We re-analyze these data along with additional observations secured during December 1992 and January, April, and May 1993. We establish a new mass upper limit for any gas-giant planet orbiting Proxima Centauri with periods 20 < P < 400 days.

We, again, compare our HST-derived proper motion and parallax values with those obtained from a 45 year duration ground-based campaign on Proxima Centauri. Finally, we extend the light curve for Proxima Centauri (V = 645 Cen, a flare star), shown (Benedict et al., op. cit.) to be a BY Draconis variable star of amplitude 0.012 magnitude. From the extended light curve we provide a refined rotation rate for the star.

46.03

Multiplicity Among M Dwarfs

D.A. Fischer (SFSU/UCSC), G.W. Marcy (SFSU/UC Berkeley)

We examine surveys of M dwarfs within 20 pc to determine the incidence of stellar companions. Observational data are drawn from high-quality surveys, including IR-array imaging, precise velocities, IR speckle interferometry, and visual imaging, and their respective incompleteness is determined. Each technique permits detection of companions down to the H-burning limit, and each is nearly complete (owing to the proximity of M dwarfs) within a specific range of separation, the farthest being 10^8 AU. The number of companions per primary per AU of semimajor axis, computed and found to decline monotonically toward larger semimajor axes. The period distribution (in bins of ln(P)) exhibits a unimodal, broad maximum with a peak in the range 0.9 < P < 2.0 yr, corresponding to separations 30-300 AU, similar to that for G dwarf binaries. Integrating over all semimajor axes yields the average number of companions per primary, 0.55 ± 0.09, which includes those companions clumped in multiple systems. Thus, 58% of nearby M dwarf primaries are single and 42% have companions, similar to Henry and McCarthy's binary frequency of 34%. The M dwarf binary frequency is lower than that for G dwarfs (57%), owing partly to the smaller range of companion masses included, i.e., companions less massive than the M-0 G-type primary. The mass function of companions to M dwarfs is roughly flat in shape, similar to the field mass function. Companions to G dwarfs also exhibit the field mass function, which provides support for protostellar "capture" as the dominant mechanism by which binaries form.

46.04

Continuous IUE Monitoring of HR 1099 Throughout Two Complete Orbital Cycles (6 days) in December 1992

J.E. Neff (Pena State), T. Simon (Hawaii), J. Pagano, M. Rodonò (Catania), B. Floyer (LPS/IAS)

In order to map the spatial structure of a stellar atmosphere using Doppler imaging techniques, observations of a rapidly-rotating star must be obtained at all of its rotational phases. In order to discriminate temporal variability (e.g., flares) from phase-locked variability (produced by magnetically-active regions on the stellar surface), observations must be obtained over at least two rotational cycles. Using the International Ultraviolet Explorer, we observed the bright RS CVn-type system HR 1099 (V711 Tau) continuously for two contiguous orbital/rotational cycles (period~2.83 days) in December 1992.

These observations were coordinated with the 1992 campaign for Multi-Site Continuous Spectroscopy (MUSICOS). The purpose of this campaign was to coordinate a network of ground-based telescopes distributed around the Earth so that moderate and high-resolution spectroscopy could be obtained pseudo-continuously for several days. Supporting photometric and radio observations were also obtained simultaneously.

We are using the IUE high-dispersion spectra of the Mg II h and k lines to map the spatial structure of the stellar chromosphere and to study atmospheric dynamics during flares. In conjunction with the IUE low-dispersion spectra, we will be able to model the radial structure of the chromosphere. We present preliminary results showing the rotational modulation of the ultraviolet line fluxes and of the high-dispersion line profiles. At least 3 transition-region flares occurred within this 6-day interval, and our observations constrain both the rise and decay phases of these flares. The effect of a non-uniform atmospheric structure is subtle, but it is visible in the observed line profiles.

