COMPARISON OF LIGHT VARIABILITY AND WATER MASER EMISSION IN V CANUM VENATICORUM

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Abstract

The 22 GHz water maser emission for V CVn has been observed at Haystack Observatory[1] approximately once each month from April 1987 to September 1988. The flux measurements from the data received during those runs have been collated and plotted both as a function of time and of phase. There is a correlation between the variability of the maser emission and the AAVSO light curve, but the maser emission has a 0.8 phase lag relative to the visual light curve. The visual light curve shows a distinct pattern suggestive of a beat phenomenon.

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The 22.2 GHz water maser emission of the variable star V CVn (M4e-M6IIIa, SRa, P=192 days) was observed in April 1987, and approximately once a month from November 1987 to September 1988 at Haystack Observatory. We compared the maser and the visual data with the goal of investigating correlations between the maser emission and the visible light curve. The visual light curve is compiled with data supplied by the AAVSO containing observations from February of 1982 to May of 1988. The visible light curve shown in Figure 1 shows asymmetries in the shape of the curve as well as periodic, fainter than usual maxima and brighter minima suggestive of possibly two periods producing a beat phenomenon.

After compiling the water maser emission data shown in Figure 2 it was obvious that the maser emission follows a regular pattern with peak activity occurring in February 1988. The emission appears to be approaching another peak this fall. Unfortunately, we have not observed V CVn's water maser emission long enough to be able to verify any periodicity.

In order to compare the maser emission data to the visible light curve we plot maser flux versus Julian date (Figure 3). Comparing Figure 3 to the visible light curve for the same time span (Figure 4) shows that the maximum maser emission occurred approximately 200 days after the 1987 July visual maximum, which establishes that the maser emission is probably collisionally pumped as explained in Benson and Little-Marenin earlier in this publication. In order to illustrate the maser emission lag better, we plot the maser flux versus the phase with respect to the AAVSO-computed visual maximum (see Figure 5). The 200 days corresponds to a 0.8 phase lag with respect to V CVn's visual maximum. The plot of flux versus phase also demonstrates the slow rise

rate, with the maser taking 0.6 of a period to reach peak flux and 0.2 of a period to fall below our detection limit of 1 Jy. During the three light cycles for which we have water maser data, we note that the water maser flux varies in intensity. We suspect the largest intensity in maser emission follows a relatively large visual maximum; however, at this point we do not have enough maser emission data from V CVn to see if this correlation holds true.
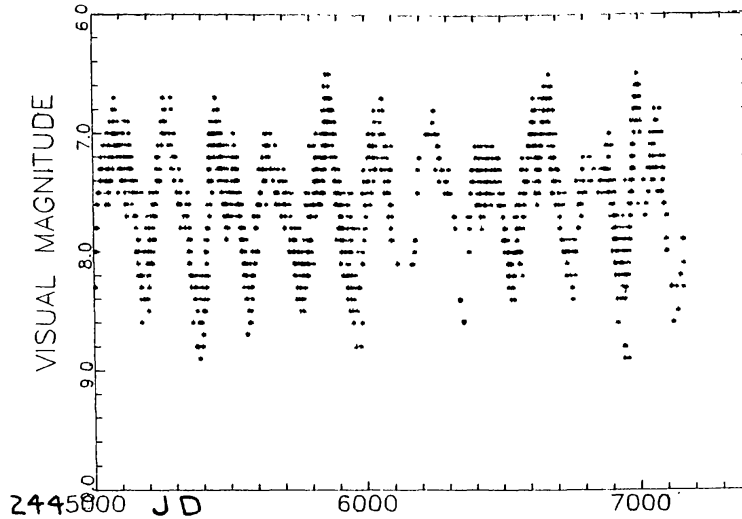
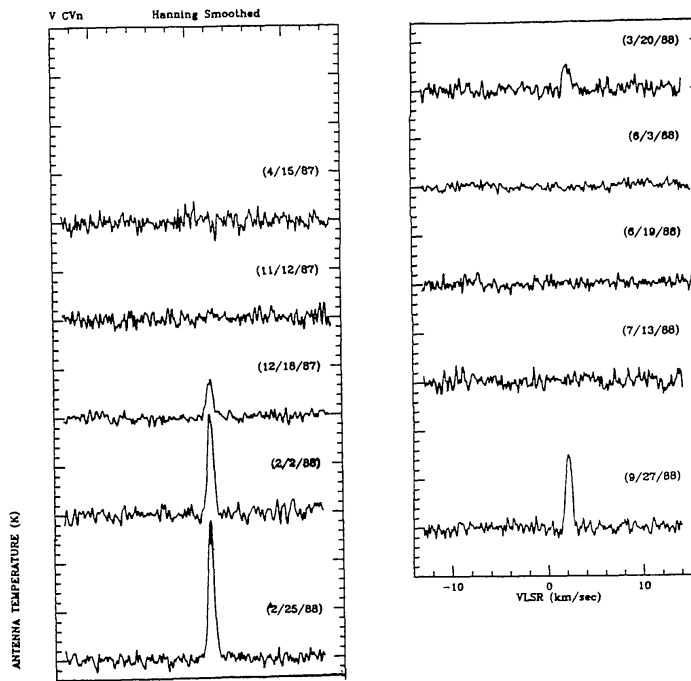Figure 1. AAVSO visual magnitude vs. Julian Date for V CVn.

