Mapping the SiO masers in the Water Fountain IRAS 16552-3050

Lucero Uscanga

University of Guanajuato, Mexico

Principal collaborators:

Hiroshi Imai, Kei Amada

Kagoshima University, Japan

Malcolm D. Gray, Kitiyanee Asanok

National Astronomical Research Institute of Thailand

José F. Gómez, Pablo Santo-Tomás

Instituto de Astrofísica de Andalucía, Spain

Tiege P. McCarthy

University of Tasmania, Australia

Daniel Tafoya

Onsala Space Observatory, Sweden

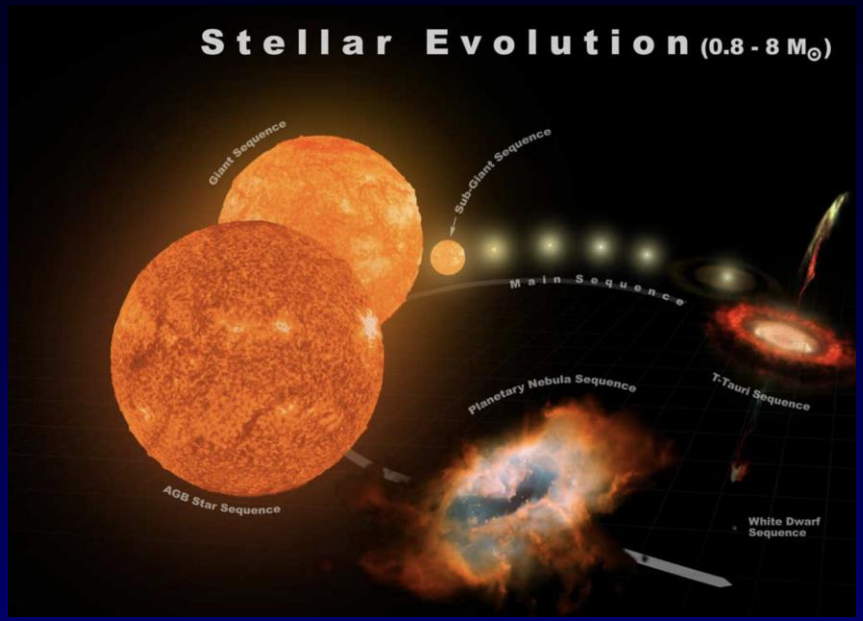
Gabor Orosz

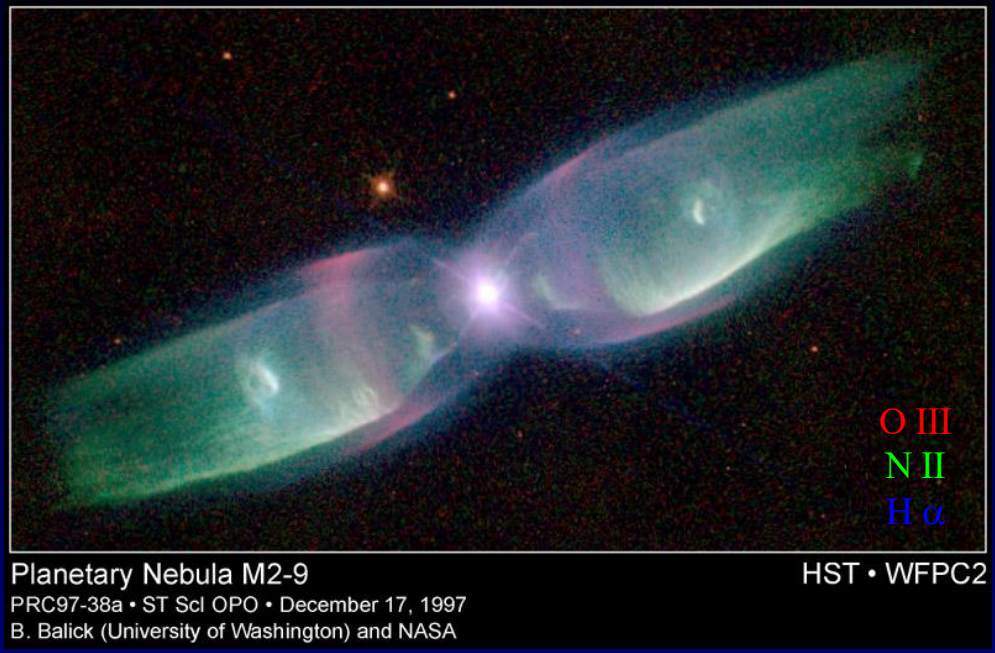
JIVE, The Netherlands

Physical Characteristics

AGBs: Strong (roughly spherical) mass-loss.
Envelope is ejected at $\dot{M} \approx 10^{-4}$ $M_\odot$ yr^{-1}
Post-AGBs: Mass-loss stops. New processes, collimated ejections (jets),
$\dot{M} \approx 10^{-7}$ $M_\odot$ yr^{-1}
Jets open cavities within the AGB envelope.

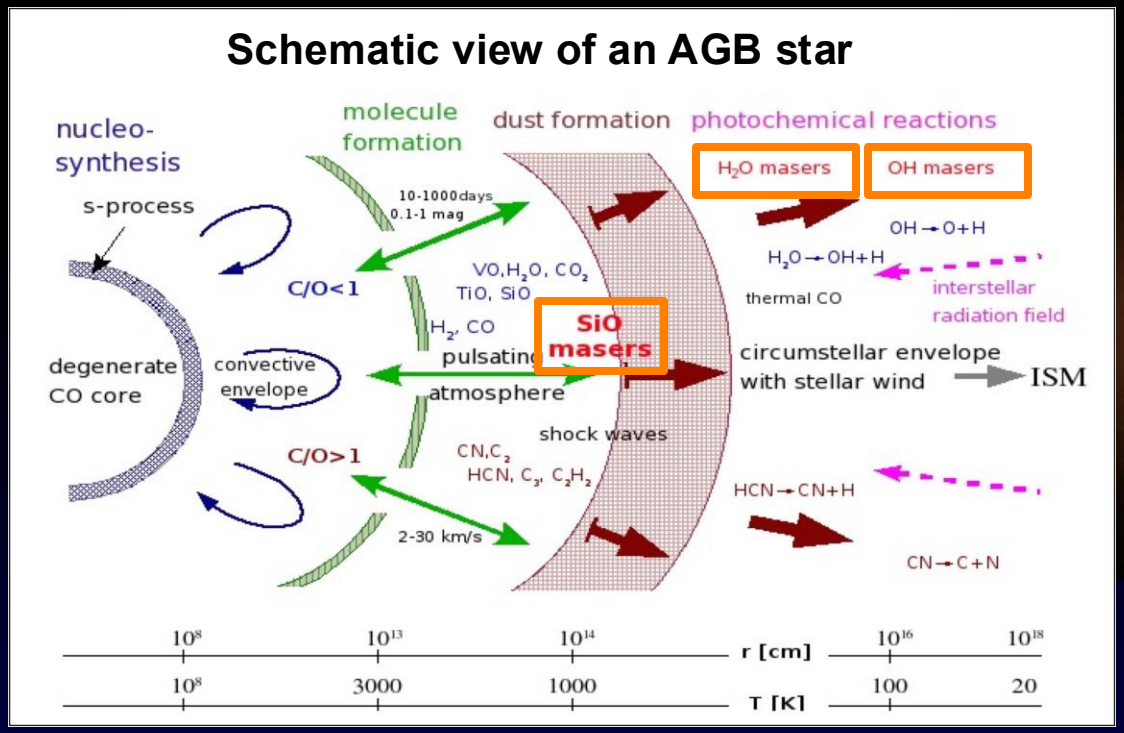
When T_{eff} = 30,000 K, central star ionizes envelope, becoming a PN.
Shape may be determined by cavities opened by jets

