論文内容の要旨

論文題目　Study of time variation in exospheric sodium density on Mercury

（水星ナトリウム大気密度の時間変動に関する研究）

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Continuous spectroscopic observations of the Mercury's sodium exosphere were conducted with a 188 cm telescope and a high dispersion echelle spectrograph at the Okayama Astrophysical Observatory, for 1-6 hours in the daytime on December 4, 13, 14, and 15, 2005. To correct the images of the sodium emission blurred by Earth's atmosphere, the observed distribution was deconvolved with the point spread function which was obtained using Hapke's surface reflection model and the observed surface reflection.

The column densities averaged over the disk were $(2.1 \pm 0.1) \times 10^{11}$ atoms/cm^2 and $(1.2 \pm 0.05) \times 10^{11}$ atoms/cm^2 during the observation times on December 4 and December 13–15, respectively. This suggests that the total release rate of sodium atoms on Mercury decreased to 60 % between December 4 and 13. The heliospheric distance of Mercury increased from 0.33 AU to 0.38 AU during this period and the solar UV flux decreased. Therefore, the release rates for photon-stimulated desorption decreased to 60 %.

The observed averaged density was stable during December 13–15. This suggests that the rate of change in the yield of the globally occurring source processes

should be low and its timescale should be more than a terrestrial day, which is much longer than the timescale of change in solar wind flux.

Asymmetric distribution was observed in this study and the north-south ratio of the sodium density was 0.98-1.08, although significant north-south asymmetry has been reported in past observations and it was suggested to be mainly caused by the solar wind sputtering.

Continuous six-hour observation was carried out in December 4, 2005. This is the longest continuous observation that has been conducted in a day. If solar wind sputtering is the dominant source process, time variation in changes of sodium density would be approximately 20 % per hour and the deviation would be 25 %. However, the observed rate of change in sodium density and the deviation were less than one-fifth.

These results suggest that photon-stimulated desorption is the dominant source process, although the past study concluded that solar wind sputtering is the dominant.

Observations of sodium emission from Mercury's atmosphere were carried out using a Fabry-Perot Interferometer at Haleakala Observatory on June 14, 2006. The Fabry-Perot Interferometer was used as a wavelength-tunable filter. The spectra of the surface reflection were subtracted from the observed spectra to obtain the intensity distribution of sodium emission because sodium emission is contaminated by the surface reflection of Mercury. The image obtained in the observation clearly shows the sodium exosphere extended to the anti-solar direction, although the whole image of the sodium exosphere had not been obtained in the past observations. The lifetime of sodium atoms was estimated to be 9.5×10^3 sec (maximum) using the observed e-folding distance (5.0×10^4 km) in the sodium tail and was lower than predicted. This suggests the lifetime might be overestimated in the past study.