

Europa's Water Vapor Plumes: Discovery with HST and Plans for JUICE-UVS Observations.

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Abstract: The discovery of plumes of water vapor emanating from Europa's south pole region [1] makes Europa the second icy satellite known to exhibit such behavior. We summarize our recent discovery of the plumes with the Hubble Space Telescope (HST), and report our plan for Jupiter Icy Moon Explorer (JUICE) [2,3] Ultraviolet Spectrograph (UVS) observations to search for and study water vapor plumes.

Far-UV Auroral Imaging of Water Vapor: Space Telescope Imaging Spectrograph (STIS) far-UV spectra and images of Europa's neutral oxygen 130.4 nm and 135.6 nm emissions contain a wealth of information about its molecular oxygen atmosphere [1,4,5,6,7]. Europa's magnetospheric plasma interaction generates auroral emissions, which exhibit a morphology that until recently has been difficult to interpret. STIS observations in Nov. & Dec. 2012 allow a new understanding of how Jupiter's magnetic field orientation and Europa's relation to the plasma sheet control the emission variability.

We have developed a technique using diagnostic spectral ratios of far-UV auroral emissions (Lyman- α : OI 130.4 nm : OI 135.6 nm) to identify water vapor emissions [1] similar to the technique that was used to initially detect the molecular oxygen atmosphere using the OI 135.6 nm : OI 130.4 nm ratio of ~ 2 [4]. Figure 1 illustrates the detection of Lyman- α emissions extending ~ 200 km above the $\sim 75^\circ$ S region, on the anti-jovian side. Together with a similar image of OI 130.4 nm emissions, this emission feature is diagnostic of a water vapor plume.

New HST-STIS observations of Europa's UV aurora are currently planned for 2014 Jan.-Feb. and will be reported at this meeting by [7]. A key objective of these new observations is to verify that the intensity of the plumes near orbital apocenter is repeatably higher.

JUICE-UVS Plans to Observe Europa: Two Europa flybys were included in ESA's Jupiter Icy Moons Explorer (JUICE) mission plan [2,3]. Detailed investigations of Europa's atmosphere using NASA's UVS contribution to the JUICE mission include searches for plumes using using far-UV imaging scans of auroral emissions during the flyby sequences. High-resolution limb imaging is planned for times within several hours of the closest approaches to Europa to directly image plume gases in a manner analogous with plume aurora imaging of Io [8].

JUICE-UVS will additionally use the stellar occul-

tation technique to characterize Europa's atmosphere structure and composition and to also search for local enhancements created by plumes. This stellar occultation technique, demonstrated by Cassini-UVIS at Enceladus [9], has the benefit of being useful at relatively large distances (i.e., a few 10's of Jupiter radii) as well as during the Europa flyby sequences (i.e., a few 10's of Europa radii). A robust search for plumes is planned in JUICE's first year at Jupiter to provide a roughly 30° grid of global coverage, followed by focused targeting of likely plumes/active-regions during early and late stages of the flyby sequences.

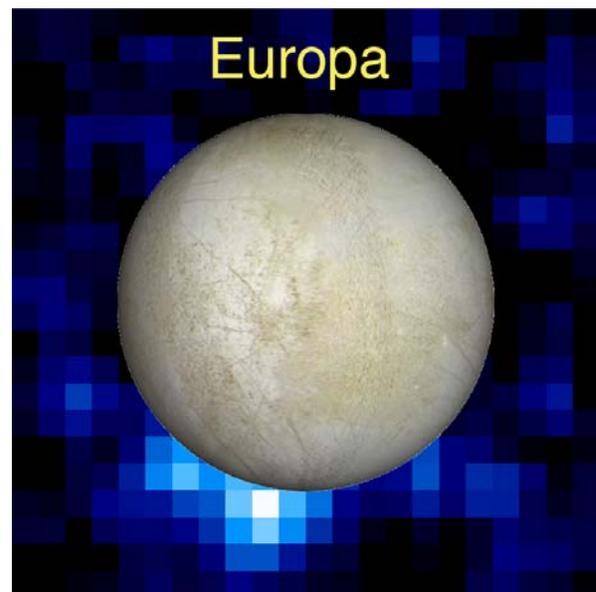


Figure 1. Illustration of the European water vapor plume detection reported in [1].

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