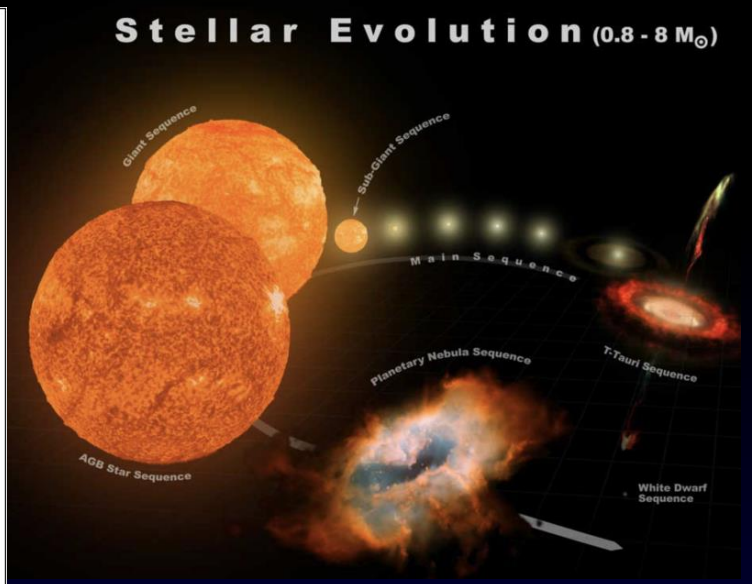




L. Uscanga l.uscanga@ugto.mx

Maser emission in the transition to PNe





Masers in the AGB phase: Different conditions for maser pumping give stratification of species

L. Uscanga l.uscanga@ugto.mx

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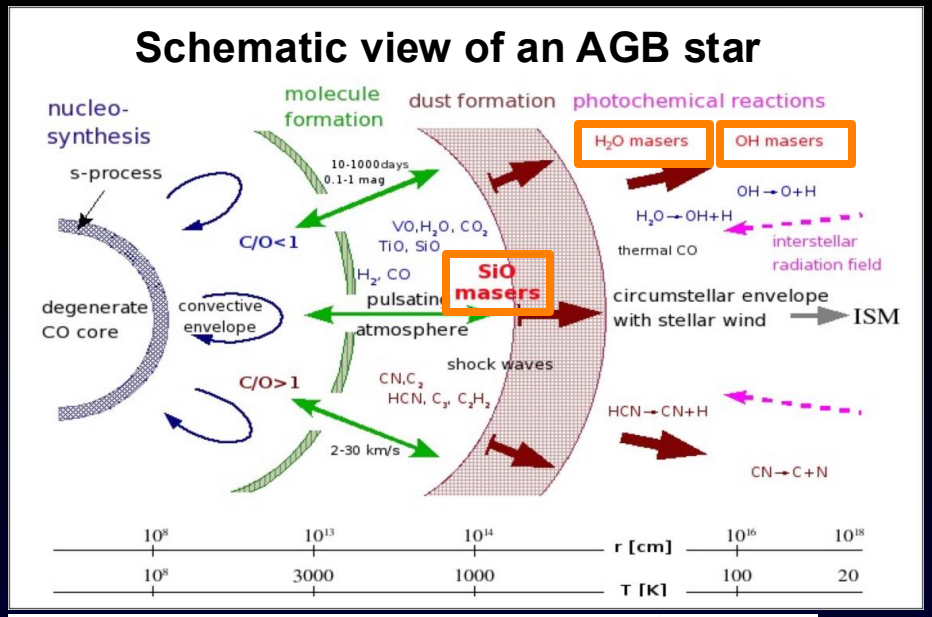
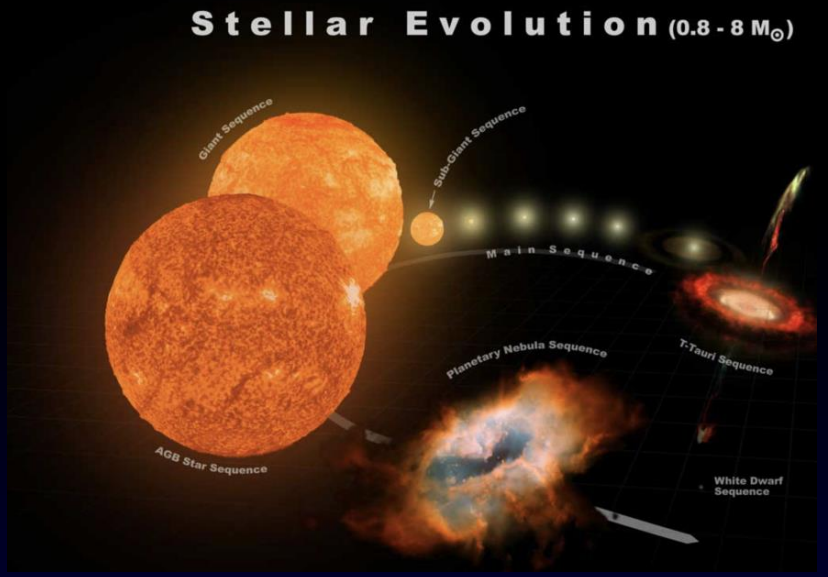
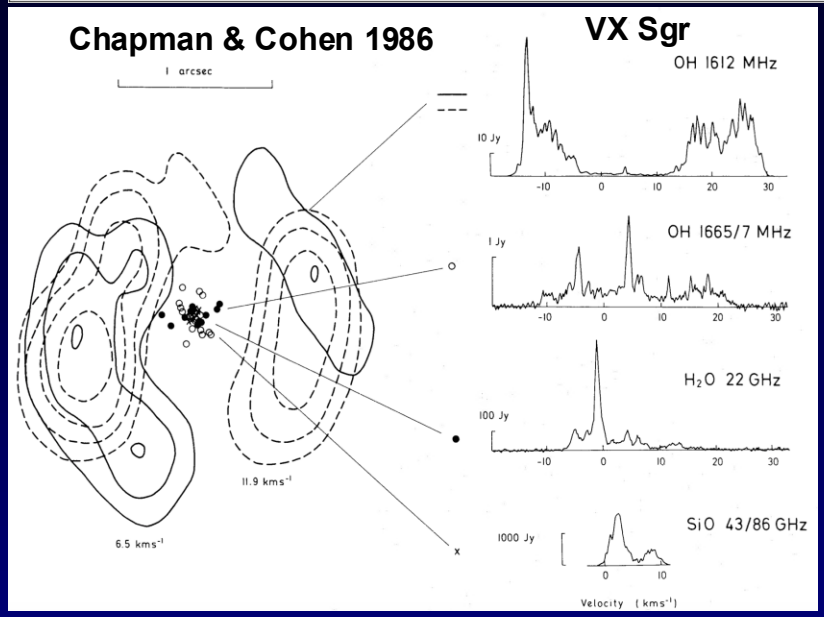


