PLASMA AND CURRENT EXPERIMENT (PACE) FOR MARS EXPLORATION

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The Martian ionosphere and thermosphere are powered by energy that originates from the Sun in the form of direct solar radiation as well as imposed electric fields and precipitating charged particles. Solar irradiance at extreme ultraviolet (0.01-0.1 keV) and X-ray (0.1–12 keV) regime produces ions and photoelectrons that heat the thermosphere and drive thermospheric chemistry. Though in great debate but the solar wind interaction with Mars atmosphere is believed to be one of the causes to taking away these ions and photoelectrons to higher altitudes of more than several hundreds to thousands of kilometers. This issue motivates to fly more plasma experiments to Mars. Further, Mars currently does not possess an appreciable magnetic field of internal origin (dynamo) and it has a comparatively small gravitational acceleration leading all known atmospheric loss processes to be active. Therefore several important constituents such as O^+, O_2^+, CO^+, N^+, N_2^+, H^+, CO_2^+ ions with energies between 0.01- 25 keV are being lost to space. The escape rates of atmospheric constituents including water from Mars indicate that the red planet could have lost an atmosphere of at least 1 bar to space during the past 3.5 Gyr. We propose to develop a Lab model of the “Plasma and Current Experiment (PACE)” in expectation to get an opportunity to fly onboard future mission to Mars. PACE aims to study the atmospheric escape processes in the Martian atmosphere and the structure of the Martian tail. PACE is a plasma imaging instrument in the energy range of 0.001-30 keV by employing an electrostatic analyzer (ESA) along with a time-of-flight technique, coupled with multi-channel plate (MCP) detectors. The instrument will be comprised of two top-hat ESAs: one forward directed for electrons, and other reverse directed for ions, which, however is coupled with time-of-flight (TOF) package. The TOF package will measure mass spectra of ions. The instrument will provide energy spectrum with energy resolution of about 19%. We propose to achieve an angular resolution of $5^o \times 22.5^0$ with $90^0 \times 360^0$ field of view throughout spacecraft orbit. Proposed instrument will provide mass-per-charge, speed, density, spatial distribution, direction and energy spectra of ions and electrons along the spacecraft orbit. These parameters will enable us to improve our current understanding of physical processes taking place in the Martian atmosphere, magnetotail as well as along the orbit of the spacecraft.