The 2009 Eclipse of Epsilon Aurigae

Spectroscopic changes pre first contact

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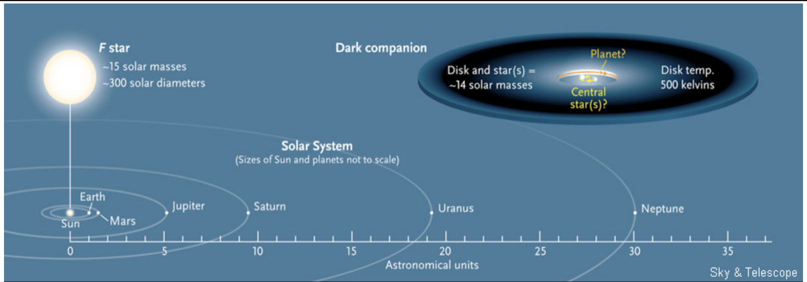
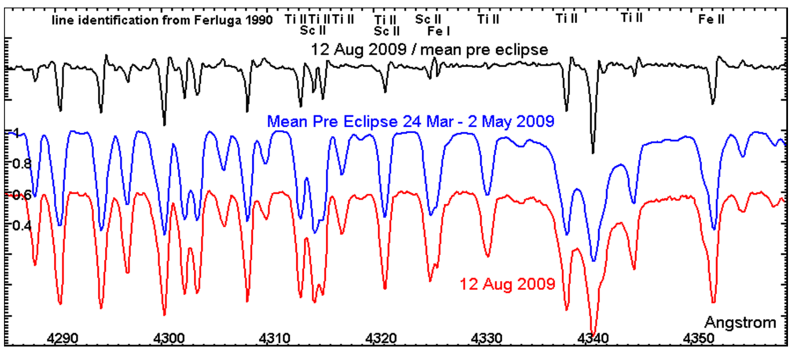


The "Consensus Model" (Epsilon Aurigae Workshop, Tuscon Arizona 1985)[1]

Every 27.1 years the 3rd magnitude star epsilon Aurigae is partially eclipsed by an unseen companion for approximately 2 years. Although the above diagram represents the current majority consensus view, much about the system is still unknown or open to debate.

As part of an international campaign covering the next eclipse due to start in 2009, high resolution (~0.3 Angstrom) spectra are being taken at frequent intervals. The equipment consists of a Lhires III spectrograph (modified to extend the range into the far red) coupled to a 200mm aperture Cassegrain telescope, located in NW England[2]. Specific wavelengths are covered which showed variations during previous eclipses. The increased frequency of observation should reveal any signs of evolution or detailed structure in the semi-transparent parts of the eclipsing body.

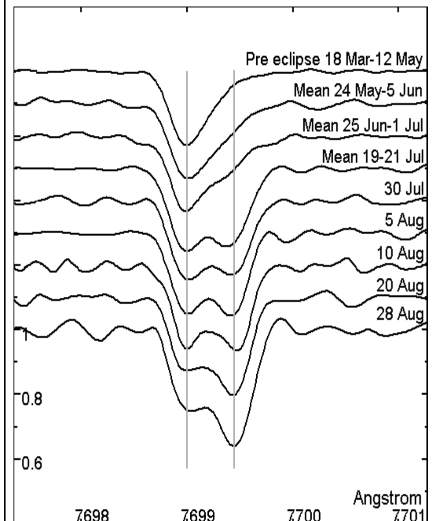
The shell spectrum



Subtle changes are seen during eclipse at the blue end of the spectrum, superimposed on the ionised metal lines from the primary star photosphere. These are revealed by dividing spectra taken during eclipse by that of the primary outside eclipse. The resulting "shell" absorption spectrum is believed to originate from an ionised semi-transparent shell of gas surrounding an opaque eclipsing disc. This spectrum was studied in detail by Ferluga & Mangiacapra during the last eclipse[3].

The spectrum above was taken 12th August 2009, around the predicted time of photometric first contact and shows the emergence of the shell spectrum, though no brightness drop had been positively identified by this time. Note the narrowness of the lines compared with the photospheric lines.

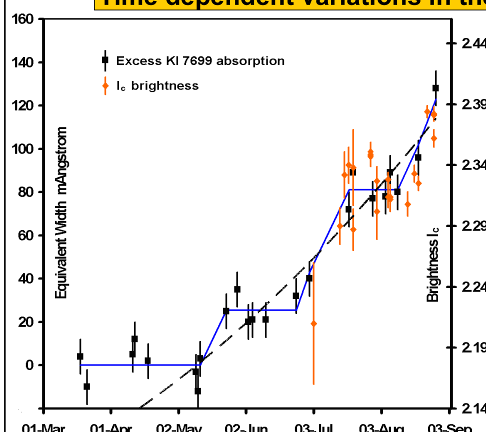
Evolution of the KI 7699 line



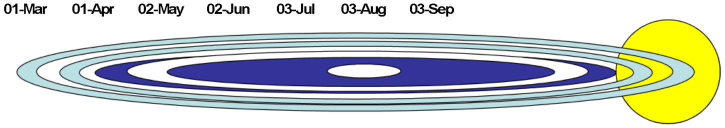
In the far red, the 769.9 nm neutral Potassium absorption line (KI 7699) shows little variation outside eclipse. During the last eclipse however an additional component was detected by Lambert & Sawyer[4], red shifted at ingress and moving to become blue shifted at egress. This behaviour is consistent with the eclipsing body being a rotating disc of material. The KI absorption is considered to come from a semi-transparent extended envelope surrounding an opaque disc (responsible for the reduction in brightness) and rotating with it.

Initially the line profile is similar to that seen by Lambert and Sawyer outside eclipse. From the end of May however there are signs of changes on the red side of the line profile and by 19th July an additional component can clearly be seen, red shifted +14km/s relative to the pre eclipse component, signalling the beginning of the 2009 eclipse[5]. Note that this is at least 6 weeks prior to first contact based on any dimming in the V band, which has not been detected as of 1st September. This early emergence of the additional KI component was also seen by Lambert & Sawyer during the last eclipse, though their data is sparse around ingress.

Time dependent variations in the KI 7699 line intensity



By subtracting the out of eclipse component in the KI 7669 line it is possible to estimate the magnitude (EW) of the absorption due to the eclipsing body. The increased frequency of observation allows a detailed study of this absorption with time. There are indications that the increase in absorption on the approach to photometric first contact may not be progressing smoothly. (Changes in brightness seen in the I band also correlate with the second step[7]).This could be an indication of inhomogeneity in the extended outer regions of the eclipsing body (perhaps part of a multi-ring structure similar to that proposed by Ferluga for the opaque inner region of the disc[6]). Further measurements at egress may clarify this.



1. *R E Stencel, Workshop on the recent eclipse of epsilon Aurigae, NASA conference publication 2384, 1985*
2. *www.threehillsobservatory.co.uk*
3. *S Ferluga, D Mangiacapra, Astron. Astrophys. 243, 230-238 (1991)*
4. *D L Lambert, S R Sawyer, PASP 98:389-402 April 1986*
5. *Central Bureau for Astronomical Telegrams CBAT 1885 27th July 2009*
6. *S Ferluga, Astron. Astrophys. 238, 270-278 (1990)*
7. *R. Miles, Golden Hill Observatory*

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