

Preliminary Analysis of the 1999 Mercury Transit

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November 21, 2006

1 Orientation

Figure 1 is a raw image of the Solar Spectrum during the 1999 Mercury transit (Sodium Filter). The x-axis is the spectral dimension and the y-axis is the spatial direction. The physical disc of Mercury is located in the middle of the image and the darkening in the top of the image is due to the solar limb. The dark vertical band in the center is the Solar sodium line.

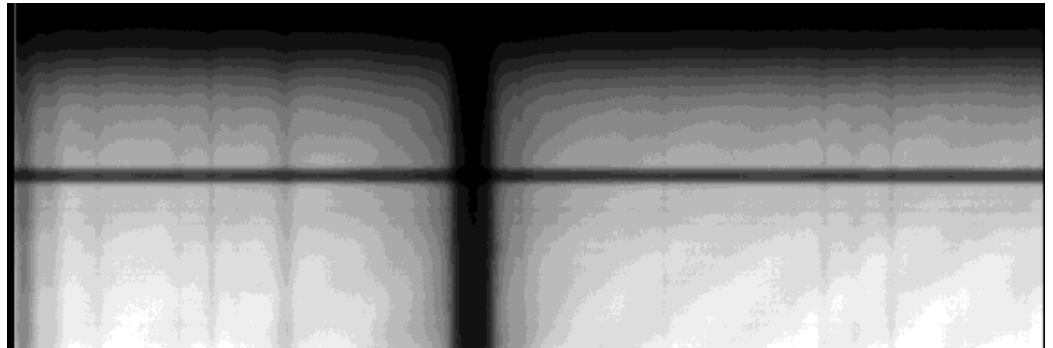


Figure 1: Raw image of Solar Sodium spectrum. Mercury is the dark horizontal band. The dark vertical band in the center is the solar sodium line.

2 Analysis

For each of the five spectral lines (Al, Ca, Ba, Na, Li) I will divide spectrum from Mercury's atmosphere by a solar spectrum. I will then try to identify the spectral lines. The Al spectra had a very low signal-to-noise and Mercury

was barely resolved, but further investigation showed that the data could still be analyzed.

