Millimeter-wave spectroscopy at Syowa Station
− Temporal variation of Nitric Oxide in the middle- and upper-atmosphere and near future plan of simultaneous multi-line observation −

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To study the influence of energetic particle precipitations (EPPs) on the upper- and middle-atmosphere in the polar regions, we have been conducting ground-based monitoring of spectral line of nitric oxide (NO) at 250.796 GHz by using a millimeter-wave spectrometer at Syowa Station since January 2012. Through the past 6 years observations, we have been detected various types of temporal variations with different timescale, such as sporadic enhancements in several days, seasonal variation, interannual decreasing trend during the declining phase of solar activity. In these two years, there were several significant sporadic enhancements of NO with an increment factor of 3-4 during August to October in 2016. In this presentation, we will present the details of the events in 2016 and summarize the features of various temporal variations of NO by comparing with the satellite data of energetic particles.

In addition, we are developing a new millimeter-wave spectrometer that enables us to make simultaneous multi-spectral line observation. The spectrometer will be equipped with a new mixer receiver with series-connected superconducting junctions, a new waveguide-type frequency selective multiplexer, new frequency-independent quasi-optical system, and an FFT signal processor with a 2 GHz bandwidth. Atmospheric molecular composition changes due to photo chemistry and dynamical transport as well as energetic particle precipitation. So, we think that simultaneous observations of various molecular species having different sensitivities to the photo chemistry and ion chemistry will provide more fruitful information to understand which process is dominant factor to each type of temporal variations. The observing frequency windows of the new spectrometer are designed to observe NO, O_3, CO, NO_2, HO_2, simultaneously, and it is plan to be installed at Syowa Station in early 2020. We will present the current status of the development of the new system in this presentation.

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