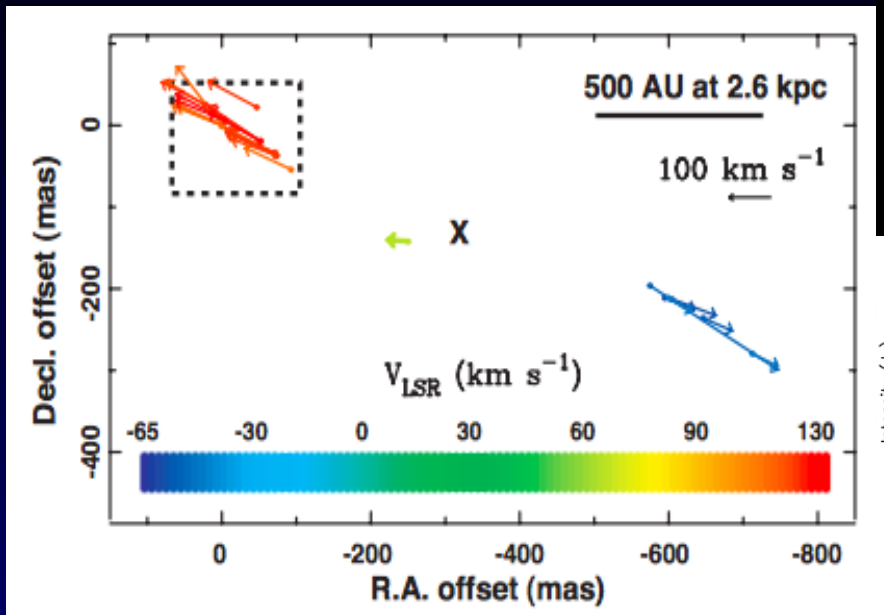




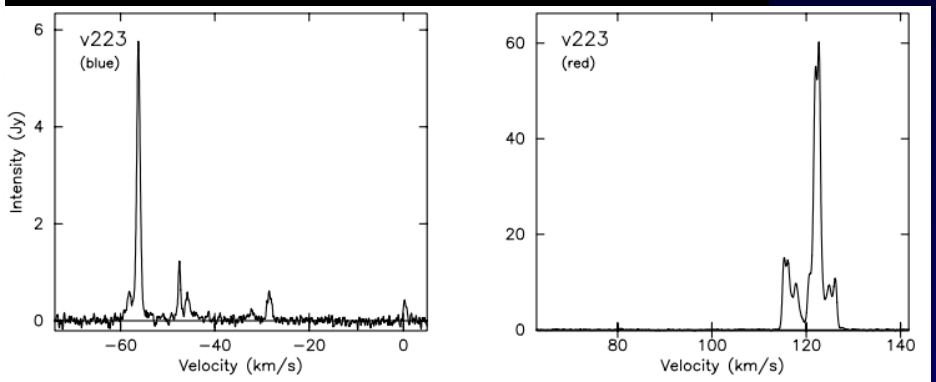
AGB mass-loss ends → post-AGB phase

Sequential disappearance of masers: SiO ≈ 10 yr, H_2O ≈ 100 yr, OH ≈ 100 yr

Water Fountains – Late AGBs & Post-AGBs

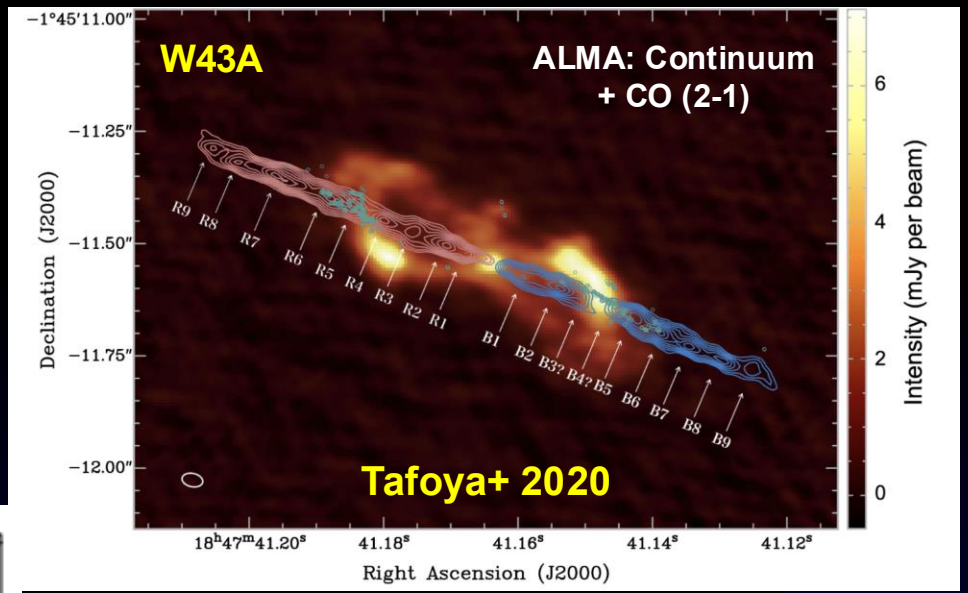


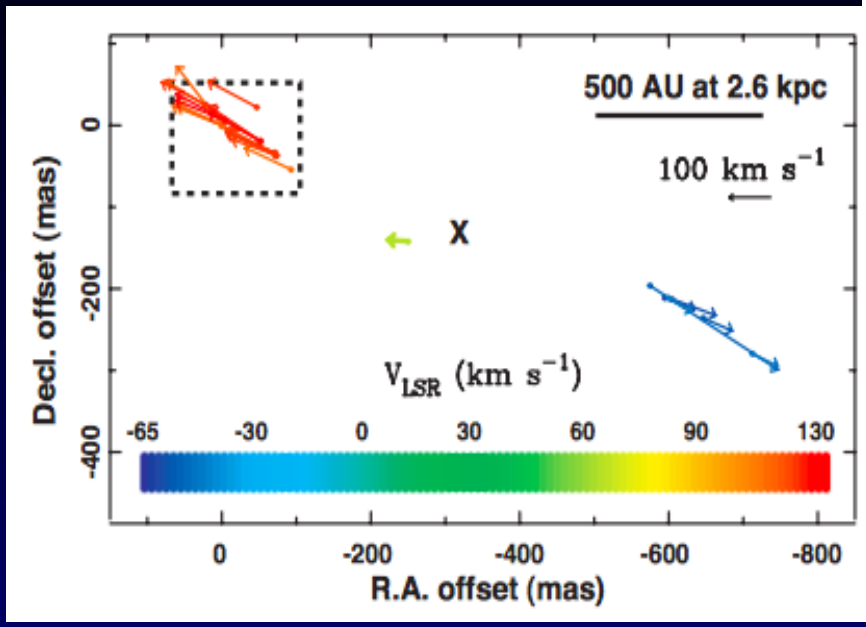
H_2O maser proper-motion measurements in W43A 2003–2004 (Imai 2007)



H_2O maser spectra in W43A (Deacon+ 2007)

Water Fountains – Late AGBs & Post-AGBs





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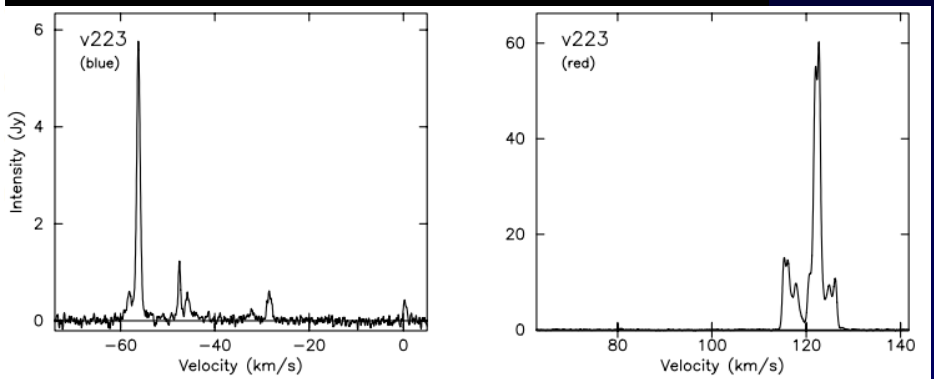

