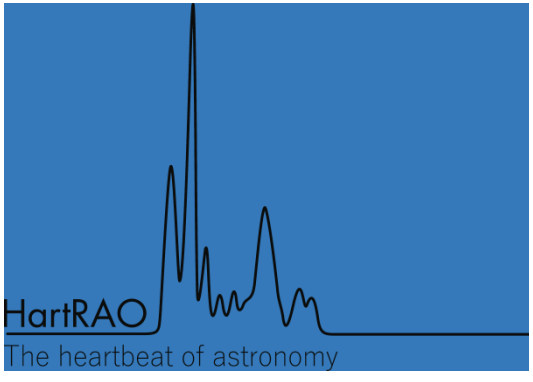
science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation | HartRAO Hartebeesthoek Radio Astronomy Observatory

How Can Cultural Diversity Improve Serendipitous Discovery?

By

Gordon MacLeod

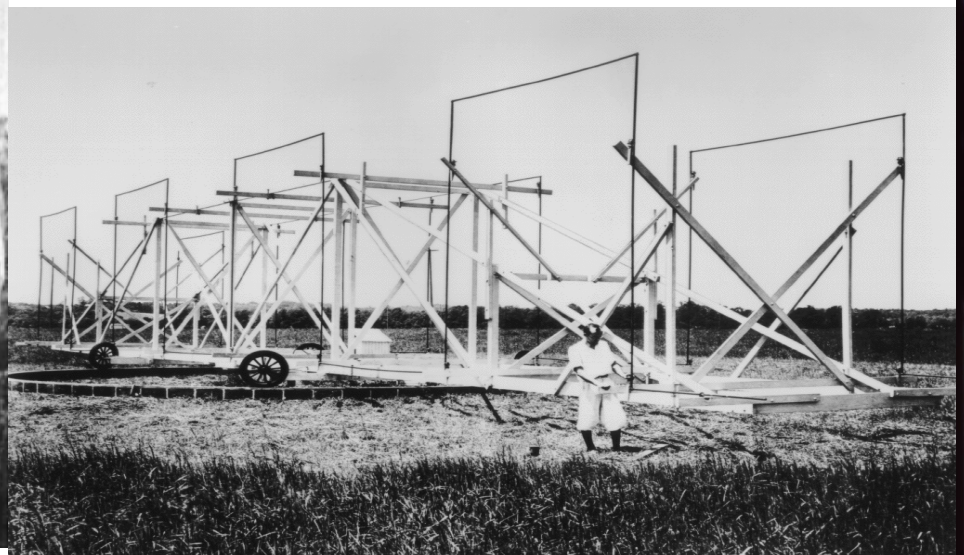


Serendipity

- accident
  - Unexpected result
