JIVE
Joint Institute for VLBI ERIC

Double Maser Super-Burst

Ross A. Burns, on behalf of the M2O-VLBI group (listed below)

The M2O

Masers are extremely variable emitters, capable of changing flux by thousands of Janskys in a matter of days. To better understand this phenomena the Maser Monitoring Organisation (M2O) was established during the IAUS 336 “Astrophysical Masers: Unlocking the Mysteries of the Universe” at Cagliari, Sardinia in 2017. The purpose of the M2O is to pool the efforts and ease coordination of single dish maser monitoring operations from observatories around the world to provide fast discovery and confirmation of transient and time-variable maser behavior.

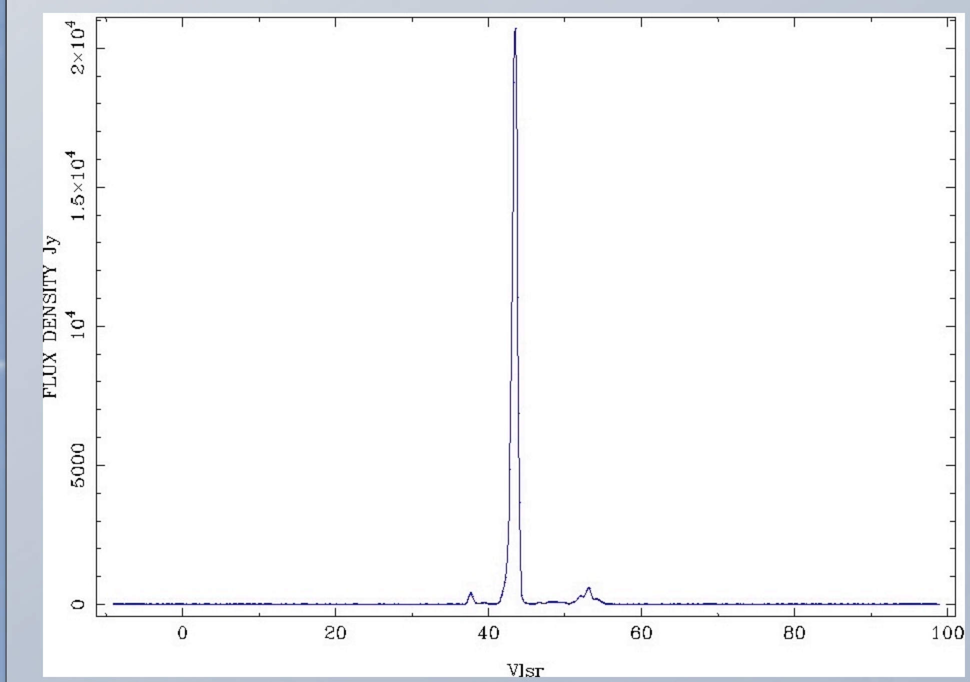

Fig 1a - The 22 GHz water maser spectrum of G25.65+1.04 taken with the HartRAO radio telescope during its super burst in September 2017.

