WATER MASER EMISSION AND THE VISUAL LIGHT CURVE OF R DRACONIS

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Abstract

The water maser emission of R Draconis was observed at 22 GHz at the Haystack Observatory approximately once each month from November 1988 to July 1990. There is a correlation between the variations of the maser emission and the AAVSO light curve; the peak of the maser activity follows the light activity by about 0.2 period.

1. Introduction

R Draconis is a Mira-type variable star (M5e-M9e, P = 245.5 days) whose water maser emission was observed approximately once per month at 22 GHz from November 1988 to July 1990. It has a single feature that appears at an average local standard of rest velocity of -120.5 km/s and has a full width at half maximum of 0.67 km/s.

2. The Data

The maser data show a cyclic increase and decrease in intensity when plotted over time. The Maria Mitchell Observatory Fourier transform program was used to find the period of this intensity change to be about 221 days. The maser data has a time resolution of about 30 days, so this is an acceptable fit to the visual period. A series of maser spectra is illustrated in Figure 1. Figure 2 shows the variation of this feature versus Julian Day superimposed on the visual light curve provided by the AAVSO (Mattei 1991).

We have compared the variability of the maser emission to the visual light curve. Figure 2 illustrates the 0.2-phase lag of the maser emission with respect to the visual light curve. This phase lag is about 58 days. To better illustrate this correlation we have plotted two separated cycles of the water emission as they relate to the visual phase of R Dra (Figure 3).

3. Conclusion

Previous investigations of other Mira variables (Blais *et al.* 1988; Webb *et al.* 1988; Woods *et al.* 1988) have suggested that a maser phase lag usually occurs at about 0.3 period or later; the phase lag of 0.1 period for R Dra is considerably shorter. The shorter lag possibly suggests that the maser in the circumstellar material of R Draconis is closer to its star than other masers of this type.

Further observation of the water maser source at R Dra may provide more complete information about its correlation with the visible light, as we only have one strong peak at present.

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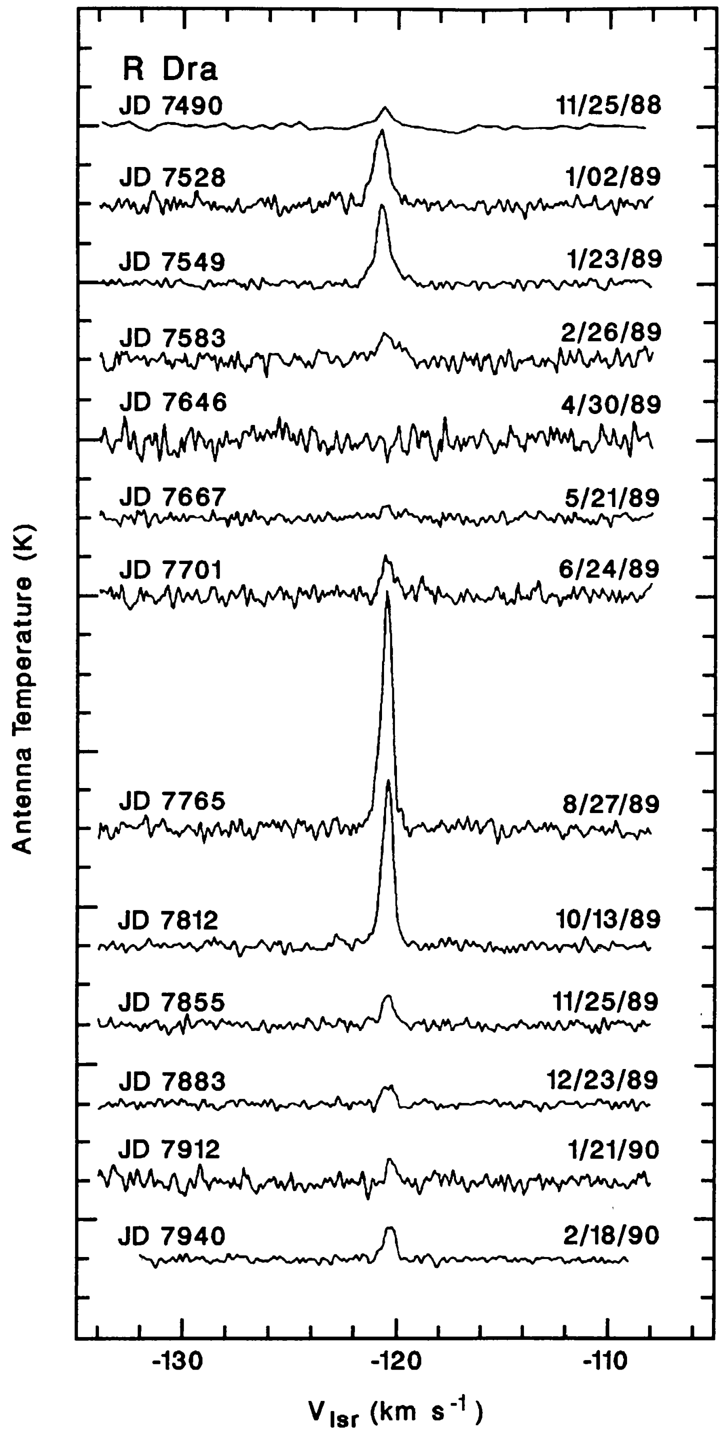

Figure 1. A series of water maser spectra of R Dra between November 1988 and February 1990. The y-axis gives the antenna temperature corrected for atmospheric effects and the gain of the telescope. The x-axis gives the radial velocity of the water maser source relative to the local standard of rest.