- Unprecedented result
- luck

Accidental
Tombaugh - 1930

Unexpected
Jansky - 1933



Unprecedented
Bell - 1967

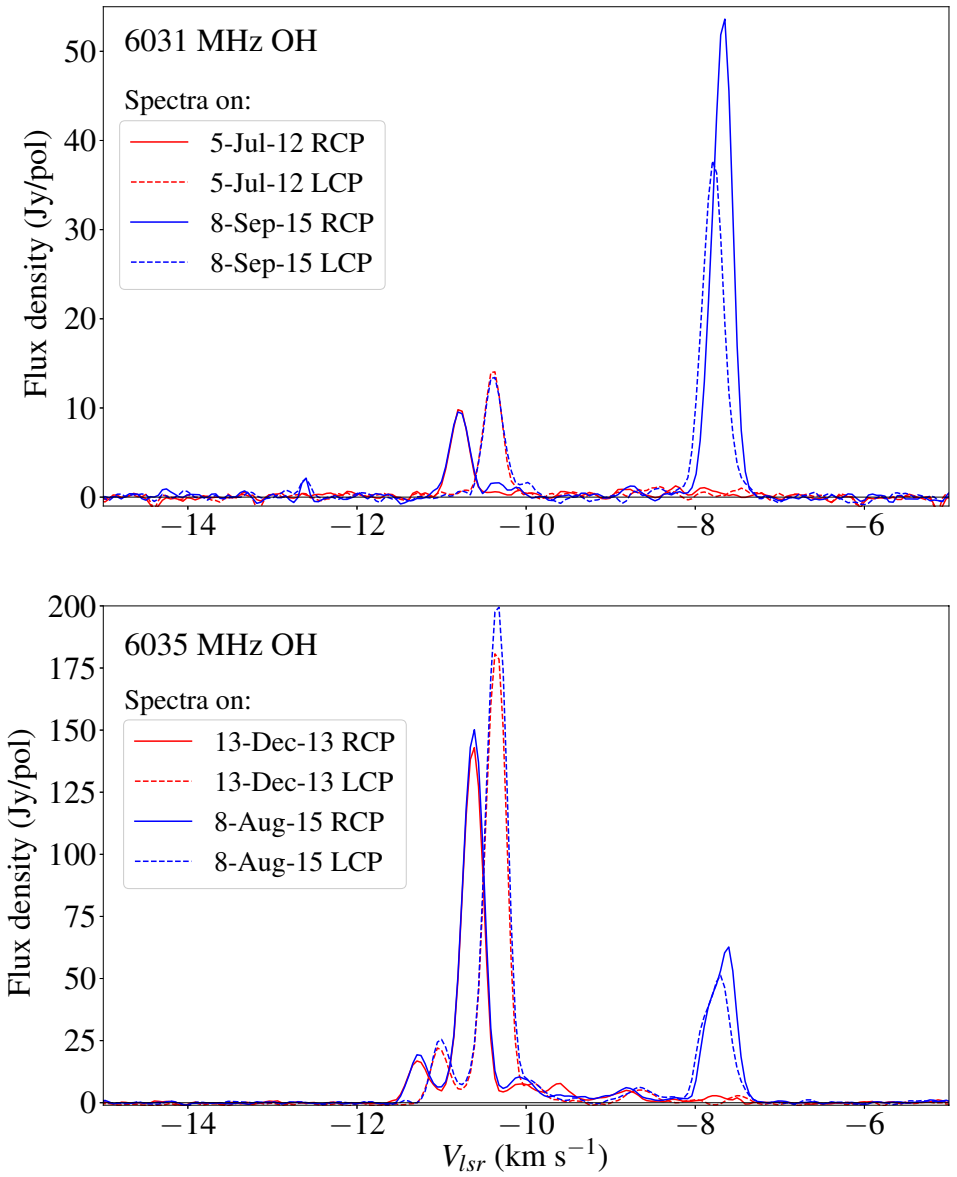
A Simple Experiment

Hypothesis – Excited OH masers are rare because they are variable

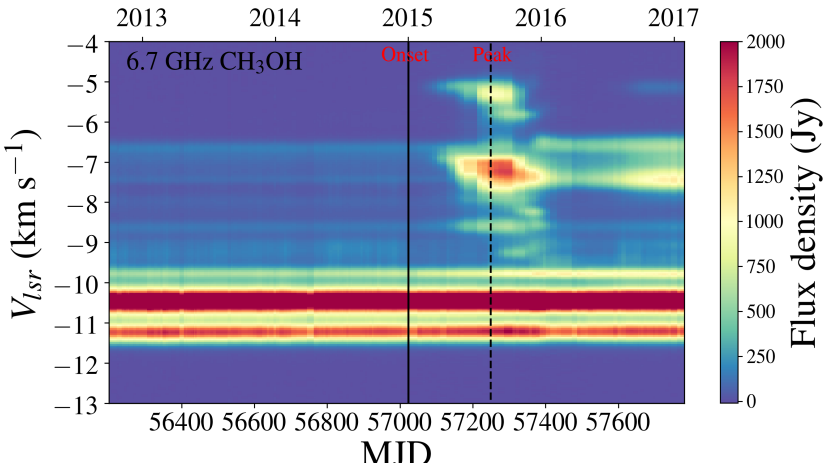
Experiment – multiple epochs of 100 OH masers