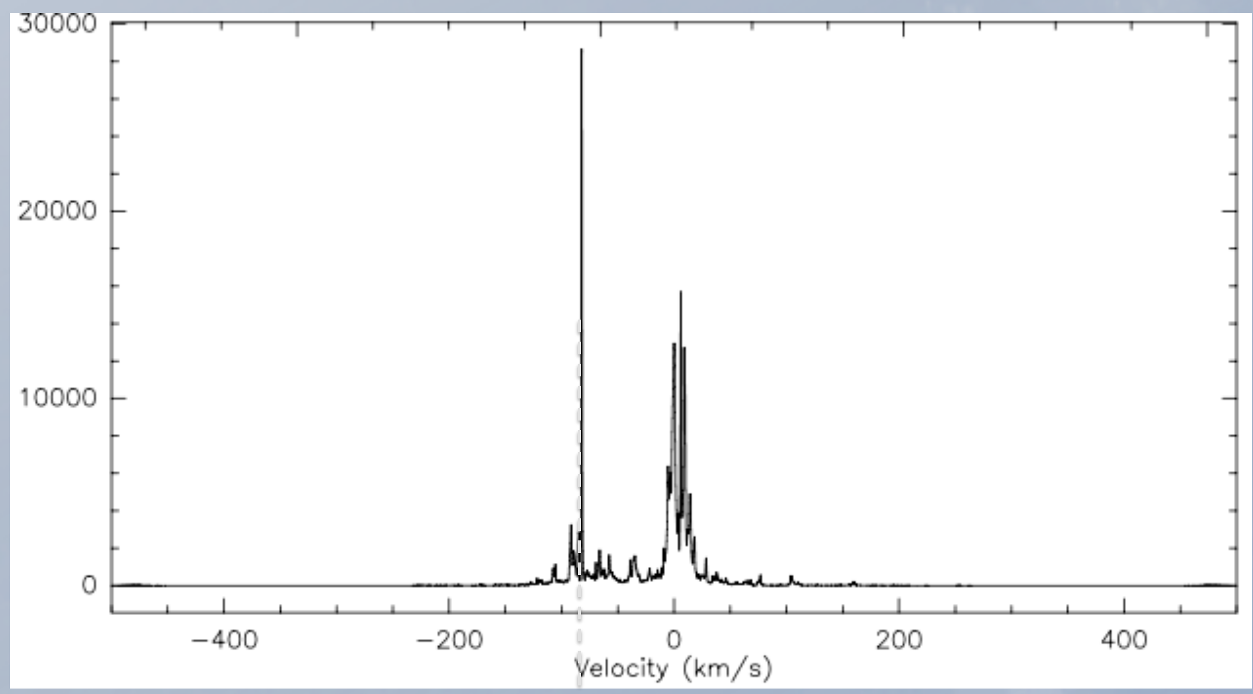

Fig 1b - The 22 GHz water maser spectrum of W49N taken with the Effelsberg radio telescope during its super burst in September 2017.

Participants of IAU symposium 336 “Astrophysical Masers: Unlocking the Mysteries of the Universe” at the Sardinia radio telescope in September 2017

Maser super bursts

During the IAUS336 in September 2017 two well-known massive star forming regions G25.65 and W49N recently underwent maser 'super-burst', reported by the M2O - their fluxes suddenly increasing above 18,000 and 30,000 Jy, respectively, several orders of magnitude above their usual values (Fig 1a,b).

M2O-VLBI

While flux variability can be monitored with single dish stations, the localisation of maser bursts within a star forming region is crucial to determining the cause of burst behavior. To fulfill this need the M2O-VLBI group was established to perform quick follow-up VLBI observations of maser bursts discovered by the M2O.

First activities of the M2O-VLBI group

In October 2017 the super burst masers, G25.65+1.05 and W49N, were observed by the EVN, KaVA and VLBA, in addition to compact-array, single dish and space-based missions. Here we show early results from the EVN. Observations were carried out in eVLBI mode in which data were streamed directly to the EVN correlator at JIVE. Participating stations were Effelsberg (Germany), Yebes (Spain), Jodrel Bank (UK), Torun (Poland), Onsala (Sweden), Hatebeesthoek (S. Africa). By merit of the real-time nature of eVLBI data products (FITS files) were delivered a few hours after the experiment.

