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Hydroxyl (OH) Spatial-temporal Distribution in Lunar Exosphere

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Abstract: Recent lunar exploration missions discover a large amount of water (H_2O) and hydroxyl (OH) on the surface of the Moon [Clark, 2009; Sunshine, et al., 2009; Pieters，et al., 2009]. These Observations show that water and hydroxyl molecules are volatized in sunlit area and the desorpted molecules run into lunar exosphere. Most of the water molecules in lunar exosphere are decomposed by solar ultraviolet radiation into hydroxyl and hydrogen molecules, and thus hydroxyl molecules are dominant the lunar exosphere. We calculate the hydroxyl molecules spatial and temporal distribution in the lunar exosphere according to the solar zenith angle (SZA) θ by particle simulation. The preliminary results show that scale height and column density of hydroxyl molecules are changed according to SZA, and the column density reaches highest at the subsolar line at which SZA $\theta=0^o$, minimum at midnight region, $\theta=180^o$. The column density of hydroxyl is about 2 to 3 orders higher than previous calculations [Stern, 1999; Wurz, et al., 2007], and the solar resonance fluorescence scattering generated by lunar exosphere hydroxyl molecules would heavily contaminate the lunar-based astronomy observations in sunlit regions, specially to a ultraviolet telescope, which intend to operate on a sunlit Lander. A part of exosphere hydroxyl molecules are ionized by solar Extra Ultra Violet (EUV) and temporal lunar ionosphere is generated instantaneously at subsolar exosphere region. The solar wind and interplanetary field (IMF) would pick up the newly born charged particles and accelerate them, and instantaneous lunar ionosphere would be blown away by the solar wind interaction. This instantaneous lunar ionosphere phenomenon can be used to explain some contradictory occultation observations of lunar ionosphere.