Jet morphology and coma analysis of comet 103P/Hartley 2

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In 2010, comet 103P/Hartley 2 was observed pre- and post-perihelion using the George and Cynthia Mitchell Integral Field Spectrometer on the 2.7-m telescope at McDonald Observatory in Texas. Data for gaseous radicals C2, C3, CH, CN, and NH2 were collected over six nights from 15 July to 10 November. The spectral data were used to create coma maps for each of the observed species, and the maps were processed using radial and azimuthal mean division techniques to create enhanced images of the coma. The enhanced images were studied to locate subtle coma morphological features for each radical. To compliment the ongoing investigation of Hartley 2 as studied by the EPOXI flyby mission, findings from other researchers are used to characterize the nucleus spin state and identify dust jet locations on the nucleus. With rotational period measurements from EPOXI, dust jet vectors on the nucleus surface are rotated to relevant observation times in November to compare the computed jet directions with the radical densities in the coma. We also calculate production rates for suspected parent species and compare them to water. Using the two enhancement techniques, 340 coma images were created for each observation and species. Visual inspection reveals that the coma is highly heterogeneous between the five detected radicals, and statistical analyses verify this result. Dust jet sites on the smaller nucleus lobe show a stronger correlation with high radical concentrations than the dust sites on the larger nucleus lobe. Production rates for potential parentage of radical species are calculated using the radial outflow Haser model, which are compared to mixing ratios relative to water from separate campaigns to constrain parentage. NH3 is likely the sole producer of NH2, whereas CN may be produced from a combination of HCN, C2N2, and CH3CN. Traditional parentage of C2, C3, and CH do not yield acceptable fits or suitable mixing ratios with the Haser model, and it is possible that extended coma ices having relatively short scale lengths greatly contribute to production of these radicals.