## Astrophysical masers: What can VLBI do for you?

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Microwave amplification by stimulated emission of radiation (maser) processes are common in the Universe. These can be found in star formation regions, in circumstellar envelopes (CSEs) around evolved stars (mainly around AGB and post-AGB stars), in our and other galaxies. These have been studied extensively, by means of radio observations in their molecular lines. Since the maser emission is bright and compact, by studying the source distribution and other characteristics with high resolution Very Long Baseline Interferometry (VLBI) observations, is it possible to provide useful information [1] on the maser sources themselves and, through precise astrometry, on galactic structure and cosmology.

The advent of recent technological developments and instruments opens new scenarios for the study of cosmic masers, being now possible to study these emissions in a much more efficient way. The Very Long Baseline Array (VLBA) in USA is very well suited for the job, also thanks to its 24x7 availability. Arrays like VERA in Japan are designed to use masers to map the spiral structure of the Milky Way. Real-time VLBI in the European VLBI Network (EVN), including e-MERLIN in U.K., allows to react quickly to maser superbursts. Moreover, multiple maser lines can now be detected simultaneously in the Korean VLBI Network (KVN) and using wideband receivers, which is useful to constrain the emission models. It is still pending to have improved uv-coverage, in particular, in the north-south direction, which may be soon achieved thanks to the African VLBI Network (AVN) and SKA-MID in South Africa. Finally, intensive and complex data processing schemes are being implemented and executed with the growing VLBI functionality of the Common Astronomy Software Applications (CASA) suite, for which VLBI reduction pipelines already exist.



**Figure 1.** Location of high-mass star forming regions in the Galaxy outlines a spiral arm pattern (left), and distances to star-forming regions in Cygnus X complex (right). [2]

## References

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- [2] T. Venturi, Z. Paragi, M. Lindqvist et al., "VLBI20-30: a scientific roadmap for the next decade The future of the European VLBI Network". EC H2020 JUMPING JIVE (2020). <u>https://arxiv.org/abs/2007.02347</u>