Ultraviolet Observations of the Hydrogen Coma of Comet Siding Spring (C/2013 A1) by MAVEN/IUVS.

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Introduction: After its arrival at Mars, MAVEN was serendipitously positioned to study the anticipated planet-grazing comet C/2013 A1 (Siding Spring) and took important scientific observations. Although water is the most abundant volatile species in comets, its lack of spectral features in the UV and visible make it difficult to observe. Hydrogen is then an important proxy for water, and observations of its production rate can give insight into the volatile content in comets.

The MAVEN mission is the first to attempt to understand the evolution of the Martian atmosphere by determining the effects of atmospheric loss to space. The IUVS instrument has two large fields of regard (60x12 and 24x12 degrees) and observes in the mid and far ultraviolet (115-340 nm). It was designed to be able to map the atmosphere in several neutral and some ionized species. These performance characteristics made IUVS ideal to study Siding Spring, as it was able to take both two dimensional spatial scans as well as spectral data.

Our observations of the comet (see Figure 1) occurred on Oct 14th and 18th 2014, before its closest approach to Mars, which was on Oct 19th. From these observations we were able to observe a majority of the H coma, and inform observations of Mars' perturbed atmosphere, as well as contributing to the understanding of volatile content in Oort cloud comets.

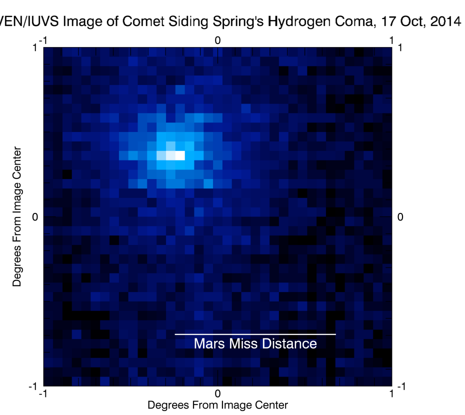

Figure 1: IUVS's false color H-LyA image of Comet Siding Spring. Two subsequent observations of the comet were coadded to create this image, with the Martian Hydrogen foreground removed.

Processing and Analysis: As MAVEN is embedded in the Martian hydrogen corona, this is modeled [1] and removed. This model solves the radiative transfer integral equation in three dimensions with azimuthal symmetry about the Mars-Sun axis, assuming a spherically symmetric Chamberlain exosphere, complete frequency redistribution, and a flat solar line. To determine the water production rate, we used a multi-species fully kinetic Adaptive Mesh Particle Simulation [2] which includes 11 major parent molecules plus HDO as well as all photodissociation products. The model solves the generalized Boltzmann equation capturing all non-LTE collisional properties. All radicals and atoms are produced with their appropriate exothermic velocities [3] which contributes to both collisional heating of the coma as well as unique expansion velocity distributions for all species. This calculation assumed a 1P/Halley molecular composition [3] and 1D spherical symmetry.

References: [1] Chaffin, M. S, J.-Y. Chaufray, I. Stewart, F. Montmessin, N.M. Schneider, and J.-L. Bertaux (2014), (2014), *Geophys. Res. Lett.*, *41*, 314-320 [2] Tenishev, V., M. Combi, and B. Davidsson (2008) *The Astrophysical Journal, 685*(1), 659 [3] Rubin, M., V. Tenishev, M. Combi, K. Hansen, T. Gombosi, K. Altwegg, and H. Balsiger (2011) *Icarus, 213*(2), 655-677