Analysis of the long-term variability of η Carinae

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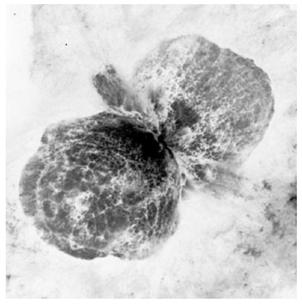
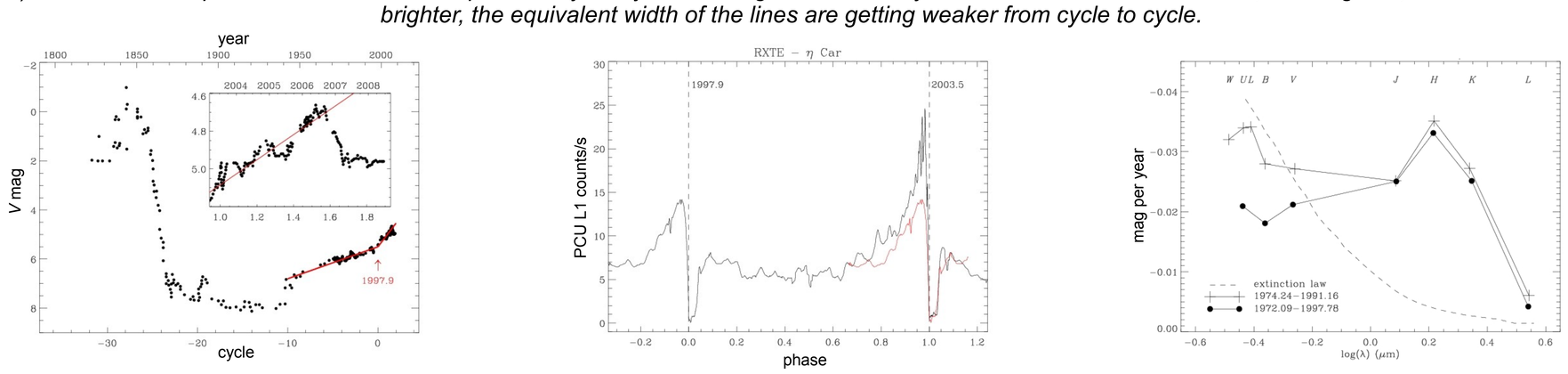
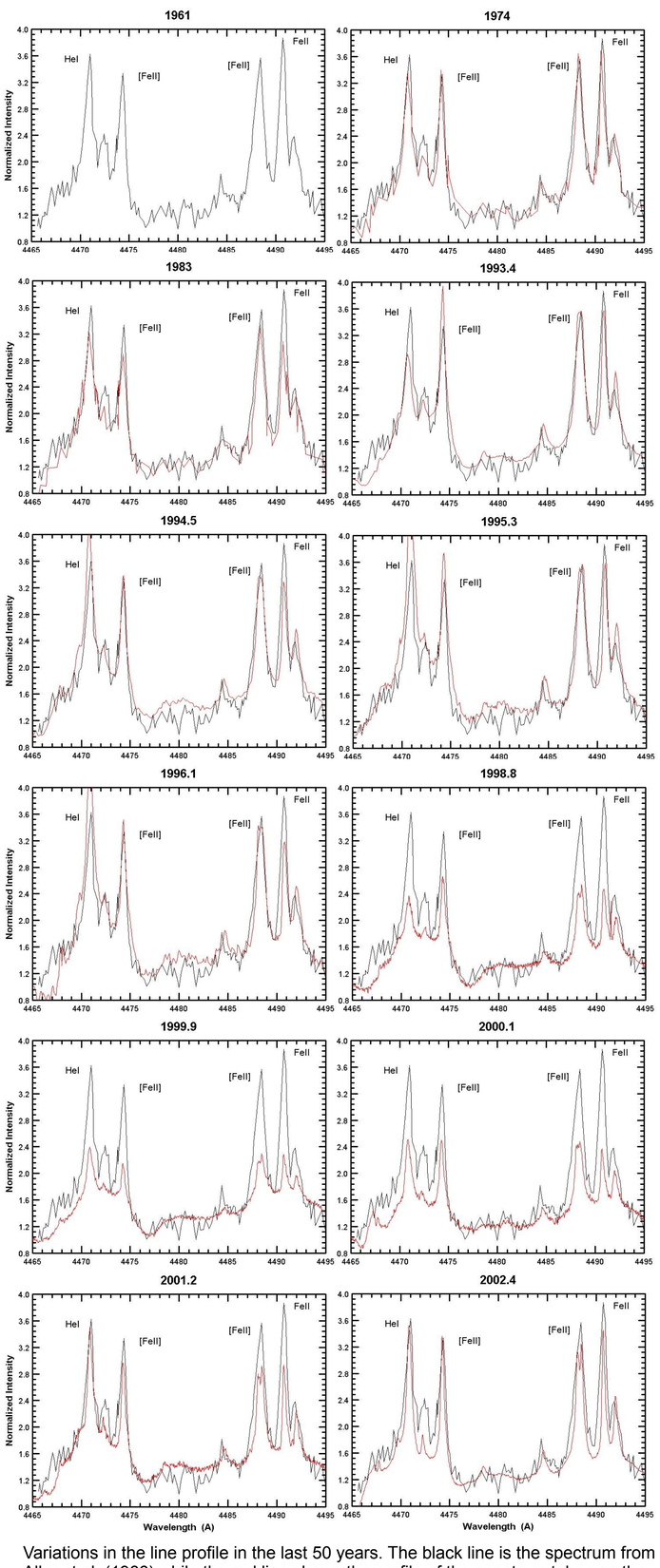


