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論　文　内　容　要　旨

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学位論文の 題　　　目	Characteristics of [OI] 630nm emission in the Enceladus torus based on the ground-based observation (地上観測によるエンケラドストーラス[OI] 630nm発光の特性に関する研究)		

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Saturn's magnetosphere is dominated by water group neutrals (e.g. H_2O, OH, O and H) because there are many icy rings and satellites in the inner magnetosphere. The main and important source is Enceladus because it is ejecting water gas and grains from 'plume' on the southern polar region. These neutral sources make Saturn's magnetospheric environment unique from Earth or Jupiter which have well-studied magnetosphere driven by solar wind and by corotation, respectively. The contribution of Enceladus plume on the Saturn's magnetosphere is under studying vividly. The neutrals have been observed by remote sensing using UV spectrometer on board Voyager, Hubble Space Telescope and Cassini [e.g. *Sandel et al.*, 1982; *Shemansky et al.*, 1993; *Melin et al.*, 2009]. These observations derived the global density distribution of H, OH and O. Especially, observations by Cassini spacecraft were successfully discovered the weekly variation and asymmetric distribution of atomic oxygen [*Melin et al.*, 2009]. However, there is a problem that the observations are limited because of lack of machine time and geometric issue. For example, observations of oxygen atoms by Cassini were operated only before Saturn orbit insertion (SOI) and cannot be made from the orbit. Therefore, the measured neutral density distribution is almost 'only one' or usual for each species.

The environment of Saturn's magnetosphere has also been studied by numerical simulation considering particle motion, chemical reactions and others. Then parameters are constraint by matching the observed neutral density distribution with calculated one. The neutral distributions are expected having various variability caused by geological activity like as Io [e.g. *Mendillo et al.*, 1990], therefore continuous monitoring is needed to understand the Saturn's magnetosphere.

In this study, we successfully carried out ground-based observations over three years. The key point of the ground-based observation is free from limitation of machine time and making observation continuously. The ground-based observations of [OI] 630 nm emission from Enceladus torus was made at. Haleakala, Hawaii from May 4 through June 9 in 2010, from May 13 through July 19 in 2011 and from May 3 through July 12 in 2012 using 40-cm telescope with high-dispersion echelle spectrograph. The purpose of this study is as follows:

- to construct the method of ground-based observation.
- to discuss the process of this emission in the torus and make interpretation for the characteristics.

Additionally, model estimation to investigate emission characteristics is performed using distribution models base on observations by HST and Cassini. The main results are summarized as follows:

- For the first time, [OI] 630 nm emission from the Enceladus torus was achieved from the ground. The intensity of 630 nm emission integrating whole data in 2010 and 2011 were 5.2 ± 0.65 R and 4.1 ± 0.6 R respectively. The S/N 7 to 8 was achieved using data whose exposure time are 40 min and integrating over 100 images. The observation method was successfully constructed.
- There was the variability of total brightness increasing from 3 RRs to 8 RRs within 20 days in observation 2010.

- The model estimation based on our observation result suggested that [OI] 630 nm emission is mainly caused by photo-dissociation of OH and electron impact excitation of O. The fractions of contribution are 56 % for photo-dissociation of OH and 38 % for electron impact excitation of O.
- [OI] 630 nm emission intensity varies by solar UV, neutral density and electron temperature. However, the contribution of variation of solar UV was ignorable in monthly observation. Therefore, the variation of emission intensity detected in 2010 suggested variation of neutral density and electron parameters especially, cold component.
- Enceladus phase dependence in [OI] 630 nm emission was not detected.

Finally, this study gives some next steps listed in the following which will be performed in the future.

- Observation for the radial distribution should be carried out.
- Since various emissions occur the Saturn’s magnetosphere, such as simultaneous observation of different emission in multi-wavelength helps us to derive density and temperature of neutrals and plasma mutually.