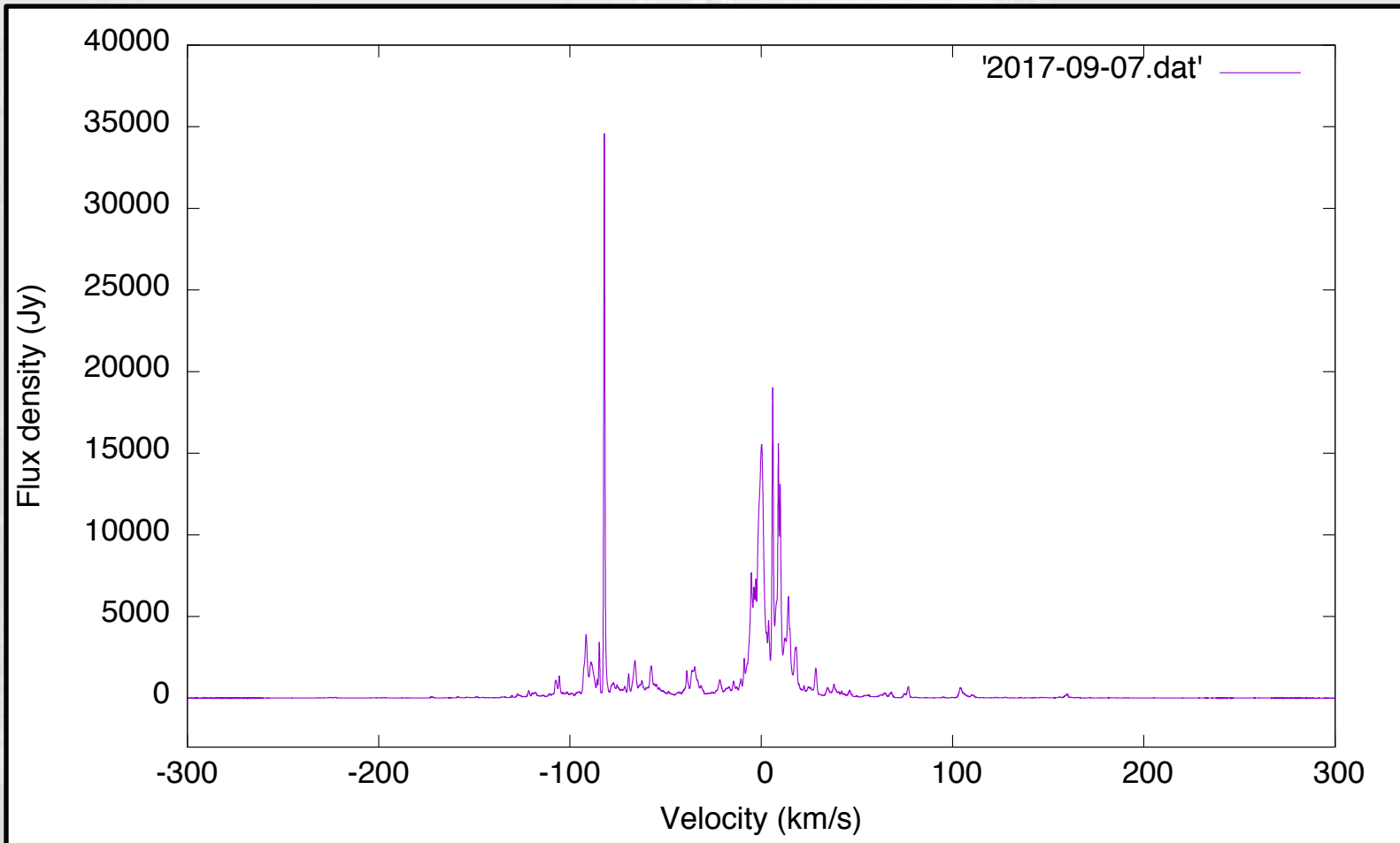
Maser Super Burst

W49N



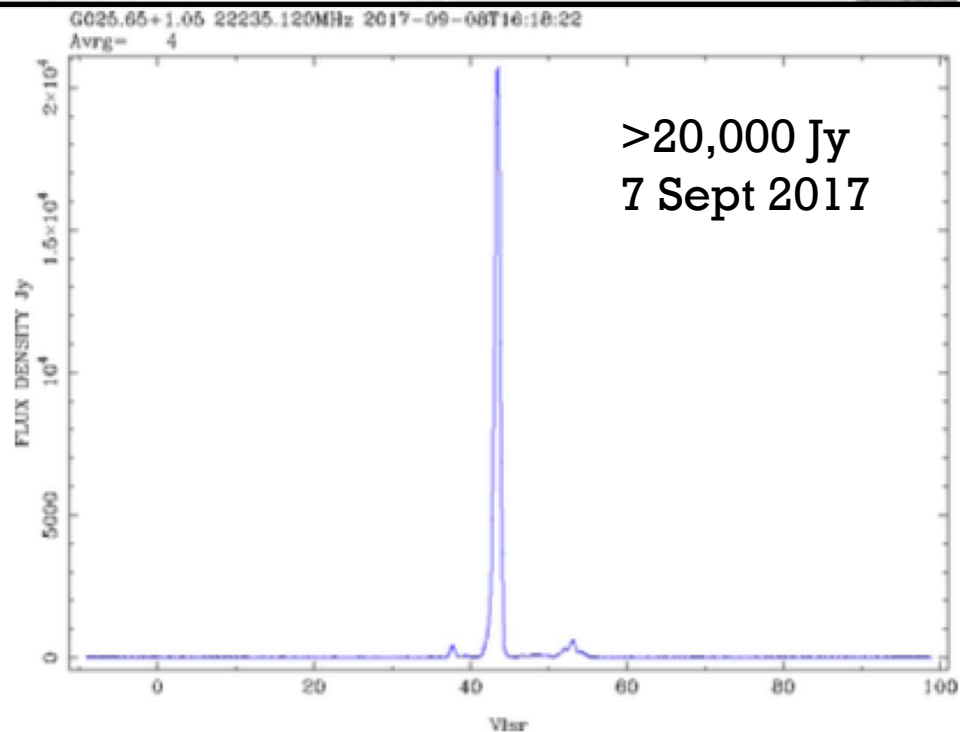
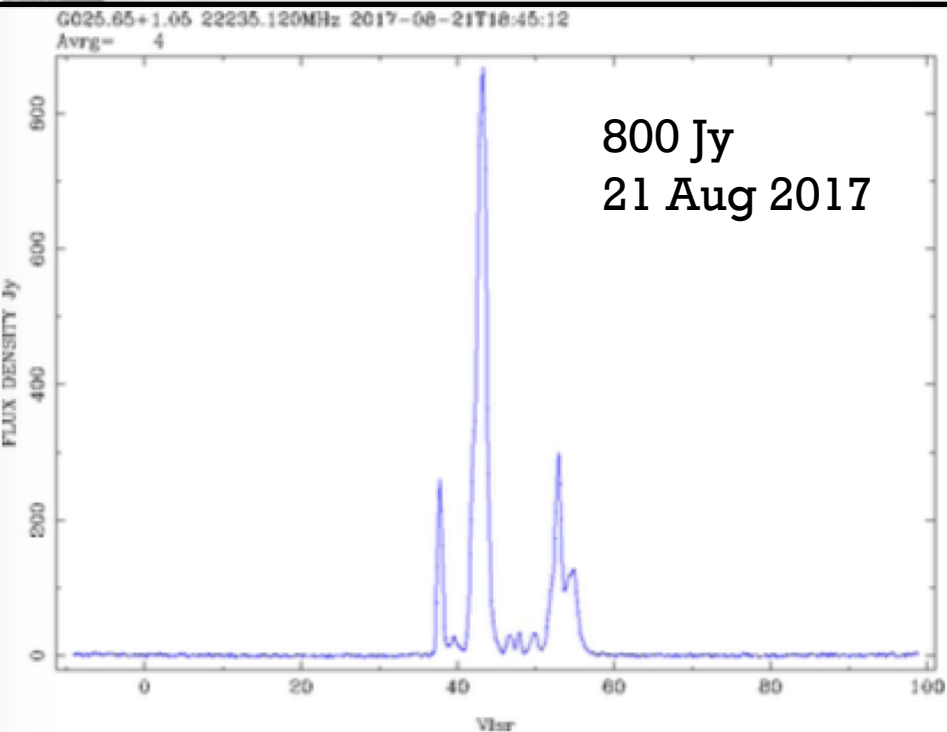
Maser Super Burst

