

A SERIES OF PAPERS ON RS CVn BINARIES: INTRODUCTION

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On 20 February 1978, Feldman *et al.* (1978a, 1978b) discovered very strong (≥ 0.5 Jy) radio emission from the RS CVn binary V711 Tau (= HR 1099); the day before, it was an order of magnitude weaker. During the remaining days of February and the first days of March, radio observations continued along with simultaneous photometry and spectroscopy, both ground-based and satellite. This issue of the *Astronomical Journal* contains discussions of most of these observations, as well as a few related to RS CVn binaries in a more general way. Many of these results were discussed at an RS CVn workshop on 6–7 April 1978 in Socorro, New Mexico, a summary of which was distributed as circular No. 9 of the IAU commission 42 working group on RS CVn binaries.

An RS CVn binary has been defined (Hall 1976) as one in which (1) the spectral type of the hotter component is F or G; (2) there is strong CaII H and K reversal seen in the spectrum outside eclipse; and (3) the orbital period is between one day and two weeks. In addition to these defining characteristics there are many more observational properties and peculiarities, described in detail in Hall's review (1976). Much additional observational material has accumulated in the past few years, most notably the discovery that the RS CVn binaries are a new class of x-ray source. This work is summarized by Walter, Charles, and Bowyer (1978a). Similar binaries with longer or shorter orbital periods share some, but generally not all of the same properties. A survey of about two dozen systems indicates that the active component rotates synchronously in all systems where $P(\text{orb.}) \leq 20$ days, and not necessarily synchronously in those with $P(\text{orb.}) > 20$ days. Perhaps $P(\text{orb.}) = 20$ days would be a better value to separate the RS CVn binaries from their longer-period counterparts. The RS CVn properties are almost certainly related closely to the so-called BY Dra syndrome observed in the dMe flare stars, although the flare stars do not all seem to be binaries (Bopp and Espenak 1977).

The above definition for RS CVn binaries is useful in that it is based on directly observable properties, but of course it makes no statement about evolutionary status. Popper and Ulrich (1977) show that most of the RS CVn systems probably comprise two stars of moderate ($1.0 M_{\odot} \lesssim M \lesssim 1.5 M_{\odot}$) and nearly equal mass, in which the slightly more massive is generally the more advanced in its evolution off the main sequence. Evolution apparently has not proceeded enough for either star to fill its Roche lobe, but some mass loss is probably occurring by an enhanced-stellar-wind mechanism. One or two systems may be pre-main sequence: HD 224085 (Rucinski 1977), and W92 in NGC 2264 (Walker 1977).

A number of papers published elsewhere, or works in progress, pertaining to V711 Tau in particular, or the RS CVn binaries in general, are mentioned here for the sake of completeness.

(1) To follow up the September 1976 campaign (Weiler *et al.* 1978) on V711 Tau and UX Ari, Weiler (1977) observed V711 Tau with the Copernicus satellite in October 1977 and arranged for simultaneous ground-based photometric, spectroscopic, and radio observations. The *UBV*, *uvby* and *I* photometry (Bartolini *et al.* 1978) and the radio observations (Gibson, Hicks, and Owen 1978) are published in this issue. The spectroscopic observations will be published elsewhere.

(2) McCook *et al.* (1978) observed V711 Tau with narrow-band $H\alpha$ filters from September through November 1977.

(3) H. Bond took high-dispersion (0.2–0.3-Å resolution) $H\alpha$ spectra with the Reticon spectrograph of the 100-in. Mt. Wilson telescope on 24.2, 25.1, and 26.1 February 1978 (UT) during the large radio outburst(s).

(4) R. H. Koch and R. J. Pfeiffer have been monitoring several RS CVn binaries polarimetrically in *u*, *B*, *V*, and *R*. V711 Tau is one of them. See also Pfeiffer (1978).

(5) G. Berriman and B. Gurney continue to observe RS CVn binaries, especially AR Lac, at infrared wavelengths with the 24-in. telescope at Mt. Wilson Observatory.

(6) D. C. Backer and R. A. Sramek (1978) performed VLBI observations of UX Ari at 21 cm with an Arecibo–Green Bank interferometer at 2315 UT, 11 February, and 2300 UT, 13 February 1977. Their preliminary result is that the ratio of correlated flux between UX Ari and NRAO 140 was about 0.05 ± 0.01 with a fringe spacing of $\approx 0.003''$. They suggest that the source was not heavily resolved. Other observations at 21 cm, with an Arecibo–Hat Creek interferometer, were made 6–8 February, in May, and in September 1978; these data have not yet been analyzed.

G. M. Resch, G. Purcell, A. E. Niell, and J. J. Wittels observed V711 Tau at 8.4 GHz with a Haystack–Owens Valley–Goldstone interferometer at three separate times during the February 1978 radio outburst(s). On the first two of these occasions technical difficulties vitiated the data. However, the data from the third observation (0101–0110 UT, 26 February 1978) yielded fringes on the Goldstone to Owens Valley baseline ($5.75 \times 10^6 \lambda$). Accordingly, the source was unresolved, with a fringe spacing of 36 milliarcsec (Resch *et al.* 1978).

N. L. Cohen *et al.* observed a number of RS CVn stars at 21 cm with a four-station interferometer (Arecibo-Bonn-Green Bank-Hat Creek) during 14–16 July 1978. The data are currently being analyzed.

(7) UX Ari underwent a series of flares observed simultaneously at five radio frequencies by Hjellming and Brown (1978) on 3–5 December 1977, using the VLA and the NRAO interferometer. One event was observed both on the rise and in decay showing clear evolution in both spectrum and circular polarization.

(8) Owen and Gibson (1978) have nearly completed a partial 6-cm survey of long- and short-period RS CVn systems using the VLA.

Gibson (1978) will soon complete a sensitive 6-cm survey of a number of nearby, single, late-type subgiants using the VLA. To date he has detected none to levels which are about a factor of 100 lower than the median radio luminosities of the RS CVn systems.

(9) Linsky *et al.* (1978) obtained far-ultraviolet observations of V711 Tau with the I.U.E. during the last stages of the radio outburst; α Aur, λ And, and ϵ Eri were also observed.

(10) At the Strömgren symposium, held 30 May–1 June 1978 in Copenhagen, H. M. Johnson suggested RZ Eri and HR 8703 as the optical counterparts of the x-ray sources 4U 0443-09 and 4U 2252 + 18, respectively.

(11) Eaton and Hall (1978) have used light-curve synthesis techniques to investigate the intrinsic variations in RS CVn, SZ Psc, and RT Lac, assuming a star-spot model. (See also Eaton 1977). Shore and Hall (1978) are developing a generalized model of the RS CVn stars based on a simple dynamo mechanism. (See also Hall and Shore 1978.)

(12) Walter, Charles, and Bowyer (1978b) have observed the soft x-ray behavior of UX Ari in detail and have modeled the emission as coronal. Cash (1978) has utilized the soft x-ray observations of RS CVn binaries to support the loop model of stellar coronae (Rosner, Tucker, and Vaiana 1978).

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