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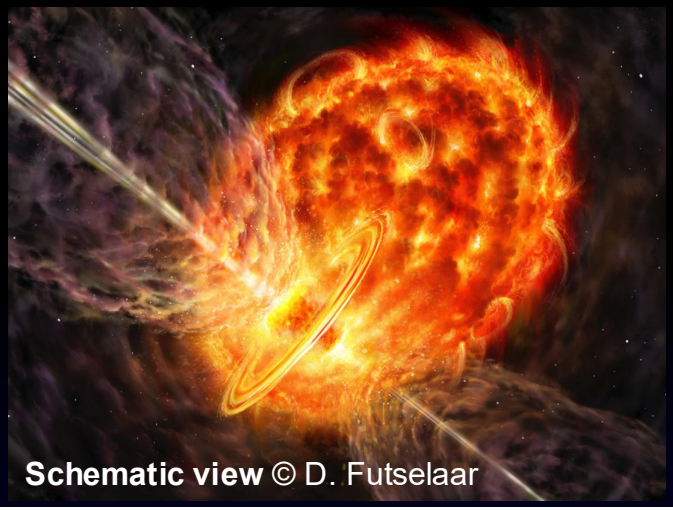
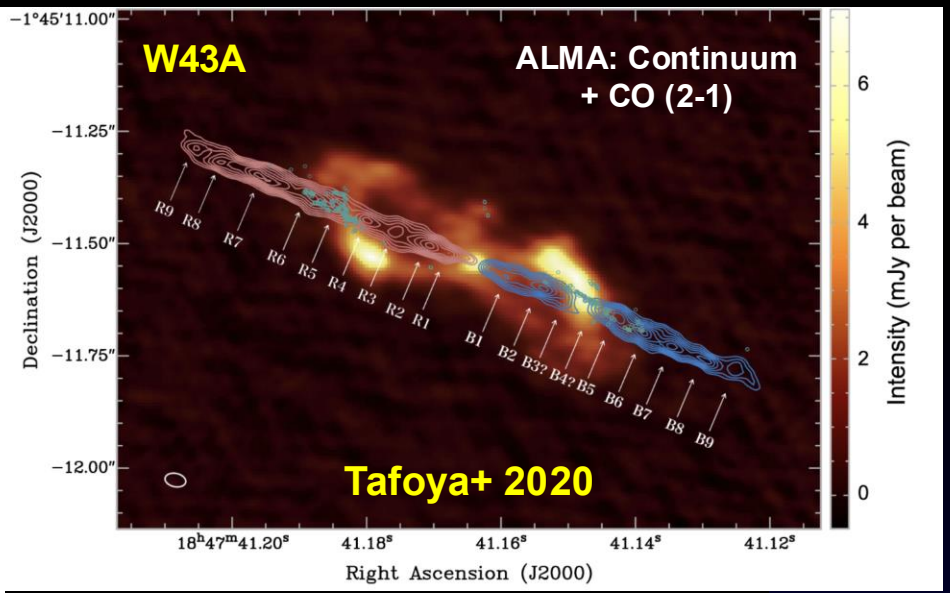
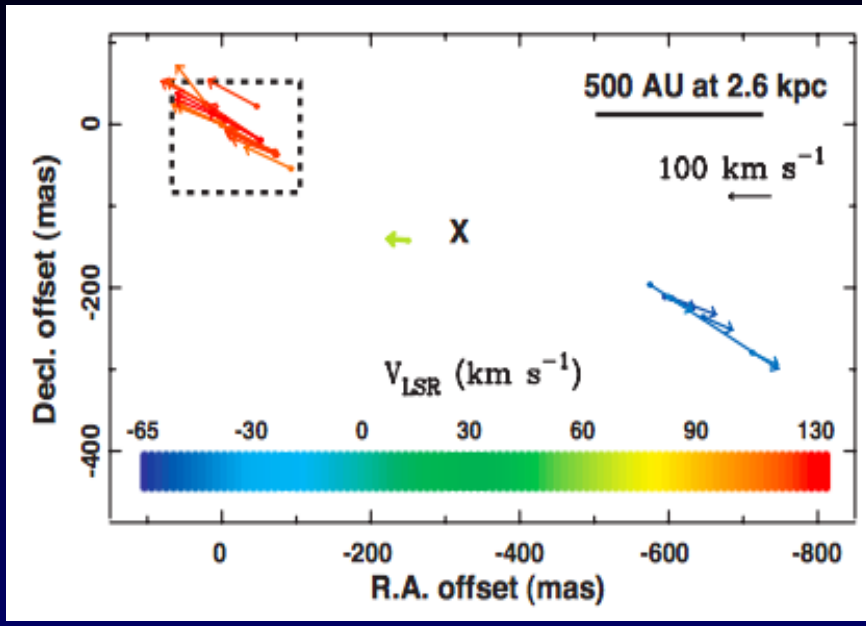
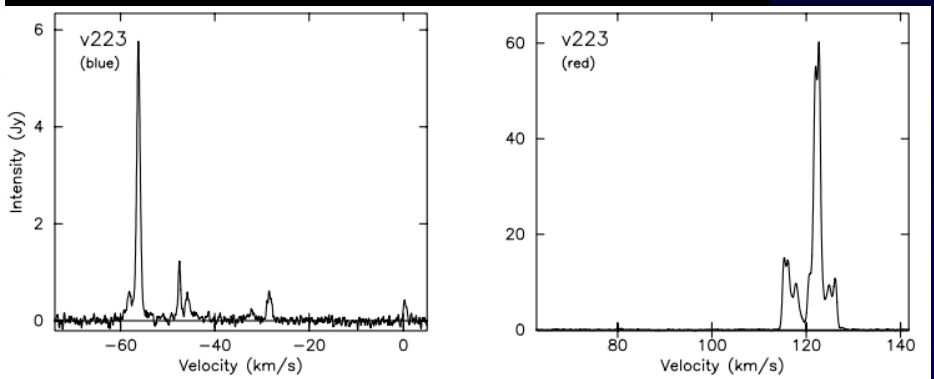
Water Fountains – Late AGBs & Post-AGBs





