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Long-term variability of Na density in Mercury's atmosphere

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Mercury has a very thin atmosphere. Its density is only a trillionth that of Earth's atmosphere; therefore, atoms and molecules in Mercury's atmosphere rarely collide. Hence, its atmosphere is called surface bounded exosphere. Atmospheric particles last only for short duration of a few hours in Mercury's atmosphere, indicating that sources of each of the constituents must exist on the planet. Mariner 10 detected H, He, and O, in Mercury's atmosphere; further, Na, K, and Ca were detected by ground-based observations. Atoms of these, Na haves ever been made ground-based observations. The three dominant source processes of Na atoms in Mercury's atmosphere are as follows.

1.Solar photon hitting the dayside surface of Mercury, Na atoms contained in the material surface are stimulated and emission.
2.Solar wind and ions in the magnetosphere hitting the surface of Mercury, and Na atoms get sputtered from the material surface.
3.Na atom emission for vaporization when the interplanetary dust on the ecliptic plane hit the surface of Mercury.

However, the most dominant among the abovementioned processes is yet to be clarified. Because of Mercury's proximity to the sun, observations cannot be made from about 30 min before sunrise or after sunset. This makes it impossible to study long-term (more than 1 h) variability of atmospheric density in order to determine the source of Na atoms. We conducted continuous spectroscopic observations of Mercury's exosphere with a 40-cm telescope at Haleakala Observatory in Maui. And we successed observation for 10 h during the daytime by replace the hood on the telescope to prevent stray light from hitting the primary mirror directly.

We compared the long-term variability of Na density in Mercury's atmosphere with date on the amount of solar wind particles such as ions and electrons around the planet; this data was obtained from NASA's MESSENGER spacecraft. We suggested a correlative relationship between the solar wind particles and the source processes of Na atoms in Mercury's atmosphere.

Keywords: Mercury, Na, airglow, Ground-based observation, Planetary Atmosphere, MESSENGER