Evidence for SO$_2$ condensation on the nightside of Io

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The surface of Io is believed to consist primarily of elemental sulfur and SO$_2$. The exact nature of these materials, their purity, their fractional surface coverage, and their interaction with a possible SO$_2$ atmosphere are still uncertain.

During the Voyager 2 encounter about 10 sequences of the dark (Jupiter-illuminated) side of Io were obtained. Because it is not possible to obtain such observations from Earth, these images represent a unique opportunity for understanding several problems relating to the surface composition of Io. One report that problem is the question of condensation of SO$_2$ frost on the nightside of Io. According to standard vapor pressure curves (Matson and Nash, 1983), the vapor pressure of SO$_2$ drops more than 10 orders of magnitude between day and night temperatures on Io, which differ by 70 K. The existence or absence of SO$_2$ condensates on the nightside is thus a sensitive indicator of an SO$_2$ atmosphere. Veverka et al. (1981) failed to observe pose-cclipse brightening as Io emerged from Jupiter's shadow. And a recent analysis by Simonelli et al. (1994) didn't show any local brightenings on the dark side in the Voyager VI 01 ct. filter, which is sensitive to the presence of SO$_2$ frost.

Our analysis applies a new approach to this problem. Instead of searching for albedo changes, we search for color changes on the dark side of Io. Because SO$_2$ frost is bluer than elemental sulfur in the UV-visible part of the spectrum, the nightside of Io should be bluer than the dayside if SO$_2$ frost is condensing on it. A color mosaic of the dark side of Io, created from Voyager II images, shows that in fact the dark side of Io is bluer than the same region on the solar illuminated side. This result provides evidence for the global condensation of SO$_2$ frost on the dark hemisphere of Io. Performed under contract to NASA.