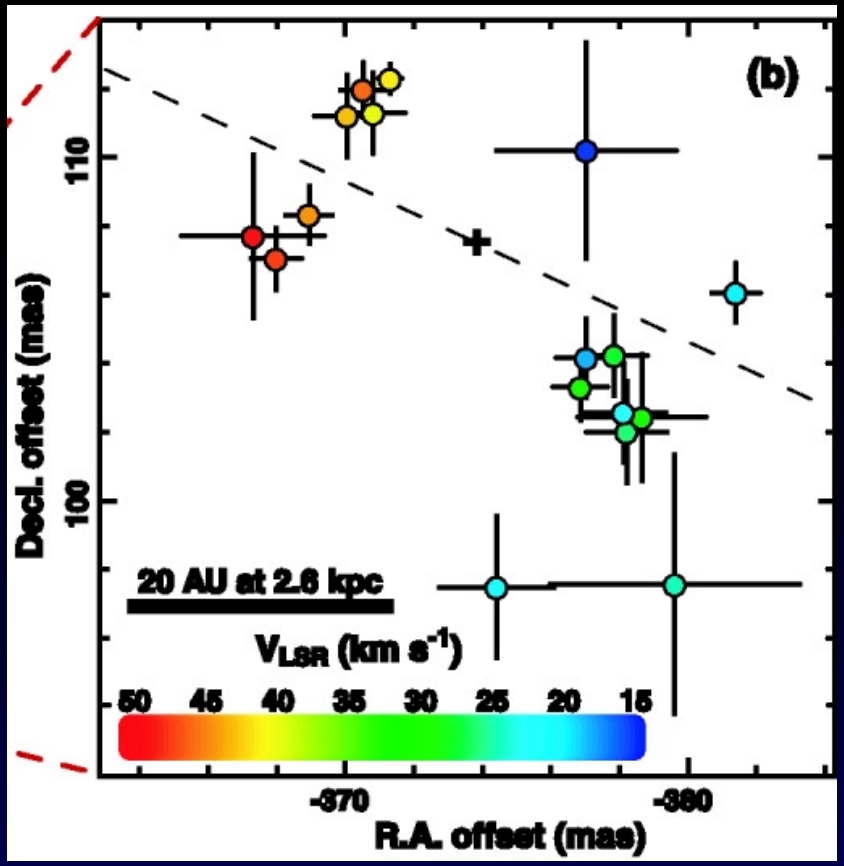




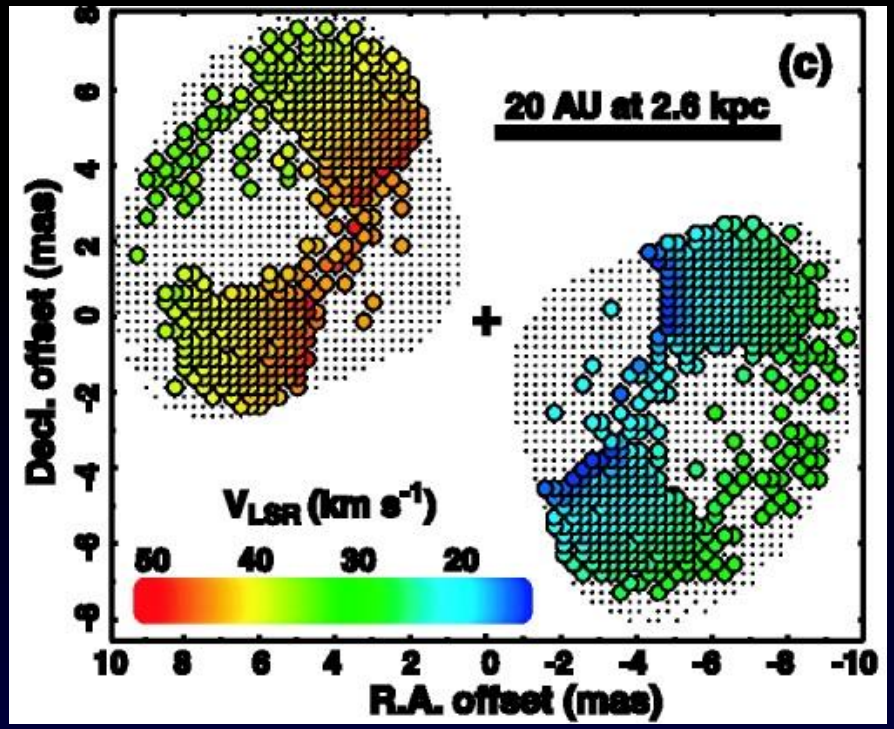
H_2O maser proper-motion measurements in W43A 2003–2004 (Imai 2007)

H_2O maser spectra in W43A (Deacon+ 2007)

SiO masers in the WF: W43A (1st detection)



Spatio-kinematics of SiO $v = 1$ ($J = 1 \rightarrow 0$) maser features



Biconically expanding flow model

Imai+2005

$V_{LSR,sys} \simeq 34$ km/s

Astrometry of the H2O and SiO masers suggests that both masers have a common dynamical center. The SiO masers may be excited on the surface of the cone.

L. Uscanga l.uscanga@ugto.mx

FLASHING = Finest Legacy Acquisitions of SiO and H2O maser Ignitions by the Nobeyama Generation

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Follow-up with the Australia Telescope Compact Array

Nobeyama 45 m (NRO)

2019 ~ 2023 PI: H. Imai

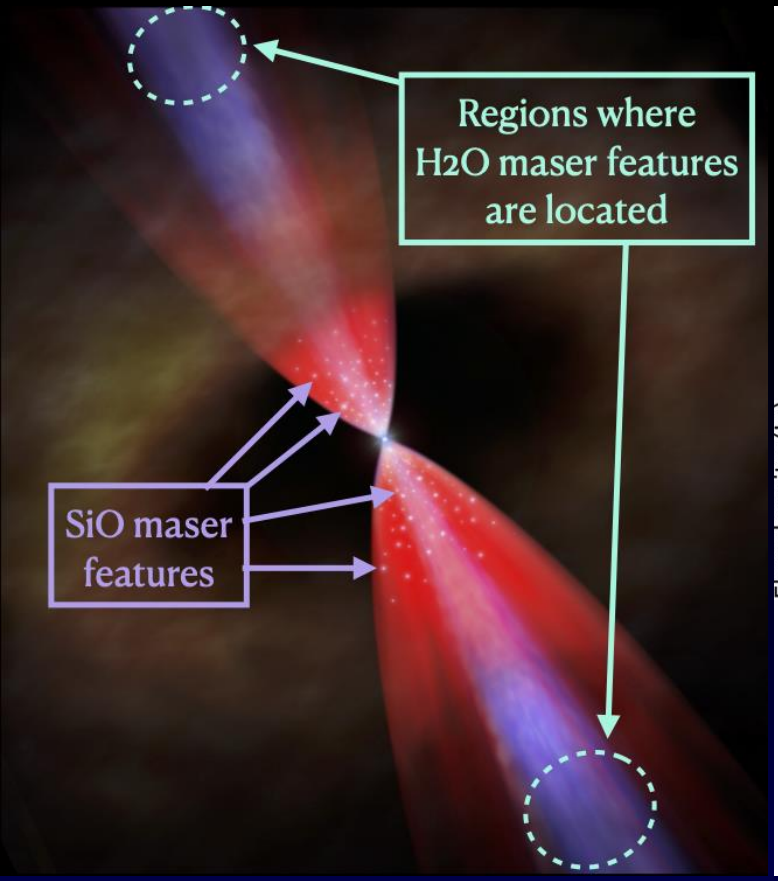
NRO 602 h

2020 – 2022 PI: L. Uscanga

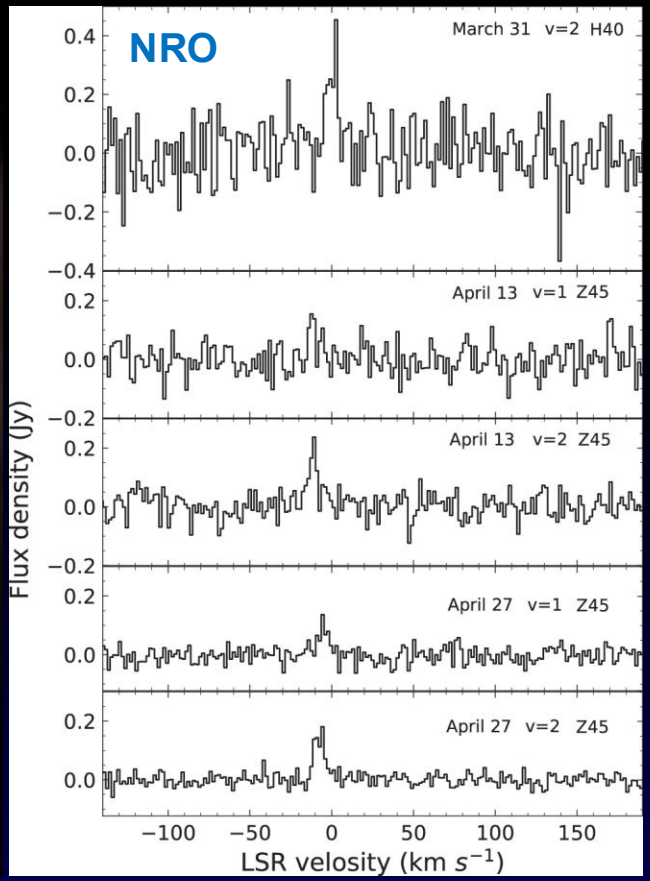
ATCA 204 h

L. Uscanga l.uscanga@ugto.mx

SiO masers in the WF: IRAS 16552-3050 (2nd detection)



Schematic structure of the jet and the nozzle structure associated with SiO maser features