W49N



Maser Super Burst

G25.65+1.05



Maser Super Burst

7th Sep '17

Single-dish detections

ToO proposals

EVN (K)
2nd Oct '17

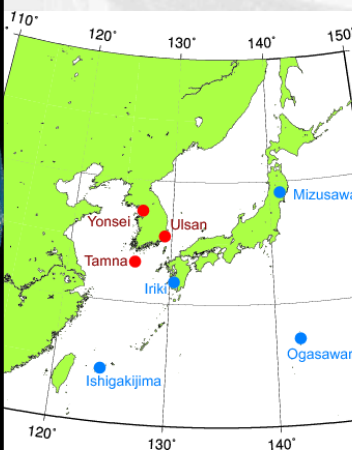
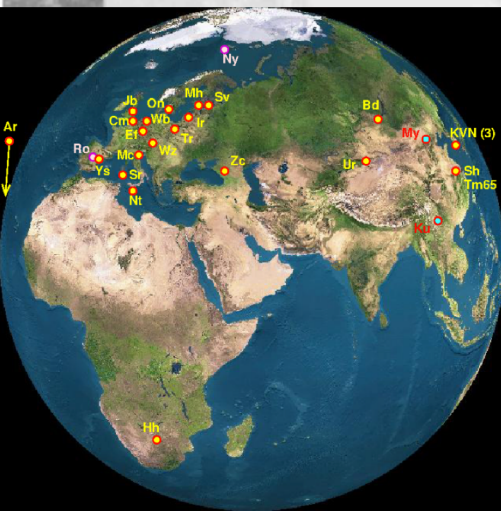
+Polarisation

KaVA (K,Q)
11th Oct '17

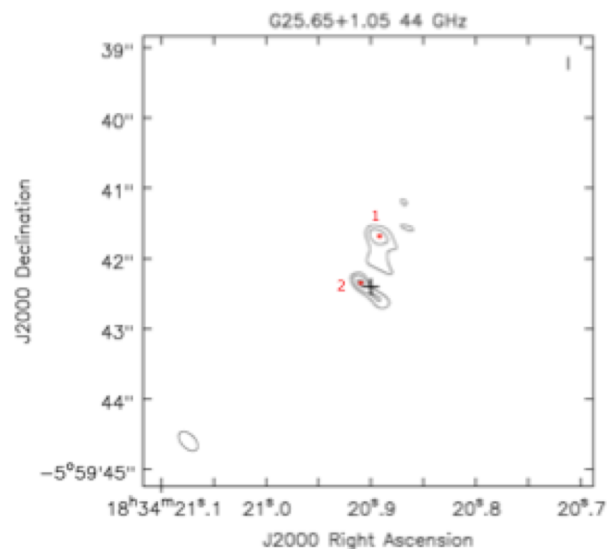
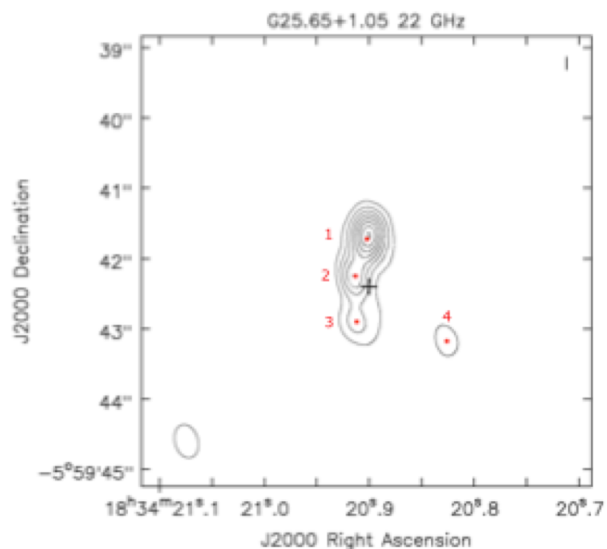
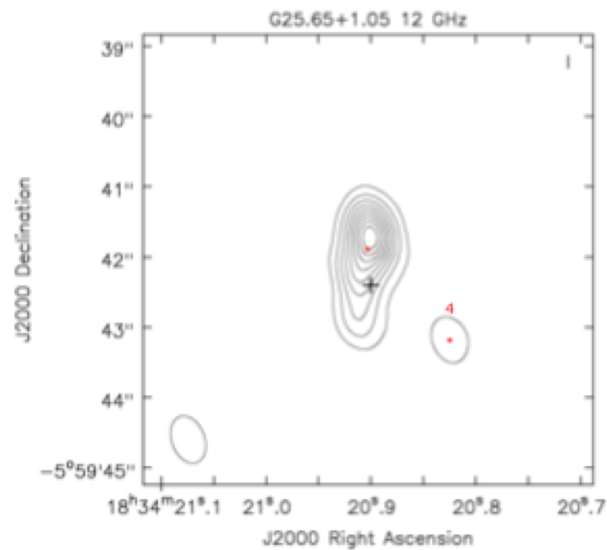
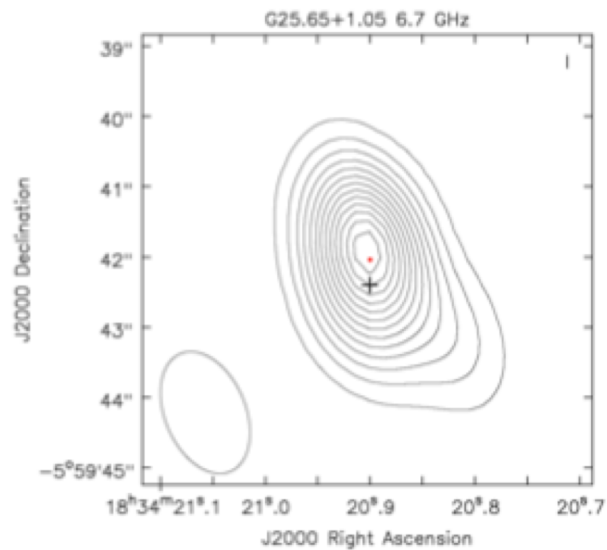
VLBA (K)
28th Oct '17

