

Ultraviolet spectroscopy of comet ISON (2012 S1)

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We performed ultraviolet (UV) spectroscopy of Comet ISON (C/2012 S1) with the Hubble Space Telescope (HST) to monitor the evolution of CO production with heliocentric distance, search for compositional changes associated with the intense heating episode near perihelion, and measure the D/H ratio. We observed C/ISON with Hubble at four different epochs: May 2.5 ($r = 3.8$ au, $\Delta = 4.3$ au), Oct 8.8 ($r = 1.5$ au, $\Delta = 1.9$ au), Oct 21.9 ($r = 1.23$ au, $\Delta = 1.53$ au), and Nov 1.5 ($r = 1.0$ au, $\Delta = 1.2$ au). No molecular or atomic emissions were detected in May, but a stringent upper limit on the CO production rate was obtained ($Q[\text{CO}] \leq 1.0 \times 10^{27}$ molecules s^{-1} , 3σ). OH emission was detected during all the later observations and showed strong temporal variations on Nov 1. CO was clearly detected on Oct 21.9 and Nov 1.5, from which we derive $\text{CO}/\text{H}_2\text{O} \sim 0.015$. Both atomic carbon and sulfur emissions were detected on Nov 1. No atomic deuterium emission was detected during the attempts to measure it on Nov 1, as the comet's gas production rates were significantly smaller than some early predictions suggested. A lightcurve derived from HST optical imaging observations on Nov 1, contemporaneous with the UV spectroscopy, suggests a nucleus rotational period of ~ 10.4 hr, but the range of plausible values is fairly broad.

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