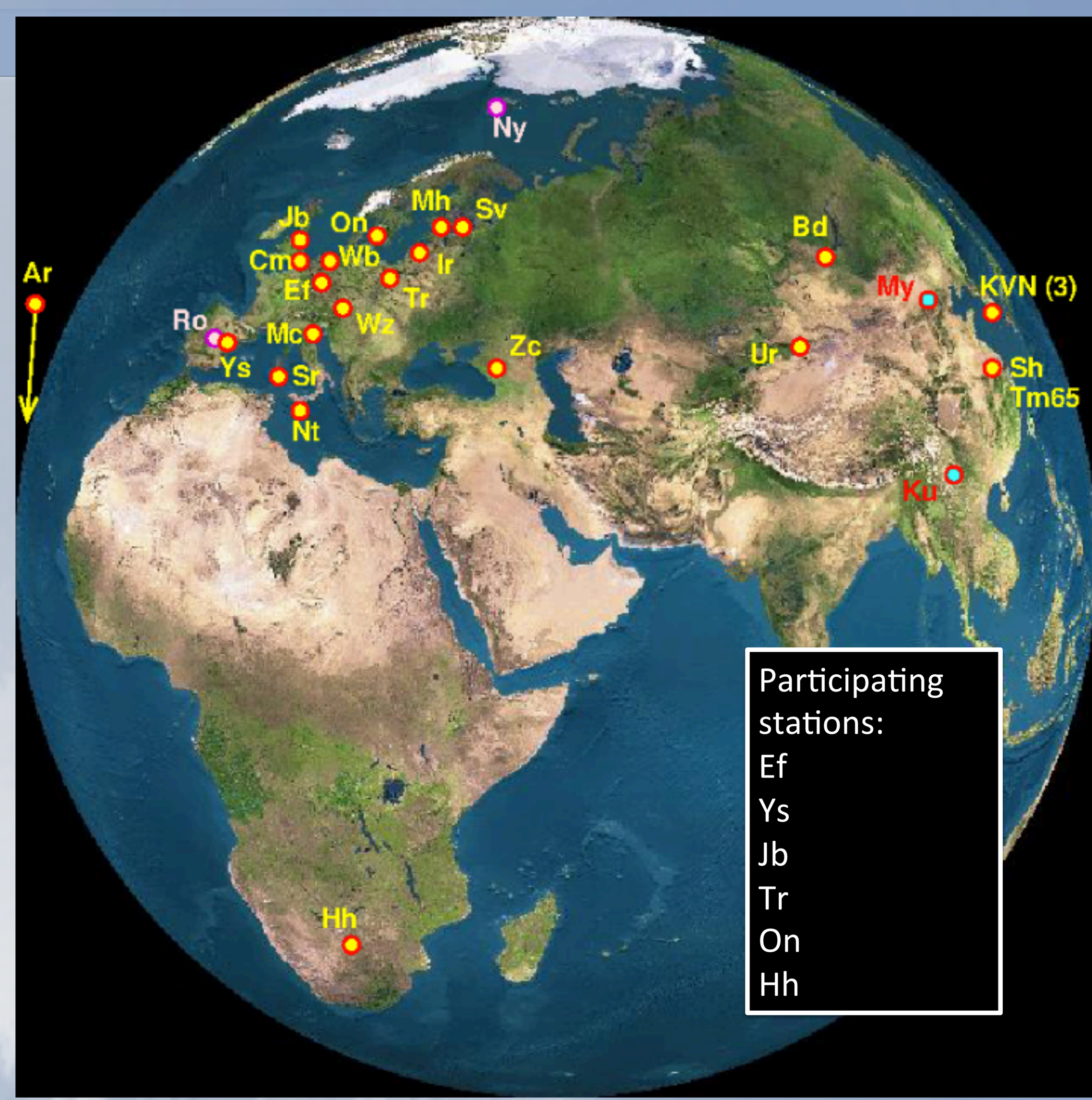

Image of the European VLBI Network (EVN) taken from www.evlbi.org

Results from the EVN

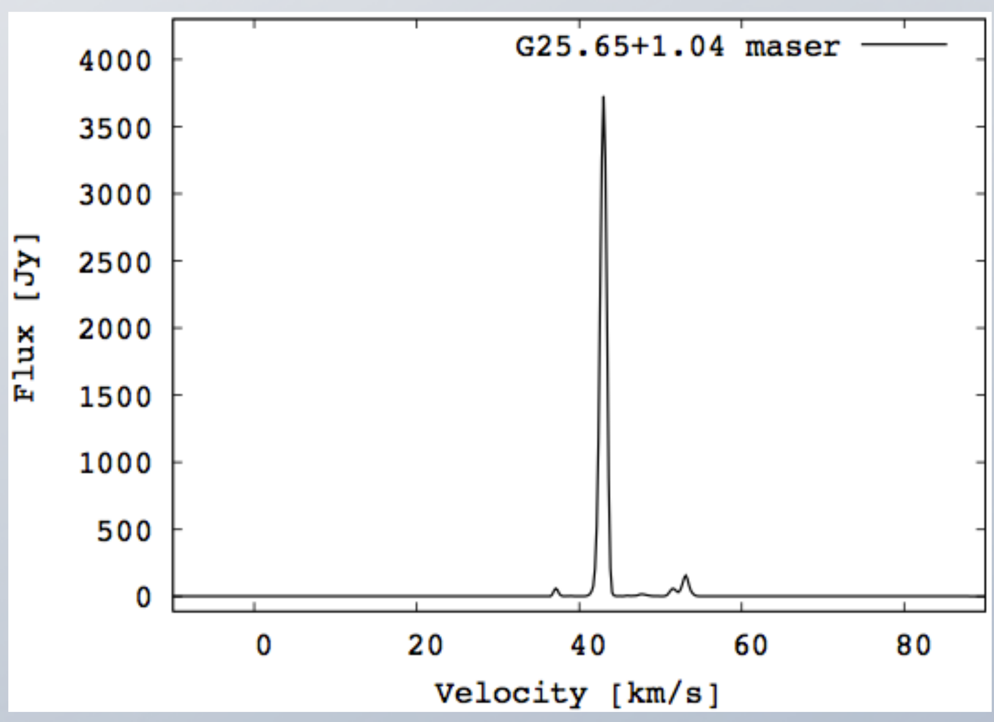

Fig 2a – The 22 GHz water maser spectrum (scalar averaged) of G25.65+1.05 