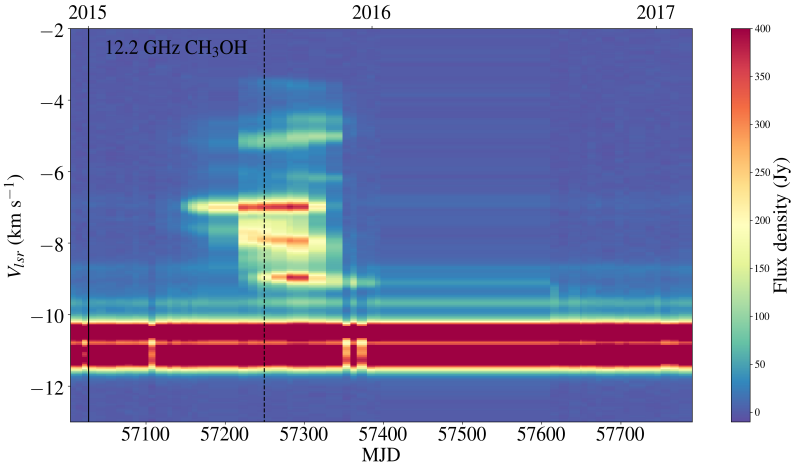
Results – new detections suggestive but must modify hypothesis

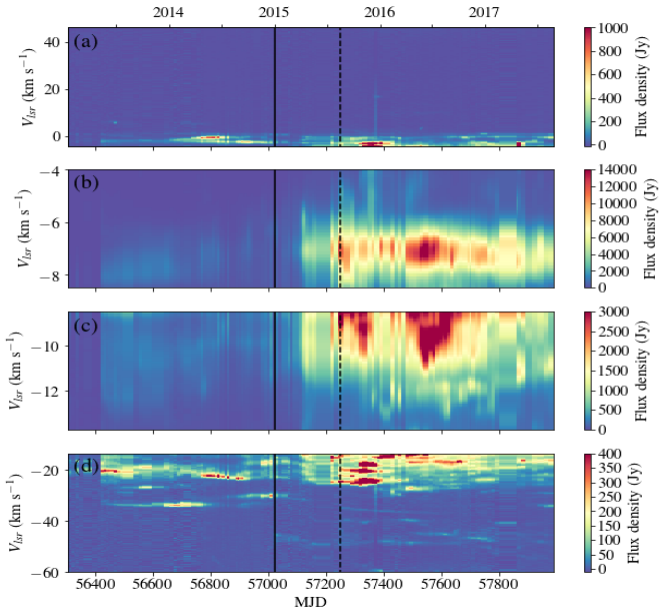
Experiment – monitor masers to see how long they live



