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Infrared Speckle Interferometry and Spectroscopy of Io

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Strategy

The goal of the project during the last year has been to continue the speckle monitoring of volcanic hot spots on Io, and to begin observations of the 1991 series of mutual events between Io and Europa. The former provide a time history of the volcanic activity, while the latter give the highest spatial resolution and the best sensitivity to faint spots. A minor component of the program is lunar occultation observations of young T Tauri stars. The occultations provide milliarcsecond resolution which let us search for circumstellar material and determine which systems are multiple.

Progress and Accomplishments

Speckle observations were obtained during the 1990 opposition which showed continued changes in activity in the Loki region. Mutual event observations were begun on January 1, 1991. The data obtained so far show major activity at Loki, and also detect a weaker spot at Pele. The Loki spot is clearly resolved. A very preliminary reduction of the data suggests it is roughly circular and has a diameter of 150 km.

The detection of Pele confirms earlier speckle observation from the Arizona group led by McLeod and McCarthy. The basic source is clearly long lived, despite the disappearance of the plume between the two Voyager encounters. When the Wyoming 5 micron data is combined with other wavelength observations obtained by the JPL group at IRTF, it is clear that Loki is a relatively cool source while Pele is hotter.

Lunar occultations show extended material around several stars, including DG Tau. In addition, several other stars are binaries. There does seem to be a correlation in that the multiple systems DO NOT contain extended material.

Projected Accomplishments

The major goal of the coming year is to finish the observations of the mutual events, and to analyze and publish that data. The location of bright hotspots can be done quickly with the existing data, but more detailed modeling is required to detect fainter ones. Several occultations of the Loki hot spot were obtained, each which gives a cut through the object at two position angles. It should be possible to use "tomographic" reconstruction techniques to obtain a rough 2-D image of this spot. That would allow a much more detailed study of the nature of the volcanism at this active center.

Publications

Nash, D. B., and Howell, R. R. 1989. "Hydrogen Sulfide on Io: Evidence from Telescopic and Laboratory Infrared Spectra." *Science* **244**: 454-457.

Chen et al. 1990. Discovery of Five Pre-Main-Sequence Binaries in Taurus. *Ap. J.* **357**: 224-230