



High-Resolution VLBI Analysis of H2O Masers in the Starburst Galaxy M82



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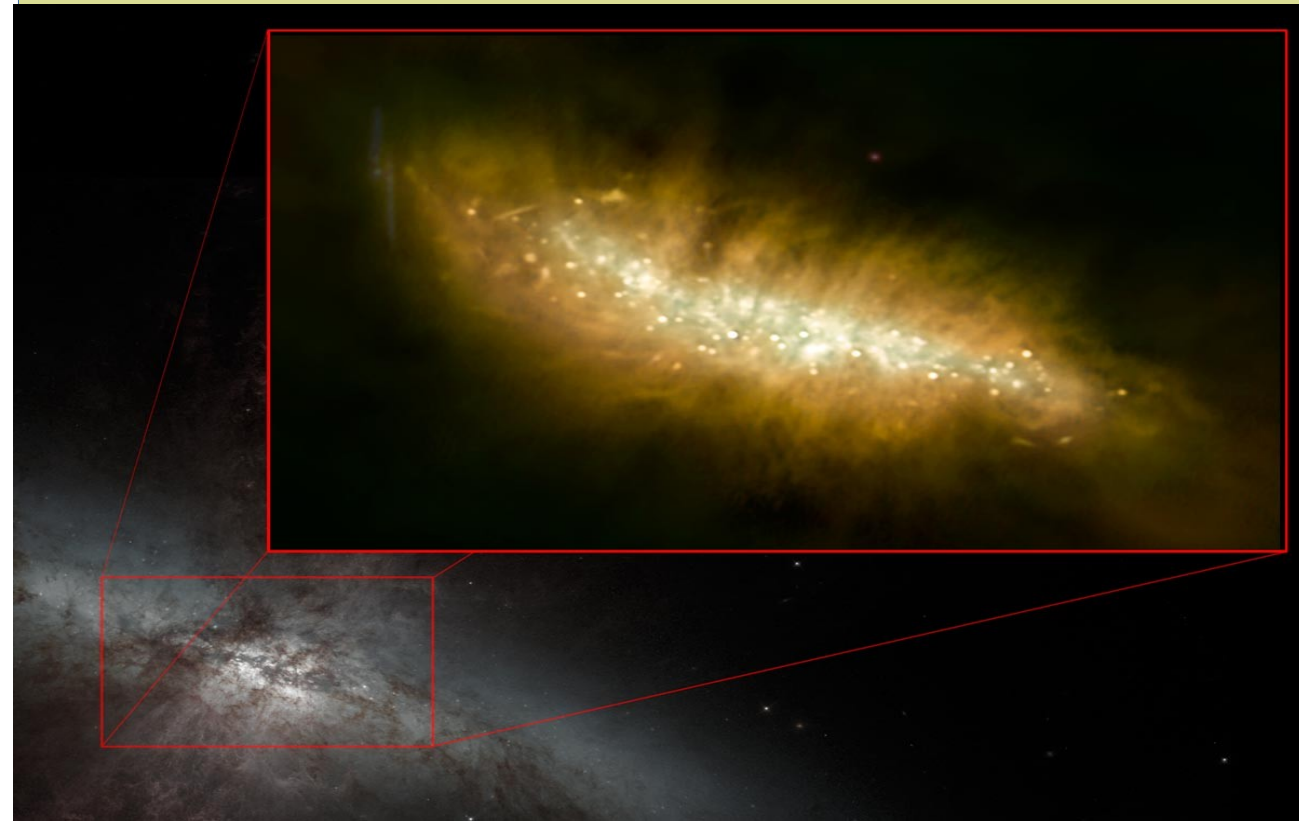
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Background Information