A Lucky Discovery







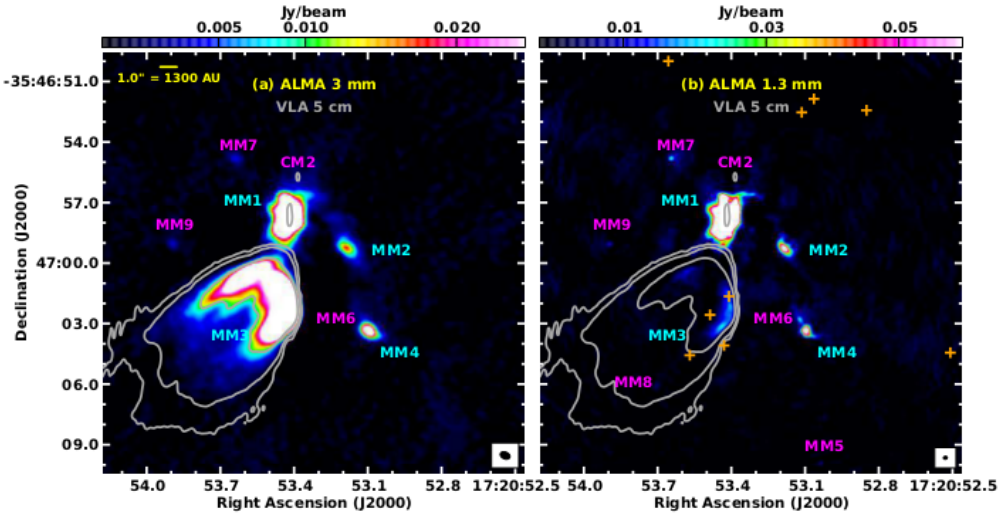
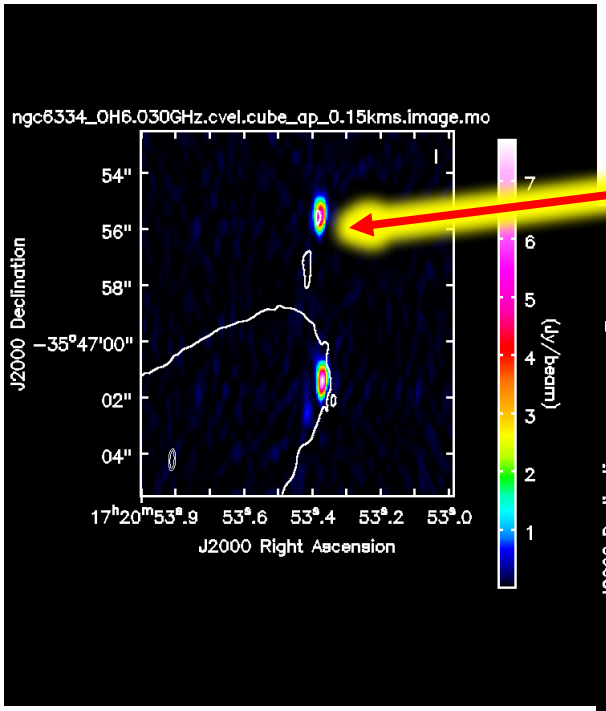
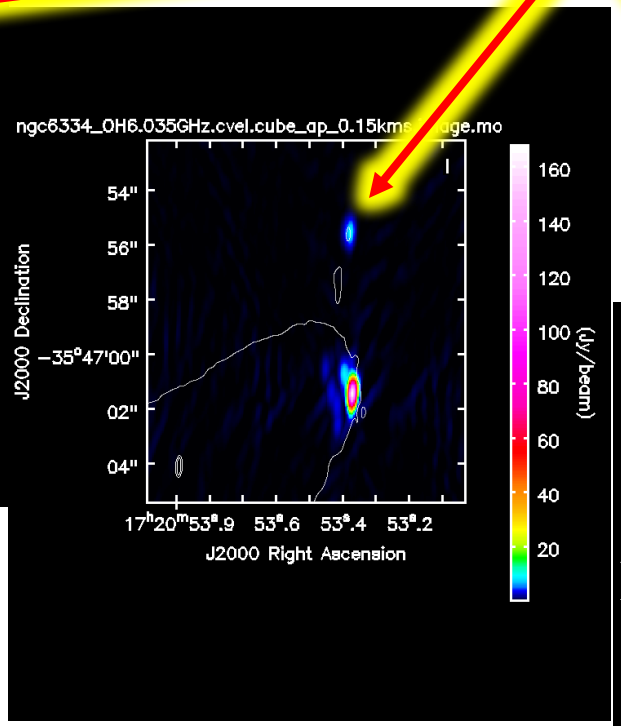


