

Broadband Spectroscopy of the Corona during the Total Solar Eclipse of March 29, 2006

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Instrument—

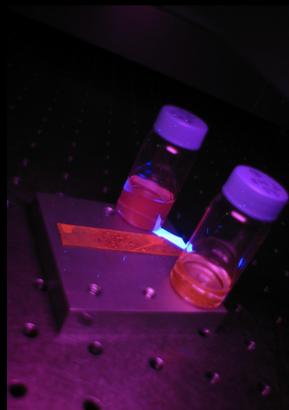
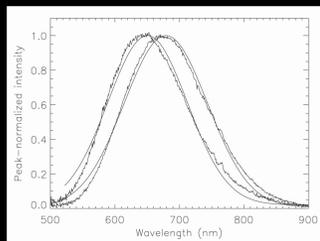
The broadband spectrometer consisted of a QE6500 Ocean Optics spectrograph with a maximum range of 350-1120 nm and a 200 x 1000 micron slit. High quantum efficiency in the spectrograph is achieved by integrating the light from the spectrograph detector. The spectrograph has no spatial resolution, therefore an incoherent home-built fiber bundle and a spherical f/1 mirror on a tracking mount were used for light collection. A digital video recorder was used for positioning the “telescope.”

The pictures show the full instrument in the lab and during the eclipse nestled in the observing tent.



Silicon Nanoparticles—

Silicon nanoparticles are suspected to exist in the dusty outer corona (Habbal 2003, Rao 2004) contributing UV fluorescence and accompanying broad emission features in the IR. Laboratory samples of fluorescing silicon nanoparticles were analyzed at the IfA lab following the eclipse with the broadband spectrograph and various other instruments (high QE CCD, InGaAs, and MCT) to discover the nature of their spectral output. Investigation in the infrared gave a negative result. The fluorescence spectrum is shown for two liquid samples with different solvents.



Gaussian Fits	x0	FWHM
THF	650.5	61.6
ISO	678.9	64.5

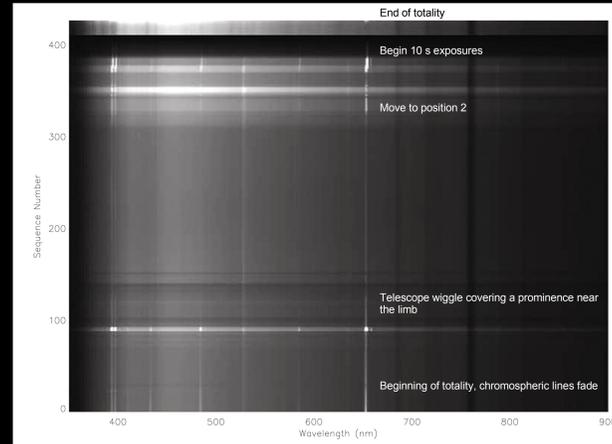


Figure 1 — A time sequence of reduced spectra collected during the eclipse. Events are indicated.

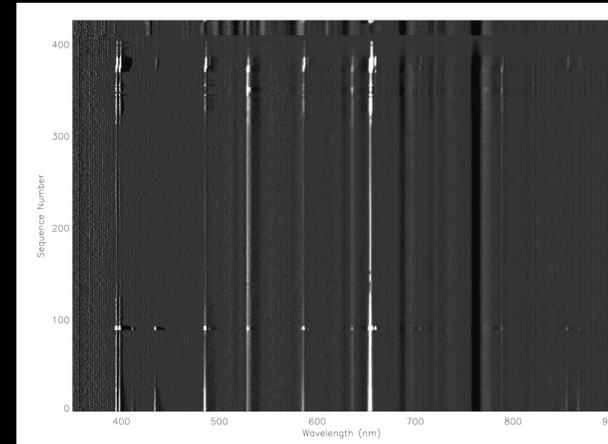


Figure 2 — The same time sequence flattened by subtracting the median smoothed spectra from each line.

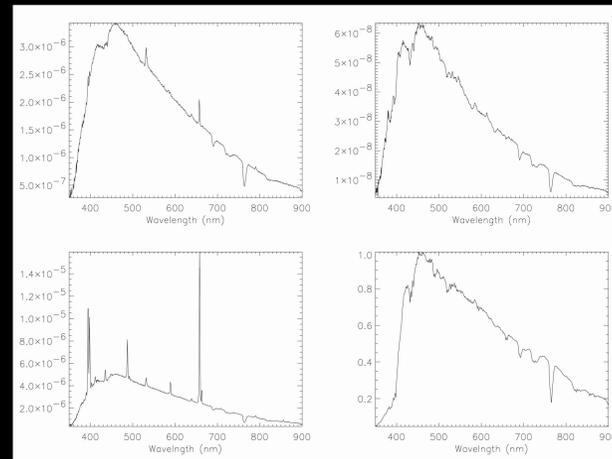


Figure 3 — The averaged spectrum from position 1 (top left), the averaged spectrum from position 2 (top right), the spectrum from a prominence (bottom left), the solar disk spectrum (bottom right).

