R005-P17
ポスター 2：11/25　PM1（13:45-15:45）

北極域 Na ライダーでの Faraday filter を用いた観測試験

#川原 琢也 [1], 斎藤 徳人 [2], 野澤 悟徳 [3], 津田 卓雄 [4], 川端 哲也 [2], 髙橋 透 [5], 和田 智之 [2]
([1] 信州大学工学部, ([2] 理化学研究所 光量子工学研究センター, ([3] 名古屋大学宇宙地球環境研究所, ([4] 電気通信大学, ([5] 国立研究開発法人　海上・港湾・航空技術研究所

Sodium lidar observations using a Faraday filter in the Arctic: initial results

#Takuya D. KAWAHARA[1)], Norihito SAITO[2)], Satonori NOZAWA[3)], Takuo T. TSUDA[4)], Tetsuya KAWABATA[2)], Toru TAKAHASHI[5)], Satoshi WADA[2)]
([1]Faculty of Engineering, Shinshu University, ([2]Center for Advanced Photonics, RIKEN, ([3]ISEE, Nagoya University, ([4]University of Electro-Communications, ([5]Electronic Navigation Research Institute

The Sodium (Na) lidar installed at the EISCAT radar site in Tromsø, Norway (69.6º N, 19.2º E) has been monitoring Na density, background temperature, and wind speed in the mesopause region (80-115 km altitude) since 2010. With its highly stable output and almost maintenance-free operation, the lidar has played a key role in clarifying the relationship between auroras and the dynamics of the mesosphere and lower thermosphere during winter nights.

Currently, efforts are underway to:

(1) extend the observation altitude range of nighttime measurements up to 200 km, and

(2) expand the observation period to include year-round measurements, including summer, while maintaining the same altitude range for nighttime observations.

To accomplish this, we are developing an ultra-narrowband filter (FWHM ~10 pm) that effectively blocks background light except for the resonance scattering. A magneto-optical filter (Faraday filter; FF) is being developed and integrated into the lidar receiver system.

In the summer of 2024, a newly developed receiver system and observation container were shipped to the site by sea and installed. The receiver system includes a 50 cm telescope, a band-pass filter with a full width at half maximum (FWHM) of 1 nm, a polarization prism, and an FF aligned along the optical path, with light detected by a Multi-Pixel Photon Counter (MPPC). By blocking the observation light and using a continuous-wave 589 nm laser delivered through an optical fiber from the transmission system as the light source, it becomes possible to measure the transmission characteristics of the FF.

In 2025, the receiver system is assembled at the EISCAT site in late September. The Faraday filter (FF) is calibrated using a calibration light, and wavelength scans are performed to measure its transmission. After these preparations, the telescope is pointed vertically, and simultaneous observations with the conventional receiver system are conducted as follows:

(1) Nighttime observation without activating the FF: The new receiver system operates as a standard system without the FF. Signal light intensity and background light levels are compared to those from the conventional system.

(2) Nighttime observation with the FF activated: The transmission profile of the FF is measured beforehand. Attenuation ratios of background light and signal light are compared within the same system, as well as with values obtained using the conventional system.

(3) Verification of consistency in derived temperature and wind speed during nighttime: Consistency between the systems (with the FF activated and the conventional system) is checked for the analyzed temperature and wind speed.

(4) Daytime observation with only the new system: Following the observation (2), the new system extends measurements from nighttime into daytime to verify that temperature and wind speed can also be obtained during the day.

(5) High-altitude nighttime observation: With the FF activated, both the new and conventional systems conduct nighttime observations while the pulse laser repetition interval is adjusted to enable high-altitude measurements. Data are collected up to 200 km in the lower thermosphere.

A preliminary report of these observations will be presented at a scientific conference.