LOKI, IO: MODEL AND OBSERVATIONS.

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Introduction: Loki is the largest and most powerful volcano on Io, the most volcanically active body in the Solar System. It is powerful enough that its eruptions can be observed in the infrared from earth-based telescopes. Measurements of Loki's activity level have been made for nearly two decades and have shown that Loki often erupts in a periodic and predictable fashion (Rathbun et al., 2002). These measurements are based on occultation light curves obtained while Io is in eclipse. Since no sunlight is reaching Io, all of the measured radiation is emitted from volcanoes. As Io passes behind Jupiter, the volcanoes disappear one at a time so their output can be measured from the resulting light curve. The light curves are measured at 3.5 microns in a methane absorption band so that Jupiter's reflected sunlight interferes as little as possible (Spencer et al., 1990). We have been making these observations at the Infrared Telescope Facility (IRTF) in Hawaii since 1992 (figure 1) with more frequency during the Galileo era (1996-2001) and the New Horizons era (2006-2007).

Loki Model: Based on the long history of Loki eruptions and the high spatial resolution data taken by the Galileo and Voyager spacecrafts, Rathbun et al. (2002) developed a model of Loki as a periodically overturning lava lake. Rathbun and Spencer (2006) constructed a quantitative version of this model and were able to match it to ground based observations taken by a variety of observers at a variety of wavelengths. This includes the 3.5 micron occultation data shown in figure 1, speckle data collected by MacIntosh et al. (2003), and adaptive optics measurements from Marchis et al. (2005). By altering the velocity at which the overturn propagates across the lava lake, the model matches the data from times when Loki was erupting periodically and those from more recent times when Loki was no longer erupting on a regular schedule. This change in velocity could easily be due to small changes in magma density or initial porosity of the solidifying crust.

Observations: While observing at the IRTF, we obtained eclipse images of Io in addition to the occultation light curves. While these 2.2 micron images have a low spatial resolution (figure 2), we can still derive Loki fluxes from them (Spencer et al., 1994). We have developed a systematic method for determining Io's flux and will present the results of these measurements and a comparison to the model described above. Io's flux is easily determined as long as the observations took place under photometric conditions. We hypothesize that Io's 2.2 micron brightness will be dominated by Loki. Since the spatial resolution is generally low (figure 2) isolating Loki's flux will be difficult. We will search the data for the best resolution images to compare Loki's brightness to the total brightness of Io to ensure this hypothesis is correct. We will also compare the temporal evolution of Loki's 2.2 micron brightness to the 3.5 micron brightness to

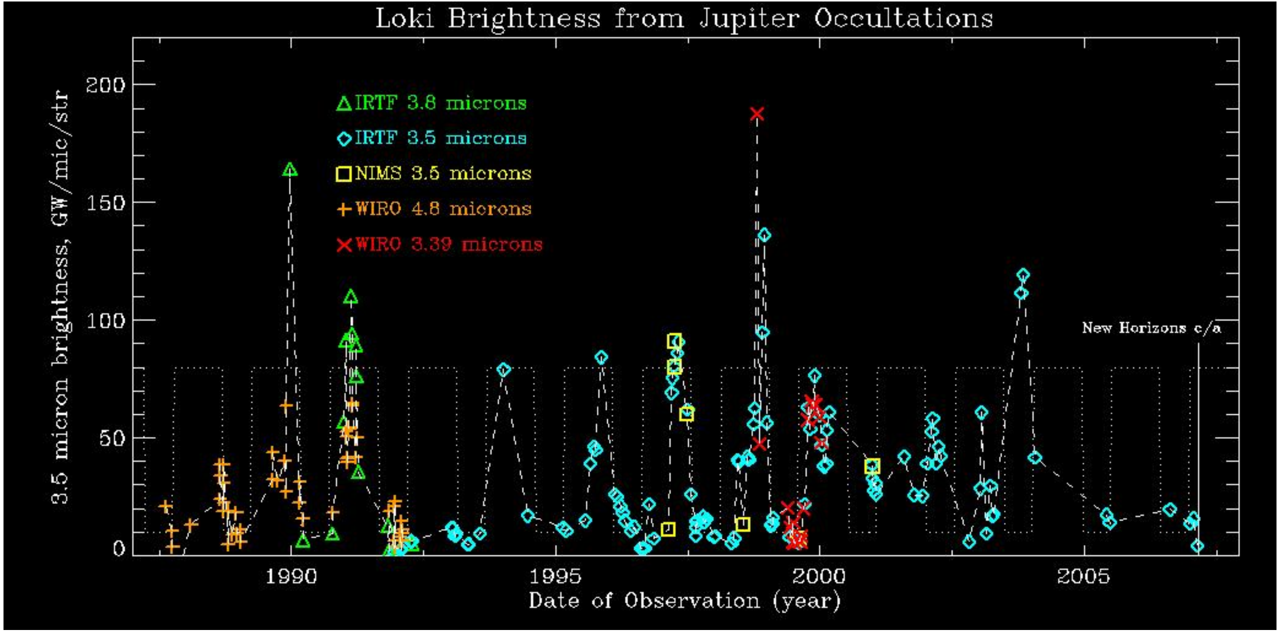

Figure 1: 3.5 micron brightness of Loki measured primarily from Jupiter occultations observations.

determine if Loki eruptions are as easy to pick out in the lower wavelength data. Finally, we will compare the measured 2.2 micron brightnesses to the model fits.

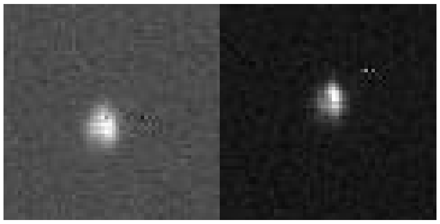

Figure 2: IRTF images of Io in eclipse on October 15, 2001. The left image was taken at 2.2 microns and the right at 3.5 microns. In both cases, Loki is the bright spot in the upper right.

Since the model was completed, more observations have taken place in support of the New Horizons mission (Rathbun et al., 2007). We were able to photometrically observe Jupiter occulting Io on four nights in 2006-2007. The data show that Loki is not currently erupting with its 3.5 micron brightness was measured to be less than 20 GW/micron/str. We will present the results of all our 2006-2007 observations and also compare them to the model. Four nights of successful observations still need to be analyzed and we also have two observing runs remaining.

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