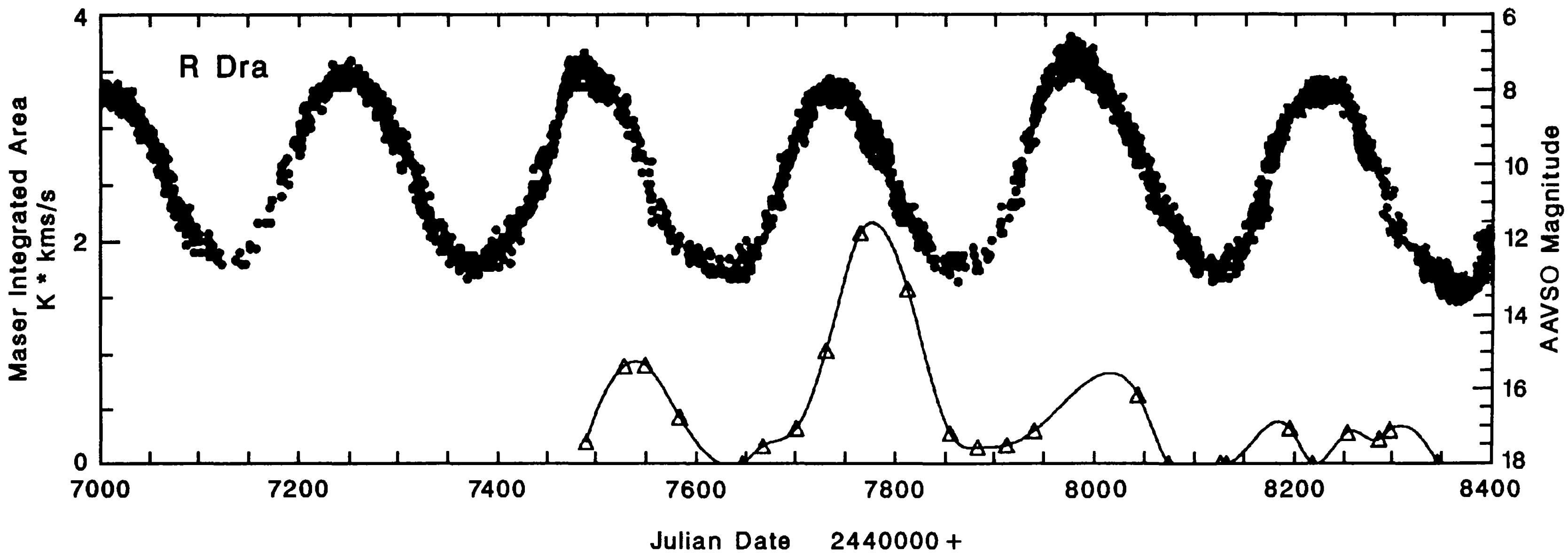

Figure 2. Water maser activity for R Dra plotted in antenna temperature versus Julian day of observation superimposed on the AAVSO visual magnitude data for R Dra vs. Julian day.

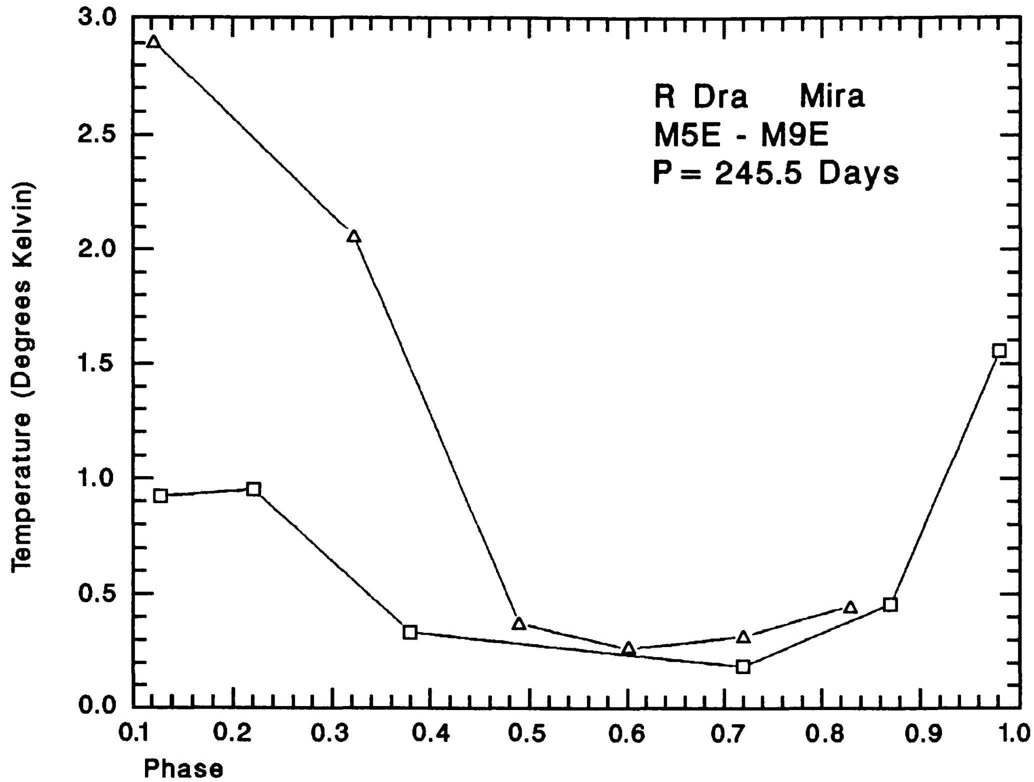

Figure 3. Water maser intensity in antenna temperature against phase of the visual data. The different symbols indicate separate cycles.