R005-13
A 会場 ：11/24　PM2 （15:30-18:15）
16:45～17:00

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Thermospheric orthohelium variations associated with a moderate storm on February 2023: the NIRAS-2 observations at Longyearbyen

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Metastable orthohelium, He(2^3S) , is known to have airglow emissions by solar resonance scattering at wavelength of 388.9 nm (3^3P-2^3S) and 1083 nm (2^3P-2^3S). The emissions from the terrestrial atmosphere have been first reported more than 60 years ago during strong twilight and sunlit aurora over Moscow (Mironov et al., 1959; N. Shefov, 1961). Transition from ground state helium, He(1^1S) , to He(2^3S) is mainly caused by photoelectron impacts with energy larger than 19.8 eV (de Heer & Jansen, 1977). He(2^3S) layer is confined in the upper thermosphere and in the lower exosphere. Photoelectron impact occurs with a maximum production rate around 250 km. Generated He(2^3S) diffuses upward, but rapidly disappears above 500 km due to photo ionisation. Below 250 km, quenching due to Penning ionization is significant. As a result, He(2^3S) layer can be formed from 250 km to 800 km or above (Bishop & Link, 1993; Waldrop et al., 2005). That's why He(2^3S) is an unique and attractive candidate for remote sensing target of the neutral atmospheric dynamics in this region.

This study presents a time variability of He(2^3S) in polar region associated with a geomagnetic storm for the first time. Continuous 17-nights dataset of He(2^3S) airglow brightness at 1083 nm was obtained from a short-wavelength infrared imaging spectrograph (NIRAS-2) installed at Longyearbyen, Svalbard (78.1°　N, 16.0°　E). The observed He(2^3S) airglow brightness clearly displayed responses to a geomagnetic storm in different time scales. The He(2^3S) airglow brightness has began to decrease sharply within an hour of sudden commencement of the storm, and it was gradually decreased over the next few days and then recovered slowly. It was nicely agreed to helium density variations at 500-km altitude calculated by MSIS. The depletion of He(2^3S) was mainly caused by enhanced Penning ionization due to upwelling N_2 from the lower atmosphere; this was consistent with decreased O/N_2 ratio in MSIS and TIMED/GUVI measurements and electron density depletion in F region observed by EISCAT Svalbard Radar (ESR). Additionally, sudden increases in He(2^3S) airglow brightness were clearly found associated with intermittent electron precipitations observed by the ESR. Therefore, direct impact by precipitating electron injected from the space to the polar upper atmosphere can play significant roles in production of He(2^3S). The NIRAS-2 measurements have successfully demonstrated that column density of He(2^3S) from the upper thermosphere to the exosphere was drastically changed by forcing both from the lower atmosphere and from the space. He(2^3S) measurements will definitely improve our understanding of thermosphere-ionosphere coupling system and extend the coverage of space weather forecasting up to the exobase.