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SPECTRA OF REFLECTED SUNLIGHT FROM PLANETS

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ABSTRACT

Spectra of reflected sunlight from Mars and Jupiter are presented. They were obtained from an educational 1-D array spectrograph covering almost a full range of visible wavelengths, 200 ∼ 900 nm with 1 nm spectral resolution. The question was whether a spectral difference could be obtained between that of terrestrial planets and gas planets with an educational spectrograph. It was installed in a 12-inch reflecting telescope at the Korea Science Academy of KAIST in Busan. Both spectra show clear absorption lines of reflected sunlight. They shows differences oin line presence, but are not very significant. This work means that the spectrograph successfully observed the reflected spectra of planets and can detect differences in spectra in terms of the absence and presence of absorption lines of planets.

Key words: Spectrograph: planets: reflected spectra: Mars: Jupiter

1. INTRODUCTION

The question regarding the performance of our newly applied spectrometer was asked; "can one easily obtain astronomical spectra with an educational device using small telescopes?". The device has been generally used for detection of fluorescence, chemiluminescence and photoluminescence light in a laboratory, for multiple purpose. In order to use the device in astronomical applications, bright objects in the sky have been chosen - Mars and Jupiter. The spectra are of reflected sunlight and it represents terrestrial and jovian type of spectra.

2. DATA

The spectrometer used is SV2100R, manufactured by Korea materials & Analysis Corp. (KMAC). The wavelength coverage is from 250 to 800 nm and the FWHM resolution is less than 1 nm. It has a 1D CCD array with 2048 pixels. Wavelength calibration has been done with the provided program, VisualSpectra, comparing with saved tungsten-hallogen lamp spectra. We installed it onto the 12-inch reflector with the help of a newly developed adapter (Song, 2015). The observatory is located in Busan, the 2^{nd} biggest city in our country.

The integration time is 1000 milliseconds for each spectrum and the observation was carried out on 1^{st} May 2014. Dark current has been subtrated.

3. RESULTS

The spectra have been successfully obtained and are shown in Fig. 1, 2. They represent continuum emission having few absorption lines. Spectra of Mars and Jupiter are clearly different in terms of their peak positions and the absorption line. Fraunhofer lines are shown in Table 1 and absorptions in Table 2, 3 for Mars and Jupiter respectively.

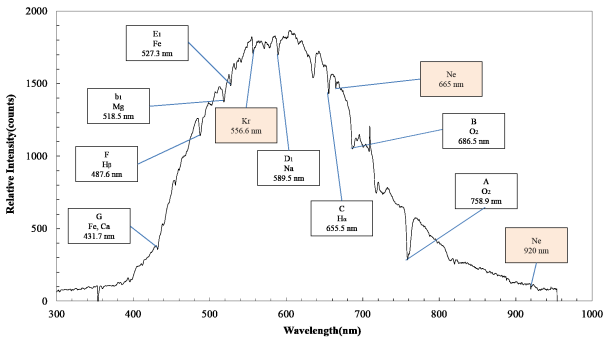

Figure 1. Mars Spectrum. The white boxes represent the Fraunhofer lines and colored boxes Mars's emission.

4. CONCLUSION

The spectra of Mars and Jupiter have been successfully observed. Apart from reflected light, they show the planets' own absorptions (Table 1, 2) which are shown in Fegley (2013). The lines from Kr and Ne have been shown in Mars' spectrum and methane lines have been obviously detected in Jupiter's spectrum.

We have detected spectra of Mars and Jupiter successfully using a small telescope. As well as continuous emission, absorption lines have been observed using an educational spectrometer. If intensity calibration were

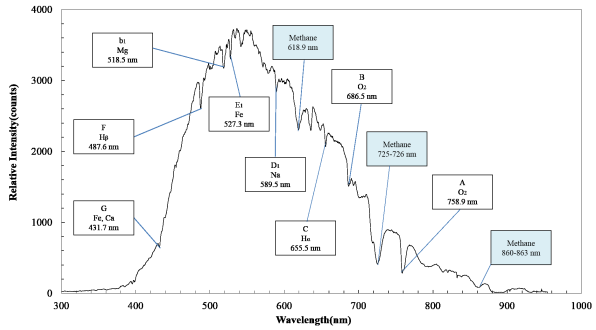

Figure 2. Jupiter Spectrum. The white boxes represent the Fraunhofer lines and colored boxes Jupiter's emission.

Table 1
Fraunhofer line in the visible wavelength

Line Name	Wavelength (nm)	Elements	From
G	431.7	Fe & Ca	Sun
F	487.6	Hβ	Sun
b1	518.5	Mg	Sun
E1	527.3	Fe	Sun
D1	589.5	Na	Sun
C	655.5	Hα	Sun
B	686.5	O_2	telluric
A	758.9	O_2	telluric

Table 2
Chemical composition of Mars

	Chemical Composition of Mars
Our result	Kr (556.6 nm), Ne (655nm, 920 nm)
Fegley (2013)	CO_2, N_2, Ar, O_2, H_2O, NO, Ne ...

Table 3
Chemical composition of Jupiter

	Chemical Composition of Jupiter
Our result	CH_4 (618.9, 725 $\sim$ 726, 860 $\sim$ 863 nm)
Fegley (2013)	H_2, He, CH_4, NH_3, HD, $^{13}CH_4$, H_2O, ...

carried out, then the amount of absorbed light could be estimated.

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