The meteoroid fluence at Mars due to comet C/2013 A1 (Siding Spring)

A. Moorhead[1], P. Wiegert[2], R. Blaauw[3], C. McCarty[4], A. Kingery[5], and W. Cooke[4]

[1]Geocent LLC, Jacobs ESSSA Group, Marshall Space Flight Center, Huntsville, Alabama 35812
[2]Department of Physics and Astronomy, The University of Western Ontario, London N6A3K7, Canada
[3]Dynetics Technical Services, Marshall Space Flight Center, Huntsville, Alabama 35812
[4]NASA Meteoroid Environment Office, Marshall Space Flight Center, Huntsville, Alabama 35812
[5]ERC Inc., Jacobs ESSSA Group, Marshall Space Flight Center, Huntsville, Alabama 35812

Long-period comet C/2013 A1 (Siding Spring) will experience a close encounter with Mars on 2014 Oct 19. A collision between the comet and the planet has been ruled out, but the comet's coma may envelop Mars and its man-made satellites. By the time of the close encounter, five operational spacecraft will be present near Mars. Characterizing the coma is crucial for assessing the risk posed to these satellites by meteoroid impacts. We present an analytic model of cometary comae that describes the spatial and size distributions of cometary dust and meteoroids. This model correctly reproduces, to within an order of magnitude, the number of impacts recorded by *Giotto* near 1P/Halley [1] and by *Stardust* near comet 81P/Wild 2 [2]. Applied to Siding Spring, our model predicts a total particle fluence near Mars of 0.02 particles per square meter.

In order to determine the degree to which Siding Spring's coma deviates from a sphere, we perform numerical simulations which take into account both gravitational effects and radiative forces. We take the entire dust component of the coma and tail continuum into account by simulating the ejection and evolution of dust particles from comet Siding Spring. The total number of particles simulated is essentially a free parameter and does not provide a check on the total fluence. Instead, these simulations illustrate the degree to which the coma of Siding Spring deviates from the perfect sphere described by our analytic model (see Figure). We conclude that our analytic model sacrifices less than an order of magnitude in accuracy by neglecting particle dynamics and radiation pressure and is thus adequate for order-of-magnitude fluence estimates.

Comet properties may change unpredictably and therefore an analytic coma model that enables quick recalculation of the meteoroid fluence is highly desirable. NASA's Meteoroid Environment Office is monitoring comet Siding Spring and taking measurements of cometary brightness and dust production. We will discuss our coma model and nominal fluence taking the latest observations into account.

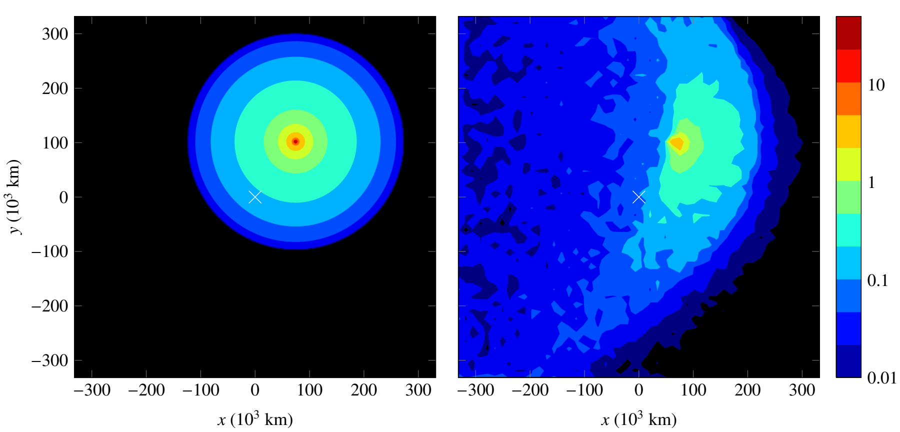

Figure: Particle fluence at Mars due to Siding Spring calculated using our analytic model (left) and simulation results (right). Colors depict total fluence per square meter as a function of location in a plane perpendicular to the velocity vector of C/2013 A1 (Siding Spring) relative to Mars (white X).

Acknowledgements: This work was supported by NASA contracts NNM12AA41C and NNM10AA03C and NASA Cooperative Agreement NNX11AB76A. This work was also supported in part by the Natural Sciences and Engineering Research Council of Canada.

References: [1] M. Fulle, et al. (2000) The Astronomical Journal 119(4):1968. [2] A. J. Tuzzolino, et al. (2004) Science 304(5):1776.