produced by all combined baselines of the participating stations.

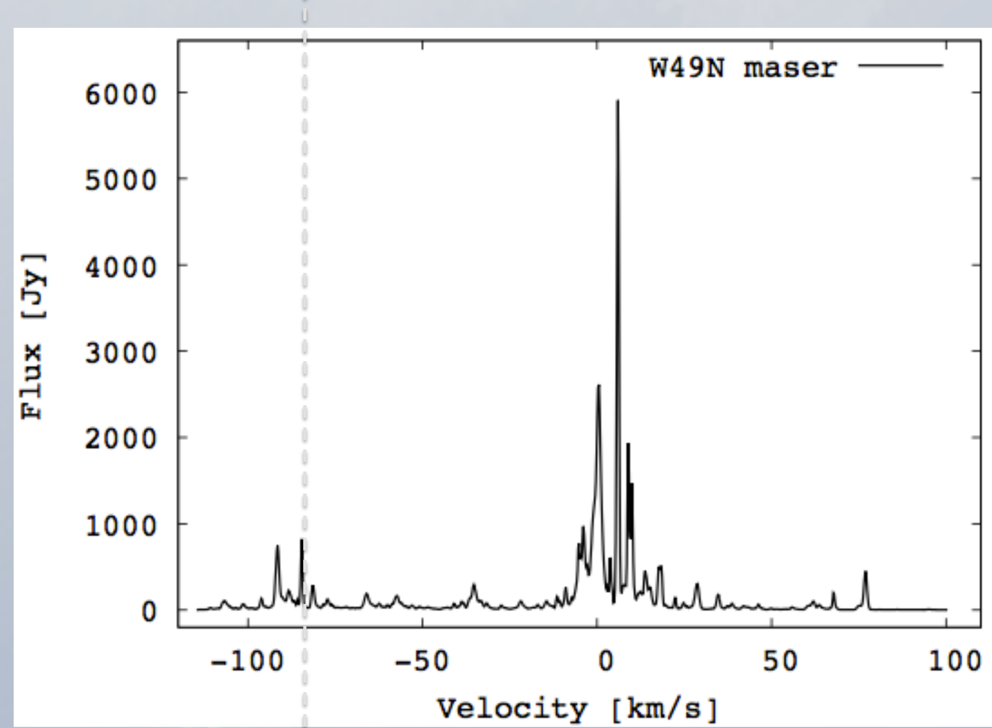

Fig 2b – The 22 GHz water maser spectrum (scalar averaged) of W49N produced by all combined baselines of the participating stations.