+Polarisation

VLA
(C,Ku,K,Q)
9th Dec '17



G25 continuum - VLA



ToO eEVN

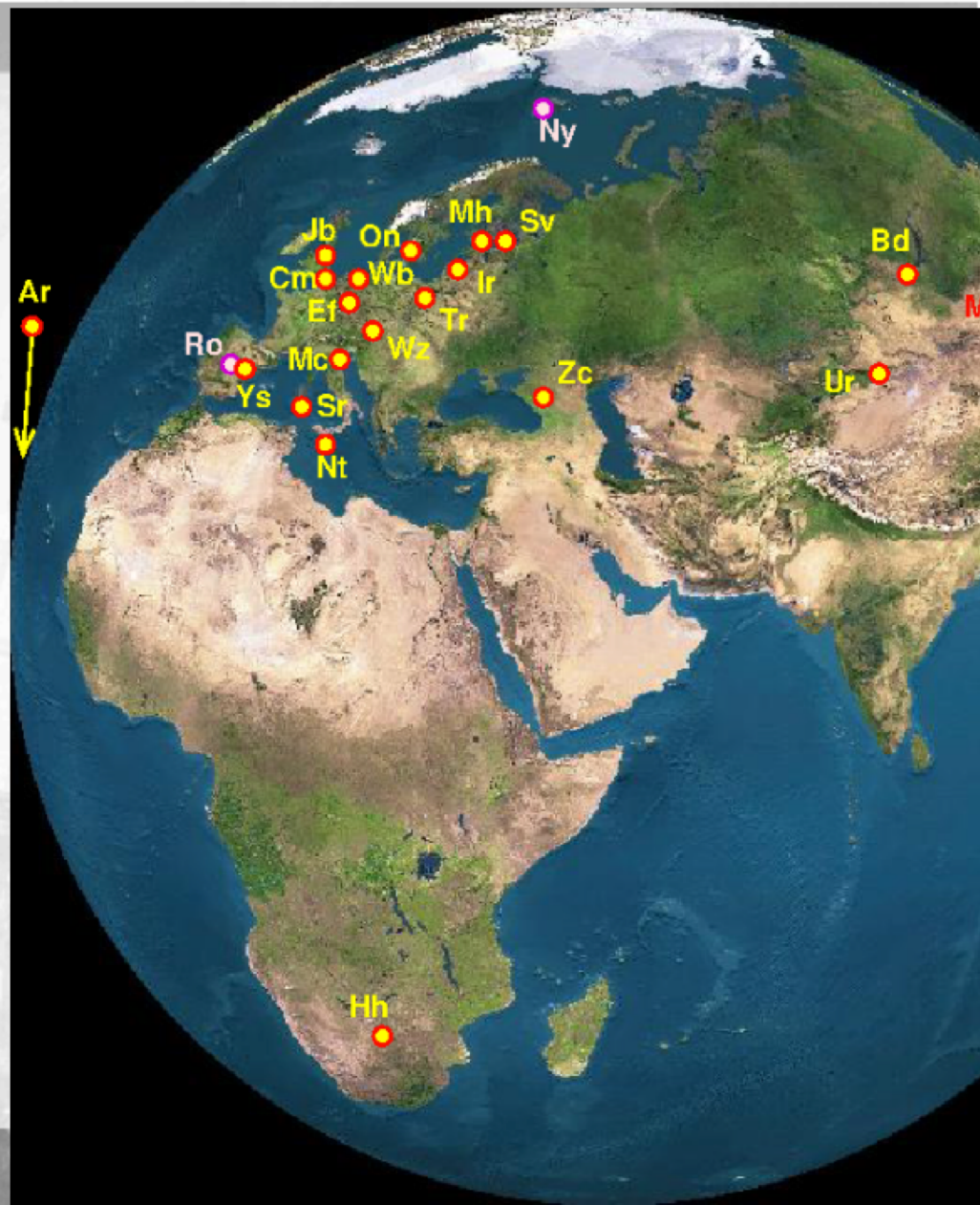
Date: 2 Oct 2017

Duration: 12 hrs

Targets: W49N, G25

Participating stations:

1. Effelsberg, Germany
2. Yebes, Spain
3. Jodrell Bank, UK
4. Torun, Poland
5. Onsala, Sweden
6. Hartebeesthoek, S.Africa