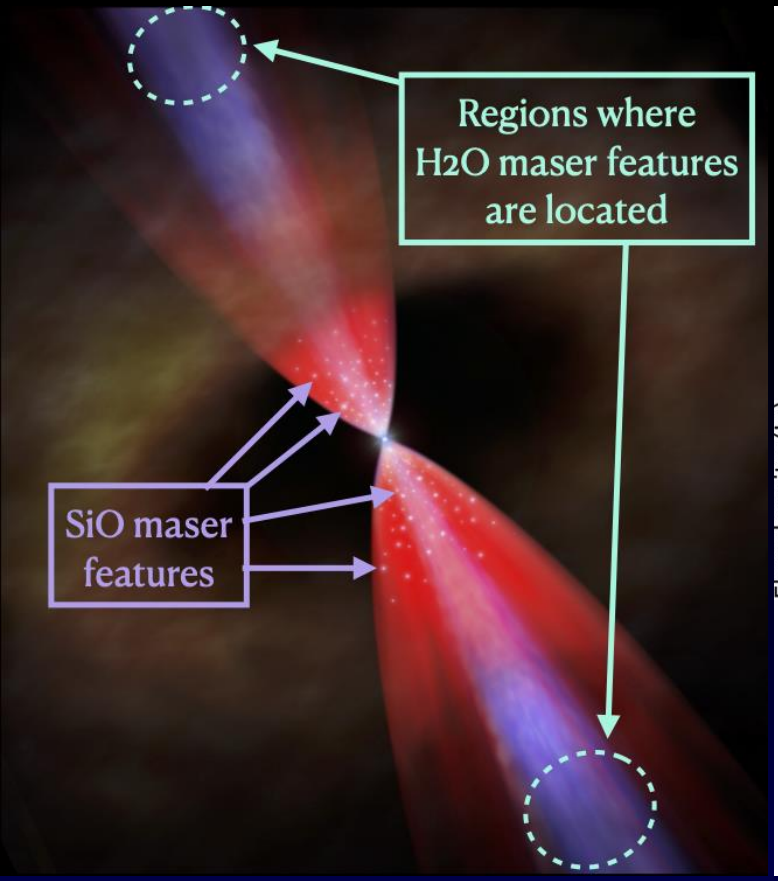


Spectra of SiO v = 1 and v = 2 (J = 1 → 0) masers

Amada+ 2022

L. Uscanga l.uscanga@ugto.mx

SiO masers in the WF: IRAS 16552-3050



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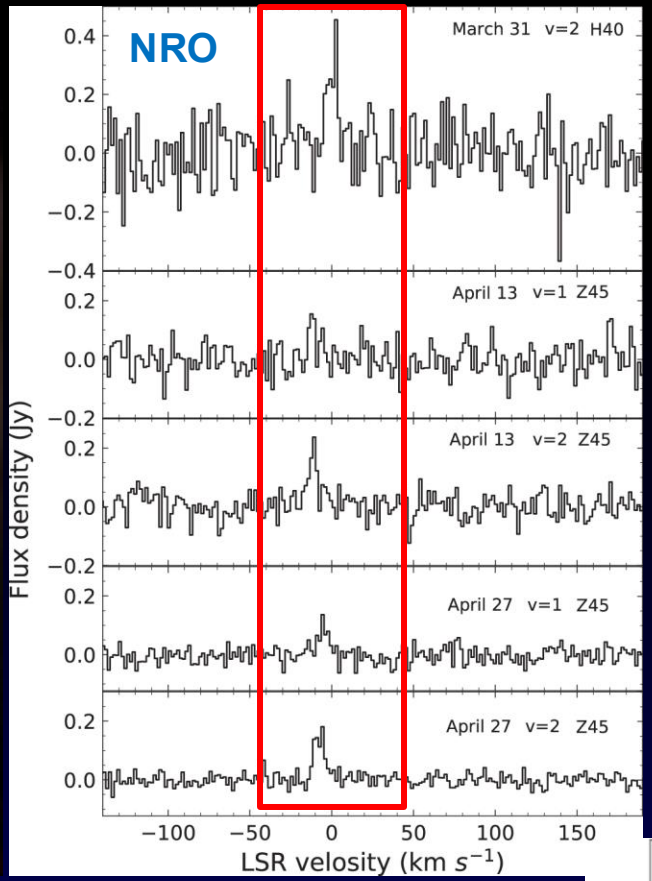
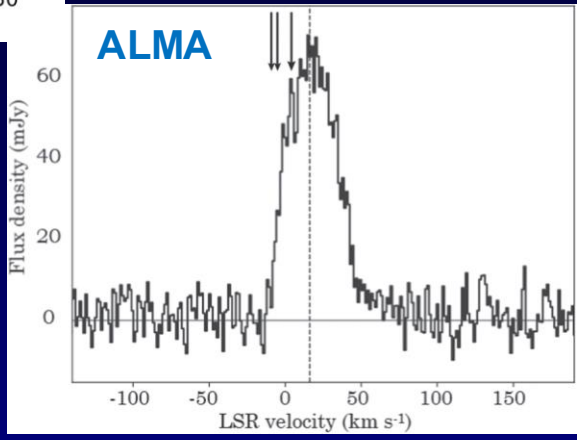


Spectra of SiO *v* = 1 and *v* = 2 (*J* = 1 → 0) masers

Amada+ 2022

Spectrum of CO (J = 2 → 1) emission



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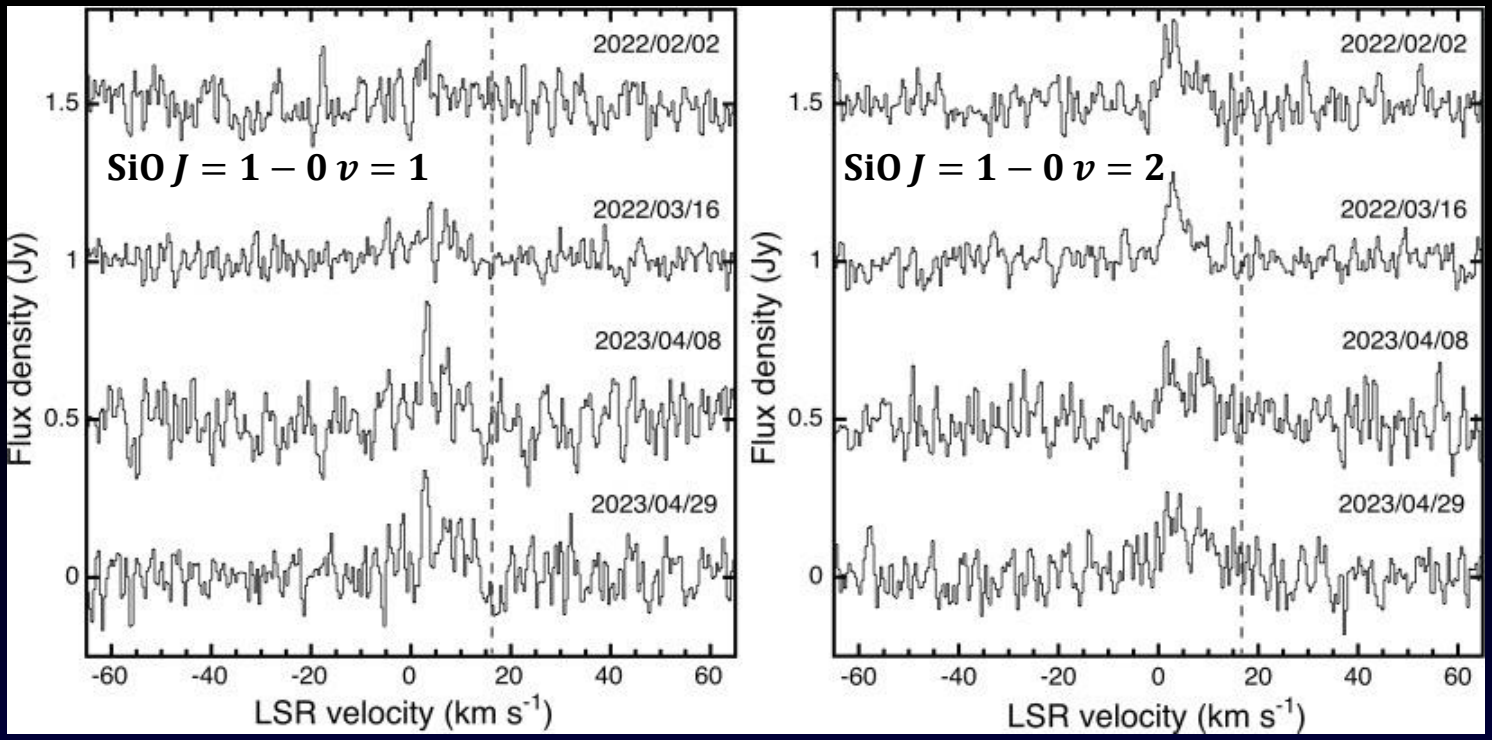
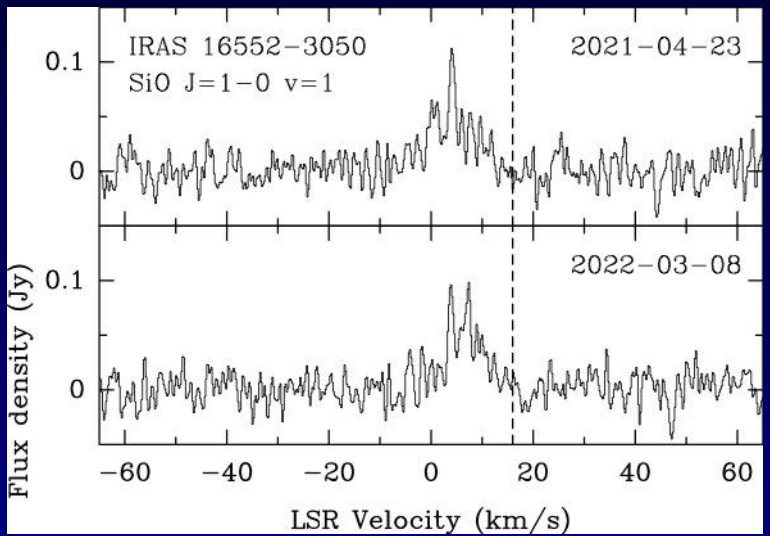
$V_{LSR,sys} \simeq 16$ km/s

