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The Terrestrial Exosphere observed by Space Satellites

KUWABARA, Masaki[1*] ; YOSHIOKA, Kazuo[2] ; MURAKAMI, Go[2] ; TSUCHIYA, Fuminori[3] ; KIMURA, Tomoki[2] ; KAMEDA, Shingo[4] ; SATO, Masaki[4] ; YOSHIKAWA, Ichiro[1]

[1]Univ. of Tokyo, [2]ISAS/JAXA, [3]Tohoku Univ., [4]Rikkyo Univ.

The terrestrial exosphere is the outmost region of the atmosphere, where scale height of particles is longer than the mean free pass of them. Thus exospheric particles are collisionless each other. Hydrogen atoms are most abundance in the terrestrial exosphere and helium atoms are the sec-ondary components. These atoms resonantly scatter sunlight and build the ultraviolet glows surrounding the Earth, called “geocorona” .

In 1972, Apollo 16 obtained the first image of the geocorona from the lunar orbit with approximately field-of-view of 10 R_E. In 1988, furthermore, the Ultraviolet Imaging Spectrometer (UVS) onboad the Nozomi satellite gave us the geocorona expanding down to 20 R_E. Therefore the observation of Apollo-16 was not enough to image whole geocorona. No observations of the geocorona had been done so far.

The observations of the geocorona have also been conducted by the Earth-orbiting satellites. Recently, hydrogen atoms in the geocorona sur-rounding from 3 R_E to 8 R_E are reported to increase by approximately 10% during magnetic storms. However, the responsible mechanism has not been proposed.

In September 2013, HISAKI/EXCEED was launched by the Epsilon rocket. It is now observing the geocorona in the orbit. During the strong geomagnetic storms in February 2014, the brightness at the Lyman-alpha emission was identified. I found the responsible mechanism to increase the brightness during the magnetic storms and compared it with observations. As a result, I have made a conclusion that thermospheric expansion and charge exchange with plasmaspheric ions should be responsible for the increases of hydrogen atoms.

In December 2014, the ultra-small deep space satellite (PROCYON) launched together with HAYABUSA-2. Lyman Alpha Imaging Camera (LAICA) is boarded on PROCYON. The LAICA instrument observes the so-lar resonant scattering lights from hydrogen atoms. It takes pictures of whole geocorona with a wide FOV (corresponding to more than 25 R_E from Earth). I have calibrated the performance of the LAICA before the launch. As a result, the LAICA has a total sensitivity of 1.1×10^{-3} cps/Rayleigh/pix at H I (121.6nm). Then, on 5th January 2015, I succeeded in imaging the geocorona from the deep space (13,000,000 km away from Earth). Not only it was 42 years after the Apollo-16 observation, but also this geocoronal imagery has the widest perspective in the world.

Keywords: exosphere, plasmasphere, magnetosphere, magnetic storm, geocorona, lyman alpha