ABSTRACT

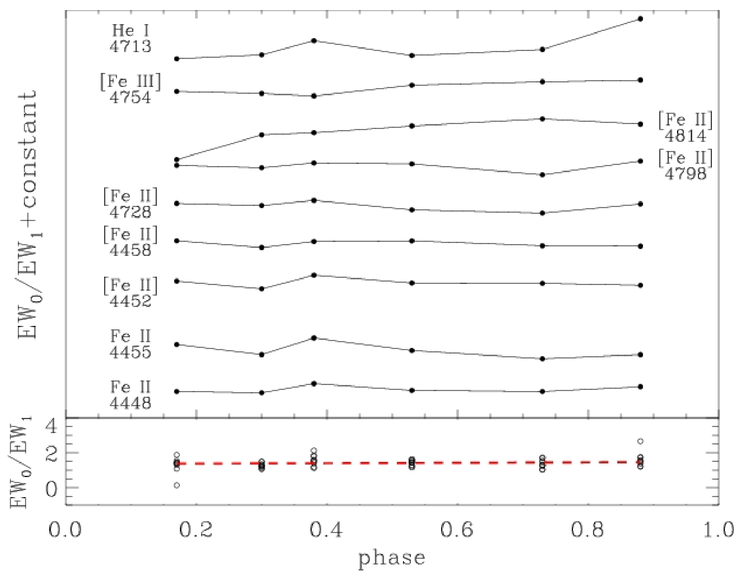
During the last 50 years, Eta Carinae has increased its brigthness at variable rates. For instance, the central source presented V=8 from 1910 to 1940, when it suddenly increased its brightness by 1 magnitude in a few years. Since then, the brightness of the central source has increased almost linearly with time at a rate of approximately 0.03 mag per year. However, after the spectroscopic event of 1997.9, the rate increased to 0.2 mag per year and remained so until mid-2006, when a drop in the brightness of the central source was observed (almost 30 per cent in less than one year!). In this work we present the results of our preliminary study on the long-term variability of the central source of Eta Car, showing that, while the central source is getting brighter, the equivalent width of the lines are getting weaker from cycle to cycle.



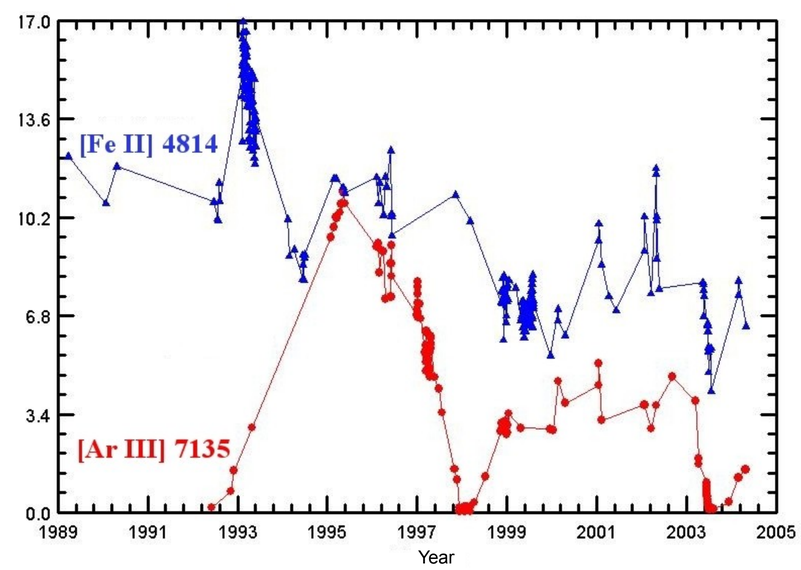
Left panel: Lightcurve of Eta Carinae. After the Great Eruption (circa 1840) the freshly formed (Homunculus) nebula enshrouded the central source causing its brightness to rapidly decrease from V=-1 to V=7-8. Around 1890, another eruption has occured which formed the Little Homunculus. During the period from 1900 to 1948, the brightness of the central source remained almost constant but around 1950 it increased by one magnitude within about 10 years. Since then, the brightness of the central source is increasing linearly. However, as can be seen in the lightcurve above, we can divide it in two parts: from early 50's up to the spectroscopic event in 1997.9 and from 1997.9 up to mid-2006. The latter represents a period of steeper increase in the brightness of the central source when compared with the former. **Middle panel**: X-ray lightcurve. The vertical lines indicate the position of each spectroscopic event. The red curve is the observed lightcurve in the previous cycle shifted by 2022.7 days. **Right panel**: Rate of increase in the brightness of the central source. The dotted line shows the behaviour of this rate if it was only due to the circumstellar dust evaporation. The other curves show the observed rates in the indicated band.



