南極昭和基地における近赤外波長領域（1.0-1.6 microns）オーロラへの広帯域/高波長分解能・分光観測計画

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A ground-based observation plan for aurora spectrum in near infrared wavelength (1.0-1.6 microns) at Syowa Station

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The motivation of this study is further understanding of dayside magnetosphere and terrestrial atmosphere coupling system by using continuous observation with high temporal and spatial resolutions. Dayside aurora, polar patch, and airglow should be key phenomena for the understanding. In particular, those phenomena in near infrared (NIR) wavelength are crucially important because lower background sky luminosity by Rayleigh scattering may allow us to conduct ground-based optical observation even in dayside. Continuous dayside optical monitoring in aurora region and cusp give us a clue to understanding of substorm pre-onset sequences at cusp region, magnetopause dynamics related to solar wind shocks, and wave-particle interactions due to electromagnetic ion cyclotron waves and whistler mode chorus. However, NIR aurora has a total lack of its spectral information with enough resolution to make a feasibility study in comparison to that in visible wavelength.

We are now planning ground-based spectroscopic observation in NIR wavelength ranging from 1.0 to 1.6 microns, which covers auroral emissions in N_2 1st Positive (1.2 microns) and N_2^+ Meinel (1.1 and 1.5 microns) [*Jones* 1974; *Zhou et al*., 2007]. This observation will start at Syowa Station (69.0^{o}S, 39.6^{o}E) in Antarctica from March 2018 when austral summer ends. We designed a narrow field spectrometer with medium-high spectral resolution that mainly consists of Czerny-Turner type imaging spectrometer (HORIBA, iHR320) with one entry port and two exit ports. This spectrometer has two mirrors and three diffractive gratings in a rotating turret. A toroidal mirror for collimating corrects for astigmatism so that the tangential (resolution optimized) and sagittal (imaging optimized) focal planes cross at the center of the focal plane. Another larger focus mirror allows the entire flat field to be used without vignetting. Collecting optics, equipped outside the spectrometer, are a gold coated off-axis parabolic mirror and a NIR longpass filter for removal of secondary diffracted light in visible wavelength. Two detectors for two exit ports are NIR-photomultiplier tube (PMT) module with thermoelectric (TE) cooling system (Hamamatsu, H10330C-75) and InGaAs camera with 640 x 512 pixels and TE cooling in 4 stages (Photon etc., ZephIR 1.7). NIR-PMT module in combination with an exit slit measures precisely individual emission spectrum with high resolution of 0.006 nm. On the other hand, InGaAs camera covers wider spectral ranges (200 nm, 45 nm, 25 nm) and medium spectral resolutions (0.31 nm, 0.070 nm, 0.038 nm) depending on the three gratings (150 gr/mm, 600 gr/mm, 900 gr/mm). The two detectors cannot be operated simultaneously but can be easily switched by a software. Additionally, Argon lamp is used as calibration source for measured wavelength in a range from 1.0 to 1.6 microns.

In this presentation, we are going to report a final configuration of the spectrometer and a current status of this project. Results of test observations at Tachikawa (35.7^{o}N, 139.4^{o}E), including a first light of OH airglow emissions around 1.5 microns, will be also demonstrated and subsequently discussed the specification of the spectrometer in detail.