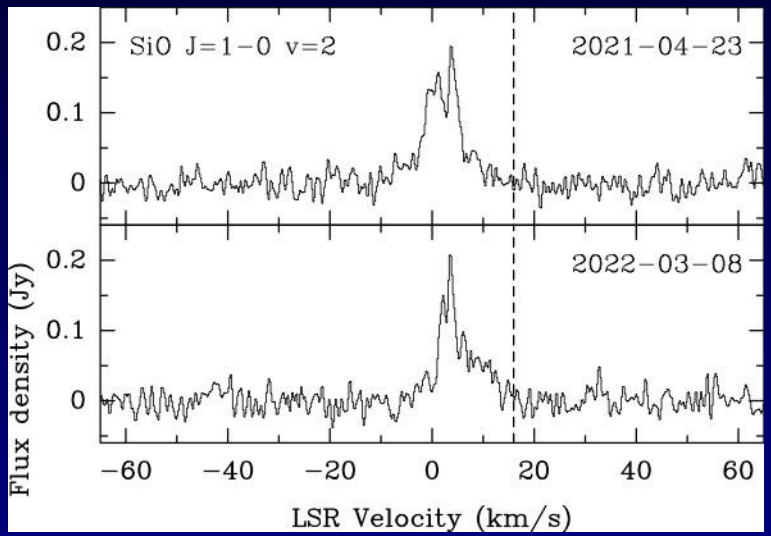
Spectra of SiO maser emission (Nobeyama)



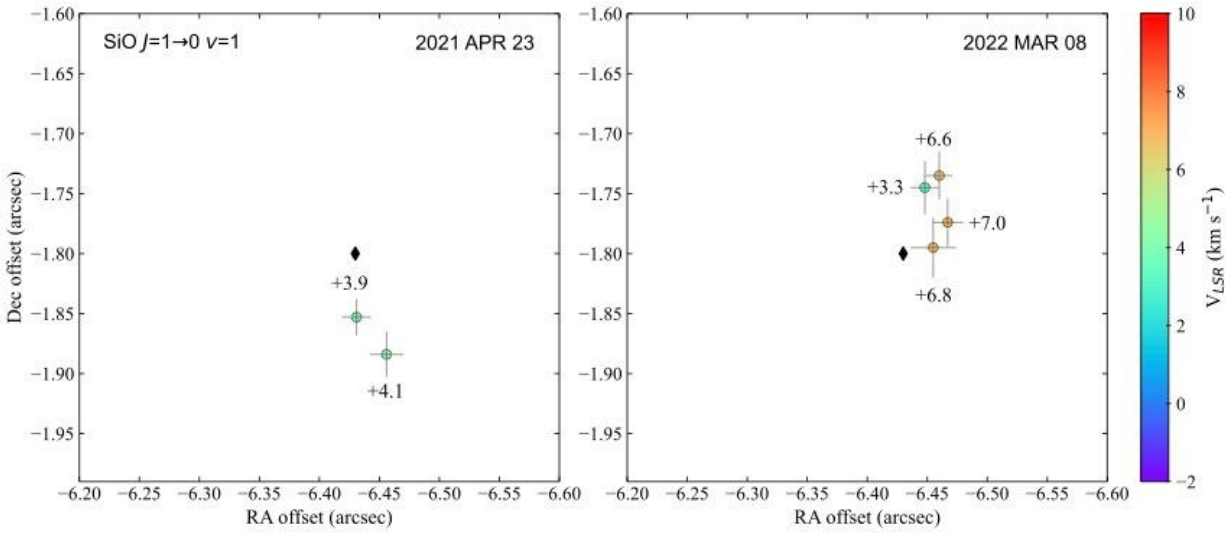
Uscanga+ in prep.

ATCA

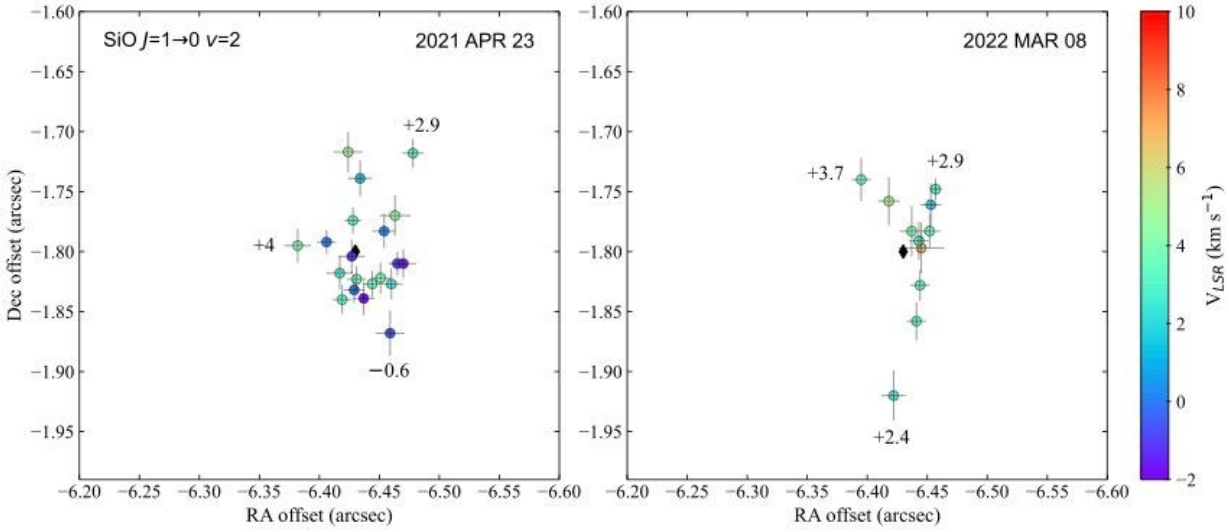




ATCA **Uscanga+ in prep.**



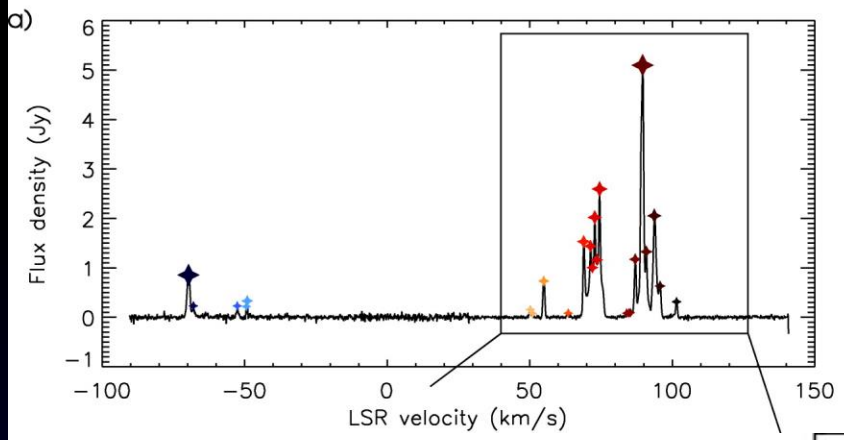
SiO masers in the WF: IRAS 16552-3050



Maps of SiO v = 1 and v = 2 (J = 1 → 0)

