Introduction. We observed Io, one of the Galilean satellites of Jupiter and the most volcanically active body in the solar system, on 16 nights in 2003 using two similar techniques for separating individual volcanoes despite the relatively low resolution imaging from NASA’s Infrared Telescope Facility (IRTF). Jupiter occultations occur once every 1.7 days and can be used to separate the flux from individual volcanoes, but can only determine locations in one dimension (Spencer et al., 1990). Every six years, including 2003, the Earth passes through the orbital plane of the Galilean satellites allowing mutual satellite occultations to be observed from Earth (Goguen et al., 1988). Satellite occultations are superior to Jupiter occultations in two major respects and inferior in one. First, satellites provide occultations by a knife edge rather than by the diffuse Jovian limb, and thus provide higher spatial resolution. Second, since the satellites are comparable in size to one another, a particular region on Io will be crossed by the occulting satellite’s limb in one direction during ingress and likely a different direction during egress, enabling the computation of two dimensional images of these regions (Spencer et al., 1994). In addition, satellite occultations can occult any part of Io, while Jupiter occultations only occult the Jupiter facing hemisphere. Satellite occultations are inferior in one respect because while one half of all Jupiter occultations occur with Io in eclipse, it is extremely rare to find satellite occultations of an eclipsed Io (none were available in 2003). When Io is in eclipse, all near infrared light received is emitted by Io’s volcanoes with no contamination by reflected sunlight. Dates of observations and occulting body are shown in Table 1.

Satellite occultations Similar to Jupiter occultations of Io, when a satellite occults Io a series of images is taken and each image is processed to reveal the flux of Io. If no volcanoes are active, a smooth curve will result, with Io’s flux decreasing and increasing in the same manner. Active volcanoes will be seen as jumps in this curve (Goguen et al., 1988). If active volcanoes are seen during both ingress and egress and the path of the occulting moon during each varies appreciably, a two dimensional representation of the volcano’s heat output can be constructed (Spencer et al., 1994). We have begun processing our 2003 images and, unfortunately, the light curves show no apparent jumps (figure 2). In order to detect even small jumps, we are calculating the expected brightness of Io assuming no volcanoes are active and comparing this to the data. We are using a geometric calculation assuming constant surface brightness of Io. This calculation relies strongly on the ephemeris used, which gives us the relative positions and sizes of the two moons. Currently, we are using three different ephemerides, and each is giving us a different curve (figure 2), none of which fit the data precisely, suggesting that

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Figure 1: 3.5 μm brightness of Loki as measured primarily from Jupiter occultations. Some of the data were taken at other wavelengths (3.8, 4.8, and 3.39 μm). The 4.8 μm data were translated to 3.5 μm assuming a color temperature of 355 K (Spencer et al., 1992). The 3.39 μm data were translated to 3.5 μm using a color temperature found to be 500 K by equating data taken at both wavelengths at the same time. Similarly for the 3.5 to 3.8 μm color temperature of 500 K. Also included are 3.5 μm measurements from Galileo NIMS observations that resolve Loki. The dotted sine wave has a period of 540 days to show the periodicity of Loki’s brightenings through 2000, and the lack of periodic behavior since then. The time of the I32 NIMS observation is also indicated.

Figure 2: Callisto occultation of Io on January 18, 2003. The points are the flux of Io (with the background and Callisto removed) measured at the IRTF at 3.5 μm. The lines are calculations of the fraction of Io visible using three different ephemerides: Bureau des Longitudes, France; Rings Node by Mark Showalter (Post-Galileo #2); JPL’s Horizons.

problems still exist with the ephemerides of the Galilean satellites. We wish to refine the model, but are not hopeful that any volcanoes were active enough to permit two-dimensional reconstructions. We will be able, however, to estimate the maximum brightness of Loki (and other volcanoes) considering the nondetection.

REFERENCES:
Lopes et al. (2002) LPSC XXXIII, abs. no. 1793.
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