IUE SPECTRA OF RS CVn STARS

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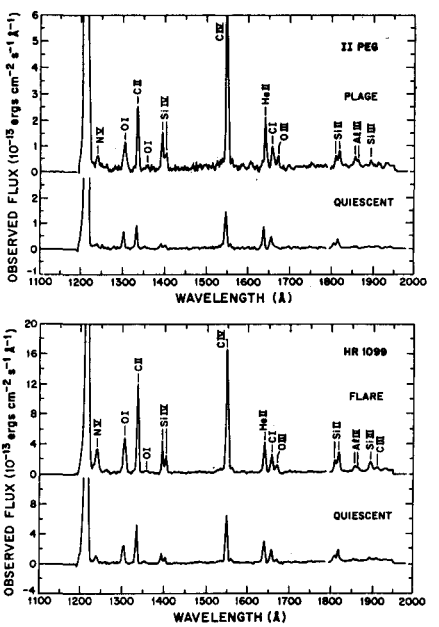
INTRODUCTION

The characteristic optical light curves of RS CVn - and BY Dra-type variables are believed to represent non-uniform distribution of dark spots akin to sunspots which are revealed by rotation. By analogy with the Sun, strong magnetic fields probably underlie this phenomenon, extending upwards into the chromosphere and corona, enhancing the emission from regions that overlie the spots. Previous work on the BY Dra variable AU Mic (Ref.1) did not clarify whether the fluxes from chromospheric and transition region lines were rotationally modulated in the sense that the phase of maximum emission was in register with spot visibility or minimum light. This important question prompted the need for further collaborative IUE, optical and radio work.

OBSERVATIONS

Three RS CVn stars were observed during contiguous ESA-NASA-SRC shifts on 1-7 October 1981. Eight spectra of II Peg, ten of HR1099 and four of AR Lac, in each of IUE's long-(LW) and short-wavelength (SW) intervals were obtained at high LW dispersion and low SW dispersion (except for one high SW spectrum of HR1099). Observations were well distributed with respect to phase of the optical light curves. Simultaneous ground-based photometry was obtained in addition to data on the mean optical light curve prior to IUE observations. Also, the fine error sensor (FES) visual magnitudes reduced using recent calibrations (Ref.2) allow a fairly



Figs. 1 & 2. Mean Plage and Quiescent Spectra & Flare Spectrum of II Peg & HR1099.

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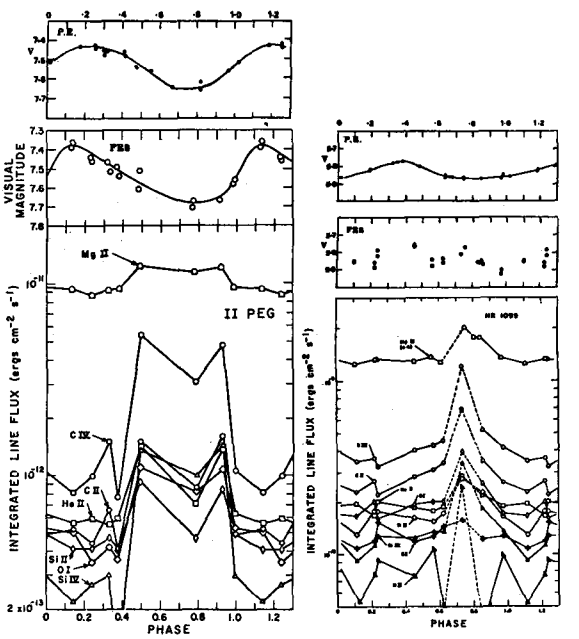
accurate check on the behaviour of the stars adjacent to the spectral exposures. Radio coverage revealed flares on II Peg (60 mJy peak) on 2 October at 0200 UT and on HR1099 (180 mJy peak) extending over 24 hrs on 2-3 October.

RESULTS AND DISCUSSION

Figs.1 & 2 show our summarized results for quiescent, plage and flare spectra from the data along with line identifications. Typical chromospheric transition region lines are seen ranging from OI to CIV and NV. Ground-based data show that all three stars had well established wavelike variations e.g. see top of Figs.3 & 4. Integrated line fluxes for the strongest chromospheric features are plotted below the photometric data as a function of phase in Figs.3 & 4. II Peg (Fig.3) clearly demonstrates that the maximum of the emission-line fluxes coincides with the minimum of the established mean light curve around phase 0.7-0.8, in agreement with the solar-type spot model. The variations at phase 0.32 and 0.79 illustrate variations in chromospheric emissions at small timescales. For HR1099 (Fig.4) the radio flare coincides with the emission maximum at phase 0.72 (shown by dotted line), and removing this peak, the strongest lines confirm the anti-phase correlation found in II Peg. Similar results are found in the sparser data available for AR Lac (not shown).

CONCLUSIONS

We present clear evidence that in RS CVn stars the UV chromospheric and transition region line fluxes vary such that maximum line flux corresponds to optical minimum or maximum spot visibility, consistent with a solar-type dark spot model.



Figs. 3 & 4. Mean wave, FES mags & line flux against phase for II Peg & HR1099.

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2. ESA Memorandum 1981. FES Calibration at Vilspa by Holm & Rice.

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