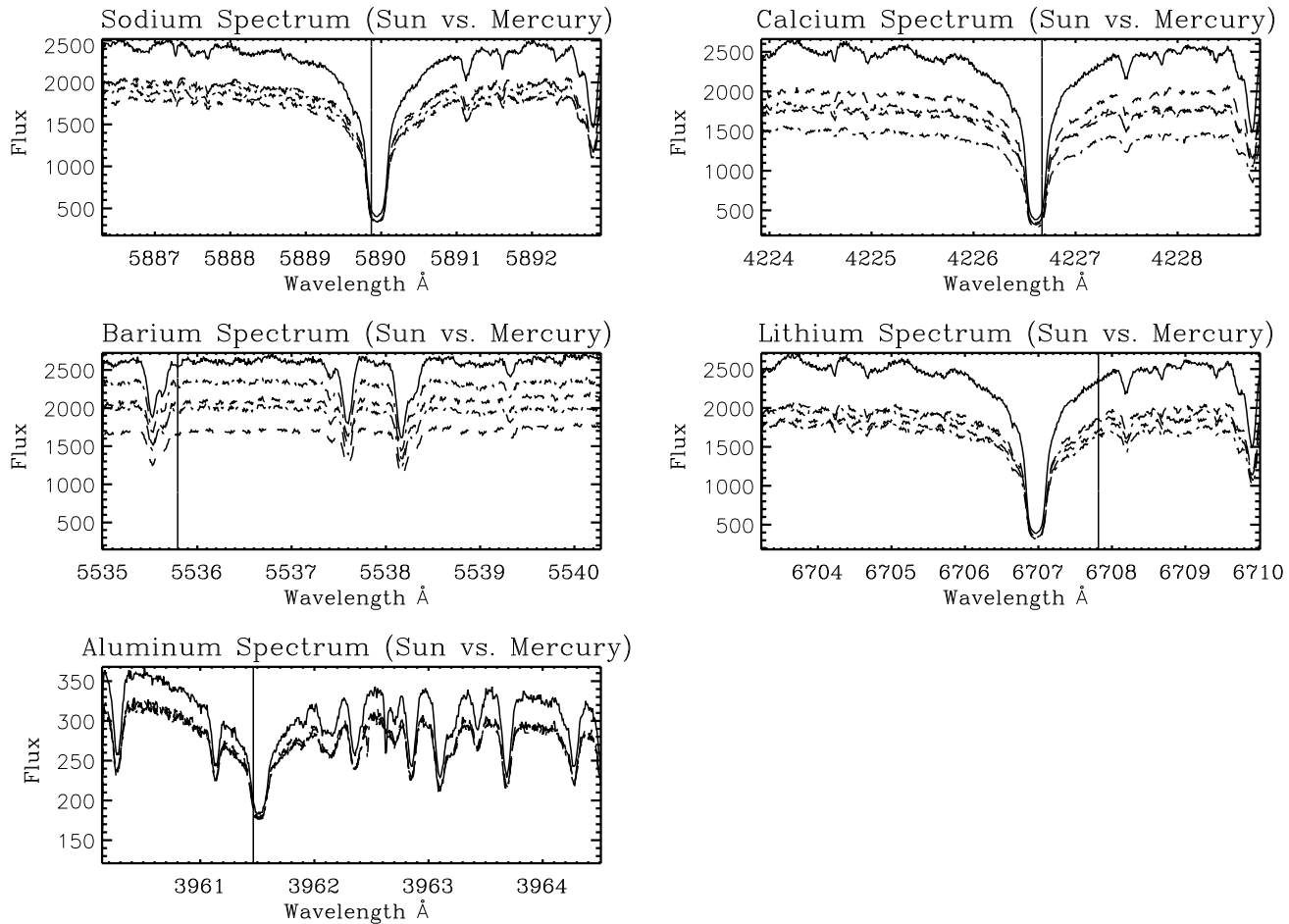


Figure 2: Solar Spectrum compared to Spectrum from Mercury's Atmosphere for each spectral line. (Two spectra from each side of Mercury). Solid Line=Solar, Dotted Line=Bottom of Mercury, Dashed Line = Top of Mercury

First, I identified where Mercury was located on the y-axis in the image. Then, I chose four lines from Mercury's atmosphere (two from each side). To begin, I compared the solar spectrum with spectrum from Mercury's atmosphere without any division, Figure ???. I will use this plot later to look for any anomalies. For now, everything looks normal. Next, I divided

each atmospheric spectral line with a chosen solar spectral line. I chose this line to be an quiet line on the sun. After flattening each atmosphere line, I co-added them. I plotted this resulting line along with the location of the spectral line, adjusting for doppler shift. The location of the spectral lines are given in Table 2. The shifted wavelength was calculated using Equation 1 with $v_{rel} = -4.17km/s$.

<i>Line</i>	λ	λ'
Calcium	4226.73 Å	4226.67 Å
Barium	5535.869 Å	5535.79 Å
Sodium	5889.950 Å	5889.87 Å
Lithium	6707.91 Å	6707.82 Å

The Spectral Lines observed during the transit.

$$\lambda = \frac{c-v_{rel}}{c} \lambda' \quad (1)$$

Below are the five plots of the spectral lines. In Figure 3, you can see a peak close to where the sodium line should be. In Figure 4 and 7 you can see a peak close to where the Calcium and Aluminum lines should be. For Figure 5 and 6, I don't know why the peak is so far from the line. Perhaps there is not an abundance of these elements, Barium and Lithium respectively. But then what is causing those peaks. I am still looking into causes for the small offset in Sodium and Calcium and the large offsets in Barium and Lithium.