EVN results: G25

> 1 month later

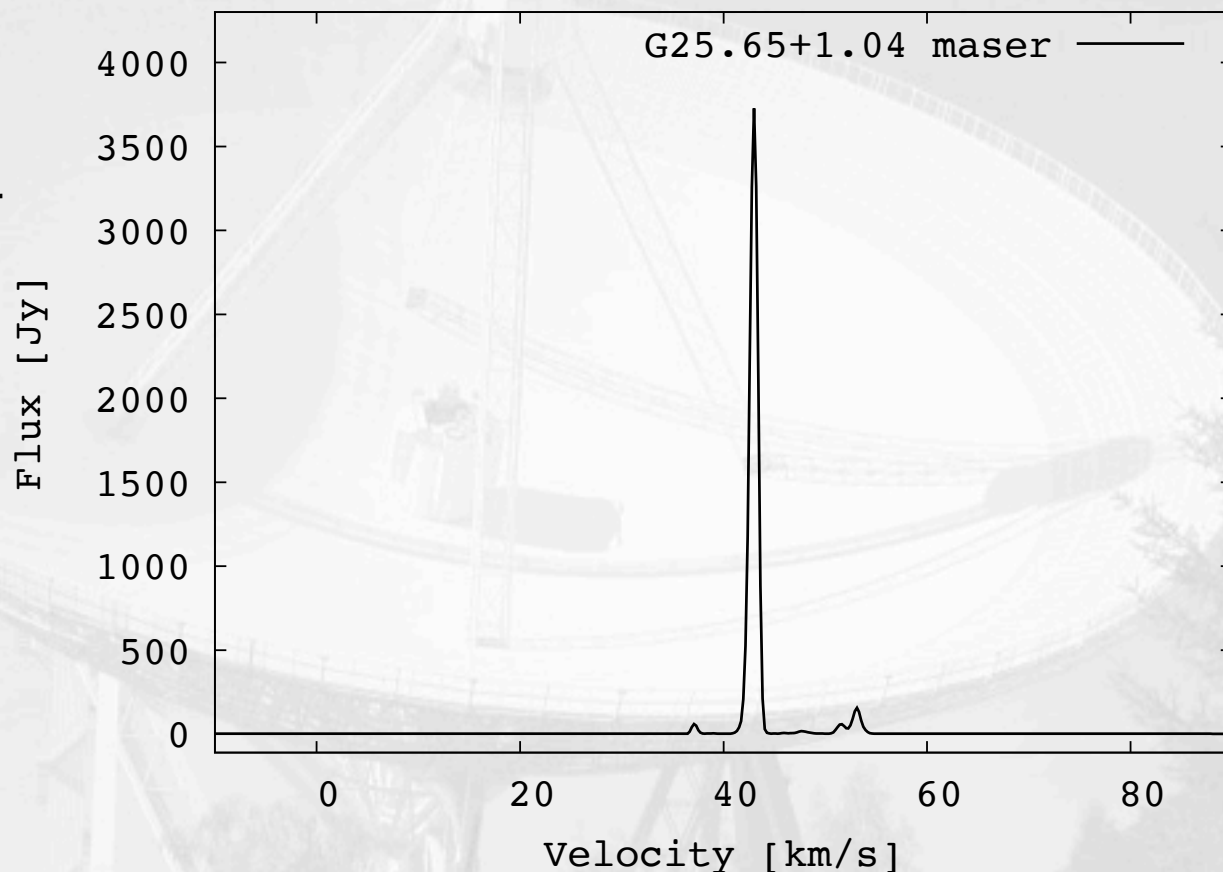
Scalar, X-corr

All baselines

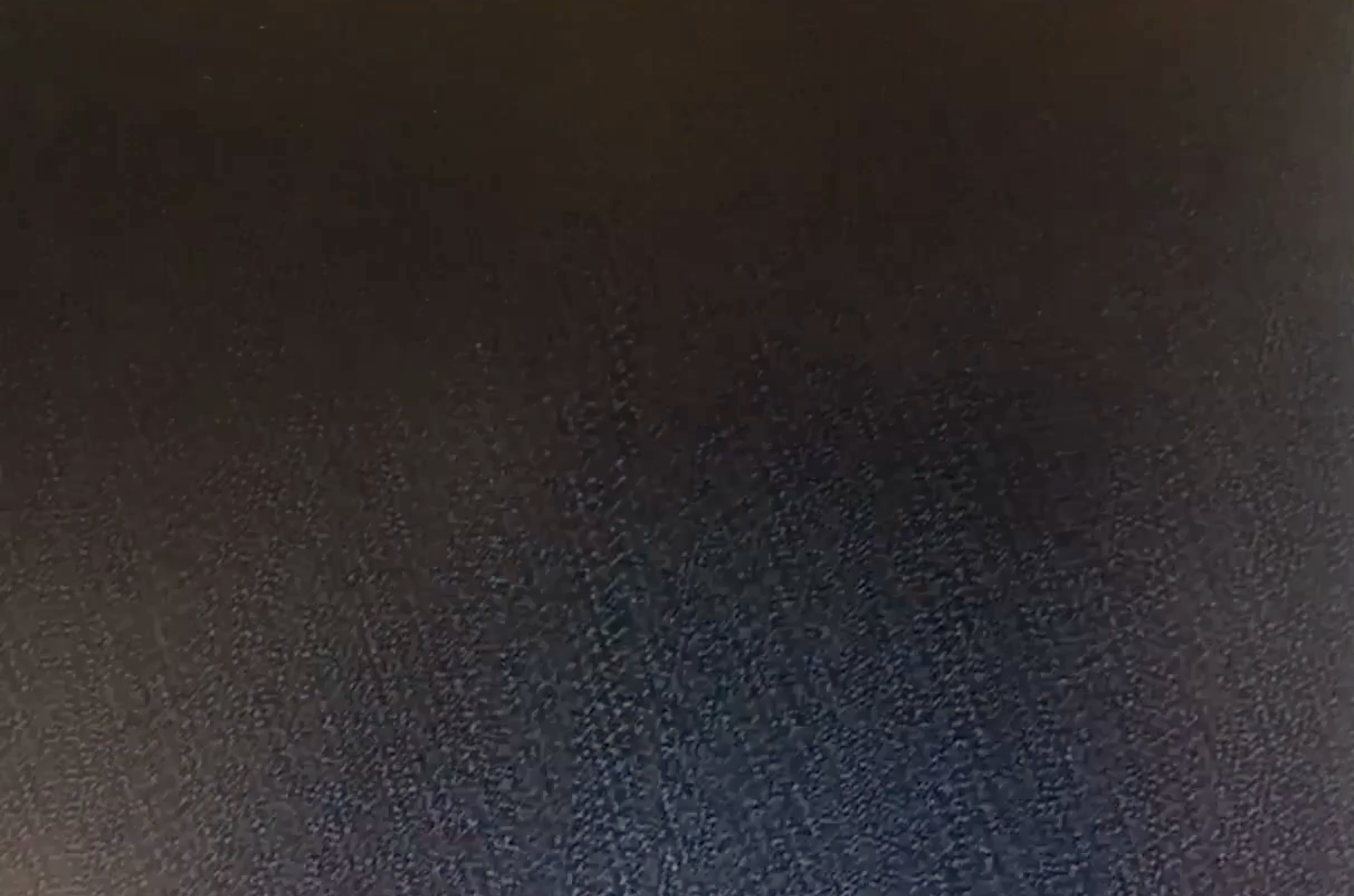
Single dish
20,000 Jy

VLBI
3,600 Jy

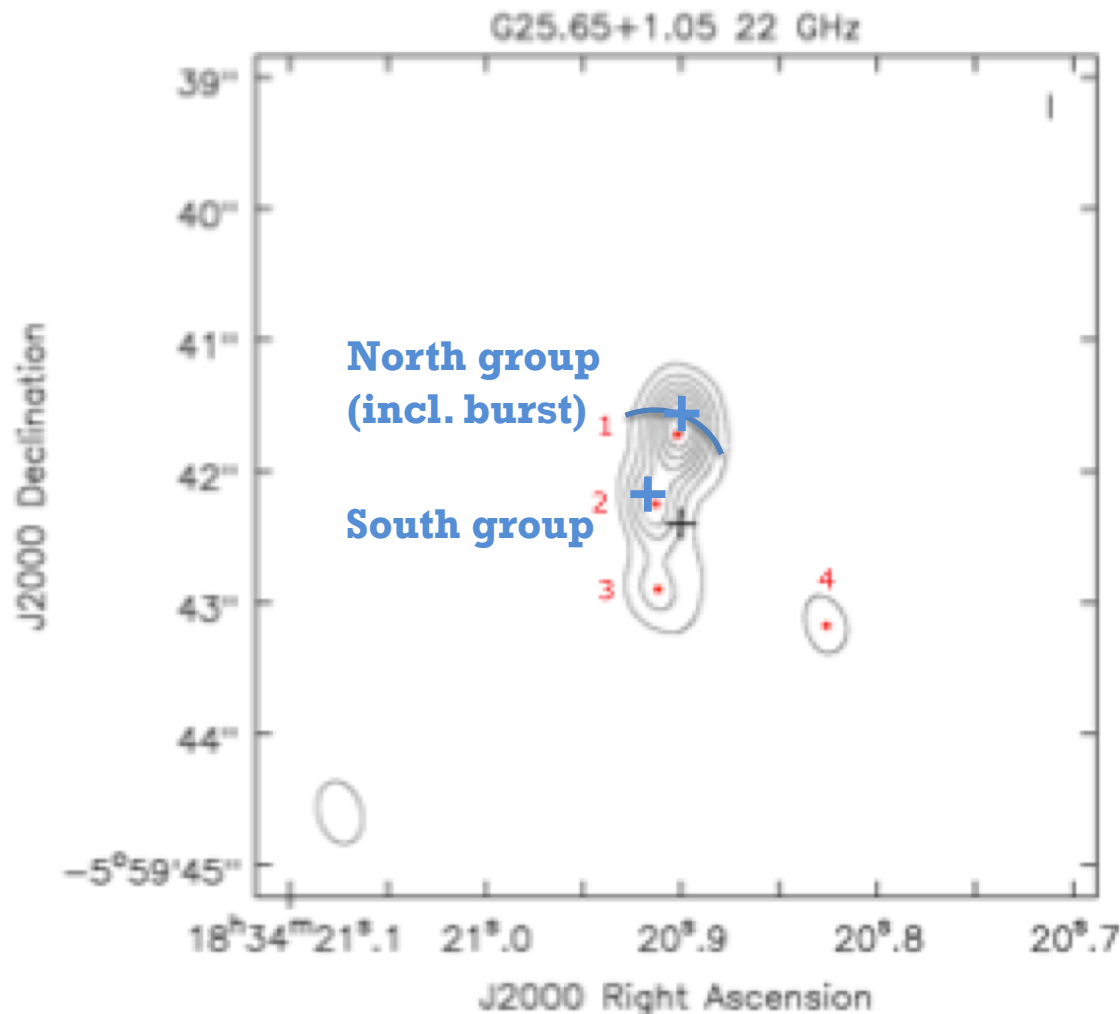
18% recovered flux
(82% lost to variability or resolved out)
Typical value for S.Dish vs VLBI



