ETA CARINAE: UV CONSTRAINTS ON POSSIBLE MODELS.
THE CLOSE BINARY HYPOTHESIS

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η Car is one of the brightest stars in our Galaxy. For its luminosity, huge mass loss, large variability can be considered as an ideal laboratory to study the LBV phenomenon, and to give constraints on possible models of LBVs. We propose that η Car is a - possibly binary - F-type hypergiant whose wind is heated by dissipation of mechanical energy.

Table 1. Basic data (and references) on η Car.

distance	2500	(7)	mass loss	0.075 M☉/yr	(3)
bol mag	0.0 mag	(3)	terminal vel	500-800 km/yr	(4)(5)
radiative power	5×10^{6} L☉	(3)	E(B-V) interst	0.4 +/- 0.1	(7)(10)
mechan power	7×10^{6} L☉	(3)	E(B-V) circum	0.7:	(3)(5)
eff temperature	7000-10000 K	(9)	Si/C abundance	0.3-2	(10)
eff radius	~1000 R☉	(10)	el density	10^{9}-10^{11} cm^{-3}	(10)

1. ULTRAVIOLET. With the aim of discussing possible models for η Car, we have analyzed (10) the UV spectrum of the star and compared with ground based observations. The simultaneous presence of both low and high ionization resonance lines with broad P Cygni profile suggests a wide ionization range throughout the whole wind, which is hard to explain with a simple photoionization model. The wind is most likely collisionally ionized. The most intense emission lines (NIII], SiIII], high excitation FeII and FeIII) display broad and narrow emission components, indicating that the expanding envelope of η Car is asymmetric with low and high velocity regions. The weakness or absence of CIII] 1909 A in emission and the strength of SiIII] (Fig.1) can be explained by a Si/C overabundance of a factor >3 to >20 (10). C and O are however present in the UV spectrum of η Car with saturated CII and OI resonance lines, whereas CIV is rather weak. Note also that OI is present with a strong IR emission (1)(8). We believe that at present no accurate abundance estimate is possible in the absence of a reliable wind model of η Car.

K. Davidson et al. (eds.), Physics of Luminous Blue Variables, 277–278.

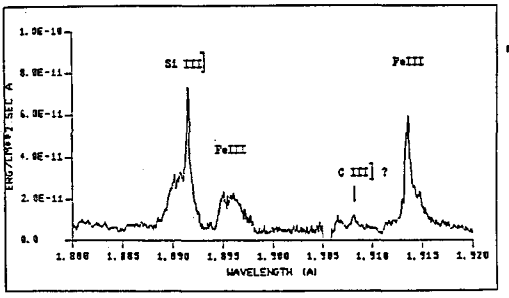

Fig.1 The UV spectrum of η Car near the SiIII and CIII lines.

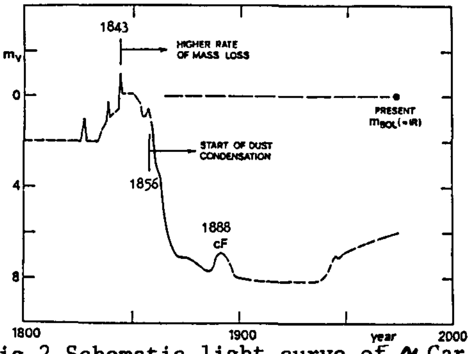

Fig.2 Schematic light curve of η Car

2. VARIABILITY. During the last century η Car underwent dramatic light variations (Fig.2). The large fading started in 1856 was due to the start of dust condensation in the wind, but the total power remained the same (3). The event could have been caused by an increase of the mass loss around 1843, followed by opacity enhancement in the wind, which favoured fast moleculae and dust grains formation (dust catastrophe)(6). The light history, luminosity and lifetime of η Car suggest that it is a massive object (>100 M⊙), which is presently a rather cool star (Teff<10000K) in a rapid evolutionary stage (9). As in AG Car and other LBVs, the smaller light fluctuations and related spectral changes are likely caused by small structural changes of the wind followed by significant opacity variations, not by shell ejection.

3. BINARITY. Speckle observations revealed that η Car is a multiple system composed of 4 stellar objects, one much brighter than the others (11). Thus η Car is a Trapezium-like system, and the individual components may likely be close binary systems. Many of the peculiarities of η Car (e.g. the wide ionization range and the X-ray emission) could be caused or enhanced by interaction in a close binary system. Binarity is also suggested by the asymmetries of the emitting envelope and of the circumstellar nebula (the homunculus), suggesting preferential directions of mass ejection. Binary interaction might eventually affect the wind structure and be the origin the observed variations of η Car and possibly of other LBVs.

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https://doi.org/10.1017/S0252921100004619 Published online by Cambridge University Press