Characteristic features of the Lunar ionosphere under varying solar geophysical conditions as revealed by DFRS onboard Chandrayaan-2.

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Previous missions including Luna-19, 20, SELENE, and Chandrayaan-1, etc. have shown the presence of plasma population in the Lunar exosphere [1, 2, 3]. Observations show that the electron density peaks at the surface and decreases with increasing altitude up to 50 km above the Lunar surface. However, there have been only sporadic measurements of the electron density profiles in the Lunar ionosphere so far, which are not sufficient enough to reveal the temporal and spatial evolution of the Lunar ionosphere. Dual frequency radio science (DFRS) payload onboard the Chandrayaan-2 orbiter is conducting regular radio occultation measurements using two coherent radio signals, generated by a very stable crystal oscillator (evacuated miniaturized crystal oscillator, EMXO) having a stability of 10^{-12} Hz/Hz over 0.1 sec integration time [4]. Observations with DFRS present first of it's kind measurements of the ionosphere in the Lunar wake region and show that the electron density thereat enhances many fold compared to the dayside [5]. The results also show a large electron density near the lunar polar regions during the solar transition period. These observations are unique in nature as they show post-sunset enhancements in the integrated electron density compared to dayside as reported by earlier missions. These results further confirm recent predictions from the theoretical model for the Lunar ionosphere [6].

These results have given a new understanding of the lunar plasma ambiance. The temporal and spatial variations in the lunar plasma from the equator to pole will be discussed in the presentation.

References:

[1] Vyshlov, A. S. (1976), Preliminary results of circumlunar plasma research by the Luna 22 spacecraft, Space Res., 16, 945 – 949.

[2] Imamura, T., et al. (2012), Radio occultation measurement of the electron density near the lunar surface using a subsatellite on the SELENE mission, Journal of Geophysical Research: Space Physics, 117(A6).

[3] Choudhary, R. K., K. M. Ambili, S. Choudhury, M. B. Dhanya, and A. Bhardwaj (2016), On the origin of the ionosphere at the Moon using results from Chandrayaan-1 S band radio occultation experiment and a photochemical model, Geophysical Research Letters, 43(19), 10 – 025.

[4] Choudhary, R.K., Bindu, K.R., Harshit, K., Karkara, R., Ambili, K.M., Pant, T.K., Shenoy, D., Kumar, C., Reddy, N., Rajendran, T.K. and Nazer, M., 2020. Dual Frequency Radio Science experiment onboard Chandrayaan-2: a radio occultation technique to study temporal and spatial variations in the surface-bound ionosphere of the Moon. Current Science (00113891), 118(2).

[5] Tripathi, K.R., Choudhary, R.K., Ambili, K.M., Bindu, K.R., Manikantan, R. and Parikh, U., 2022. A study on the characteristic features of the lunar ionosphere using Dual Frequency Radio Science (DFRS) experiment onboard Chandrayaan-2 orbiter. *Monthly Notices of the Royal Astronomical Society: Letters*.

[6] Ambili, K.M. and Choudhary, R.K., 2022. Three-dimensional distribution of ions and electrons in the lunar ionosphere originated from the photochemical reactions. Monthly Notices of the Royal Astronomical Society, 510(3), pp.3291-3300.