

SPECTROSCOPY OF THE KOREAN GEOSTATIONARY EARTH ORBIT SATELLITES (GEO)

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ABSTRACT

We present a preliminary investigation on the spectroscopic properties of geostationary earth orbit satellites (GEO). The optical wide-field net system (OWL-Net) has been developed and used for tracking and monitoring of low earth orbit satellites (LEO) and Korean GEOs since 2010, and complementary spectroscopic data for four GEOs were acquired using the 1.8 m telescope at the Bohyunsan Optical Astronomy Observatory (BOAO). Reflectance spectroscopy of GEOs is a useful technique to investigate the surface material and their attitude. Furthermore, long term spectroscopic observations covering time variations will provide comprehensive data on the space weathering effects in the GEO orbit environment. Previous spectroscopic analysis of a meteorological GEO COMS has revealed interesting emission features including H-alpha and sodium lines. Subsequent follow-up spectroscopic observations on the GEOs (KOREASAT-5, -6, and COMS) using Longslit spectrograph at the BOAO are scheduled throughout 2018 for a further study of GEO orbit environment.

1 INTRODUCTIONS

Reflectance spectroscopy has long provided a tool to explore the fundamental properties of astronomical objects such as age, metallicity and chemical abundance. It is now applied to artificial space objects to serve the same purpose in recent years. Spectroscopic studies on

orbiting objects, rocket bodies and debris have been carried out, as well as comparison between laboratory measurements and space measurement of the same material [2][3][4]. One interesting phenomenon reported is the increase of reflectance with wavelength which is also called reddening [1]. This phenomenon seems to be dependent of material and caused by exposure in space environment since it is only observed in space.

A series of observation runs is scheduled and conducted to examine the several Korean GEOs currently in operation, including COMS ((Communication, Ocean and Meteorological Satellite), Koreasat 5, 6, and 7. Photometric and spectroscopic studies on the Korean GEO satellites have been far and few between until the launch of Koreasat 7. We expect to carry out long-term spectroscopic observations and explore the possible effects of space environment on the surfaces of the satellites.

In this study, we report the preliminary findings from the spectroscopic observations performed with the BOAO 1.8-m telescope (Fig. 1).

2 OBSERVATION

We use and analyze the previously obtained spectra with

Bohyunsan Optical Echelle Spectrograph (BOES). From 2018, spectra are taken with Longslit spectrograph and the configuration is such that the wavelength range covers 400 ~ 1000 nm with the central wavelength of 700 nm. Data are collected throughout 2018 and we assign a full night to each satellite to fully cover the phase variations. The exposure time was varied between 1200 s to 1800 s. Tab. 1 lists the GEO satellites observed and their international IDs and apogee/perigee values. 1-d spectra are extracted through a standard procedure using IRAF.



Figure 1. BOAO 1.8m telescope

Table 1. List of observed GEO satellites

Name	INTLDES	Apogee (km)	Perigee (km)
KOREASAT 7	2017-023A	35793	35779
KOREASAT 6	2010-070B	35793	35782
COMS 1	2010-032A	35787	35786
KOREASAT 5	2006-034A	35788	35787

3 RESULTS

BOES spectra of COMS are displayed in Fig. 2 where spectra are placed arbitrarily apart for a clear presentation. The top 3 spectra exhibit an emission-like feature. A further check with other H lines was unfortunately not

possible due to low S/N. In Fig. 3 a similar emission feature prominently shows for the sodium line for the top 4 spectra. Thus it does not seem to be caused by cosmic ray. We are currently in the process of analyzing the Longslit spectra of COMS to verify and confirm the emission feature.

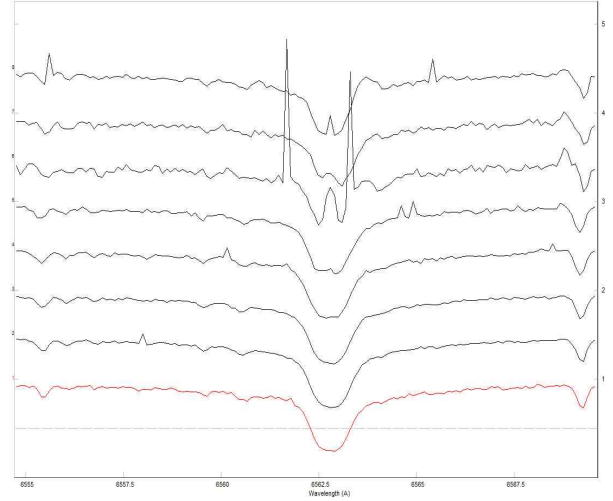


Figure 2. The observed BOES spectra of COMS for H line

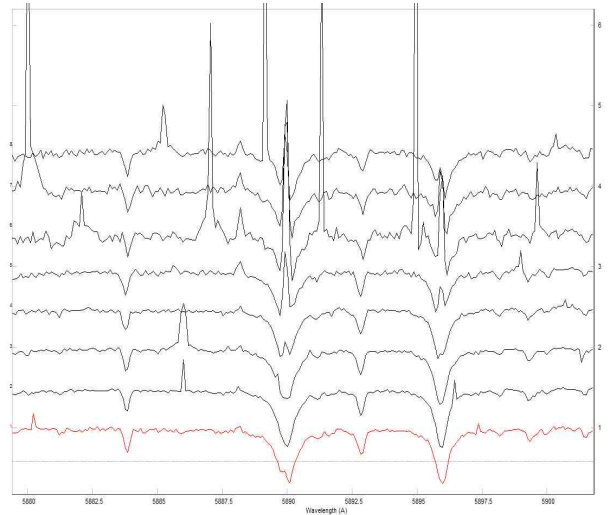


Figure 3. Same as Fig. 2 but for sodium line.

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