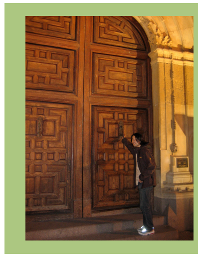

# VERA observations of R Leonis Minoris under the NAOJ-OAN collaboration

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## R-Leonis Minoris

We have observed five epochs of SiO maser (v=1 and v=2) at 43-GHz and three epochs of $H_2O$ (at 22-GHz). We aim to produce astrometrically aligned images of all these transitions.

R-LMi is a strong, simple, SiO maser, with $H_2O$ emission.

We observe a prime calibrator (0927+39) which is only 5° from the targets. We observe two reference sources with beam B (14x16 MHz) and the SiO with beam A (2x16 MHz, separated by 300 MHz) (mode VERA7 SiO2).

## Observational approach

The reference source, although marginally detected in the 24-GHz fringe search, could not be detected in our experiments. Nevertheless we believe that we have astrometrically calibrated the data using the prime calibrator delays and the phases from the stronger maser channel.

We have retained only the delays from the prime calibrator, calculating the relative IF phases from that delay. We use a central frequency of 43.0 GHz for the reference point, which reduces the rate of change of relative IF phase. Furthermore we do not transfer the potentially confusing phases from the prime calibrator. These would, on being added to the smoothly varying phases generated from the delay, prevent the interpolation (in time) of the IF phases. These steps guarantee unambiguous phase connection.

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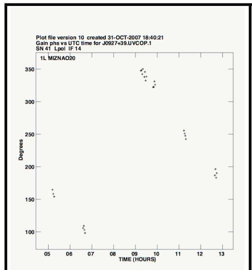
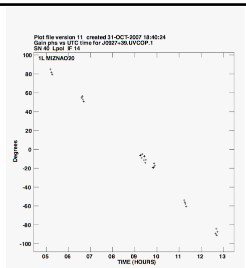
|  | Phases in IF 14, from prime calibrator delays, referenced to 42.8-GHz (IF 1). Prime phases and rates removed. |  | Phases referenced to 43-GHz (band centre). Connection over the target is now completely unambiguous. |

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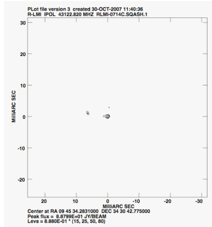
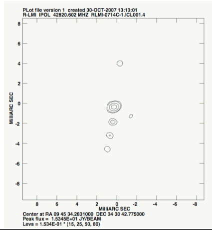
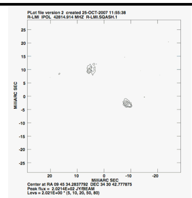
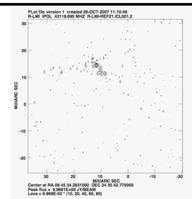
|  |  |
| January 2007, v=2 | v=1 referenced to v=2 |
|  |  |
| May 2007, v=1 | v=2 referenced to v=1 |

Observations in January and May are shown here. In all cases the maser emission is very simple, being one or two spots. The strongest maser channel in either transition provides the phases for all images here. In January the strongest feature in both transitions is very close to co-spatial (0.5 mas apart). In May it is the secondary feature which appears in both transitions, and this time they are 3 mas apart.

## Conclusions

We believe we have successfully phase referenced the two SiO transitions, using the prime calibrator for the delays. This is only possible because of the predictable performance of the VERA digital basebands, and the strategy with which we use the delays to generate the IF phases. The question we wish to address is the pumping model of SiO; whether it is radiative or collisional. These both allow the possibility of maser coincidence, but in the radiative model it is much less likely, therefore the statistics of co-emission will be a good indicator. Nevertheless further refinement of the models is needed, in view of recent theoretical results on the interactions of $H_2O$ and SiO IR lines.