Figure 2. Several spectra of the water maser emission of V CVn plotted as Antenna Temperature vs. Radial Velocity with respect to the local standard of rest.
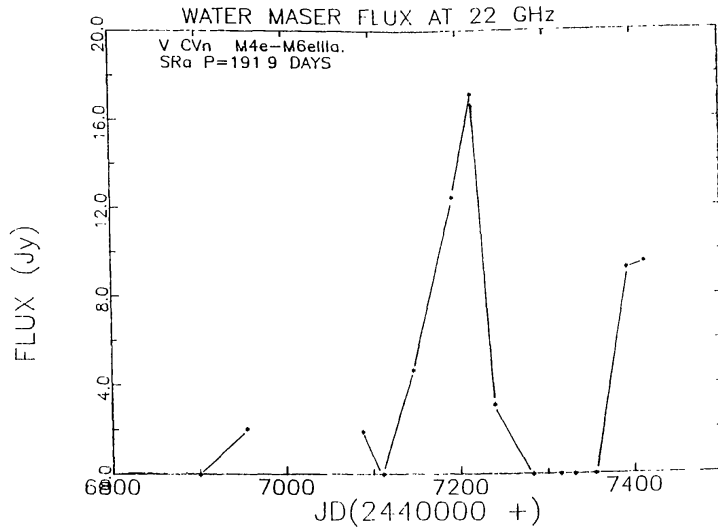
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WATER MASER FLUX AT 22 GHz

V CVn   M4e-M6ellla.
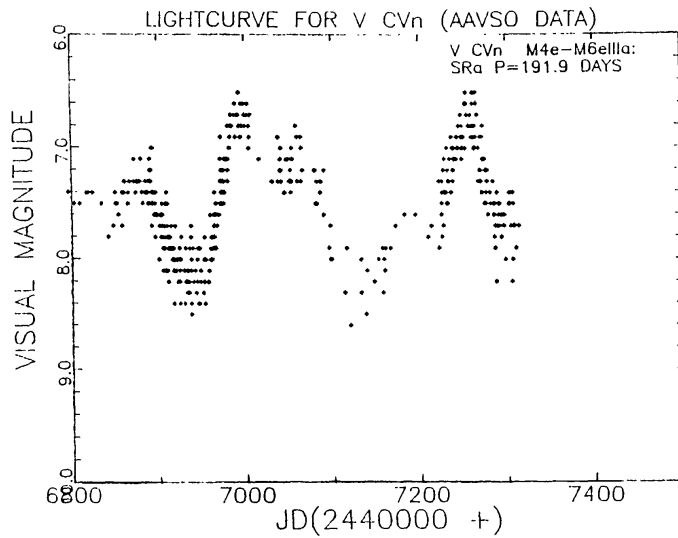SRa P=191 9 DAYS

FLUX (Jy)

JD(2440000 +)

Figure 3. Water maser flux in Jy vs. Julian date for V CVn.

LIGHTCURVE FOR V CVn (AAVSO DATA)

V CVn   M4e-M6ellla:
SRa P=191.9 DAYS

VISUAL MAGNITUDE

JD(2440000 +)

Figure 4. AAVSO visual magnitude vs. Julian date for V CVn.

WATER MASER FLUX AT 22 GHz

V CVn   M4e-M6ellla:
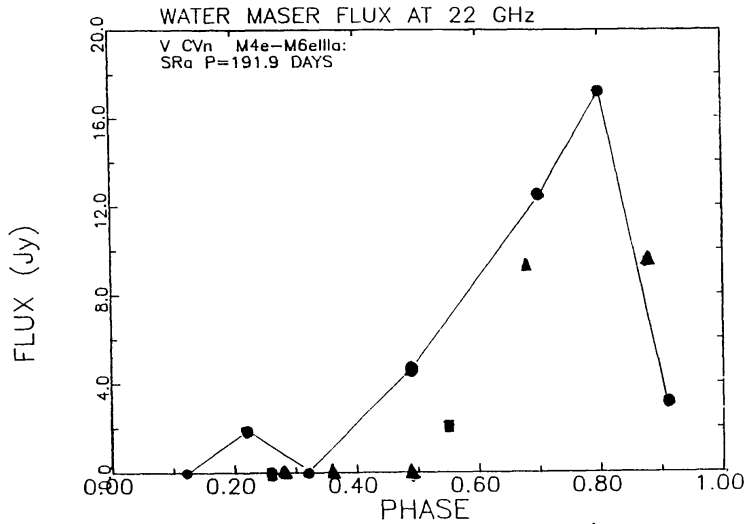SRa P=191.9 DAYS

FLUX (Jy)

PHASE

Figure 5. Water maser flux in Jy vs. phase with respect to the visual maximum. Different symbols indicate different cycles.

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