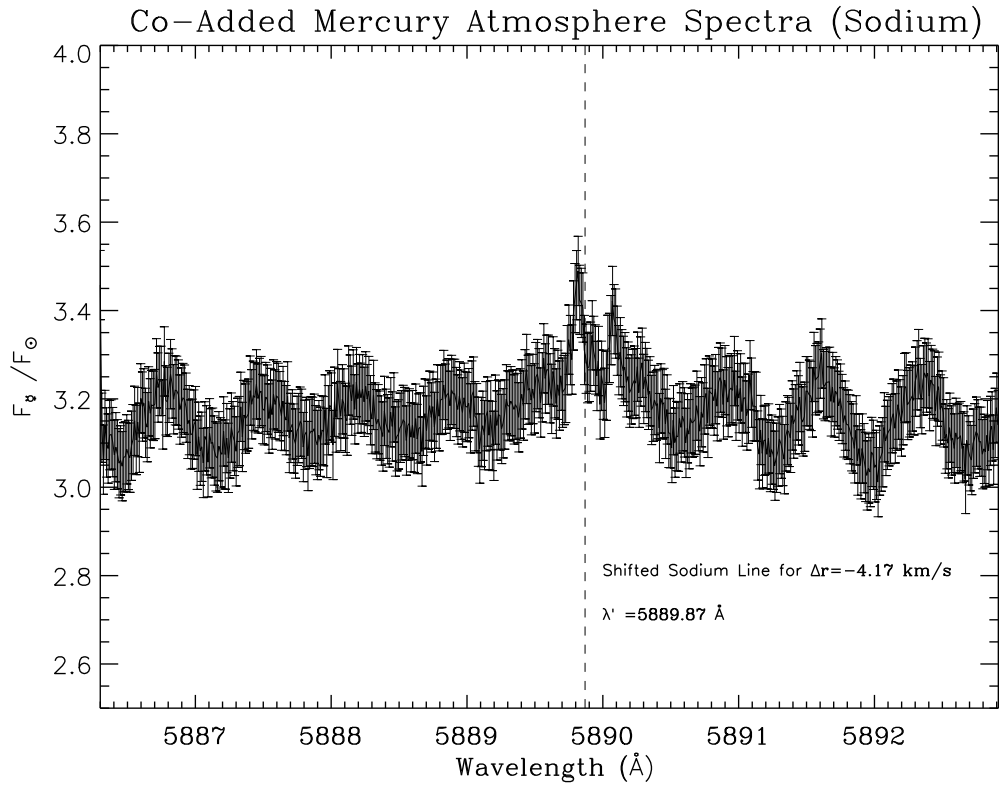


Figure 3: Sodium Spectrum of Mercury's Atmosphere

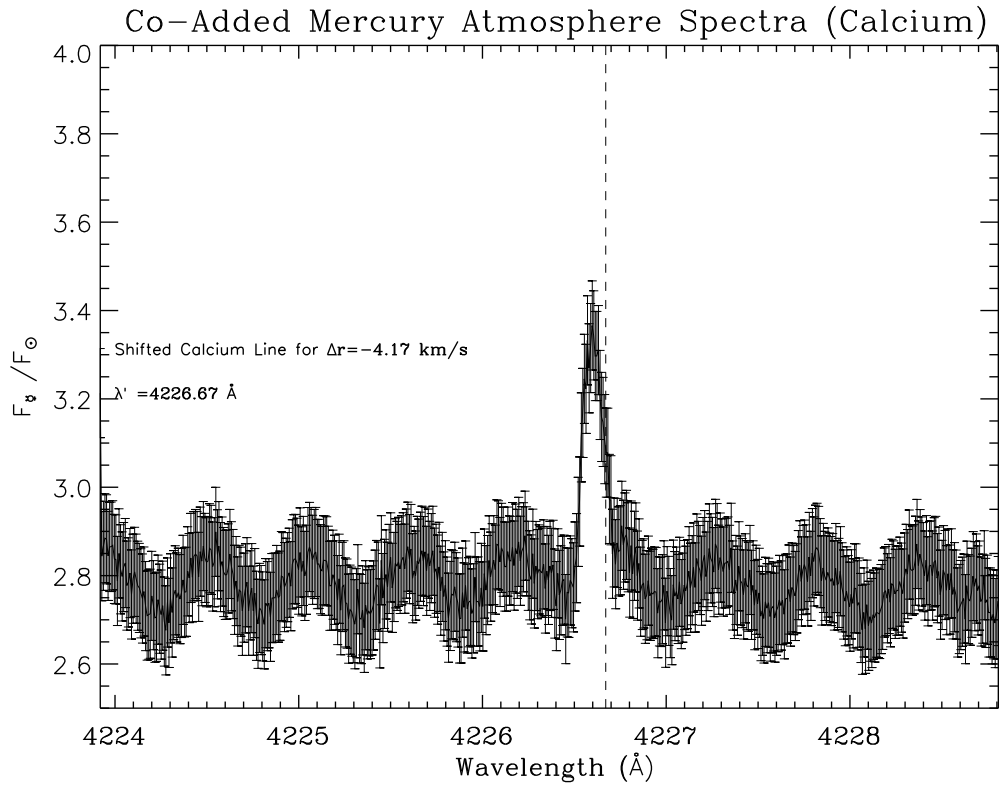


