Phase–referenced VLBI observations of the OH masers around U Her

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We have started phase referenced monitoring of the 1667 MHz masers in the Mira variable U Her. Ultimately we hope to determine the annual parallax for this star. Three sets of VLBA observations have been performed so far. The first on July 22 1994, the second on March 6 1995 and a third on August 14 1995. Observations included bright extragalactic sources to calibrate instrumental effects and cycles of calibrator–source–calibrator ($\approx 2^\circ$ away) of typically 6 minutes. Without any special astrometric analysis software we detect the proper motion of U Her with an accuracy of several milli–arcseconds.

The VLBI observations detect mostly emission from several components in the blue–shifted peak of the profile. The basic assumption for the parallax measurements is that the brightest peak reflects the stellar position. The theoretical idea behind this is that on this line of sight the maser cascade is started by photons from the stellar continuum (e.g. Van Langevelde & Spaans 1993). In many objects the peak brightness temperature is in the blue–shifted emission, as predicted (e.g. Norris et al. 1984). In U Her further evidence has been obtained by Sivagnanam et al. 1990, who have shown that the brightest and most blue–shifted feature in the 1665 MHz coincides with the brightest and most blue–shifted feature of the 1667 MHz transition. With the current data we have confirmed this result.

But at the same time it appears that our observations do not agree with a simple spherically symmetric model. In such geometry one expects a single high brightness peak to occur at the most blue–shifted velocity. However, we find at least 3 high brightness components at the blue–shifted side of the spectrum, and the proposed stellar image is in fact not the most blue–shifted. Moreover, at one of the epochs it is not even the brightest. These observations need an explanation. The change in brightness ratio between amplified stellar emission and self amplified emission could change with the stellar cycle, as the pumping and saturation conditions in the maser vary. But identifying some of the peaks with self amplified maser emission does not seem consistent with the absence of such peaks in the red wing. A tentative explanation is that the maser amplifies more than one stellar body inside the molecular envelope.

REFERENCES

Norris R.P., Booth R.S., Diamond P.J., Nyman L.A., Graham D.A., Matveyenko L.I., 1984, MNRAS 208 435

Sivagnanam P., Diamond P.J., Le Squeren A.M., Biraud F., 1990 A &A 229, 171

Van Langevelde, H.J., Spaans, M., 1993, MNRAS 264, 597