



## A New Perspective on Solar Wind Interaction with Moon after Chandrayaan-1 Mission

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India embarked on the planetary exploration program in 2008 with the launch of Chandrayaan-1 orbiter mission to Moon. The Chandrayaan-1, with 11 experiments on board, and having circular polar orbit of 100-200 km, was a highly successful lunar mission, which discovered, including many other new findings, the water on Moon. The Sub-keV Atom Reflecting Analyzer (SARA) was one of the 11 experiments on the Chandrayaan-1, and first of its kind of instrument to fly to the Moon [1, 2]. The SARA consisted of two sensors mounted at 90 degree to each other; while the Chandrayaan Energetic Neutrals Analyzer (CENA) sensor measured energetic neutral atoms (ENAs) around Moon in the 0.1-3 keV energy range, the Solar Wind Monitor (SWIM) measured ions in the same energy range in lunar environment.

The solar wind is an incessant straight flowing stream of energetic charged particles from the Sun, consisting largely of protons, having velocity of about 400 km/sec and frozen-in interplanetary magnetic field of around 5 nT. Unlike Earth, the Moon does not have an atmosphere or intrinsic global magnetic field (except few magnetic anomalies). Hence, the solar wind directly impacts the lunar surface.

The new findings from SARA have revolutionized our understanding on solar wind interaction with the Moon through some startling discoveries [3 – 17], namely, 1) large (~20%) and sustained reflection of solar wind protons as Energetic Neutral Hydrogen Atom (ENA) from lunar surface, disproving the previous belief that Moon is a passive absorber of solar wind, 2) discovery of "mini-magnetosphere" in ENA, 3) two new mechanisms for entry of ions in lunar plasma wake (nightside of Moon), where none was predicted earlier, 4) unexpectedly strong (10-50%) deflection of solar wind ions by surface magnetic anomalies, and derivation of electric potential above the anomaly region, 5) detection of "sputtered oxygen atom" from lunar surface, 6) preferential backscattering of solar wind protons as ENA – contrary to that observed in laboratory.

This talk will summarize the innovative results obtained by the SARA experiment aboard Chandrayaan-1 mission. These results imply that the micro-physics of plasma-regolith interaction is complex and less understood. These outcomes have vital implications on lunar science, space weathering processes and formation of water on Moon, and applications to other atmosphere-less bodies in the solar system and extra-solar system, as well as future human exploration of Moon.

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