

First Simultaneous High-Sensitivity Lidar Observations of Permanent and Sporadic D-Region Ca⁺, Ca and Na Layers at Yanqing (40.5°N, 116.0°E), Beijing

Yuchang Xun ⁽¹⁾, Xinzhao Chu ⁽²⁾ (corresponding), Xu Zou ⁽³⁾, Jing Jiao ⁽⁴⁾, Zhibin Yu ⁽⁵⁾, Guotao Yang ⁽⁶⁾
(corresponding)

⁽¹⁾ Taiyuan University of Technology, Taiyuan, China E-mail: xunyuchang@tyut.edu.cn

⁽²⁾ Cooperative Institute of Research in Environmental Sciences & Department of Aerospace Engineering Sciences, University of Colorado Boulder, Boulder, CO, USA, E-mail: xinzhao.chu@colorado.edu

⁽³⁾ Department of physics and electronic engineering, Hainan Normal University, Haikou, China, Haikou, 571158, China, E-mail: christian5022@163.com

⁽⁴⁾ National Space Science Center, Chinese Academy of Sciences, Beijing, China, E-mail: jjiao@swl.ac.cn

⁽⁵⁾ Institute of Space Science and Applied Technology, Harbin Institute of Technology (Shenzhen), Shenzhen, China, E-mail: yuzb@hit.edu.cn

⁽⁶⁾ National Space Science Center, Chinese Academy of Sciences, Beijing, China, E-mail: gtyang@swl.ac.cn

We report the lidar observations of weak Ca⁺ layers at Yanqing Station (40.5°N, 116.0°E) near Beijing, China. Detection of tenuous Ca⁺ layers (0.1 ion cm⁻³) was enabled by high-sensitivity lidar. The diffuse calcium ion layers constituted the background main layers has been identified and the similar morphological structures with Ca background layers has first been found. In this study we also present 75 events of the simultaneous observations of sporadic Ca and Ca⁺ layers below 90 km that were obtained from 155 nights. The lowest height of the Ca⁺ layer reached 78 km, and the peak densities of these Ca⁺ layers reached 814.0 cm⁻³. Nearly all the Ca⁺ layers below 90 km lasted more than 1.5 hours. These long-lived metal ions below 90 km are noteworthy as they provide tracers to investigate the electrodynamics and metal chemistry in the D region. We believe that these observational results imply some new formation

mechanisms of sporadic Ca and Ca⁺ layers, and these observations will provide the basis for future improvement of metal layer models.