Imaging C/2013 A1 (Siding Spring) with the Hubble Space Telescope

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On October 19, 2014, comet C/Siding Spring will approach to within 1.35×10^5 of Mars (3-σ error 5,000 km). This natural flyby offers an extremely rare opportunity to study a dynamically new comet from up close for the first time. HiRISE camera onboard the Mars Reconnaissance Orbiter (MRO), together with other available instruments and Mars orbiters and rovers, is expected to obtain images of the comet with pixel size down to 140 m at the closest distance, resolving the nucleus and inner coma structure. In preparation for this unprecedented event, we observed C/Siding Spring using the Hubble Space Telescope Wide Field Camera 3 UVIS channel on October 29, 2013, January 21, 2014, and March 11, 2014, when the comet was at 4.58, 3.77, and 3.28 au from the Sun, respectively. The second epoch was specifically selected for the time the Earth crossed the orbital plane of C/Siding Spring. The comet was imaged through two broadband filters, F606W and F438W for all three epochs. The dust tail morphology in October 29 and March 11 images is consistent with β=0.01 (β is the ratio between solar radiation pressure and solar gravity) particles, corresponding to >10 µm radius, dominating the observed dust tail. Based on a simple solar radiation pressure model, the size of dust coma envelope in the sunward direction indicates a dust ejection velocity of a few m/s for >10 µm dust particles. The color of the inner coma appears to be relatively bluer than that of the outer coma, similar to that of C/2012 S1 (ISON) at similar heliocentric distance, an indication (but not necessarily a proof) of the existence of icy particles in the inner coma. Two dust features are observed in all three epochs of images in northwest and south-southeast directions. The northern feature remained at ∼300° PA, and the southern feature rotated from ∼150° to ∼180° and back to ∼130° PA over the three epochs. Assuming these features are originating from mid- to high-latitude areas in the opposite hemispheres, the spin axis direction of the nucleus is inferred to be near (RA, Dec) = (280°, +45°) or the diametrically opposite direction. The $Af\rho$ (a proxy for dust production) of C/Siding Spring from October 29 and January 21 images are ∼1600 cm and ∼1400 cm, respectively, in 1.0"-radius aperture from F606W filter, suggesting that it is somewhat dustier than comet C/ISON. No photometric variations >0.06 mag were evident in an 0.12" aperture.

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