M82 as a Galaxy

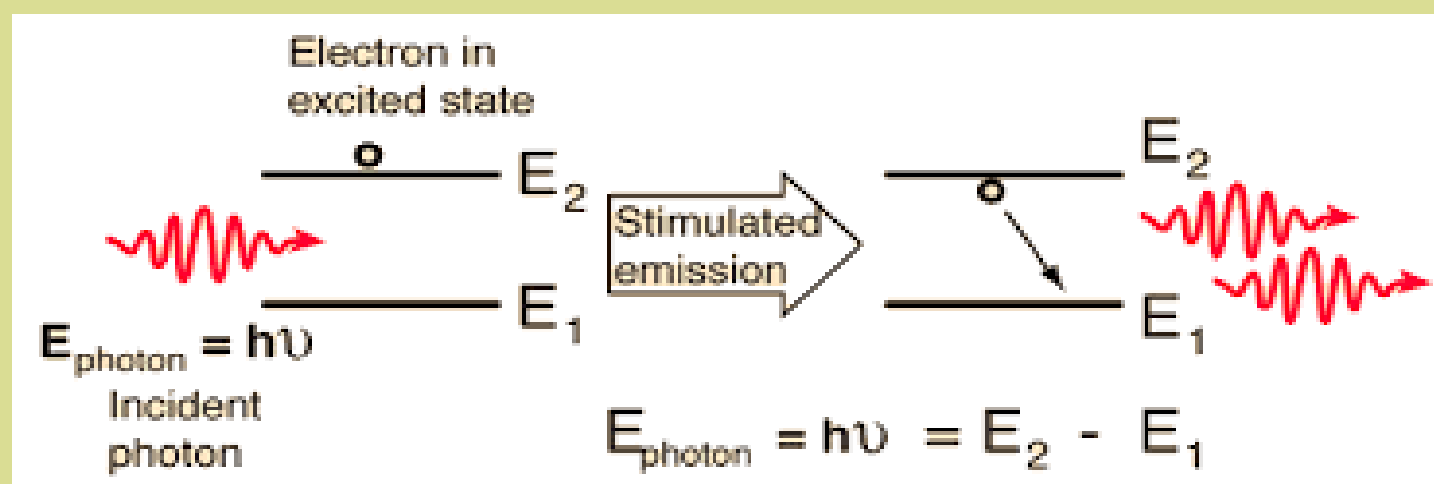
- ◆ Nearest (~3.6Mpc) starburst galaxy in Ursa Major constellation.
- ◆ Associated with supernova remnants, galactic super winds and High star formation rate of $\sim 10M_{\odot}$ /yr within its central starburst region (~500pc).

- ◆ The figure alongside show HST visible light image of M82(left). Inset (Right) is a radio image from Karl G. Jansky VLA displaying the central starburst of M82 galaxy.



H2O Masers in M82

- ◆ **MASER: Microwave Amplification by Stimulated Emission of Radiation.**



- M82 hosts low luminosity H2O masers at 22GHz along the central starburst ~1kpc bar.
- ◆ They trace the dense molecular gas linked to the continuum radio sources such as HII regions.

