The ion environment of Phobos as observed by MAVEN

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The surface and subsurface of Phobos are altered by solar wind and Martian ions. Previous advanced simulations have shown that these ions are the main contributors to sputtering of the surface. However, ion composition and fluxes remain to be quantified from in-situ particle measurements to further study their effects.

In this presentation, we show how ion measurements obtained by the MAVEN mission are used to constrain the average and extreme ion fluxes bombarding Phobos. We will first remind that the trajectory of MAVEN enabled the spacecraft to repeatedly cross the orbit of the moon from September 2014 to February 2019. The 2.3 Martian year-long dataset covers all the Mars-Solar Orbital (MSO) longitudes around the planet, so that all the plasma regions seen by Phobos along its orbit in the solar wind and induced magnetosphere can be quantitatively discussed. We aggregate, bin, average and analyze the measurements obtained by the three MAVEN ion experiments for average and extreme conditions: the Solar Wind Ion Analyzer (SWIA, 5 eV to 25 keV), the SupraThermal And Thermal Ion Composition instrument (STATIC, 0.1 eV to 30 keV) and the Solar Energetic Particle investigation (SEP, 20 to 6000 keV).

The new averaged ion fluxes determined from the MAVEN observations are then used to revisit the two major space weathering effects at Phobos. First, the timescales associated to implantation of each ion specie and kinetic energy are reassessed in order to discuss if ions may explain the Phobos color dichotomy. Secondly, fluxes of neutral particles sputtered from the surface of Phobos are recomputed. We will finally report on our attempt to detect in MAVEN ion observations the neutral and ionized tori of Phobos that are sourced by the sputtered particles.