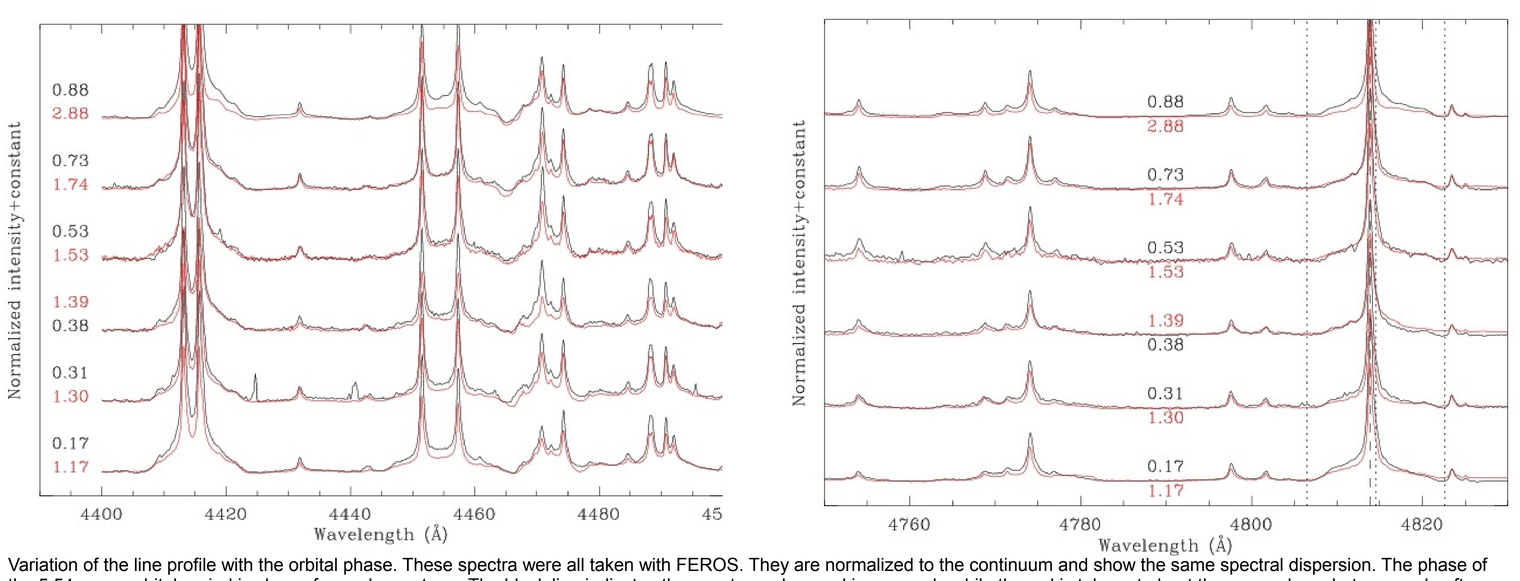
Variations in the line profile in the last 50 years. The black line is the spectrum from Aller et al. (1966) while the red line shows the profile of the spectrum taken on the epoch indicated at the top of each panel.



Ratio of the equivalent widths of some selected lines (the index 0 corresponds to our reference cycle and the index 1 to one cycle after). The upper panel shows the isolated behaviour of each line (the vertical axis is in arbitrary units). The bottom panel shows the actual equivalent width of each line. The red dashed line is a linear fit to the points and gives the ratio by which the equivalent widths of the lines are decreasing (about 35%).



Variation of the equivalent width of the [Fe II] 4814 (7.87 eV) and [Ar III] 7135 (40.74 eV) along the cycles. The low-excitation lines are decreasing at a lower rate than that observed for the high-excitation lines.



Variation of the line profile with the orbital phase. These spectra were all taken with FEROS. They are normalized to the continuum and show the same spectral dispersion. The phase of the 5.54 years orbital period is shown for each spectrum. The black line indicates the spectrum observed in one cycle while the red is taken at about the same phase but one cycle after.

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