# Distribution characteristics of Mercury's exospheric atmosphere as explained by a modeling calculation

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It is known that Mercury wears quite rare atmosphere named 'exospheric atmosphere'; i.e. the number density is expected to be at most 10^6 1/cc even at the planetary surface. One of striking characteristics of Mercury's atmosphere is its comparably-large content of alkaline metal elements (sodium and potassium). The sodium and potassium atmospheres were first discovered in the middle of 1980's by ground-based optical observations [Potter and Morgan, 1985; 1986]. Further investigations have been revealed the following spatial and time-variable characteristics [see Killen and Ip, 1999]; i.e., 1)the alkaline atmosphere often shows non-uniform distribution: concentration near the polar regions and dawn-dusk asymmetry, 2)the distribution shows global variations at a time-scale of at least less than 1 day, and 3)it is not well confirmed, but there is a possibility of large expansion of dense atmosphere far above the planetary surface, which means the substantial hot component (several thousands K) would dominate in the atmosphere.

In order to investigate origins of the spatial and time-variable characteristics of Mercury's atmosphere, we have made a model calculation for Mercury's exospheric atmosphere based on the Monte-Carlo method. In the calculation, we have assumed three types of plausible source process; 1)photon-stimulated desorption, 2)ion sputtering, and 3)meteoritic impact vaporization, and one sink process; photo-ionization. As a distribution function of released particles from the surface, the Maxwell-Boltzmann velocity distribution was adopted for the first and third source processes, while the Sigmund-Thompson velocity distribution was adopted for the second source process. A quantitative evaluation for released amount by each source process was made in this study. The effect of the recirculated process of photo-ionized particles to the surface was also taken into account particularly in the examination of the spatial characteristics.

The major findings by the model calculation are summarized as follows.

1. The most plausible source process for the large amount of the dayside atmosphere is the photon-stimulated desorption.
2. The localized and time-variable distributions near the polar regions and largely extended atmosphere are explained by the ion sputtering process.
3. The dawn-dusk asymmetry is explained by the ion sputtering caused by the precipitation of the magnetospheric recirculated ions to the surface.