GROUNDBASED OBSERVATIONS OF IO IN SUPPORT OF THE NEW HORIZONS FLYBY. J. A. Rathbun[1] and J. R. Spencer[2], [1]University of Redlands (1200 East Colton Ave., Redlands CA 92373, USA *jullie_rathbun@redlands.edu*), [2]Southwest Research Institute (1050 Walnut St., Suite 400, Boulder, CO 80302, USA).

Introduction: Io is the most volcanically active body in the solar system and Loki is the largest volcano on Io. It is powerful enough that its eruptions can be observed from earth-based telescopes. These eruptions have been observed for nearly two decades (figure 1) and have shown that, at times, Loki erupts in a periodic and predictable fashion (Rathbun et al., 2002).

The New Horizons spacecraft will flyby Jupiter on February 28, 2007 and will take observations of Io on its way through the system. In order to help put those observations in temporal context, we began observing Io from the Infrared Telescope Facility (IRTF) in Hawaii during August 2006. Because of solar conjunction, we were unable to observe Io from October through December. We resumed observations in early January 2007 and will continue through June 2007 with the highest concentration of observations nearest the flyby. We hope to determine Loki's behavior during the New Horizons epoch to aid interpretation of the spacecraft data, and detect major eruptions elsewhere on Io.

Observations: Several of the observations are scheduled during Jupiter occultations, when Io is in Jupiter's shadow and the volcanoes are seen without interference by reflected sunlight. During these events, we can obtain one-dimensional spatial resolution across Io by plotting Io's total brightness as a function of time as it passed behind Jupiter. From this, we can determine the brightnesses of individual volcanoes on the Jupiter facing hemisphere of Io. Since Loki is the most powerful volcano on this hemisphere, it is the volcano whose brightness we are able to measure most often, and thus have brightness information over a long period of time (figure 1). We have also been able to measure Kanekehelli in this manner (Spencer et al., 1990).

During observations that do not take place during Jupiter occultations, Io's brightness will mostly be due to reflected sunlight. On these occasions we will be looking for any major eruptions that are taking place. During the Galileo era, we observed an eruption at Tvashtar (figure 2) before the Galileo spacecraft obtained a higher resolution view (Howell et al., 2001). A list of all scheduled observations in given in table 1. They are spread in time to get good coverage of Io at all longitudes.

Figure 2: IRTF 3.8 micron image of Io during the November 1999 Tvashtar eruption.

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)

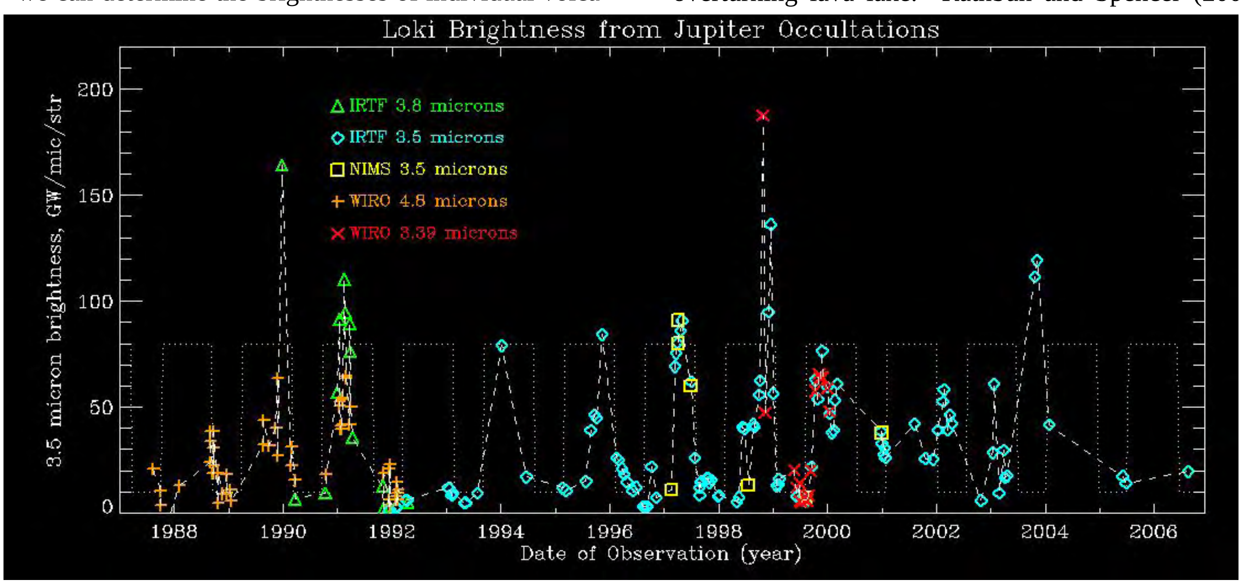

Figure 1: 3.5 micron brightness of Loki measured primarily from Jupiter occultation observations.

constructed a quantitative version of this model and were able to match it to groundbased observations taken by a variety of observers at a variety of wavelengths. By altering the velocity at which the overturn propagates across the lava lake, the model matches the data from times when Loki was overturning periodically and those from more recent times when Loki was no longer overturning on a regular schedule. This change is velocity could easily be due to small changes in magma density or initial porosity of the solidifying crust. While high temporal resolution of observations was obtained during the Galileo era, only one observation was made in 2004, two in 2005, and one in 2006. Our multiple 2007 observations will allow further testing and development of this model.

Table 1: Dates of IRTF observation in 2007. Occultation observations are of the in-eclipse occultation and also include eclipse observations.

Date (2007)	Observation type
Jan. 3	Occultation disappearance
Jan. 10	Occultation disappearance
Jan. 18	Sunlit
Jan. 19	Occultation disappearance
Jan. 23	Sunlit
Jan. 24	Sunlit
Jan. 26	Occultation disappearance
Jan. 27	Sunlit
Jan. 29	Sunlit
Feb. 18	Occultation disappearance
Feb. 20	Occultation disappearance
Feb. 23	Sunlit
Feb. 25	Occultation disappearance
Feb. 26	Sunlit
Feb. 27	Occultation disappearance
Feb. 28	Sunlit
Mar. 2	Sunlit
Mar. 6	Occultation disappearance
Mar. 15	Occultation disappearance
Mar. 31	Occultation disappearance
Apr. 22	Occultation disappearance
May 7	Occultation disappearance
May 16	Occultation disappearance
Jun. 24	Occultation disappearance

Coordination with New Horizons: Our groundbased observations will aid in analysis of many of the New Horizons observations of Io. New Horizons will be looking for surface albedo changes that have occurred since Galileo. Our ground-based observations will allow us to correlate any observed albedo changes with large eruptions, like the Tvashtar eruption, that have occurred recently.

The groundbased measurements of Loki's brightness can be used to find the start date for any recent overturn event and the velocity at which that overturn propagates across the lake. These, in turn, can be used to predict the location of the overturn front during the New Horizon's flyby. Since New Horizons will be imaging near-infrared thermal emission from Loki at resolutions of 15 km, we should be able to test this prediction.

References:

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