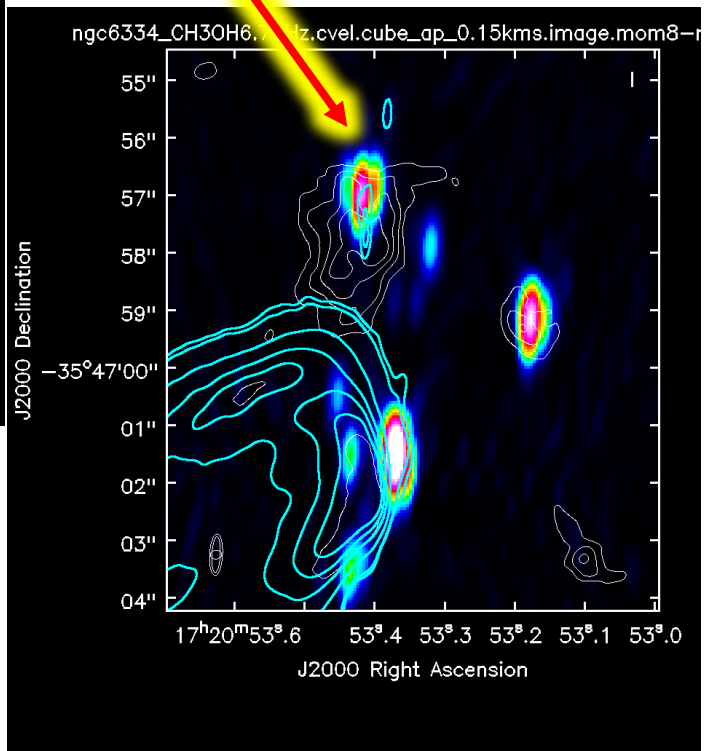
FIG. 1.— Colorscale of the (a) ALMA 3 mm, and (b) ALMA 1.3 mm images of NGC6334I over a 21″ field of view, with VLA 5 cm contours (grey) overlaid (contour levels 0.042 mJy beam^{-1} (1σ) * [4, 20, 200]). The ALMA synthesized beam is shown in the lower right of each panel. Previously known sources (e.g. Hunter et al. 2006) are labeled in cyan, while newly discovered sources are labeled in magenta in the panels corresponding to the bands in which they are detected. Note that the new source CM1 (see Table 2) is outside of the displayed field of view, and CM2 is only detected at 5 cm. In panel (b) the locations of X-ray point sources from Townsley et al. (2014) are marked with orange + symbols.