Justification for the study

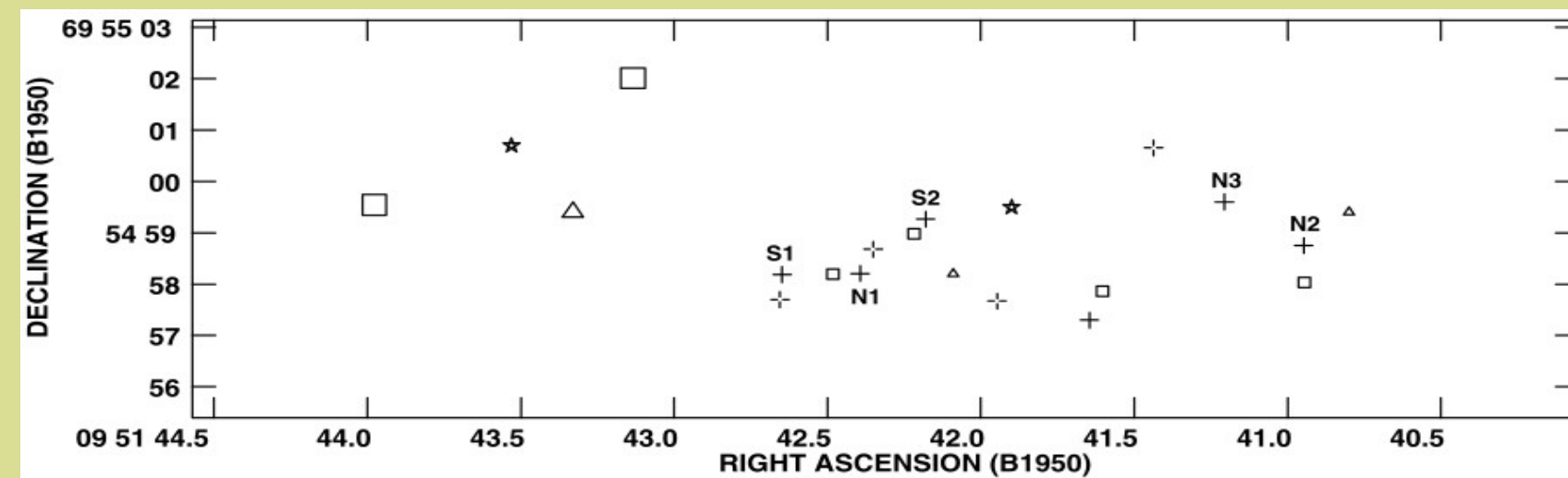


Figure above show the location of detected H2O masers (crosses) in M82 using VLA at A configuration in a velocity range of $V_{LSR}=50-150\text{km/s}$ (Hagiwara, 2007).

- ◆ The H2O masers were unresolved at a subarcsecond resolution of $\sim 93\text{mas}$.

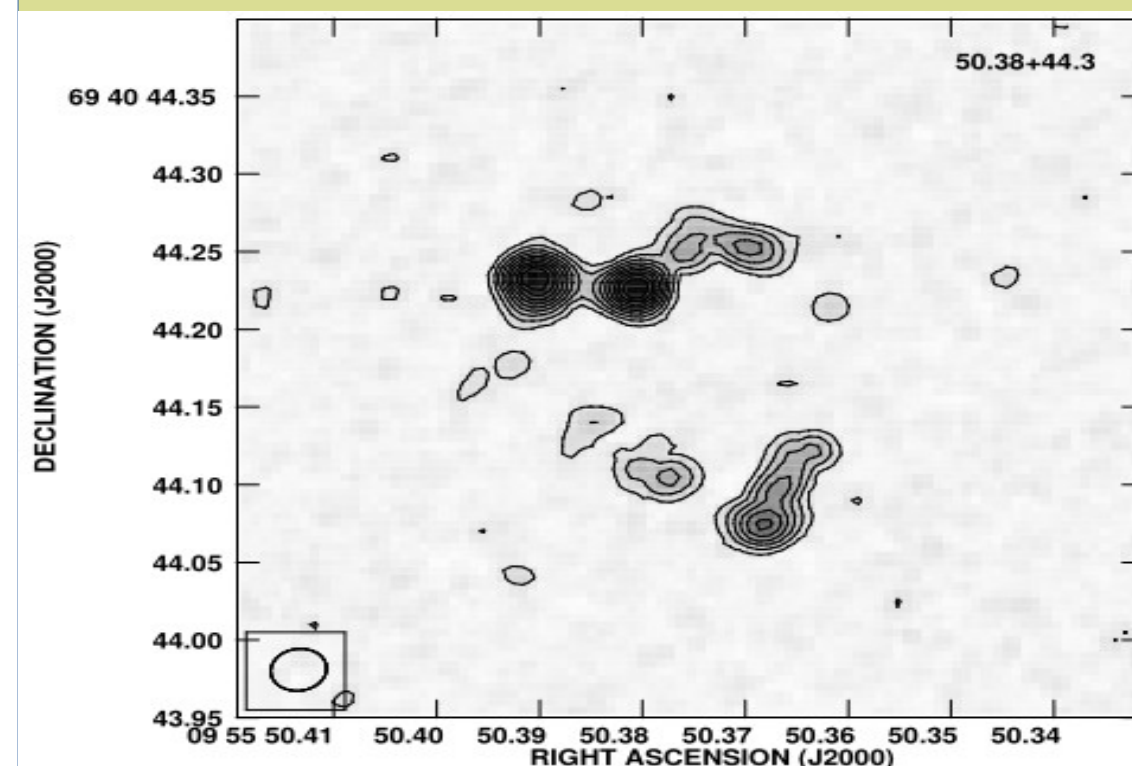


Figure alongside show the resolved, brightest OH maser (50.38+45.4) detected in M82 using EVN at a resolution of $\sim 30\text{mas}$ (Argo et al.,2013)

