[OI]630.0nm emission in the Enceladus torus obtained with Haleakala T60/Vispec

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The moon Enceladus, revolves round Saturn at 3.9 Saturn Radii(Rs), emits the plume mainly composed of water vapor from cracks in south polar region called “Tiger Stripe”. This plume cause the neutral particle rich inner magnetosphere and the neutral density is ten times greater than the plasma density. Though, its time variation and spatial distribution has been discussed by models and simulation studies, there are few studies based on observation data. We aim to understand the physical processes in the Saturn’s inner magnetosphere based on continuous observation of atomic oxygen [OI]630.0nm emission. The [OI]630.0nm emission are caused by resonance scattering with sunlight and by electron impact excitation.
In this study, we carried out the Enceladus torus observation with a 60-cm telescope(T60) at Haleakala observatory and a high-dispersion spectrograph (Vispec:Visible Imager and Spectrograph with Coronagrphy). During a period from 2015/7/13 through 2015/9/18. Vispec adopts 1024pix×1024pix cooled-CCD as a detector covering the wavelength of 629[nm]~632[nm] with a wavelength dispersion of 5.98×10^{-3}[nm/pix] with a 2x2 binning mode.
We used two kind of slits; one is 60[μm] width×10[mm] length, or 100[μm] width×10[mm] length, of which correspond to FOVs of 300″x2″,300″x3″, respectively. In the former slit case, the slit was centered at a distance of 3.9Rs from Saturn and aligned parallel to the east-west direction of Saturn’s equatorial plane (E-W slit), and in the latter slit case, the slit was aligned in north-south direction(N-S slit) centered the same point. Exposure time was 20[min] per 1 frame, and we totally obtained 74 frames (38 frames of E-W data, 36 frames of N-S data). Using the N-S silt data(22 frames, total exposure time is 7.3[hour]), we estimated the [OI]630.0[nm] at 3.9Rs in the east side of Saturn, and the result indicates that the emission intensity was below the detection limit of our observation system, which is less than 2.4[R] in 3-σ. But there is the possibility to improve this limit about three times better. Since the past study obtained in 2009 reported that the emission of [OI]630.0[nm] was 4.0±2.0[R]. We would be able to discuss the time variation of the [OI]630.0nm emission. One of the possible cause of variation is the difference of observation geometry. Saturn’s Ring-Opening Angle(ROA) observed from the earth vary every 15 years. Against ROA is 4.5[deg.](nearly horizontal) in 2009, ROA during our observation period is 22.4[deg.] So the number of atomic oxygen along the line of sight and the apparent spatial distribution of Enceladus torus were changed during the period. We also have to consider the variability of solar EUV flux, the activity of Enceladus plume and so on as the cause of this variation. In this presentation, I will discuss these causes by comparison with condition of past study.

Keywords: Saturn's inner magnetosphere, Enceladus, groundbased-observation

