

## Solar Energetic Particles Events and Models for Mars on the Eve of the MAVEN Mission Arrival

**J.G. Luhmann** (1), M.L. Mays (2), D. Odstrcil (3), D.N. Baker (4), D.A. Brain (4), D. Larson (1)

(1) Space Sciences Laboratory, University of California, Berkeley, CA, USA, (2) Catholic University of America, Washington DC, USA, (3) George Mason University, Fairfax, VA, USA, (4) LASP, University of Colorado, Boulder, CO, USA (jgluhman@ssl.berkeley.edu)

### Abstract

Planetary space weather has attracted much interest as missions including Mars Express and Venus Express observe the responses of the solar wind interactions and atmospheres at those planets to solar activity-related events. In addition, models of space weather phenomena are increasingly realistic and available. In this presentation we describe a particular advancement in the area of solar energetic particle event modeling with potential applications to the terrestrial planets. In particular, this tool can be used to relate particle events observed at several sites in the inner heliosphere, including Mars where the new MAVEN mission will be providing local measurements.

### 1. Introduction

One of the major goals of the MAVEN mission scheduled to enter Mars orbit next month is the response of the Mars upper atmosphere and ionosphere to space weather storms. In addition to solar wind plasma and field disturbances, these also include SEP (Solar Energetic Particle) events such as those observed by the MARIE investigation on Odyssey, and by RAD on MSL on the surface. In particular, it has been speculated (Leblanc et al. [1]) that a major SEP event may deposit more energy in the exposed portion of the atmosphere than solar radiation. The related effects may be especially noticeable at night. Since the initial modeling of these impacts was completed, much more has been learned about the heliosphere-wide behavior of SEP events, in large part because of the combined STEREO and ACE mission measurements and also the further development of modeling tools to

understand the connections between what is happening at the Sun, in interplanetary space, and at Mars. The solar wind modeling framework provided by ENLIL has already been applied to observations by Mars Express by Falkenberg et al. [2] and most recently by Opgenoorth et al. (personal comm. 2014). We describe the related potential of the added SEP component of such tools for both predicting major SEP enhancements at Mars, as well as understanding the wider heliospheric context of events observed to affect Mars.

### References

- [1] Leblanc, F., Luhmann, J.G., Johnson, R.E., and Chassefiere, E.: Some expected impacts of a solar energetic particle event at Mars, *J. Geophysical Res.*, 107, doi:10.1029/2001JA90017, 2002.
- [2] Falkenberg, T.V., Taktakishvili, A., Pulkkinen, A., Vernerstrom, S., Odstrcil, D., Brain, D., Delory, G., and Mitchell, D.: Evaluating predictions of ICME arrival at Earth and Mars. *Space Weather*, 9, doi:10.1029/2011SW000682, 2011.