Result of Luck

New

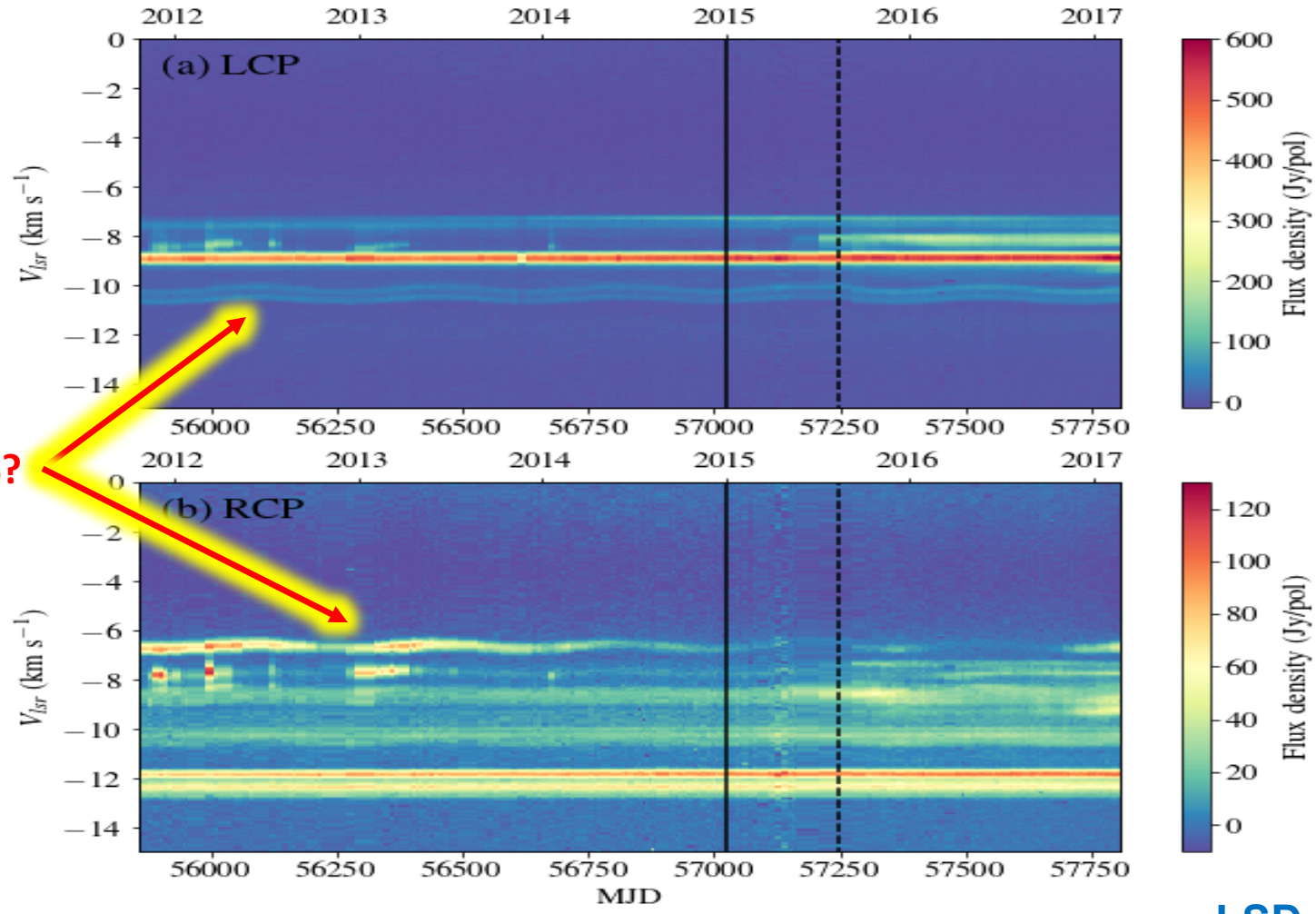






Kitty Visited by Aliens?

1665 MHz OH

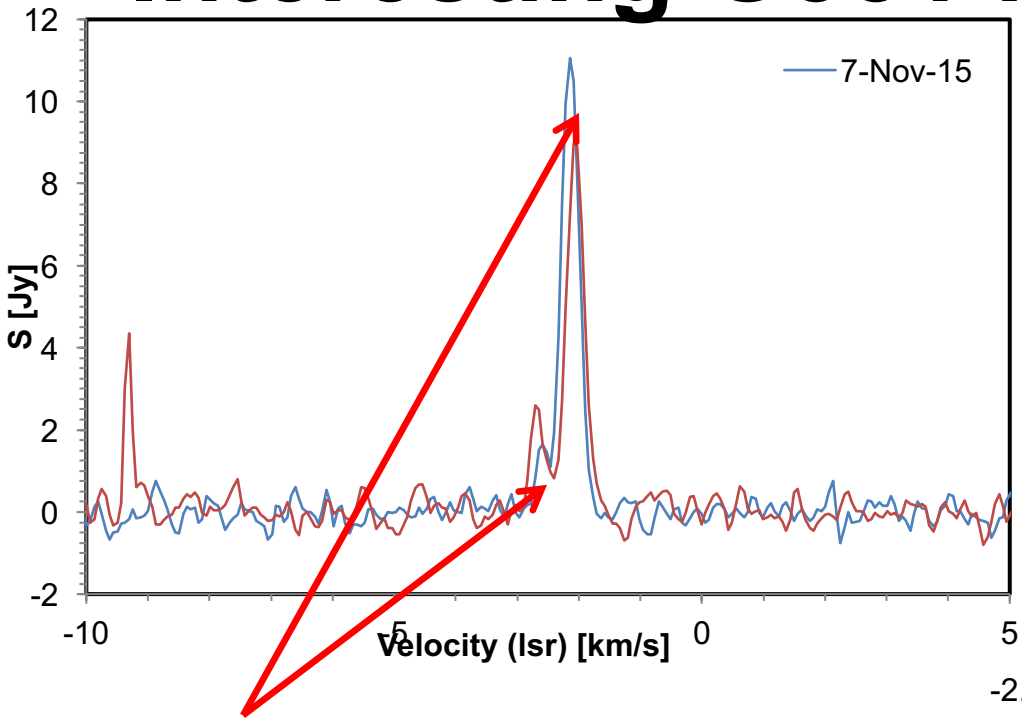


ALIENS?

