Abstract
The SiO maser emission from Mira was observed using the Haystack Radio Telescope from 2001 until 2006. These observations were carried out in the v=0, J=1-0, and v=2, J=1-0 transitions. The v=3, J=1-0 transition was search for but not detected. The Mopra Telescope of the Australia Telescope National Facility observed SiO maser spectra from Mira, and a large number of other sources, from 2008 until early this year. Mopra observed the v=1, J=1-0 (J10) and the v=1, J=2-1 (J21) transitions. The velocity range of emission versus stellar phase has been determined for these various transitions and is compared with existing theory.

Background
Humphrey et al. (2002) show J10 SiO maser spectra for each 0.05 of stellar phase. In these spectra the velocity range of emission varies from approximately 4 km s\(^{-1}\) to 20 km s\(^{-1}\). The spectra indicate a broad, weak plateau of emission with a range of about 20 km s\(^{-1}\). For about half of the variation period this plateau emission is a large part or all of the emission.

More recently Gray et al. (2009) investigated the dynamics of the circumstellar region in which the SiO masers originate and have provided the most thoroughly developed theory for the maser spectra in long period variables such as Mira. They model a shock traveling out from the star generating different velocities at different distances from the star. As the shock travels out the velocities change as a function of distance from the star and phase. They indicate:

- a J10 velocity range of emission of ~10 km s\(^{-1}\)
- no emission at a phase of 0.4 in any transition except the J10
- no v=0 masers at any phase
- weak v=3 emission being strongest in the J21 transition at a phase of 0.1
- the J21 transition is generally narrower than the J10 transition, but the difference is phase dependent and difficult to quantify.

Observational Conclusions
- There is no evidence of a continuous, broad plateau of emission.
- The J10 emission shows a larger velocity range of emission than the J21 emission. This result is consistent with the predictions of Gray et al. (2009).
- During some cycles the velocity range of emission decreases between phases of 0.3 to 0.7 for the J10 and J21 transitions.
- Various masers are observed at a phase of 0.4.
- The v=0, J=1-0 maser was observed in all phase ranges.
- The v=3, J=1-0 was not observed at any phase.

Acknowledgements
We acknowledge with thanks the variable star observations from the AAVSO International Database contributed by observers worldwide and used in this research.

Thanks to Krishna Dahal, Loren Naland, Sandra Rambo, Chad Reverman, the Haystack Radio Telescope staff, and the UMM Faculty Research Enhancement Fund for contributing to this research.

References
AAVSO Bulletin 74: Predicted Dates of Maxima and Minima of Long Period Variables 2011