Figure 4: Calcium Spectrum of Mercury's Atmosphere

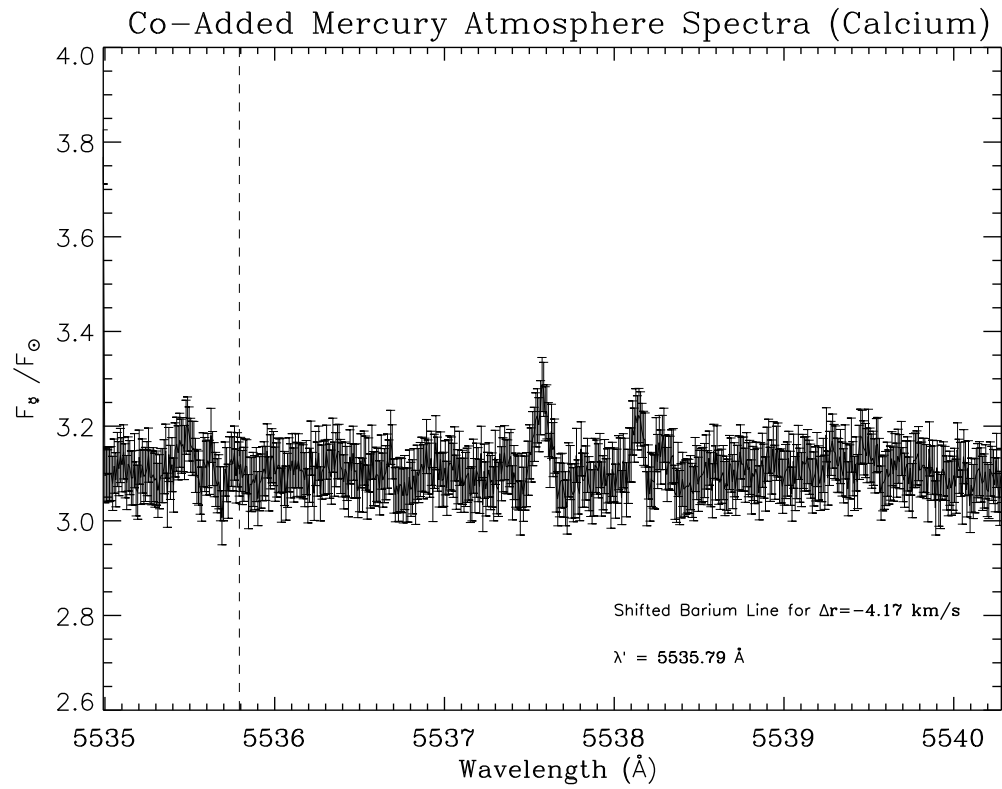


Figure 5: Barium Spectrum of Mercury's Atmosphere

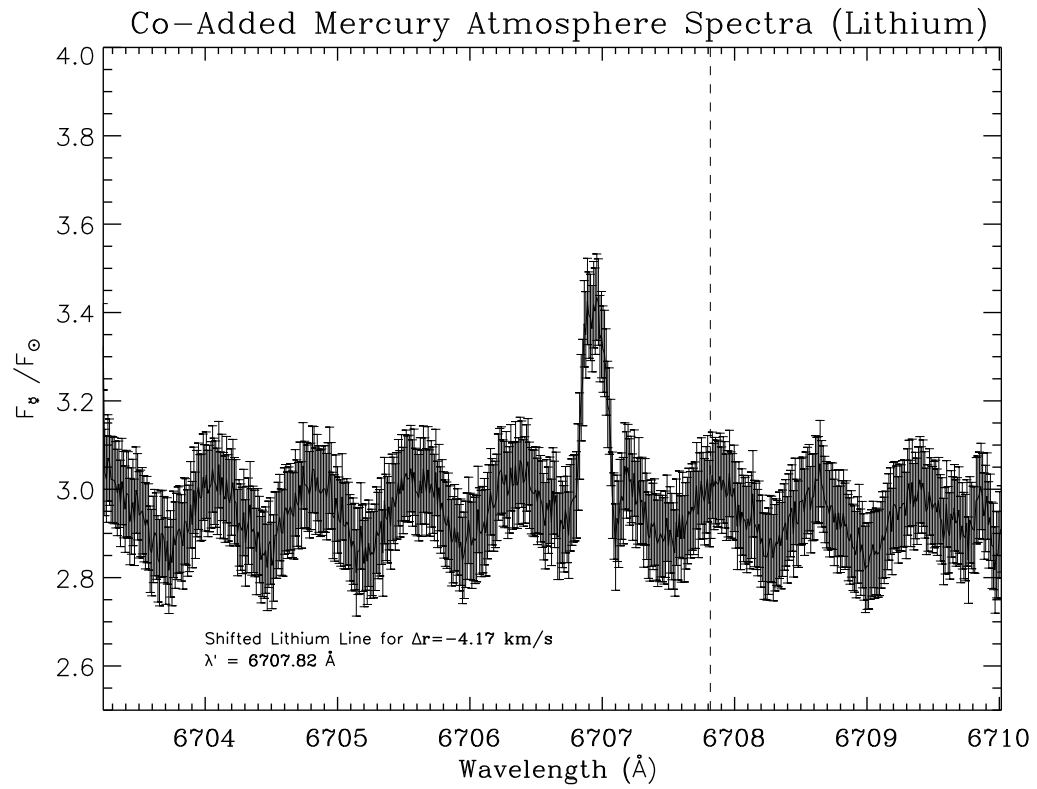


