GROUND BASED OBSERVATION OF MERCURY’S SODIUM AT HALEAKALA OBSERVATORY IN 2013-2017. S. Kameda1 and M. Kagitanī2, 1Rikkyo University (3-34-1 Nishi-Ikebukuro, Toshima, Tokyo 171-8501, Japan), 2Tohoku University.

Introduction: Mercury’s exospheric sodium has been most investigated in exospheric species to understand the dynamics and source process of surface-bounded exosphere because its emission is the brightest in exospheric emission. Since its discovery [1], a lot of ground-based observations for more than three decades and MESSENGER observations have been done and sodium atoms are thought to be released from the surface by photon-stimulated desorption [2, 3], thermal de-sorption [4], chemical sputtering [5], solar wind ion sputtering [6, 7], and micrometeoroid vaporization [8, 9] however, the source process of sodium is yet to be clarified.

Observation: In this study, daily variation in Mercury’s sodium exosphere was observed at the Haleakala Observatory in Hawaii by using a 40 cm Schmidt Cassegrain telescope, a high-dispersion spectrograph, and a charge coupled device (CCD) camera. During observation seasons, elongation between Mercury and the Sun is more than 15 °, and the observation time varies from 30 min to 1 h before sunrise or after sunset. The exospheric emission observed from the ground is part rather than entire of dayside. The ratio of the observed emission varies by phase angle. Thus, we estimated the averaged column density of sodium atoms by using the exospheric model and assuming constant exospheric temperature.

We confirmed that the column density of sodium atoms over the dawn side differs from that over the dusk side. We originally focused on column density over the dawn side, which had been observed until January 2015 and confirmed the seasonal variation greater than that of dusk side. However, our observational data of March 2015 confirmed significant variation over the dusk side. In addition, we examined the ratio between the dawn and dusk sides. Although roughly 1 in the true anomaly angle (TAA) of >180°, the ratio is greater than 2 at maximum in the TAA of <180°.

Model: In the observational data of the dawn side, the local maximums of the column density of sodium atoms were present near the TAA of 140° and 320°, which indicates contribution by interplanetary dust impact. Interplanetary dust is known to be distributed densely in the dust symmetry plane; however, its detailed distribution in the vicinity of Mercury is unknown. By applying the dust distribution model by Kelsall et al. [1998], these TAAs show the points at which Mercury passes through the dust symmetry plane. To verify the contribution of interplanetary dust to exospheric yield over the dawn side, model parameters that maximize the correlation coefficient were derived, revealing a value of 0.822. Therefore, the column density of sodium atoms may correlate highly with the interplanetary dust density.

However, the variation in column density over the dusk side showed a local maximum near the TAA of 180°. Therefore, such variation cannot be explained by the consideration applied to the dawn side. Thus, it is necessary to examine factors indicating the differences in variation between the dawn and dusk sides.

We also took into account the transportation effect by solar radiation pressure. The result shows this process is effective and may explain the temporal variation of sodium density at the dusk side. Additionally, we consider the adsorption to the night-side surface, which explains the temporal variation at the dawn side.

Future work: We started continuous observation using the same telescope and spectrograph in 2013, and the system is still working. Recently, we succeeded in fully automatic observation of Mercury, i.e., unmanned guiding and spectroscopic observation with calibration data. Due to the high clear-sky occurrence rate at Haleakala, we can obtain the data constantly. We also plan to keep this facility and Mercury observation to 2025 when BepiColombo will arrive there to perform simultaneous observation and to clarify the relationship between solar cycle and temporal variation of Mercury’s sodium.