THREE-DIMENSIONAL MAP OF LUNAR IONOSPHERE USING PHYSICS BASED IONOSPHERIC MODEL. K. M. Ambili[1] and R. K. Choudhary[1], [1]Space Physics Laboratory, VSSC, ISRO(post), Trivandrum, Kerala, 695029, (ambilisadasivan@gmail.com, rajkumar.choudhary@gmail.com).

Abstract: The atmosphere of the Earth's Moon is so tenuous that the gas atoms hardly collide, rendering it to the category of exosphere. The lunar exosphere is bounded on one side by its surface and extend thousands of kilometers before it merges with the interplanetary medium. This makes Moon a typical example of a Surface Boundary Exosphere (SBE) in the solar system. As an airless obstacle to the torrents of photons and solar wind particles, Earth's Moon is a natural laboratory to study the interaction of Sun with the SBEs in the solar system. The lunar exosphere is a repository of a wealth of information about the lunar surface, interiors as well as different physical processes operative on the Moon. Lunar Ionosphere is produced by the interaction between solar radiation and lunar atmosphere. Hence study about the Lunar ionosphere will give ideas about the interaction of lunar atmosphere with solar radiation and the history of Lunar atmosphere itself.

In the present study, using physics based ionospheric model, the occurrence of ionosphere on Moon and its possible origin is revisited. The physics based ionospheric model, includes photo-chemistry of fourteen ions namely, CO_2^+, H_2O^+, H_3O^+, OH^+, O^+, O_2^+, Ar^+, Ne^+, He^+, H^+, H_2^+ , CH_3^+ , CH_4^+, and CH_5^+ and interaction of these ions with the solar wind[1]. The model calculations are supported by the measurements from India's Chandrayaan-1 mission such as ChACE neutral density, and Radio occulatation electron density measurements. In the present work, the analysis has been carried out for low, mid and equatorial latititudes when the Moon is inside and outside Earth's magnetosphere.

Model runs suggest that the surface electron density at Moon could be as high as 1×10^5 cm^{-3} over the mid latitudes, if dynamical interaction between solar wind and lunar plasma is not accounted. The dominant ions, in this case, would be Ar^+, Ne^+ and He^+. The absence of any intrinsic magnetic field, however, leads the ionosphere at Moon to interact continuously with the solar wind, resulting in the removal of positive ions. This, in turn, leads to a negligible presence of plasma in the lunar ionosphere. A case study was conducted where the Moon's exosphere was considered to have a presence of CO_2, H_2O, and OH molecules in addition to the inert gases like Ar, He,and Ne. Our calculations suggest that while the inert ions are swept away by the solar wind, the molecular ions, like CO_2^+, H_2O^+, H_3O^+ and OH^+ still remain present because their recombination rate is fast enough for the solar wind to interact and act upon for their removal. When the ionosphere interacts with the solar wind, the maximum electron density is around 500cm^{-3} over the mid latitude near the surface. The next maximum is observed for the low latitude region and is around 400 cm^{-3}. Above 100 km, the low and mid latitude show only marginal difference in density. As the CO2, H2O and OH density is high over mid latitude region [2], [3], the resultant molecular ions are also high at mid latitudes. The lowest was observed for polar region and is around 250 cm^{-3} at the surface.

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