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ETA CARINAE RECOVERING FROM THE 2003.5 SPECTROSCOPIC EVENT

GROH, J. H.[1]; DAMINELI, A.[1]

[1] Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo, São Paulo, Brazil

The Luminous Blue Variable star Eta Carinae suffers spectroscopic events every 5.5 yr characterized by the fading of the high excitation lines of [Ar III], [Fe III], [Ne III] and [S III] (Damineli 1996). The last of such events occurred around the end of June 2003 (Abraham et al. 2003). The line of highest excitation energy [Ne III] λ3868 vanished on June 23th, followed by the others of lower energy. The narrow component of HeI λ6678 vanished on June 29th, which implies in a period of 2025 days, when comparing present data with previous observations. We adopt that date as the zero phase of the cycle 11, in order that cycle 10 started in December 1997 and cycle 9 in June 1992. The ingress in the phase of totality for all lines ocurred within days of the X-ray minimum (Corcoran 2003).

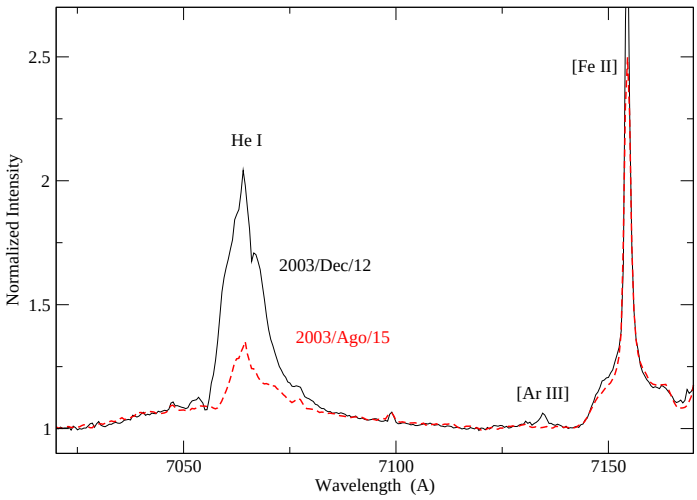

Figure 1. He I, [Ar III] and [Fe II] lines near the center of the 2003.5 spectroscopic event (August 15th) and in December 12th, when it was ending.

As noted in previous spectroscopic event (Damineli et al. 2000), different lines should recover from the minimum in different times, following the inverse sequence of excitation energy they did when faded. Unfortunately, the star could not be observed from the

ground through October-November, when the lower excitation lines like [N II] and [Fe II] were expected to be recovering. We succeeded to take spectra at the Observatório Pico dos Dias (LNA/Brazil) on 2003 December 12-14, corresponding to phase 0.08. We used the 1.6m telescope and Coudé focus to achieve spectral resolution of 0.6 Å and spectral coverage from 3800 Å to 11000 Å with S/N > 100 in the stellar continuum. Such observations proved to be crucial, since all the lines that faded are showing up again, except for [Ne III] λ3868. The line [Ar III] λ7135 is faint but definitively present, as can be seen in Figure 1. This figure displays the present spectrum and another taken on August 15th, when the spectroscopic event was near the center of the event.

In the December spectrum, the narrow components of He I lines start to rise again, and the broad components are much stronger than those in August. The lines [S III] λ6312 and [Fe III] $\lambda\lambda$4658-4701 are mildly intense as compared to [N II] λ5755 that is almost half way of full recovery. Also HeI λ10830 is much stronger than that inside the minimum. Another remarkable feature of our data is that [Ne III] is absent from the spectrum along the last 22 weeks, almost twice the duration of totality in X-rays (Corcoran 2003). [Ne III] is expected to reappear in the next weeks, indicating that the time delay between different lines to egress from the event is spread in a timescale of a month. These time delays could be related with the recombination times and the progress of the ionization front in the circumstellar envelope.

We have noticed previously that the spectrum is evolving secularly, in the sense that the high and intermediate excitation lines are becoming fainter and fainter from cycle to cycle (Damineli et al. 1999). In Figure 2 we compare the lines of [Ni II] λ6666 and HeI λ6678 around phase 0.08 in the last three cycles. It can be seen that the secular fading is continuing, but the step between the previous (10) and present cycle (11) was smaller than from cycle 9 to 10. It is seen also that the P Cygni profile in He Iλ6678 is deeper than previously. Other lines of He I and Si II show the same trend. Since the radial velocities of these P Cygni components are not changing, it seems that the stellar wind is becoming optically thicker.

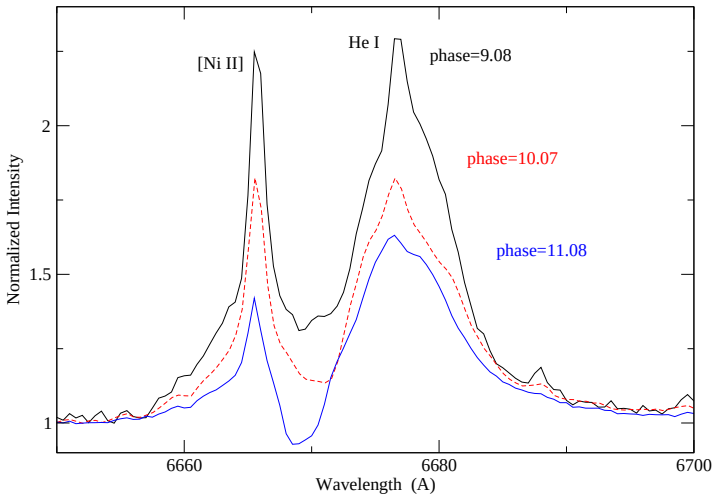

Figure 2. Comparison between line intensities in three subsequent cycles, around the same phase. We adopted the period = 2025 days and T_0 = 2452820 (2003/June/29) as the starting point of cycle 11.

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