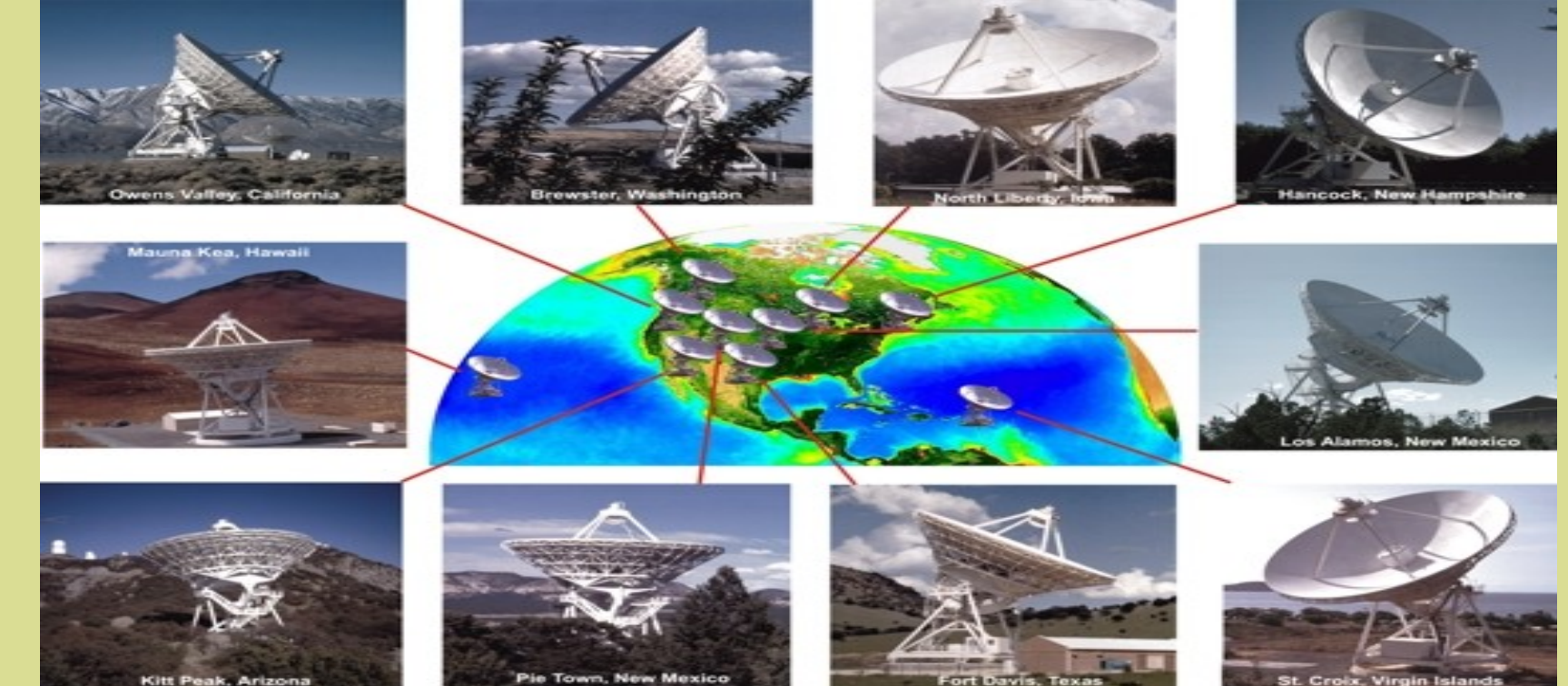
- ◆ High resolution ($\sim 1\text{mas}$) VLBI data will help disentangle the individual maser spots, obtaining fine-scale structure and properties of H2O masers which are critical in distant galaxy distance estimation.

Objectives

- ◆ To examine the variability of resolved H2O maser spots
- ◆ To analyze the spatial distribution of resolved individual H2O maser spots.

Methodology

- ◆ We utilize high-resolution archival VLBI 22GHz H2O maser datasets spanning over three years of observation.



VLBA antennas used to obtain the Archival datasets. Credit: Image courtesy of NRAO/AUI and Earth image courtesy of the SeaWiFS Project NASA/GSFC and ORBIMAGE.

- ◆ We will use CASA to perform data reduction following the standard data reduction process.
- ◆ Spectral line analysis to identify individual maser spots obtaining; flux densities, brightness temperature, line width, center velocities

References

Baudry, A., *et al.* 1994, A&A, 287:20-31; Baudry, A., & Brouillet, N.1996, A&A, 316:188-195; Hagiwara, Y. 2007, AJ 133: 1176 – 1186; Brouillet, N., & Schilke, P. 1993, A&A, 277:381; Dietz R. D., *et al.* 1989, AJ, 98:1260; Kimani, N. K. 2016, PhD Thesis. pp. 57-66; National Radio Astronomy Observatory(2014). Starbursting in the Galaxy M82. Phys.org.
<https://phys.org/news/2014-02-image-starbursting-galaxy-m82.html>

