HST Ultraviolet Observations of Europa and the Global Surface Distribution of SO_2. T. M. Becker[1,2], S. K. Trumbo[3,4], P. M. Molyneux[1], K. D. Retherford[1,2], A. R. Hendrix[5], L. Roth[6], U. Raut[1,2], J. Alday[7], M. A. McGrath[8]
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Introduction: We present near-global, ~80 km/pixel resolution spectral images of Europa in the ultraviolet (UV; 210 – 315 nm) using the Space Telescope Imaging Spectrograph (STIS) on the Hubble Space Telescope. This data closes a gap in spectral observations of Europa between 210 – 240 nm. We show comparisons of the spectra between the leading, trailing, sub-Jovian, and anti-Jovian hemispheres and maps of a broad absorption feature centered near 280 nm that has previously been attributed to SO_2 [1-4].

SO_2 Spectral Signature: We observed a broad absorption band (~50 nm in width) centered near 280 nm (Fig. 1) that varied in depth across the surface of Europa (Fig. 2). The presumably SO_2 feature is most prominent near the apex of the trailing hemisphere, where the band depth reaches a maximum of 25%, and is undetectable on most of the leading hemisphere. This is consistent with the large-scale distribution of the feature from previous detections, and with the hypothesis that SO_2 on Europa's surface is formed by the irradiation of Iogenic sulfur ions that have been preferentially emplaced on the trailing hemisphere by Jupiter's magnetic field.

Our models show that a small concentration of SO_2 (<1%) trapped within the water ice grains is capable of reproducing the depth and width of the observed absorption band.

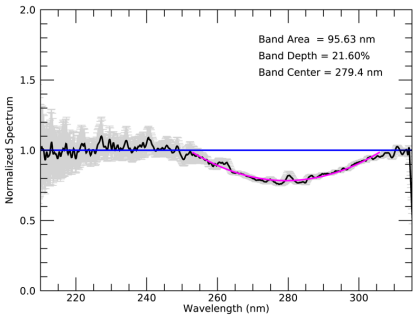

Fig. 1: SO_2 absorption feature observed near the apex of Europa's trailing hemisphere with the HST STIS.

Additional Findings: *Lack of H_2O Spectral Signature:* Although the majority of the surface of Europa is expected to be water ice, previous observations of Europa's surface indicated that the UV spectrum does not display the sharp spectral edge at 165 nm that is diagnostic of water ice. Instead, the spectra gradually increase in brightness from the far-UV to the visible, implying some sort of UV-absorbing contaminant is present across the entire surface of Europa, including the leading hemisphere.

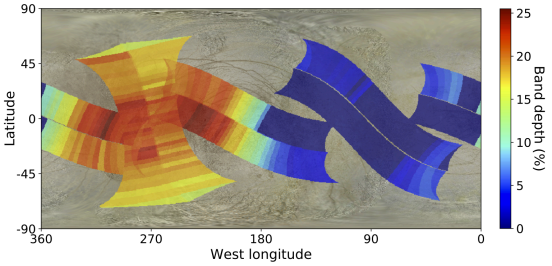

Fig. 2: Distribution of band depths of the SO_2 absorption feature across the surface of Europa from HST STIS measurements.

Sodium Chloride in Chaos Terrains on the Leading Hemisphere: As recently reported by Trumbo et al. [5], a broad, shallow absorption feature near 230 nm was detected for the first time in this HST dataset. The spectral feature is spatially correlated with chaos terrain on the leading hemisphere, similar to a previous HST detection of an absorption feature near 450 nm that was attributed to irradiated sodium chloride [6]. Recent laboratory studies show that the 230 nm feature is also consistent with irradiated sodium chloride at Europa's surface temperatures [7].

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