EVN results: G25



G25 continuum - VLA



- Negative spectral index
- H₂O masers trace shocks
- Morphology: arc

Interpretation

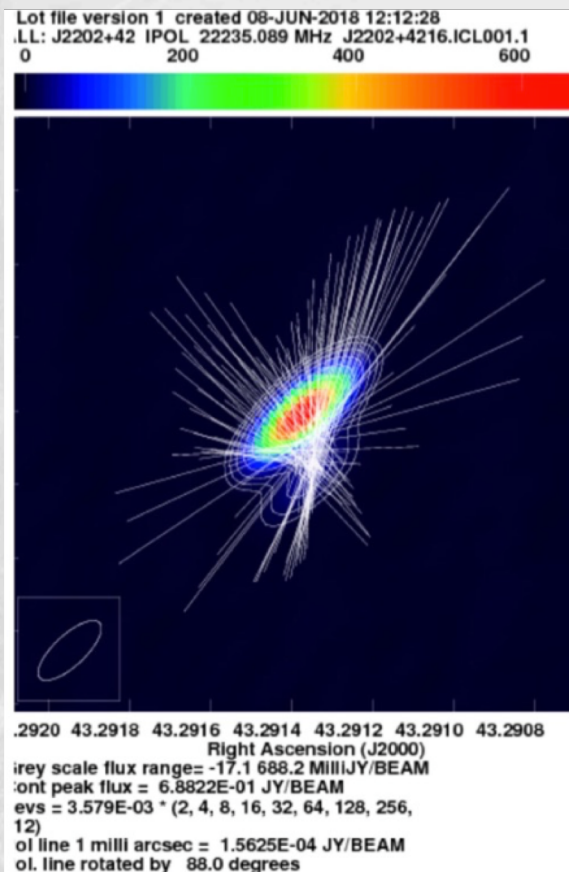
Bursting maser group
associate w/ young shock
at VLA 1

Shock from recent
ejection activity

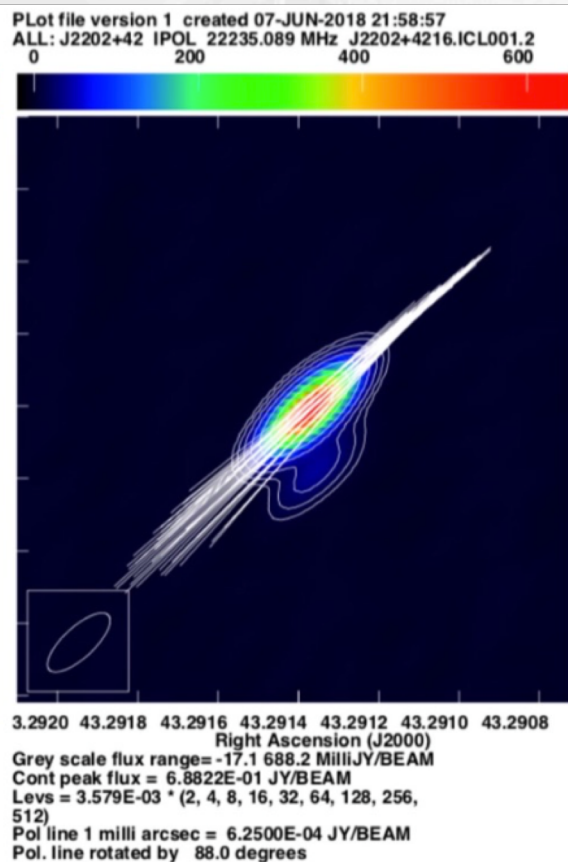
Look for more evidence of
shock compression

Polarisation: Calibration (cont.)

Before



After



J2202+4216
(BL Lac)

D-term calibrator

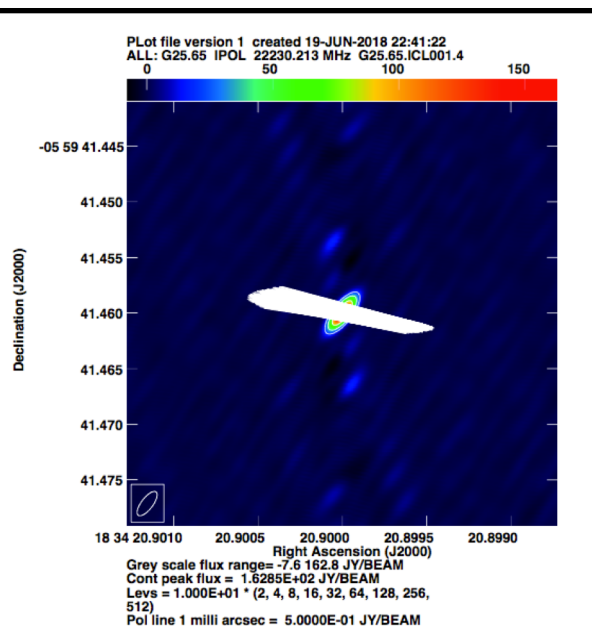
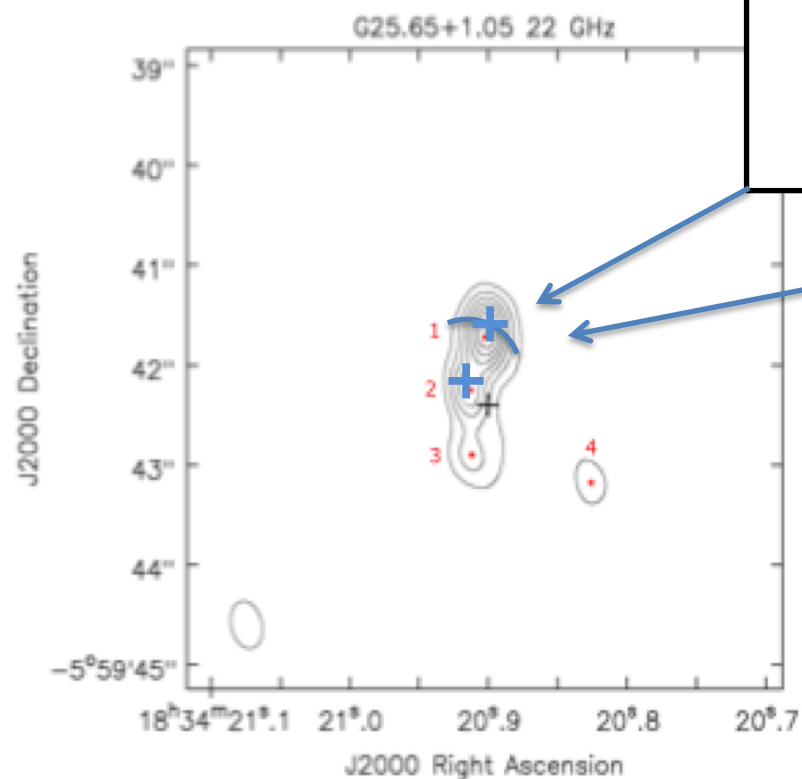
Delay calibrator

