THE STUDY OF MULTI-BAND RADIO OBSERVATIONS ON ULTRAVIOLET FLARES OF CHROMOSPHERIC ACTIVE BINARY V711 TAURI

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Abstract. The chromospherically-active binary, V711 Tau, had been observed by using the American Very Large Array (VLA) at five bands from 1.4 to 15 GHz. During the observation, the source was undergoing an intense flare, its radio luminosity up to $1.8 \times 10^{38}$ erg s$^{-1}$ Hz$^{-1}$. The degree of circular polarization in the phase of the most intense flare was very small. With the decaying of the flare the flux density decreased, spectral index became smaller, spectra steeper and reversal frequency lower; the degree of circular polarization increased and its direction was dependent on frequency. These observational facts support the conclusion that the emission during intense flare is synchrotron (or synchro-cyclotron) mechanism. The magnetic intensity is about 10 G near $\nu = 1$, the average electron energy, 4 MeV, the electron density with larger than 10 keV, $3 \times 10^4 - 9 \times 10^4$ cm$^{-3}$ and the electronic energy spectrum index in power-law distribution 1.3.

1. Introduction

RS CVn is a chromospheric active binary, compared to a single star with the same spectral type and luminosity, it has abnormally strong Ca II H and K emissions. In addition, the system also exhibits enhanced fluxes of all UV chromospheric transition region in the spectra obtained by IUE satellite. It also has the features with strong X-ray, Hα and microwave radiations. In visible light waveband, a typical character of RS CVn is its periodic variation in luminosity. Rodono et al. (1987) noted that extensive areas of the surface of one or two of RS CVn components was covered by dark (cool) starspots (larger than 20 per cent of the surface in some cases) and by bright plage-like region. Due to rotational modulation, the appearing and disappearing of these large spot groups in the hemisphere of facing-on observer cause periodic changes in photometric variability. Usually, the activity of stellar chromosphere and corona is developed through the analogy to the similar activity on the Sun. The available observations show that RS CVn system has much higher activity than the Sun.

V711 Tau is a non-eclipsing binary with a distance of 36 pc, its orbital and rotational periods are 2.83774 and 2.841 days, respectively. The binary consists of a G5 IV star and a K1 subgiant. During its intense flares in February 1978, a joint observation was made on V711 Tau and the later observations of this binary system revealed that its radio emission was highly variable and often circularly polarized. Lestrade et al. (1984) observed the source using VLBI technique in its flare phase.

2. Observations

Multi-frequency observations were carried out at centimeter waveband using the American Very Large Array (VLA) on 9, 15, and 21 October, 1988. The array consists of 27 antennas each 25 m in diameter, and operated in mixed A–D configuration, with the shortest baseline of 50 m and the longest 36 km. The half-power width of the synthesized beam at 6 cm was about 0.3.

The radio source was observed at five wavebands and the frequency ranges are given in Table I.

<table>
<thead>
<tr>
<th>Wavelength (cm)</th>
<th>Observation frequency and bandwidth (MHz)</th>
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<tbody>
<tr>
<td></td>
<td>IF = 1</td>
</tr>
<tr>
<td>20</td>
<td>1464.9 ± 25</td>
</tr>
<tr>
<td>18</td>
<td>1652.4 ± 15</td>
</tr>
<tr>
<td>6.2</td>
<td>4885.1 ± 25</td>
</tr>
<tr>
<td>3.6</td>
<td>8414.9 ± 25</td>
</tr>
<tr>
<td>2.0</td>
<td>14964.9 ± 25</td>
</tr>
</tbody>
</table>

During these three days V711 Tau was observed in turn at every frequency each day. Before and after the observation at each frequency, a survey on primary and second calibrators had to be made. The observations on V711 Tau and those on calibrators formed an observation set. In each set V711 Tau was observed for 16–18 minutes, before and after that a 3–4 min scan was carried on phase calibrator 0235 + 164 (point source), and a 3-min observation was taken on the primary flux density calibrator 3C48 and then switched to next frequency.

3. Data Reduction

The observational data were reduced by the use of NRAO AIPS software system on Vax 11/780 computer of Iowa University.

3.1. THE CHECKING AND EDITING OF THE DATA

The original data of phase calibrator 0235 + 164 were tested through the known flux density of the primary calibrator 3C48, and bad data were found out and flagged. By