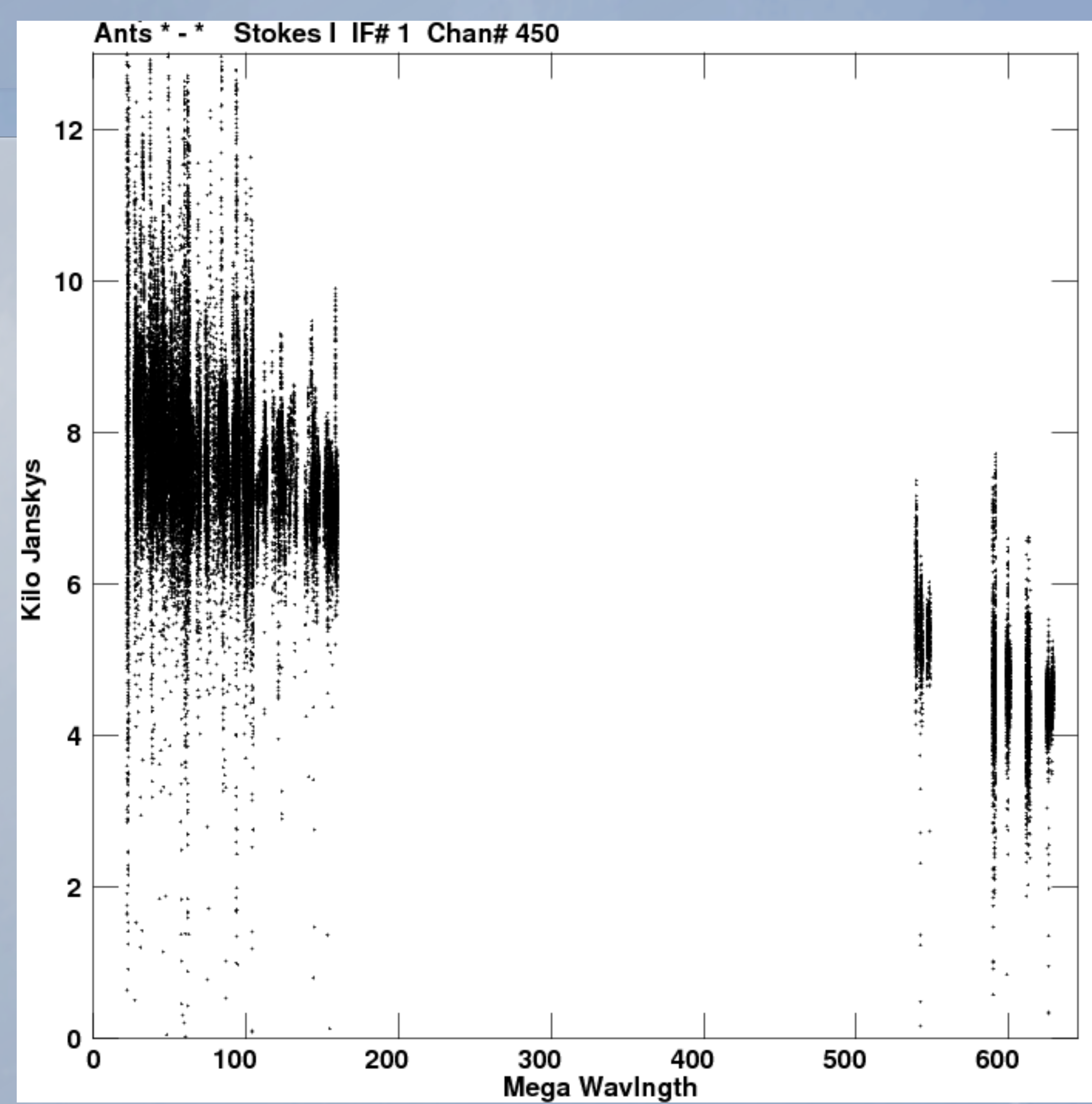

Fig 3 – A ‘rad plot’ showing the amplitude vs baseline length of the brightest maser in W49N. Data on the right hand side of the plot show amplitudes for long baselines to Hartebeesthoek (S.Africa) indicating that some maser emission may be resolved out.

G25.65+1.05

Comparison of the M2O and EVN spectra show that the super burst follow-up was successful. The bursting emission comes from a single maser feature suggesting that the enhancement is a local effect rather than a global effect in which one would expect all maser features to enhance.

W49N

While a very bright feature of >5000 Jy dominates the spectrum this does not appear to be the same bursting component as reported by the M2O. Comparison of single-dish and VLBI spectra requires consideration of the ‘resolve out’ effect in which VLBI arrays are insensitive to extended emission. Bright masers are typically compact, but the plot of amplitude vs. baseline length (Fig 3) shows that some structure is lost on the longest baselines – i.e. the emission may be somewhat resolved. The burst in W49N also seems to be a locally produced effect but full processing and imaging of the data are required to make concrete statements on the maser burst phenomenon and its relevance as a tool to studying (massive) star formation.

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