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The Carbon Monoxide Abundance in Comet 103P/Hartley

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Abstract

We report the detection of several emission bands in the CO Fourth Positive Group (4PG) from comet 103P/Hartley during ultraviolet spectroscopic observations from the *Hubble Space Telescope (HST).* Our team was allocated a total of 15 orbits of *HST* time to observe 103P during the fall of 2010, which we divided into three 5–orbit observing runs: on September 25 ($r = 1.15$ AU, $\Delta = 0.22$ AU), on November 4 ($r = 1.06$ AU, $\Delta = 0.16$ AU; *EPOXI* closest approach was on Nov 4.5832 UT), and on November 28 ($r = 1.14$ AU, $\Delta = 0.28$ AU). On the latter two dates we detected CO 4PG emission near 1500 Å using the Cosmic Origins Spectrograph (COS) with the G160M grating (Figure 1). The CO emissions exhibited short-term temporal variability at the level of ∼30%, apparently in phase with the rotation of the comet's nucleus. For the spectra taken at the time of the *EPOXI* flyby, we derived a CO/H_2O ratio of 0.15–0.45% [3]. Our preliminary analysis gives a similar CO abundance on November 28; the final estimates will be presented at the meeting.

The CO abundance varies by a factor of ∼50 among the comets observed to date, and the value measured in 103P/Hartley is among the lowest ever recorded. The highly depleted CO abundance in 103P suggests several possibilities: the nucleus formed in a region of the solar nebula that was either depleted in CO or too warm to retain much CO ice, repeated passages through the inner solar system have substantially depleted the comet's primordial CO reservoir, or any CO still in the nucleus is buried below the regions that contribute significantly to the coma.

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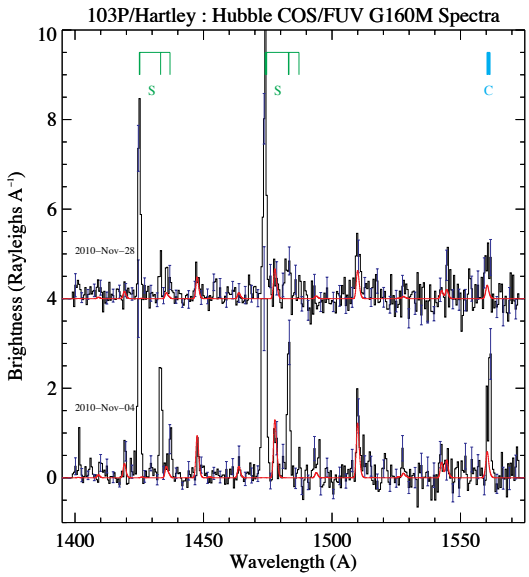

Figure 1: Spectra of 103P/Hartley taken on 2010 Nov 04 (lower) and on Nov 28 (upper). The total exposure time was 2410 s on Nov 4 and 2371 s on Nov 28. The strongest emissions are from atomic sulfur and carbon [1] multiplets, whose locations are marked. Several weak emissions in the CO Fourth Positive Group (4PG) are also detected; a model 4PG spectrum [2] that approximately matches the cometary features is also shown (red).

References

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