

Energization of Martian Heavy Ions during Solar Energetic Particle Events: MAVEN Observations

C. Krishnaprasad^{1,2*}, Smitha V. Thampi¹, Tarun K. Pant¹

(1) Space Physics Laboratory, VSSC, ISRO, Thiruvananthapuram 695022, India

(2) Cochin University of Science and Technology, Kochi 682022, India

*Corresponding Author E-mail: kpchirakkil@gmail.com, krishnaprasad_c@vssc.gov.in

Abstract:

The Solar Energetic Particle (SEP) events of late solar cycle 24 in July and September 2017 are studied to understand their effects on the Martian topside ionosphere and corona. Mars being an unmagnetized planet (with strong patches of crustal magnetic fields on the surface, mostly located in the southern hemisphere), the solar wind can directly interact with the upper atmosphere and ionosphere. Previous studies have shown that solar wind interaction cause atmospheric and ionospheric escape, with the escape rates increasing during transient solar events such as solar flares, Coronal Mass Ejections (CMEs), and Corotating Interaction Regions (CIRs) events [1, 2]. The in-situ observations from the unique suite of plasma instruments onboard Mars Atmosphere and Volatile EvolutioN mission (MAVEN) provides an opportunity to study the response of Martian plasma environment to SEPs [3]. The SEP instrument measured significant flux of energetic ions and electrons during the period of solar eruptive events in July and September 2017. The measured ions are of energies above ~20 keV upto few MeV. The Suprathermal and Thermal Ion Composition (STATIC) instrument measures 1 to 70 amu planetary ions of energies above ~0.1 eV upto ~30 keV. Previously, it is found that during the passage of a CIR event, the heavy ions are enhanced in the Martian topside ionosphere and exosphere [4]. An increase in the precipitating ion flux by more than one order of magnitude was observed during the arrival of an interplanetary CME compared to the average flux during quiet solar conditions [5].

Figure 1 shows the STATIC energy and mass resolved ion energy flux. Figure 1(a) is during a solar quiet period before the arrival of SEPs and Figure 1(b) is during the SEP event in September 2017. The observations during the SEP event period indicates an energization of planetary heavy ions such as O^+ (amu 16) and O_2^+ (amu 32) to energies above 10 eV. The possible mechanism of energization of ions is solar wind pickup and acceleration by the convective electric field. The detailed results from the study shall be presented.

References:

[1] Lee et al. (2018) *GRL*, 45, 8871–8885. [2] Thampi et al. (2018) *JGR Space Physics*, 123, 6917–6929. [3] Jakosky, B. M. et al. (2015) *Space Science Reviews*, 195, 3–48. [4] Krishnaprasad et al. (2019) *JGR Space Physics*, 124, 6998–7012. [5] Martinez et al. (2019) *JGR Space Physics*, 124, 420–432.

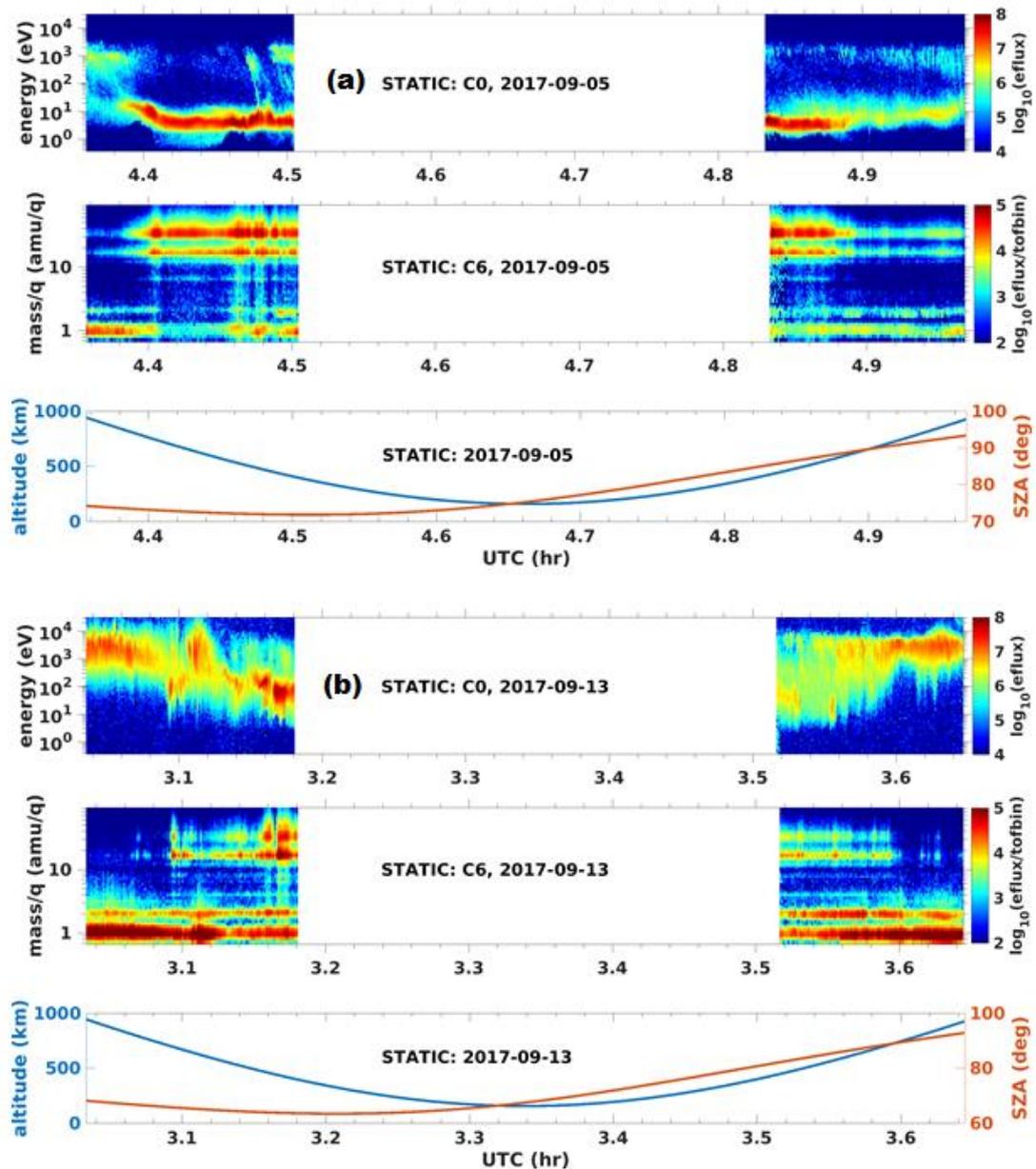


Figure 1. STATIC observations on (a) 5 September 2017 (Quiet period), and (b) 13 September 2017 (SEP event period)

The work is supported by the Indian Space Research Organisation (ISRO). The MAVEN data are taken from the Planetary Data System (<https://pds.nasa.gov/>). We gratefully acknowledge the MAVEN team for the data.