Gain selfcal

No EVPA cal yet

EVN pol. cal.
successful

22 GHz water maser polarisation in the **North** group

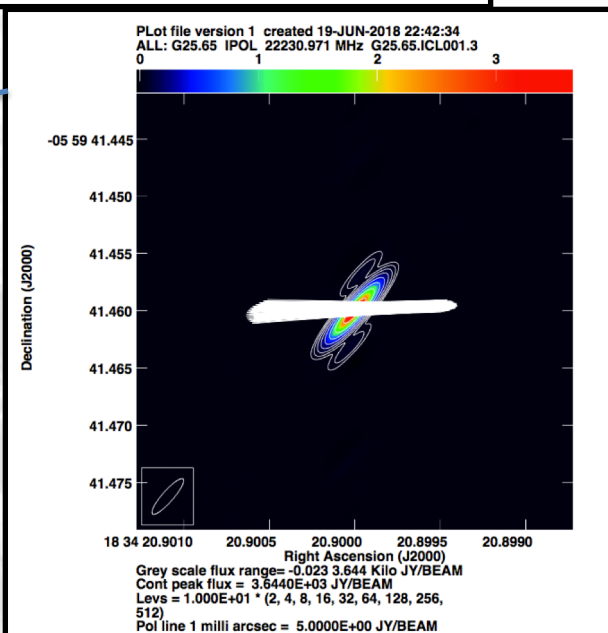


Regular maser

Stokes Q
8 Jy

Stokes I
160 Jy

5% Linear
polarisation



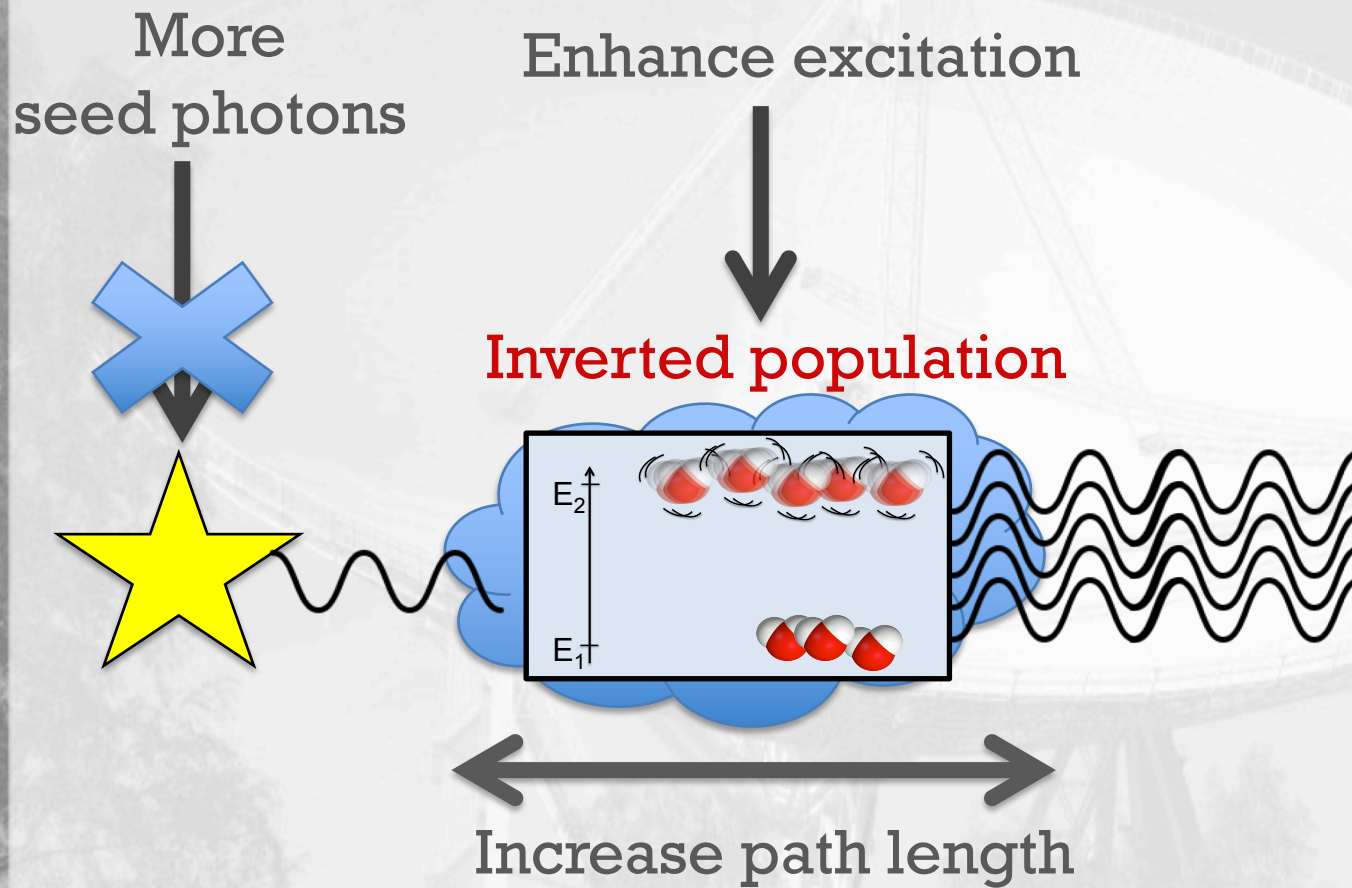
Super burst

Stokes Q
90 Jy

Stokes I
3600 Jy

2.5% Linear
polarisation

How masers work



22 GHz H₂O masers in G25.65+1.05

- Extremely variable super-burst behavior
- Masers reside in shock region
- No evidence of enhanced B-field

The G25 super-burst explanation favors rapid change in the shock region physical conditions

Ejections from MYSOs tell of accretion activity, providing an observational handle on epis. acc.

Important to note

- Masers are common tools for studying MSF but VLBI imaging is crucial to their interpretation

What next?

Rich data set has far more to be explored...

**Polarisation
evolution**

- **Flux evolution**
- **Proper motion**

Multi-scale

EVN (K)
2nd Oct '17

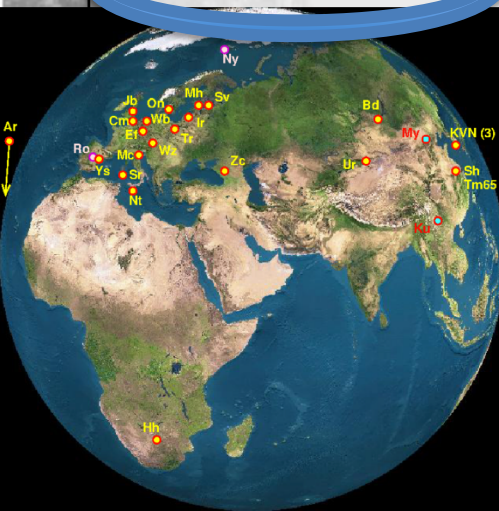
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VLBA (K)
28th Oct '17

VLA
(C,Ku,K,Q)
9th Dec '17

+Polarisation

+Polarisation



Finding maser super bursts

- Rare
- Short-lived
- Unexplained

Maser Monitoring Organisation (M2O)

- To coordinating single-dish maser monitoring programs worldwide.

