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Io's volcanic enhancement observed in mid-infrared from the ground

Abstract

We present new ground-based observations of Io's volcanic activity made in 2011 and 2012 using a 1-m telescope, at mid-infrared wavelengths where Io's thermal radiation dominates solar reflected light seen at shorter wavelengths. The emitted power from Daedalus in 2011 was estimated to be $\sim 10^{13}$ (W). This level of power has never been observed from Daedalus from previous observations, and is almost as powerful as the lava lake Loki Patera, the most powerful hotspot on Io. However, the angular separation between Loki and Daedalus is only 0.1 arcsec at most. This means most of the ground-based telescopes cannot observe these two hotspots individually at infrared wavelengths. The possibility that the power of Daedalus has been underestimated should be noted. Previous thermal measurements from ground-based observations of Loki might be overestimated, as they may also include the thermal emissions from Daedalus as well. The diffraction limit in the mid-infrared range using a 1-m diameter telescopes is significantly larger than the angular size of Io from the ground. However, this study successfully distinguished a hotspot on Io by focusing on light curves that show Io's radiance as a function of Io's central longitude. The potential of small telescopes with infrared detectors for observing Io's volcanic activity should also be noted.

1. Introduction and Observation

Io, one of the Galiean moons orbiting Jupiter, is also the most volcanically active body in the solar system. Its volcanism has been observed by detecting its thermal emissions in near infrared. Infrared spectrometers. Although [2] showed Io's volcanic thermal radiance in near infrared from the ground for various Io's longitudes, they adopted a model to subtract the reflected solar light component. In contrast to the near-infrared, the mid-infrared radiance from Io is dominated by a thermal emission component [2]. [1] and [2] actually successfully observed Io's volcanism in the mid-infrared range even when Io was sunlit. We made observations of Io's volcanism in the mid-infrared range from the ground without worrying about using any complicated model or being restricted by geometry among Sun, Jupiter, Io, and Earth. Our observation was carried out at the University of Tokyo Atacama Observatory of which altitude is the highest in the world as an astronomical observatory using a 1-m telescope. The wavelength we observed is 8.9 μm.

2. Observation results and conclusions

A distinct radiance is seen around a longitude of 272 deg in 2011, but not in 2012. Because of the large diffraction limit, we cannot distinguish each hot spot from this observation. However, this large flux seems to be from Daedalus Patera, which has been observed around 280 deg in the past. While this hotspot achieved a radiance of 500 (GW/μm/sr) in 2011, the radiance from almost the same longitude is same as the background level which is ~ 300 (GW/μm/sr). We can say that the radiance from this hotspot alone is ~ 200 (GW/μm/sr). Estimated total emitted power from this hotspot is $\sim 10^{13}$W. This power is comparable to that from Loki in its active state.

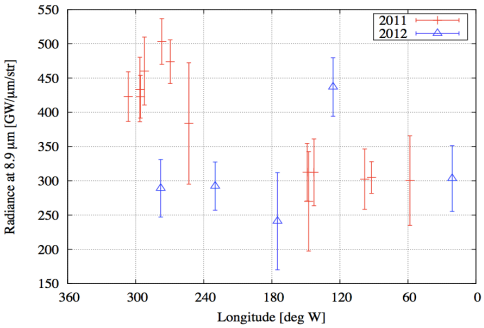

Figure 1: Observed radiance from Io at 8.9 µm in 2011 (red) and 2012 (blue) as a function of Io's central meridian longitude.

References

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