Figure 6: Lithium Spectrum of Mercury's Atmosphere

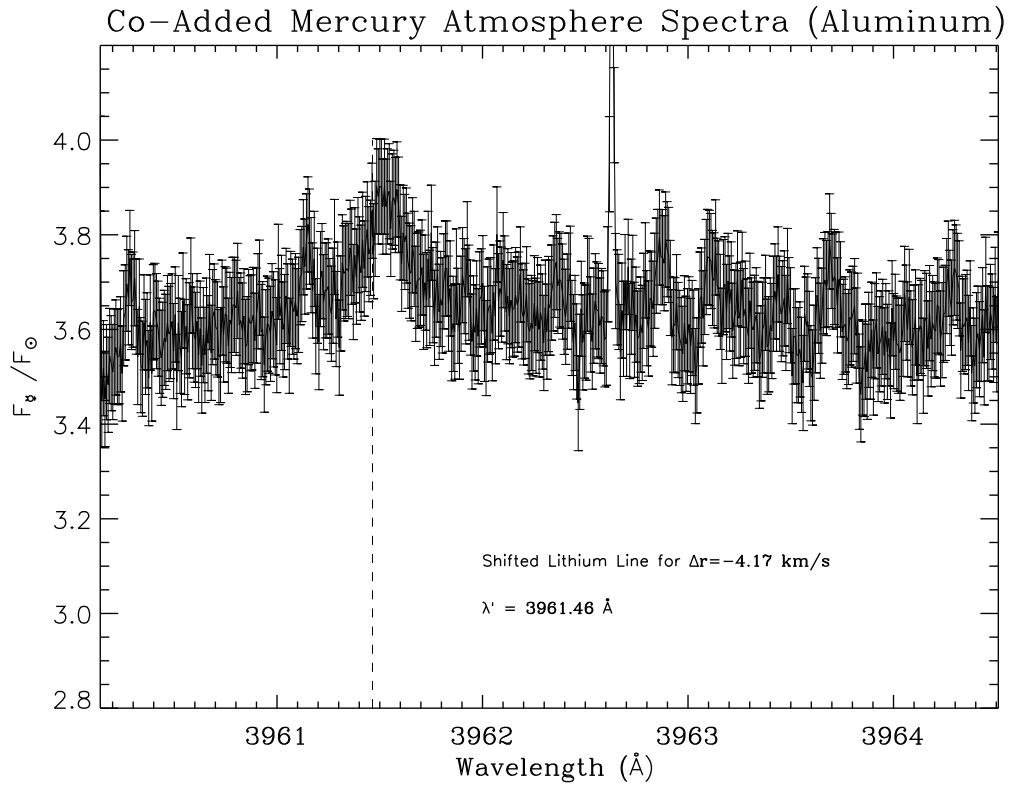


Figure 7: Aluminum Spectrum of Mercury's Atmosphere