Understanding maser super bursts

- Quick-response observations
- Multi-scale
- Multi-epoch

M2O-VLBI

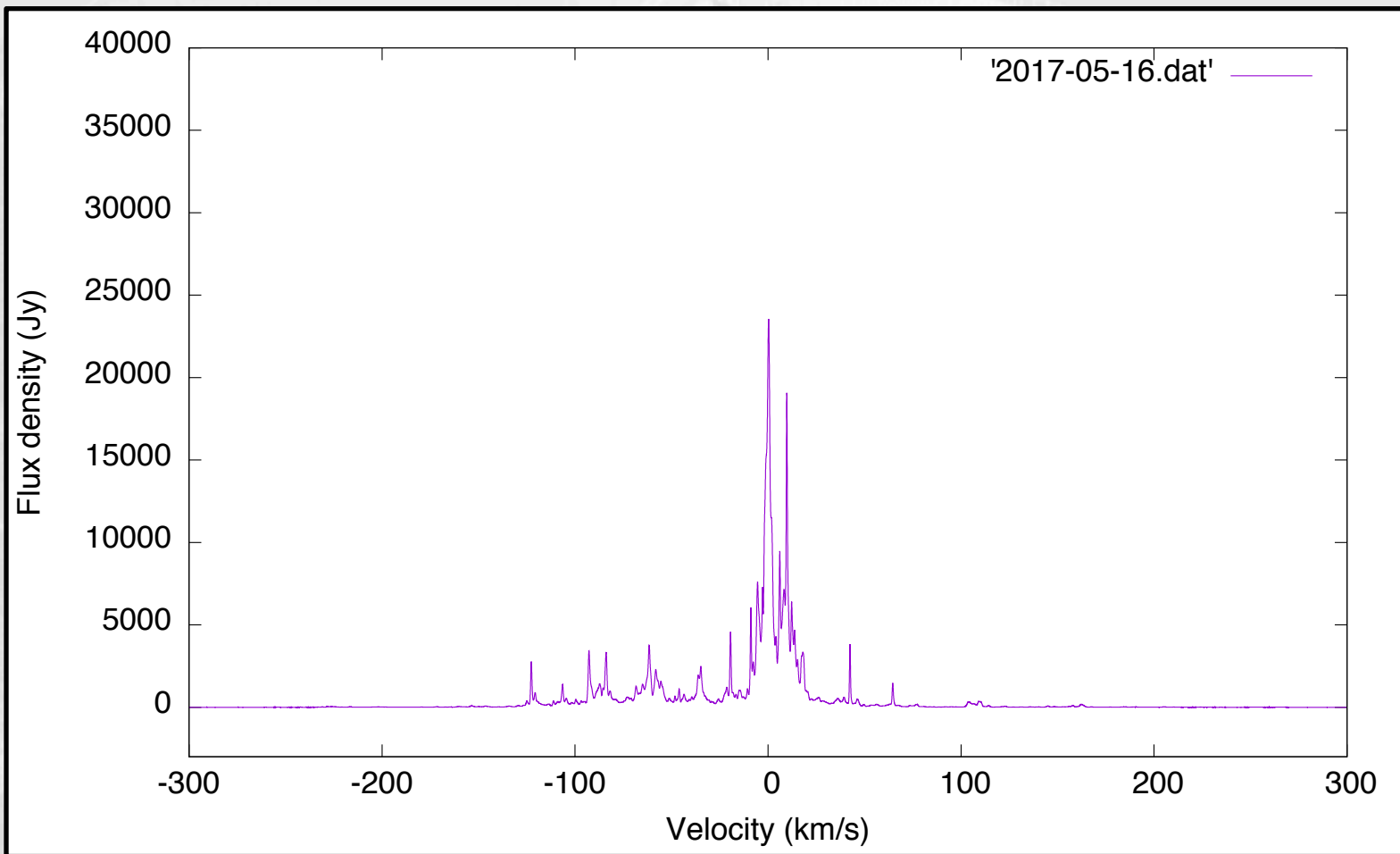
- To obtain quick VLBI follow-up observations in quick response to M2O burst alerts



