17.24 VLA Observations of Rapid 6 cm Flux Variations in α Ori

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We began to monitor the red supergiant star α Ori with the VLA in mid 1986 (during periastron of a putative close companion – Karovzak et al. ApJ. 1986). Thirteen observations at 6 cm between 1986 July and 1987 February show stochastic variations, at the 30-40% level, with no long-term trend. All data was clipped and tapered in AIPS to minimize differences between VLA arrays. The calibration source, 0529+075, varied by less than 10% over the same interval. We are continuing the VLA observations of α Ori, as well as α Her and α Sco, at both 6 and 6 cm, to confirm this result and search for long-term trends.

The stochastic 6 cm flux behavior, with 30-40% changes on all timescales from the shortest interval of 10 days to the longest (8 months), seems at odds with the 400 day periodic variations in U-band photometry and Mg II UV fluxes reported by Dupree, et al. (1986 BAAS 18, 982). The observed 6 cm flux during late 1986 was 25% below the 6 cm flux reported earlier this decade by Hjellming and others.

Several models for the outer atmosphere of α Ori place the 6 cm optical depth unity location at several stellar radii above the optical photosphere (e.g. Wisniewski and Wendker 1981 A&A 96; Skinner and Whitmore 1987 MNRAS 224). The rapid, stochastic variations reported here are difficult to reconcile with almost any global process, such as pulsation, Alven waves or periastron passage, because these dynamical timescales are orders of magnitude larger than the shortest timescale for the observed radio variability. One non-global process may be that analogous to solar flares. The molecular catastrophe scenario of Muchmore et al. (1987 ApJ 315) also predicts rapid cooling of lower chromospheric gas on timescales of several days. Rapid, localized cooling could serve to stochastically reduce the 6 cm emitting area on the observed timescale.

17.25 A DEEP, DOPPLER-COMPENSATED IUE SWP ECHELLOGRAM OF THE K0 PRIMARY OF HR 1099

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Over a 45-hour period in the fall of 1986 (25-27 September) we conducted a series of observations of the bright RS CVn system HR 1099 (=V711 Tauri: K0 IV + G5 V; P = 2.8 d) using the International Ultraviolet Explorer. Nearly 20 hours were occupied in exposing a very deep high-dispersion (0.15 Å resolution) echellogram in the far-ultraviolet region (1150-2000 Å), using a novel observing strategy. In particular, we periodically stepped the stellar image in the large aperture (10''x 20'') along the axis of dispersion to compensate for the changing orbital Doppler shifts of the UV-bright primary star, which otherwise would have smeared out the profiles of the numerous emission lines found in the far-ultraviolet region. In the Doppler-compensation mode, the stellar image was repointed every two hours; at which time a 40-second, low-dispersion (9 Å resolution) echellogram was taken in the longwavelength region (2000-3200 Å: LWP camera) to record the strength of the Mg II 2800 emission doublet, a useful tracer of flare activity. Furthermore, in order to achieve the 19.5-hour exposure without risking observations during periods of high cosmic particle radiation, we conducted the exposure exclusively during US1 and Vilupa time: the SWP camera was held in standby mode during the 12-hour period with (FPM > 0.85) that separated the two sets of low-radiation shifts required. During the "high-radiation" time, we acquired a series of low-dispersion and high-dispersion LWP spectra, including several very deep echellograms to record the density-sensitive multiplet uvw0 of singly-ionized carbon near 2252 Å.

We will present measurements of the spectrometers, and discuss their significance with respect to the density stratification and gas dynamics of the outer atmosphere of the intensely-active K subgiant of HR 1099.

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17.26 Simultaneous EXOSAT and VLA Observations of Active Cool Binaries VN Cep and XY Leo: A Flare in VN Cep

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The stars were observed during 14 hours (XY Leo/27 Dec 85, VN Cep/2 Jan 86). No orbital modulation was evident, contrary to the EXOSAT observations by Viluva and Heise (1986, ApJ 311, 937). The quadruple system XY Leo (W UMa + BY Dra: Enden 1987, IA 1986) is a constant 1.5 mJy source at 6 cm. We derived the following average luminosities: XY Leo (d=58 pc): log L_e = 30, log L_e/L_bol = -3.3, log L_e/L_bol = -6.5, VN Cep (d=31 pc): log L_e = 30, log L_e/L_bol = -3.6, log L_e/L_bol = -7.8.

In VN Cep we saw a strong flare at 20:25 UT (Figure). For the flare peak: log L_e = 30.6, log L_e/L_bol = -7.0. During this flare VN Cep moved more off from the Bremstrahlung value log L_e/L_bol = -8.6 (10^23 K), into the domain where the most active stars are (like XY Leo). The micro-wave emission is probably of gyrosynchrotron origin, when high energy electrons spiral in the (dynamo-generated) coronal magnetic fields. We found evidence for the presence of a very hot gas (>10^7 K). We continue to study polarization and finer time-resolution at 6 cm, as well as EXOSAT's ME-spectra, to obtain better constraints for the physical parameters of the flare.

17.27 Effective Temperatures and Gravities of S Doradus Like Stars in the Large Magellanic Cloud

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Temperatures and gravities of S Doradus and 7 stars with similar spectroscopic character in the Large Magellanic Cloud (LMC) are measured through a comparison of ultraviolet-to-optical spectrophotometry with LTE, plane-parallel model atmospheres (Kurucz 1979). The optical spectra of the S Doradus-like stars are dominated by numerous strong emission lines of Fe II and [FeII]; the Balmer hydrogen lines are in emission to at least Hγ, usually with P Cygni-like profiles. An estimate of photospheric temperature from absorption line spectral classification is not possible for these stars unless there are no photospheric absorption features. The effective temperatures derived here are equivalent to B-type supergiants. In comparison with previous studies of some of these stars, we are finding lower temperatures and gravities. These differences are attributed to the use in earlier work of the published grid of Kurucz model atmospheres that do not extend to gravities near the radiation limit. However, the optical spectra clearly demonstrate that these S Dor-like stars are at, or near, the radiation limit. For this study we have made use of model atmospheres calculated with Kurucz's code calculated to the radiation limit (Fitzpatrick 1987).