

## **Building a Unique Scenario to Support Cross-Mission Science with SPICE: The Siding-Spring comet encounter with Mars**

**M. Costa** (1), O. Witasse (2), B. Sánchez-Cano (3).

(1) European Space Agency, ESAC – Cross Mission Support Office, Spain, (marc.costa@esa.int), (2) European Space Agency, ESTEC – Scientific Support Office, The Netherlands (olivier.witasse@esa.int), (3) University of Leicester, Department of Physics & Astronomy, United Kingdom

### **Abstract**

On October 2014, Mars experienced a close encounter with Comet Siding Spring. This contribution outlines a SPICE scenario built to assist studies combining MEX, MAVEN, Mars Odyssey, MSL, and Siding-Spring data focused on a SPICE-Enhanced Cosmographia 3D scenario.

### **1. Introduction**

On October 19<sup>th</sup> 2014, Mars experienced a close encounter with Comet C/2013 A1 (Siding Spring), at a distance of only 141,000 km, or one third the Earth Moon distance. The gaseous coma washed over Mars and Mars passed directly through the cometary debris stream [1]. As a close encounter of this type is predicted only once in 100,000 years, this is likely the only opportunity for measurements associated with planetary/cometary encounters. This unique event allows us to investigate the response of the Mars' upper atmosphere to such a rare encounter, as this may have implications for overall atmospheric evolution. Additionally, one of the largest Coronal Mass Ejections (CME) of the current solar cycle hit Mars about 44 hours before the comet flyby, creating a strong perturbation in the system that, although somewhat diminished over the following hours, was still present during the comet passage.

### **2. Building a unique scenario with SPICE**

The ESA SPICE Service (ESS) leads the SPICE [2] operations for ESA missions [3]. The group generates the SPICE Kernel datasets for the Mars Express. The ESS also provides consultancy and support to the Science Ground Segments of the planetary missions, the Instrument Teams and the

science community. In this context, a multi-mission SPICE scenario has been built in order to assist the studies of the Siding-Spring comet encounter with Mars. This scenario contains the appropriate SPICE datasets of Mars Express, MAVEN, Mars Odyssey and MSL missions. The particulars of this scenario will be outlined in this contribution.

### **3. Four Spacecrafts and a Comet at once**

The generated scenario has also been implemented in tools provided by ESS to facilitate and support the science data exploitation of this scenario [4].

#### **1.1 SPICE-Enhanced Cosmographia**

SPICE-enhanced Cosmographic is an interactive tool used to produce 3D visualizations of planet ephemerides, sizes and shapes; spacecraft trajectories and orientations; and instrument field-of-views and footprints. A scenario has been built that includes Mars Express, MAVEN, Mars Odyssey and MSL information along with comet Siding-Spring and which is also focused on the actual operations that were carried out by Mars Express. This complete operational scenario will be outline in the contribution.

#### **1.2 WebGeocalc**

The WebGeocalc tool (WGC) provides a web-based graphical user interface to many of the observation geometry computations available from the "SPICE" system. A WGC user can perform SPICE computations without the need to write a program; the user need have only a computer with a standard web browser. WGC is provided to the ESS by NAIF.

This contribution also presents the WGC instance to support this scenario.

## References

[1] Espley, J. R., et al. A comet engulfs Mars: MAVEN observations of comet Siding Spring's influence on the Martian magnetosphere, (2015) *Geophys. Res.Lett.*, 42, doi:10.1002/2015GL066300.

[2] Acton C., Ancillary data services of NASA's Navigation and Ancillary Information Facility (1996), *Planet. And Space Sci.*, 44, 65-70.

[3] Costa, M., SPICE for ESA Planetary Missions, this conference.

[4] Acton, C. et al., A Look Towards the Future in the Handling of Space Science Mission Geometry (2017) *Planet. And Space Sci* (submitted).