To Questions

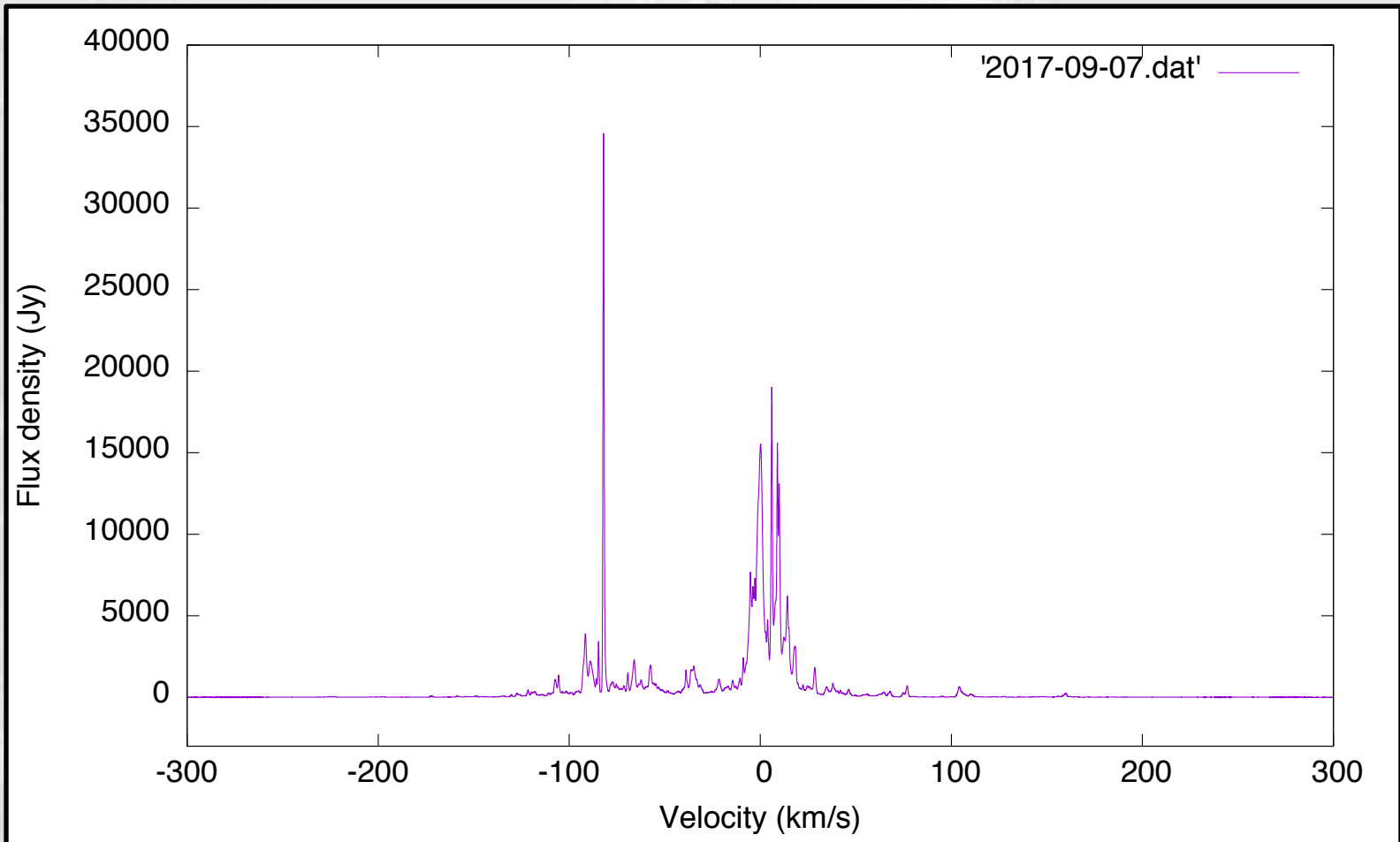
Maser Super Burst

W49N

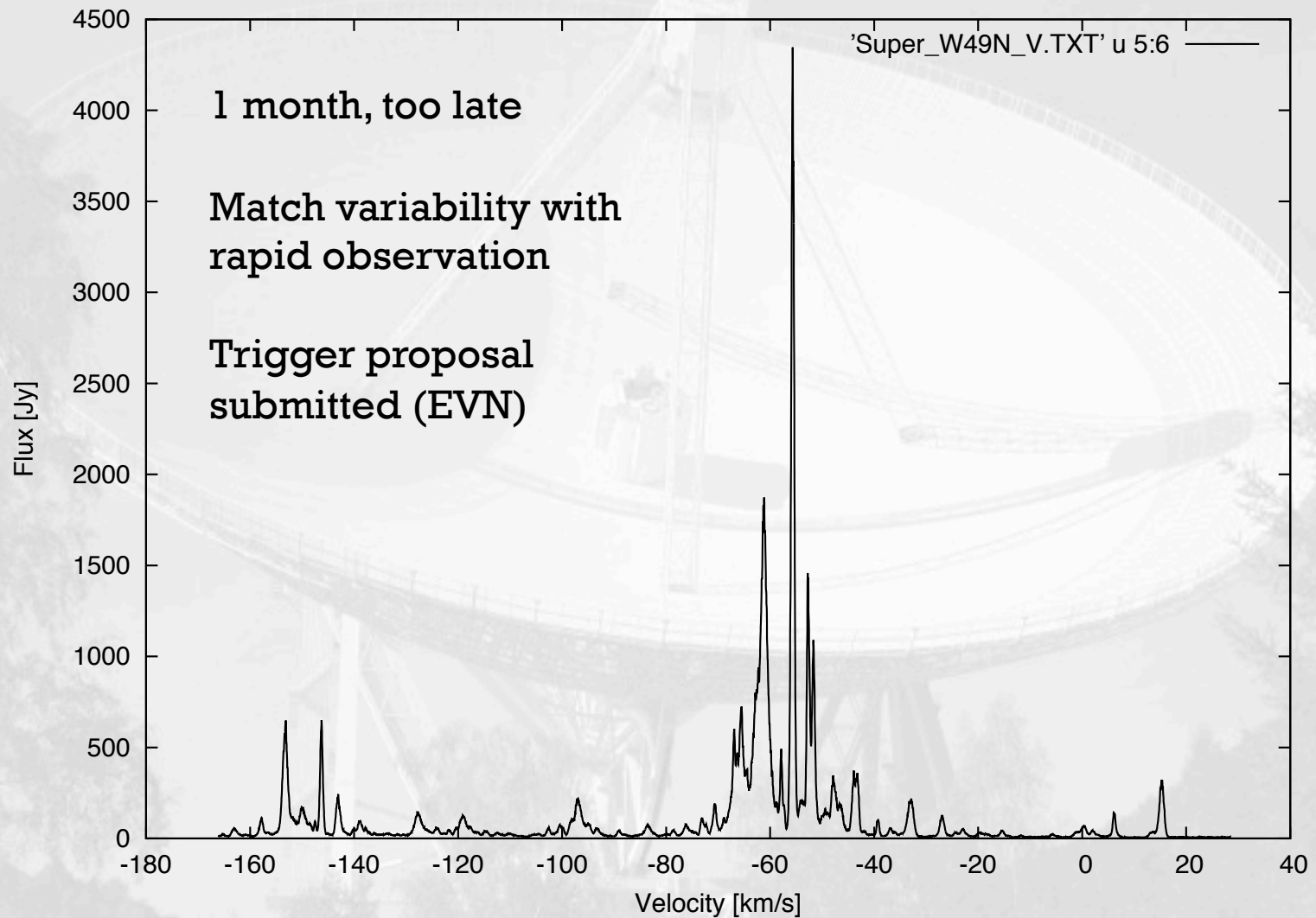


Maser Super Burst

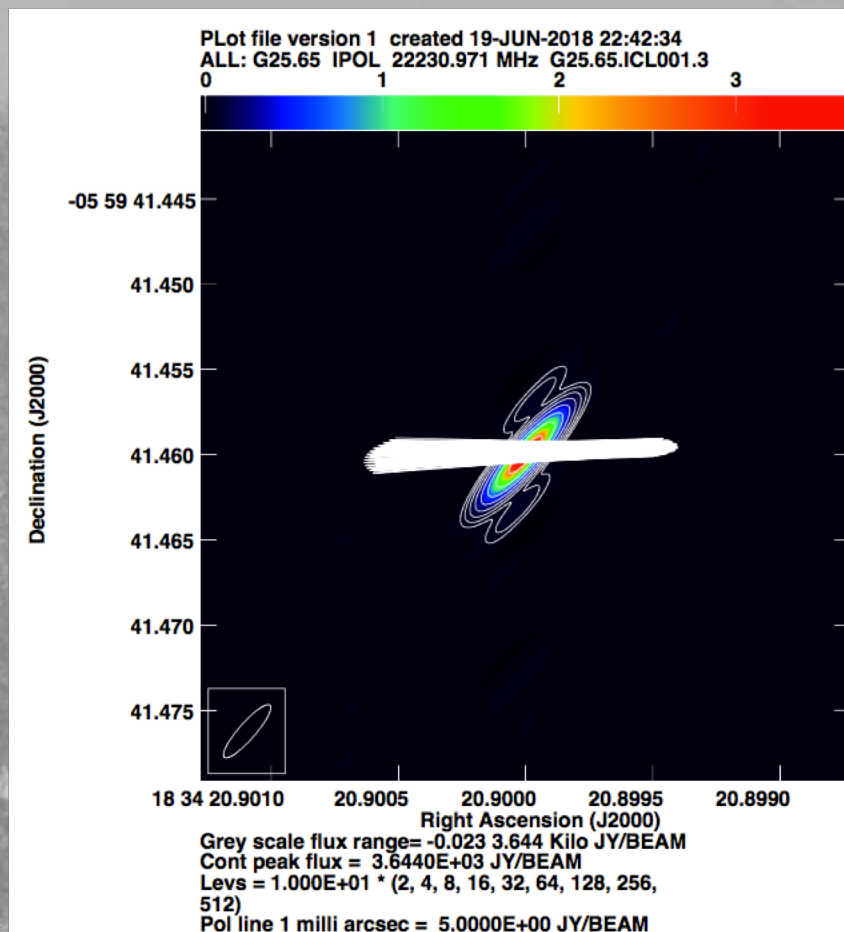
W49N



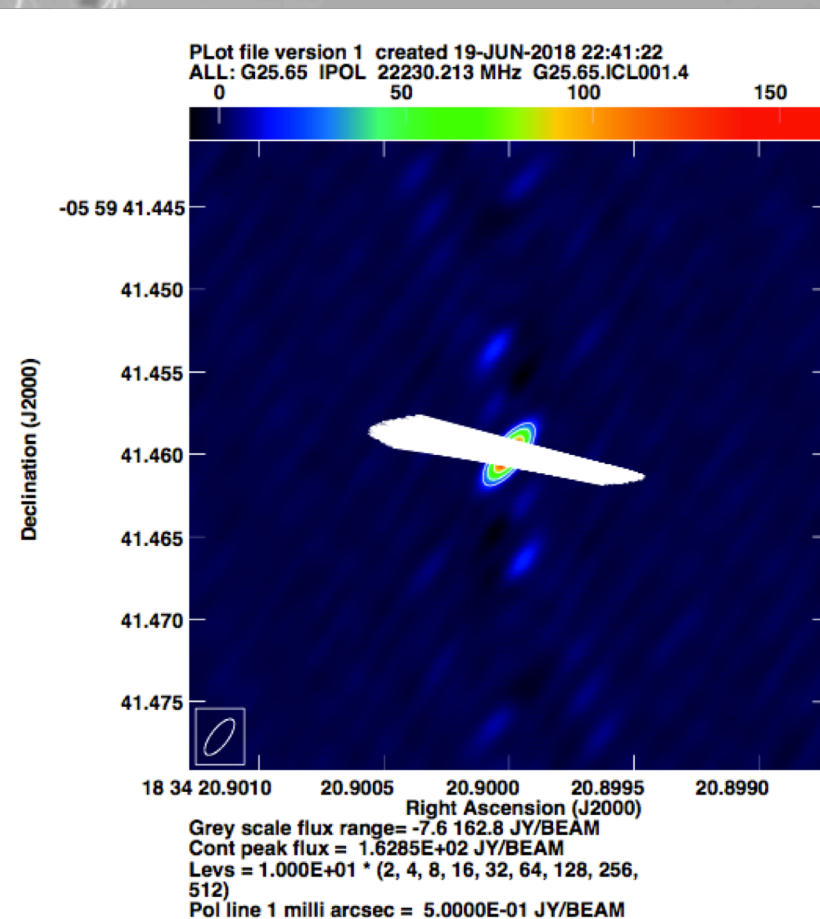
Maser Super Burst



Polarisation: Maser features



Stokes Q = 90 Jy
 Stokes I = 3600 Jy
 2.5% Linear polarisation



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Regular masers

