Laboratory experiment of resonance scattering of Lithium for S-520-23 sounding rocket experiment

Yuki Yokoyama[1]; Masa-yuki Yamamoto[2]; Yuichi Otsuka[3]

[1] Electronic and photonic,Kochi University of Tech; [2] Kochi University of Technology; [3] STELAB, Nagoya Univ.

http://www.ele.kochi-tech.ac.jp/masayuki/

1. Introduction

The S-520-23 sounding rocket is scheduled to launch at Uchinoura Space Center, Kagoshima, in August 2007. The main purpose of the experiment is measuring themospheric neutral wind by resonance scattering luminescence of Lithium vapor to be released from the Lithium canister (LES) onboard the rocket. Taking images of 670 nm resonance scattering light of Lithium in the evening, neutral wind velocity vector in thermosphere will be measured as motions of three red clouds of Lithium vapor to be observed from several ground observation sites in western Japan. Purpose of the study is to obtain background luminosity at 670 nm in evening condition as well as to measure the Lithium resonance scattering light in laboratory experiment.

2. Experiments and results

Four digital cameras of Canon EOS Kiss Digital N are prepared for optical observation of Lithium clouds. Lenses have been developing by Photocoding and Kochi University of Technology. Because the 670 nm wavelength light is difficult to be taken by usual digital cameras with infrared cut filter, we removed the filter. In laboratory experiment, we measured the sensitivity curve of the digital cameras with respect to wavelength by using continuum light source with a slit, laser diodes of 532 nm and 650 nm for references, interference filter of 670 nm with 10 nm bandwidth, and a grating. As a result, we confirmed that the 670 nm light can be detected by the cameras without infrared cut filter. Moreover, we had a laboratory experiment of Lithium release in ground condition at Japan Carlit Co., Ltd. in February 2007, resulting successful detection of 670 nm resonance scattering of Lithium.

Background intensity of the sky at around 670 nm in evening condition is significant to our measurement. We measured absolute intensity spectra of background sky at several elevation condition and solar zenith angle condition by a scanning photometer of STEL, Nagoya University. Comparison with rough estimates of Lithium resonance scattering luminescence with a condition of 20 nm bandwidth, a 1 M rayleigh Lithium cloud will be measured at 5 s after a release, however, a 10 K reyleigh at 50 s by diffusion. It is found that intensity of the Lithium cloud will be reached in limitation of S/N at 60 s after the release.

3.Discussion

Estimating the motion of first Lithium clouds in a digital image assuming 40 m/s wind in thermosphere, 24 pixels difference will be measured at about 2.5 minutes after the release. The motion will be difficult to measure in poorer S/N or weaker wind condition. The four Lithium cameras will be installed at four independent ground stations at Shionomisaki, Kochi, Goto, and Amami, however, more backup imaging instruments should be simultaneously operated.

4.Conclusion

Resonance scattering light of Lithium at 670 nm was successfully detected in laboratory experiment in the preparation process of the Lithium release experiment by S-520-23 sounding rocket to be launched in August 2007.

Reference: Paul A. Bernhardt, Supplemental ideas for the Japan Li release experiment, 2006.