THE PROBLEM OF X PERSEI +

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X Per is a variable emission line star which shows among other peculiarities a weak X-ray emission (4U 0352+30) and a strongly variable IR excess (Ferrari-Toniolo et al. 1978, Viotti et al. 1980). In the past decade the star has undergone three phases of enhanched "activity" (1972-73, 1978 and 1980) characterized by brighter visual luminosity, excess in the Balmer continuum and in the IR, stronger X-ray emission, with intermediate periods of minimum activity (1974-77, 1979) when the optical-infrared energy distribution was closer to that of a normally reddened early type star (figure 2). But during most of its history the energy distribution largely deviated from that of a non-emission line early type star, and the first problem is to determine the interstellar extinction, disregarding any "local" effect. The strength of the 2200 A band in the UV spectrum of X Per is consistent with E(B-V)=0.35, a value close to the extinction towards other Per II stars: ζ Per (0.34), o Per (0.31), ξ Per (0.32, Viotti & Lamers 1975). The i.s. Lyα line observed in the high resolution IUE spectrum of X Per obtained on 1979, December 23, has a FWHM of 11.0 A corresponding to N(HI)=4.9 10^{20}cm^{-2}. The Copernicus observation of H_2 lines(of not good quality) gives N(H_2)$\simeq$1.1 10^{21}(Mason et al. 1976). A much lower value of 3-5 $10^{20}$was derived by Snow (1976, 1977) for o and ζ Per. Taking for X Per N(H_2)$\simeq$5 10^{20}we have N(H total)$\simeq$1.5 10^{21}, yielding to N(H)/E(B-V)=4.3 10^{21} cm^{-2}/mag in agreement with Bohlin law (1975).

At minimum luminosity the IR excess vanishes or is much smaller (figure 2) and the Balmer discontinuity is closer to that of a BOV star (de Loore et al. 1979). We then derive from the colours at min.(U-B=-0.78, B-V=0.08; V=6.72) E(B-V)=0.40 and $(B-V)_o$=-0.31.

+ Based on observations with the International Ultraviolet Explorer (IUE) collected at the Villafranca Satellite Tracking Station of ESA.

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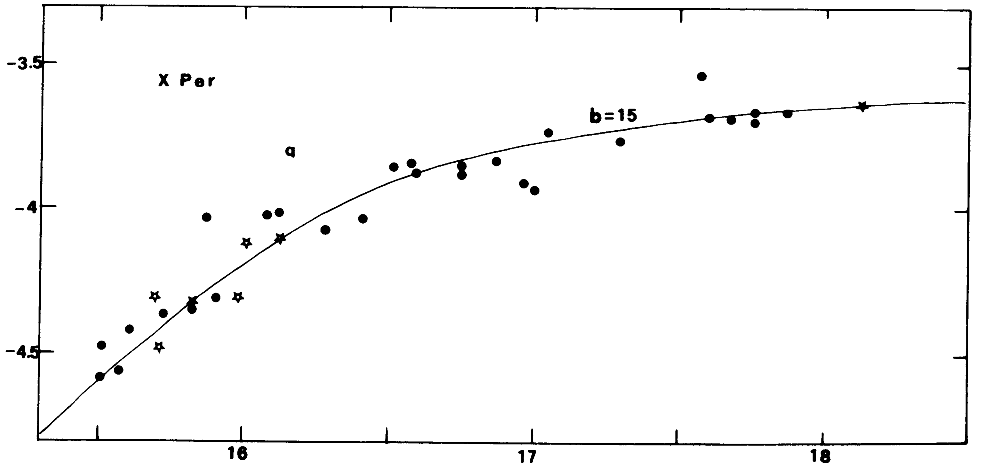

Figure 1 Curve of growth for the UV interstellar lines of ionized species and of NI, OI. Stars: CIV, SiIII,IV, AlIII. The solid line is the theoretical curve for b=15 km/s from Spitzer (1978).