NO!

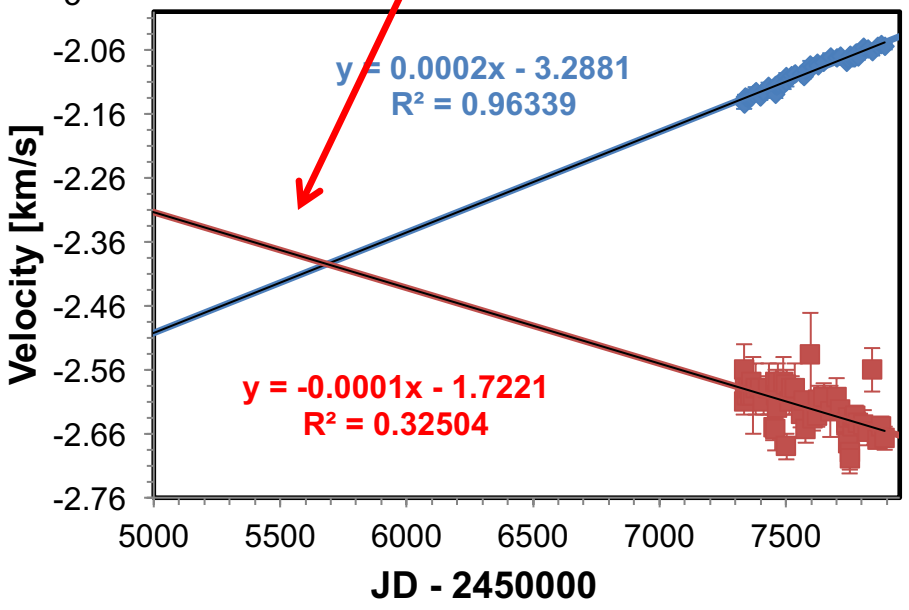
LSD needed

Interesting G351 in 4660MHz OH



Two components drifting apart

Suggest origin during HartRAO repair



Spectroscopy at HartRAO

- 18 cm (1.6 GHz)
  - 1612, 1665/7, 1720 MHz OH
- 5 & 6 cm (4.8 – 6.1 GHz)
  - 4660, 4750, 4765, 6016, 6030/5, 6049 MHz OH
- 4.5 cm Methanol receiver
  - 6.7 GHz CH3OH
- 2.5 cm (12 GHz)
  - 12.2 GHz CH3OH
- 1.3 cm (22.2 GHz)
  - 22.2 GHz H2O, 23.1 GHz CH3OH, NH3 lines
- All dual polarisation & only 12 GHz not cryogenic
- 1024 channel spectrometer (0.125 – 32.0 MHz)

BUT CAN USE ONLY ONE RECEIVER AT A TIME
INEFFICIENT!

Different Solutions to the Same Problem

Forks

How do I eat without using my hands?

Chop sticks

Cultural diversity offers new prospectives

Increase Serendipitous Discoveries?

Need to:

- Increase no. of sources observed
- Increase cadence of observations
- Increase no. of transitions monitored/source

Nice Kitty

FORK:

- Broad band, & digitise at, receiver
- Better backends

CHOP STICKS:

- Coordinate telescopes

Preferably both!

IAUS336: MASER Monitoring Org (M2O)

- **Formation of a network of MASER monitoring telescopes:**

- **Functions:**
  - **Provide calibration and confirmation services to each**
  - **Create catalogue of interesting and monitored sources**
  - **Develop triggering methodologies**
  - **Operate as a 24 hour monitoring service when required**
  - **Inform other facilities of interesting phenomena**
  - **Provide fast follow-up observation services.**

