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# Hubble Space Telescope detects sub-solar water atmosphere on Ganymede

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Ganymede's tenuous atmosphere is produced by charged particle sputtering and sublimation of its icy surface. Previous far-ultraviolet observations of the OI1356 Å and OI1304 Å oxygen emissions were used to derive sputtered molecular oxygen, $O_2$, as an atmospheric constituent. We present a new analysis of high-sensitivity spectra and spectral images of Ganymede's oxygen emissions acquired by the COS and STIS instruments on the Hubble Space Telescope. The COS eclipse observations constrain atomic oxygen, O, to be at least two orders of magnitude less abundant than $O_2$. We then show that dissociative excitation of water vapor, $H_2O$, is found to increase the OI1304 Å emissions relative to the OI1356 Å emissions around the sub-solar point, where $H_2O$ is more abundant than $O_2$. Away from the sub-solar region, the emissions are more than two times brighter at OI1356 Å than at OI1304 Å, and $O_2$ prevails as found in previous analyses. A ~6-fold higher $H_2O/O_2$ mixing ratio on the warmer trailing hemisphere compared to the colder leading hemisphere, a spatial concentration at the sub-solar region, and the ratio-estimated $H_2O$ densities identify icy surface sublimation as a local dayside atmospheric source.
Our analysis provides the first evidence for a sublimated atmosphere on an icy moon in the outer solar system.