ROTATION-ACTIVITY CONNECTIONS IN MAIN SEQUENCE BINARIES

O. Vilhu
Observatory and Astrophysics Laboratory
Univ. of Helsinki, Finland

S.M. Rucinski
Max-Planck-Institut für Astrophysik
Garching b. München, W. Germany

We have studied transition-region (NV + SiIV + CIV) and chromospheric (MgII) emission observed with IUE (Vilhu and Rucinski, 1982; Rucinski and Vilhu, 1982; Ayres et al., 1981) together with coronal (soft X-ray) emission observed with the Einstein satellite (Cruddace and Dupree, 1982; Walter, 1982) for contact (W UMa) and detached main sequence binaries. The components are main sequence stars (or near ms) and rapid rotators due to spin-orbit coupling. They can thus be expected to give information of dynamo-processes in rapid rotators, although the binary effects clearly produce extra complications in this discussion.

We note that the transition region (NV + SiIV + CIV, 10^5 ^{o}K) fractional fluxes (f/f_{bol}) become "saturated", i.e. unsensitive to the period and spectral type, below $P \approx 3$ days; at the same time soft X-rays still are quite sensitive on both quantities, as shown in Fig. 1. Notice also a clear distinction in coronal emission between detached and contact binaries.

Separate wavelength-bands (excitation levels) have quite different rotational-period dependences so that estimates of the total radiative losses are rather difficult to do. We find that the magnetically-confined coronal-loop models are a convenient way to try to estimate these losses. In the simplest models (see e.g. Rosner et al., 1978) the loop pressure p, multiplied by the filling factor ξ, is proportional to the transition region surface flux, whereas the maximum loop-temperatures T_{max} can be estimated using the X-ray data (for details see Vilhu and Rucinski, 1982). The total radiation from loops (mainly in EUV) can then be computed from

$$f_{loops} \propto \xi p \cdot T_{max}^{1/2} \text{ erg cm}^{-2} \text{ s}^{-1}$$

Dependence of this radiation (f_{loops}/f_{bol}) on period is shown in Fig. 2 for stars in our sample for which both IUE- and Einstein-data are available. The dashed line shows the dependence as estimated from the Ayres et al. (1981) scaling laws for fluxes ($X \sim (NV + SiIV + CIV)^2$) used

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together with the Walter's (1982) X(P)-relation for G stars (see Fig. 1). Comparing the Sun and the most rapidly rotating stars ($P \sim 10^{-2} P_{sun}$) we find f_{loops}/f_{bol} on average to increase with decreasing period slightly more steeply than the linear P^{-1} - relation; this rise may not, however, be necessarily linear. Note that the short-period RS CVn-stars HR 1099 and UX Ari (1099 and UX in the figure) are not strictly main sequence stars.

The chromospheric radiative losses are difficult to model, but in the Sun MgII 2800 resonance lines (h and k) may represent roughly 30 % of the identifiable emission-line cooling of the chromosphere. If a similar picture holds also in the rapidly rotating active stars (i.e. losses equal to MgII/30 % + loops), we find that in the Sun chromospheric radiation dominates while in rapid rotators most of the radiation comes out from the loops. In this way, if the total (chromo + TR + coro ≡ chromo + loops) radiation is considered, only the Sun in the Fig. 2 will be considerably shifted upwards by approximately 1.0 dex. In this case the rapid rotators ER Vul and σ^2CrB would follow quite closely the P^{-1} - relation when compared with the Sun. With still decreasing the period (but then a physical contact sets in) the total radiative losses "freeze in" or even slightly diminish (see Fig. 2).

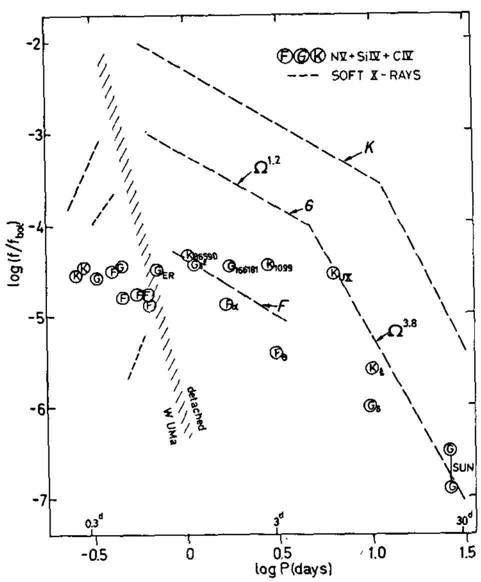

Fig. 1. Period-activity connections for transition region (NV + SiIV + CIV) and coronal (X) radiation.

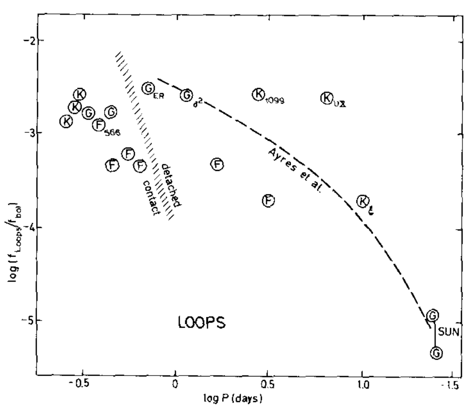

Fig. 2. Period-dependence of the total radiation from loops.

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