We have identified in the IUE spectrum of X Per 63 i.s. lines of neutral and ionized elements (H,C,N,O,Mg,Al,Si,S,Mn,Fe,Ni,Cu,Zn) and of CO. Their intensity is systematically stronger than those of o and ζ Per measured by Snow. This should be ascribed to a large velocity dispersion of unresolved absorption components, implying that in front of and close to X Per there are additional low and high temperature i.s. media. CO is stronger than expected from E(B-V) but we note that a strong CO emission towards X Per was found by Knapp & Jura (1976). A preliminary curve of growth analysis following the method described by Spitzer (1978) gives a good fit for a velocity dispersion of 15 km/s for all the ionized lines and for NI, OI (figure 1), and of 5 km/s for the other neutral elements. Taking logN(H)=21.18 as above, a large element depletion is derived for all the elements with respect to the Sun, in particular for Al,Mg,C,Si and Fe. The high ionization i.s. lines of CIV, SiIII,IV, AlIII are much stronger than in the nearby stars implying the presence of a hot local medium, probably resulting from photoionization by a hot radiation field rather than from interaction of the stellar wind with the i.s. medium, also because there is no sistematic velocity difference with the other i.s. lines. The UV spectrum of X Per shows broad asymmetric resonance lines belonging to a large ionization range (from SiII to CIV and probably NV, Viotti et al. 1980) formed in the outer layers of the expanding envelope where large temperature differences seem to be present. The

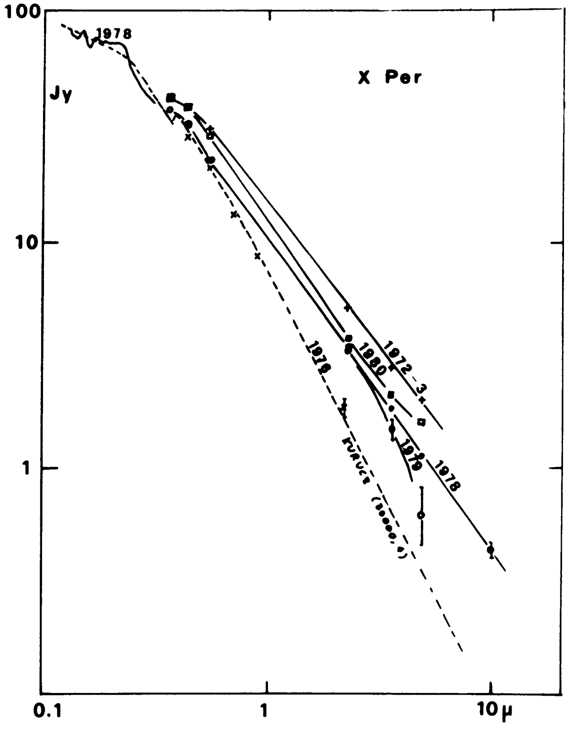

Figure 2 : The energy distribution of X Per in different epochs. Crosses : 1972-73, x : November 1976, dots : Nov. 1978, circles : Dec. 1979, squares : Aug.-Sept. 1980. The IUE spectrum of Oct. 1978 and the Kurucz (30000,4) model atmosphere are shown. See Ferrari-Toniolo et al. 1978. Persi et al. 1977 and this Symposium, Viotti et al. 1982.

excited lines of HeII, NIII, OIV that are formed in the deepest parts of the atmosphere (and might be considered as "photospheric"), are broad and symmetrical indicating a large rotational velocity of about 200 km/s of the "star". We conclude that a large acceleration of the stellar wind should take place in the upper atmosphere, up to about 650 km/s (Bianchi & Bernacca 1981). No significantly large variation of the line intensity and profile, in particular of the resonance lines was found from a preliminary analysis of the UV spectrum of X Per during 1978-79 notwithstanding the large luminosity changes observed during that period, supporting the idea that the observed optical and IR variations probably took place in the higher atmospheric layers. Figure 2 shows the energy distribution of X Per during different activity phases. It is evident that the whole

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optical-IR spectrum is varying with a larger amplitude in the IR. This suggests that it could be the result of two contributors, one constant and close to the spectrum of an early type dwarf with $V_0 \simeq 5.62$, $(B-V)_0 = -0.31$, and the other one strongly variable which could be associated to emission from the variable outer layers. However difficult is to say if the observed variations are related to strong changes of the mass loss rate, or it is largely due to structural changes of the expanding envelope. We have estimated the rate of mass loss from the IR excess of $4\ 10^{-7}$ $M_\odot$/yr (Persi et al. this Symposium) which is probably variable in time and largely depends on the adopted model, but that is definitely much larger than the rate of 10^{-8}–10^{-9} estimated from the asymmetric profiles of the UV resonance lines (Hammershlag-Hensberge et al. 1980,Bernacca & Bianchi 1981). We hope that a more detailed analysis of the UV line profiles will overcome this discrepancy.

Finally, variations of the X-ray flux was found that seem to be associated with the activity of X Per (e.g. de Loore et al. 1979, White et al. 1976), indicating that it should be originated in a region, or compact star, not too far from X Per. However the presently published data on the X-ray emission are not sufficent to give a clearer picture.

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