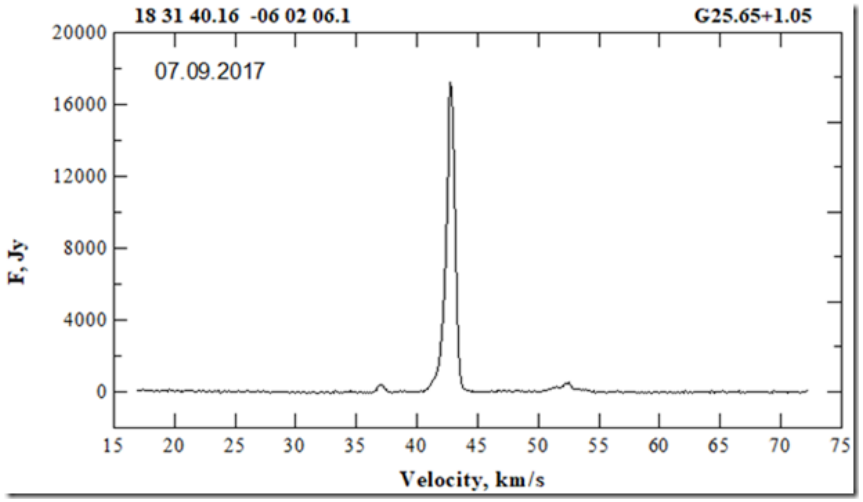
- **Longer term**
  - **Provide multi-wavelength monitoring,**
    - **millimeter, optical/IR, etc.**

- **Countries represented:**

  Australia, Canada, China, France, Germany, Italy, Japan, Korea, Latvia, Poland, Russia, South Africa, Thailand, USA

  No Brazil or India yet

Early Success of M2O

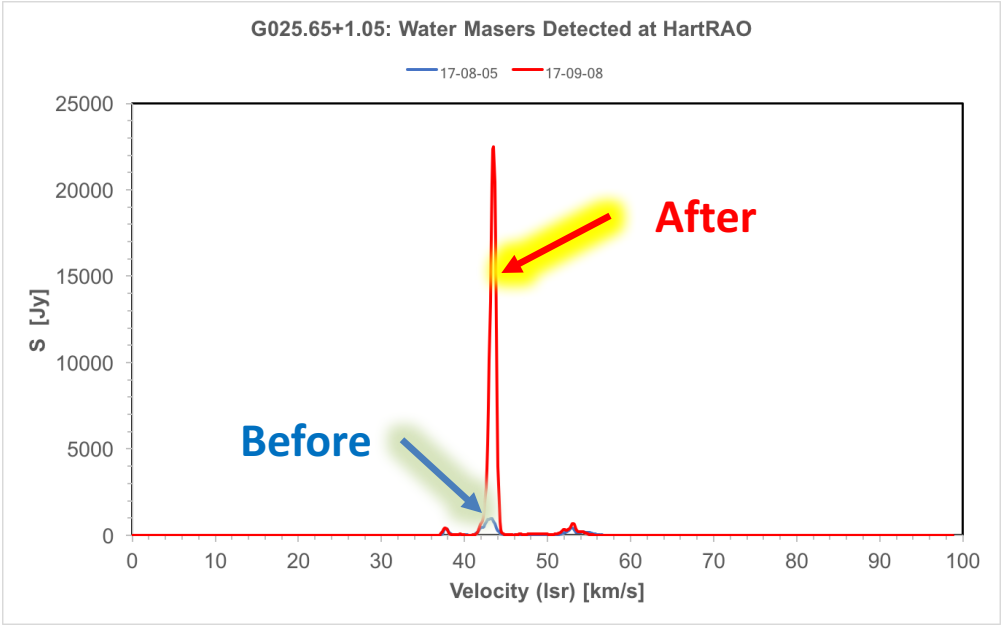


Super-burst water masers:

- **Short-lived**
- **Very intense**
- **Hard to confirm**

HartRAO Confirmed

Crimea 22 RT Discovered



Triggered follow-up observations:

- **ToO SMA observations**
- **ToO EVN/VLBA proposals submitted**
- **Shared monitoring data**
- **All within 10 days of discovery**

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Cultural diversity leads naturally to new ideas.

How can we utilise to increase serendipitous discovery?

Cooperation, Coordination, & Collaboration