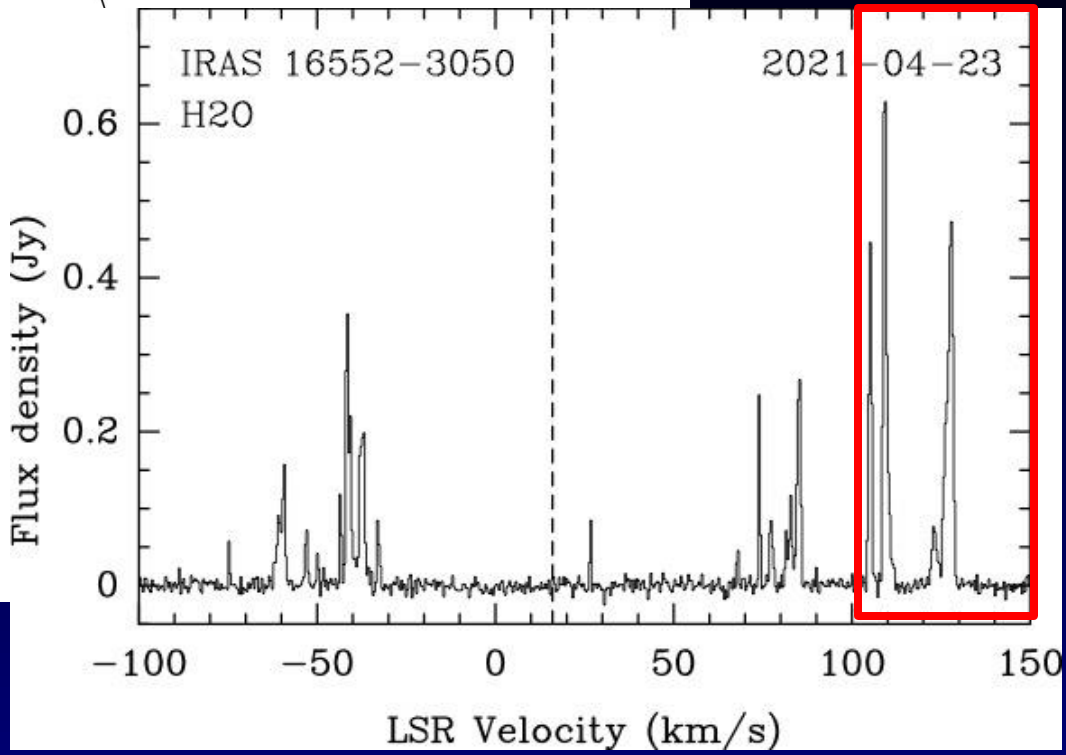
Spectra of H_2O maser emission toward IRAS 16552-3050

VLA



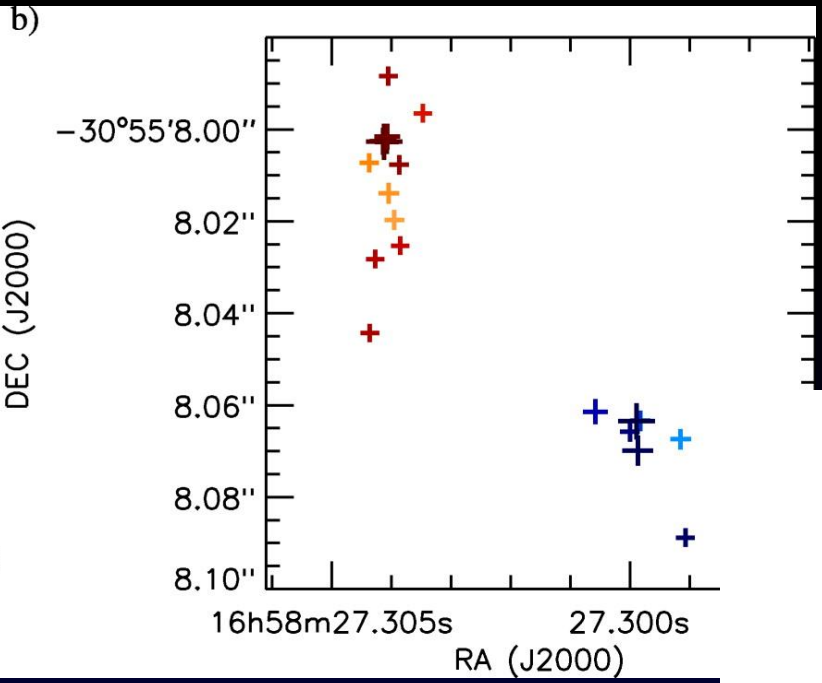
Suárez+ 2008

ATCA



Uscanga+ in prep.

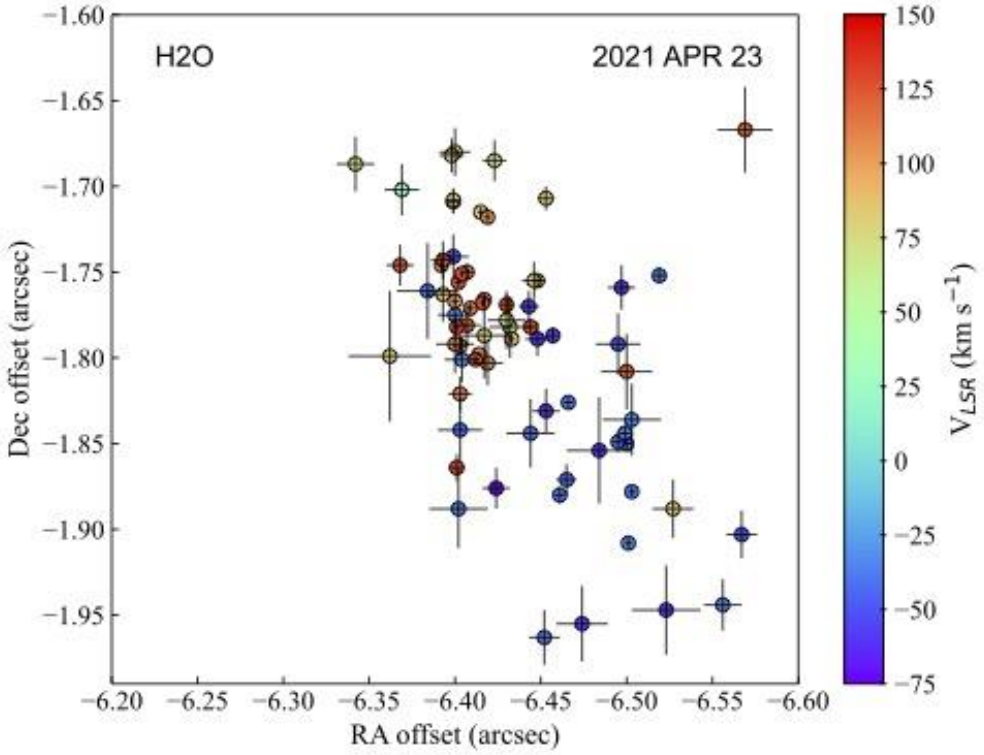
Map of H_2O maser emission from IRAS 16552-3050



Suárez+ 2008

A rough estimation for the dynamical age of the maser jet ≈ 8 yr

Uscanga+ in prep.



Summary and future work

- **Thanks to the synergy between NRO and ATCA observations, we were able to map the positions of the SiO masers recently detected with NRO (Amada+ 2022), in the WF IRAS 16552−3050. This SiO maser emission was detected and mapped for the first time in our project.**
- **H2O maser observations with ATCA reveal new highest-velocity components, suggesting a rapid grow of the outflow triggered by an increase in the maximum outflow velocity.**
- **Mapping with a higher angular resolution is necessary to spatially resolve and locate more precisely the individual maser components, a recognized larger extent of the SiO maser distribution in IRAS 16552-3050 comparing with that in W43A implies that the SiO masers in the WFs also may exhibit some variety of their distributions similarly to H2O masers.**

Спасибо за внимание!

L. Uscanga l.uscanga@ugto.mx