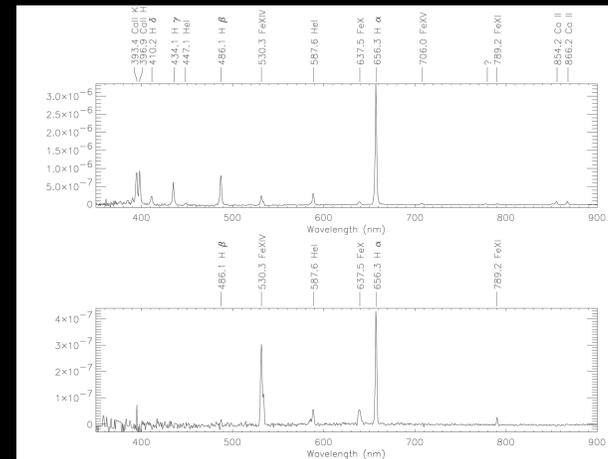


Figure 4 — The line spectrum from just after 1st contact (top), and the flattened average spectrum from position 1 (bottom).

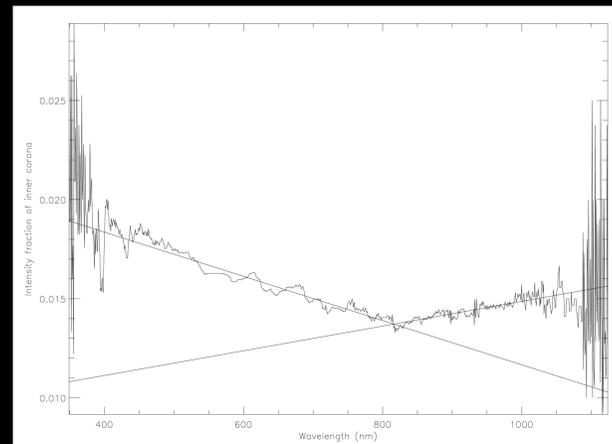


Figure 5 — The smoothed average spectrum from position 2 divided by the smoothed average spectrum at position 1, showing the color difference between the F and K corona.

Coronal Color—

Atmospheric models of the site done with MODTRAN indicate that the color of the sky changes by only a few percent over several degrees at positions near to the sun. Color differences between the solar disk or K-corona, and the F-corona can be accounted for by scattering due to dust near the sun. A model of the elongation dependence of color, defined as the ratio of intensities at 1000 and 500 nm, is done in Mann 1993.

The model falls within the error of these observations, however it fails to explain the rise in relative intensity at blue wavelengths and the change in slope at 800 nm.

I would like to thank all additional members of the Eclipse 2006 team for their invaluable help and support: Martina Arndt, Adrian Daw, Judd Johnson, Don Mickey, Huw Morgan, and Ilia Roussev. I would also like to thank Randy Chung for his patience and expertise during the design and construction process of the instrument.

References:

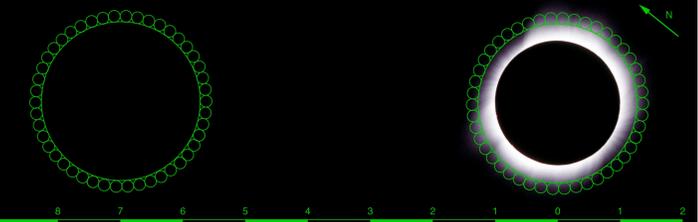
Habbal, S.R., et al., 2003, On the Detection of Silicon Nanoparticle Dust Grains in Coronal Holes, *ApJ*, 529, L87-90.
 Mann, I., 1993, The Influence of Circumsolar Dust on the Whitelight Corona—Study of the Visual F-Corona Brightness, *Planet. Space Sci.*, 41, 301-305.
 Rao, S., et al., 2004, Excited States of Tetrahedral Single-core Si29 Nanoparticles, *Phys. Rev. B*, 69.

Eclipse Summary—

A site near Waw an Namus, Libya was selected for the highest chances of good weather and longest duration of the eclipse. Second contact occurred at 10:15 UT, 12:15 local time, on 29 March 2006. During the 4m06s of totality ~400 exposures of 100 msec were taken at position 1, 1.25 R_{solar}; and ~20 exposures of 10 sec were taken at position 2, 5.75-8.25 R_{solar} to the northeast.



A picture of the site facing north-northwest just after first contact is shown above. The tent to the left contains one of the expedition's other experiments which Jeff Kuhn is seen preparing



The positioning during the eclipse and angular size of the fiber bundle are shown above. Position 1 is on the right and position 2 is on the left.

Conclusions—

The color model agrees with the data but a better understanding of the wavelength and elongation dependence of dust near the sun is needed. Could the fluorescence of nanoparticles be responsible for the blue color excess? Or is a different property of the F-corona responsible?



A photograph of the zodiacal light taken in early evening in the great Libyan Sahara.