46.05

The Spot Distribution on II Peg in 1992

Artie P. Hazes (U.T. Austin and McDonald Observatory)

Doppler images are presented for the spot distribution on the RS CVnstar II Peg in late 1992. Data were taken with the McDonald Observatory 2.1-m Sandfield Cassegrain echelle. When used with a Reticon 1200x400 CCD, this high-efficiency spectrograph provides a 2-pixel resolving power of 60,000 with a wavelength coverage of 1200 Å centered on 6200 Å. Doppler images were derived using the Ca II 6349 Å and Fe 6340 Å spectral lines. Both images are consistent and show 4-5 spots concentrated between stellar latitudes 0-60°. The largest spots occur near phase 0.38 and covers more than 20% of the visible hemisphere of the star. The expected photometric variations for the derived distribution produces a V-band amplitude of about 0.25 magnitudes. The Doppler image lacks a polar spot like those seen on other, more rapidly rotating RS CVn stars. The spot distribution on II Peg is similar to that found on the long-period RS CVn star σ Gem. The different spot morphology of these two stars compared to other RS CVn stars may be due to the slower stellar rotation rates or smaller tidal effects from the binary companion.

Ho is found to be in emission and with its lowest intensity near those phases where the spot coverage on the visible stellar surface is a minimum. This suggests that the spot distribution is co-spatial with the dark spots.

46.06

Similar X-Ray/Microwave Ratios in Solar Flares and Corona of Active Stars

A.O. Benz (ETH Zurich), M. Gudel (JILA/NIST&CU)

We have compared the soft X-ray/microwave ratio of solar and stellar flares with the ratio of the corresponding 'quiescent' emissions of active M and K stars and other active stars. Solar flare X-ray observations by the GOES satellite have been converted into total luminosities (erg s^-1) using the inferred temperature and emission measure, and standard X-ray model spectra. Microwave luminosities (erg s^-1 Hz^-1) near the spectral peak of gyro-synchrotron emission (5-10 GHz) have been selected. The average ratio is 10^13.2±2 Hz for impulsive and gradual flares, and slightly more for microflares. Highly polarized stellar flare microwave emission probability is different of origin and cannot be compared. The only simultaneous observation of stellar flare X-rays and unpolarized microwaves in the literature has a luminosity ratio of 10^15 Hz.

The average ratio between 'quiescent' X-ray and microwave luminosities of young, rapidly rotating M and K stars has previously been reported to be 10^15 Hz. It is only slightly smaller for Algols, RS CVn binaries and post T Tauri stars. The observation of comparable ratios between thermal X-rays and gyro-synchrotron emission in the 'quiescent' active corona and solar/stellar flares suggests that the coronal heating mechanism and the flare energy release are similar physical processes. In particular, the heating process of active stellar coronae seems to be associated by acceleration of electrons.

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46.07

Strong Microwave Radiation from "Solar-Twin" GV Stars

M. Gudel (JILA/NIST&CU), J.H.M.M. Schmitt (MPE Garching), A.O. Benz (ETH Zurich)

We report the detection of four solar-type main-sequence G stars as strong, steady 8.5 GHz VLAs microwave sources. The targets were X-ray selected based on a previously reported relation between quiescent X-ray and microwave luminosities (Lx and Lp) of active stars. Lx was obtained from the ROSAT All-Sky Survey. The fluxes of the radio detections (6 < σ < 13) match our predictions within ~0.05 ~ 0.2 dex (for age estimates, see references below):

- star spect. d(pcm) flux (mJy) log(Lx) log(Lx) age (yrs)
- GI 97 G1V 13 0.28±0.03 13.8 28.9 ~ 2.0 x 10^7
- GI 755 G5V 19 0.18±0.03 13.9 29.4 ~ 1.0 x 10^7
- GI 559.1 dG3e 21 0.34±0.02 14.3 29.6 ~ 0.07 x 10^7
- HR 9107 G2V 29 0.19±0.03 14.3 29.5 ~ 1.0 x 10^7

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