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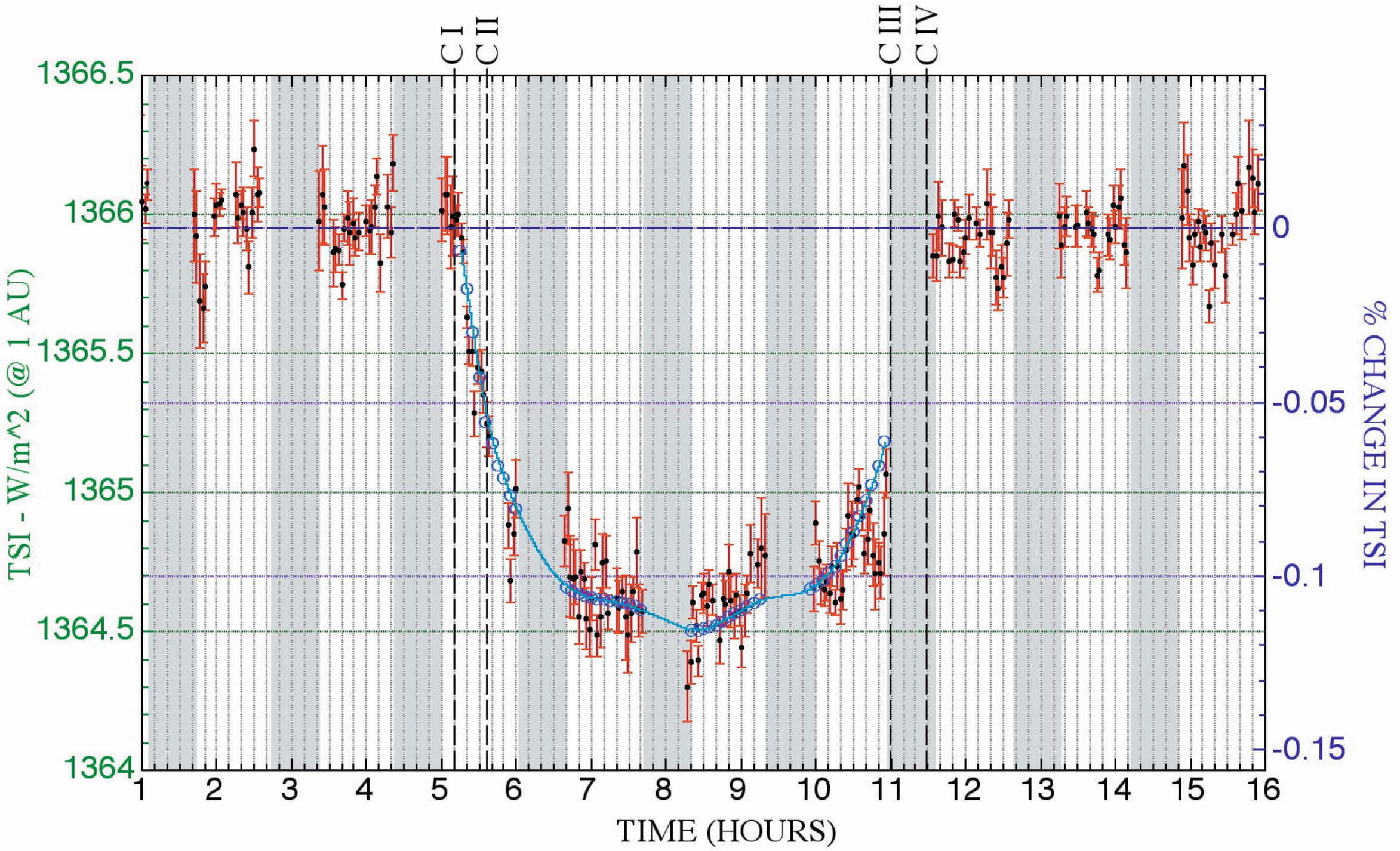
Abstract. We used observations made with ACRIM 3 on ACRIMSAT on 8 June 2004 at a cadence of 131 seconds to follow the effect of the transit of Venus, which lasted about 6 hours, on the total solar irradiance (TSI). Venus's angular diameter, in transit, is approximately 1/30 the solar diameter, so it covered approximately 0.1% of the sun's surface. With our ACRIM 3 data, we measure temporal changes in TSI with a one-sigma per sample (unbinned) certainty of approximately 100 milliwatts per square meter (0.007%). We found a diminution in TSI of approximately 1.4 watts per square meter (approximately 0.1%, closely corresponding to the geometrically occulted area of the photosphere) at mid-transit, compared with a mean pre-/post-transit TSI of 1365.9 watts per square meter. The measured light curve is complex because of the parallactic motion of Venus induced by the satellite's near-polar orbit, but exhibits the characteristic signature of photospheric limb-darkening when orbit-driven variations are accounted for. Analysis of the limb darkening can reveal temperature structure with height in the photosphere and asymmetries can, in principle, be attributable to planetary atmospheres. Similar observations will increasingly be obtained from exoplanet transits, so detailed analysis of the transit within our solar system will provide a useful analogue for interpreting the many more such transits expected to be discovered within the next decade.

A "MODEL" LIGHT CURVE

We constructed a "model" light curve by building a two-dimensional synthetic image of the Sun, parametrically representing the center-normalized radial limb-darkened surface brightness of the profile of the photosphere, $F(u)$, as suggested by Hestroffer and Magan (*Astron. & Astroph.* **333**, 338, 1998):

$F(u) = 1 - a(1 - u^b)$, where $u = \mathrm{sqrt}(1 - r^2)$ with r being the fractional solar radius.

From that, we find a best fit to the model light curve with $\boldsymbol{a = 0.85}$ and $\boldsymbol{b = 0.80}$, and times of contacts *(see table below)* very closely agreeing with expectations based upon the spacecraft orbital ephemeris. The total (area integrated) flux density "predicted" by the model was compared with what would be expected with regions of the limb-darkened photosphere occulted by Venus as it transits the solar disk. The resulting model light curve for times when the Sun was visible to ACRIMSAT is overplotted on the ACRIM 3 radiometric measures in the graph below.



The black points, and the associated red error bars, are the ACRIM 3 measures and their 1-sigma uncertainties. The blue circles are expected values from a geometrical orbit and solar limb darkening model (discussed below), during the transit (at 5 minute intervals) while the Sun was visible to ACRIMSAT. The Sun, as seen from ACRIMSAT, was occulted by the Earth during the times indicated by the regions of the vertical gray bars in the above graph, thus no data were obtained during those intervals.

VENUS TRANSIT TIMES FROM ACRIMSAT (LIGHT-CURVE SOLUTION)

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Contact I   (external tangency at ingress) = 05:10:19 UT
Contact II  (internal tangency at ingress) = 05:35:35 UT
Contact III (internal tangency at egress)  = 10:59:15 UT
Contact IV  (external tangency at egress)  = 11:29:30 UT
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