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Mercury's Sodium Exosphere: from ground-based to space observations – a unique view.

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Observations of Mecury's exosphere provide essential data necessary for understanding the combined effects of solar radiation and micrometeoroid bombardment on the surface and the interaction of the solar wind with Mercury's magnetic field and surface. Here we compare ground-based Na data with MESSENGER (MErcury Surface, Space ENvironment, GEochemistry, and Ranging) spacecraft data taken during the third MESSENGER flyby that took place on September 29, 2009. Ground-based observations of Na were conducted using the 2.7 m telescope at the McDonald Observatory at very high spectral resolution in the period of September 28 to October 1, 2009. Given Mercury's orbit configuration during that period, the dusk hemisphere of the planet was captured from Earth. The Ultraviolet and Visible Spectrometer (UVVS) onboard MESSENGER obtained spacecraft measurements mostly in the tail region anti-sunward of the planet during the flybys. Thus, the MESSENGER and ground-based observations observed complementary regions.

MESSENGER observations of Na showed relatively high abundances over the north and south poles during the third flyby. The Na emission exhibited a two-component structure that seems to be consistent with a mix of low-energy processes (such as photon-stimulated desorption) and high-energy processes (such as ion-sputtering and meteoroid impact vaporization). Temporal and spatial variability of the sodium emission was observed from the ground on the dayside and the dusk terminator of the planet. These data also show north/south asymmetries on day of the flyby in the regions of peak emission.

The MESSENGER tail observations on September 29 are studied simultaneously with the ground-based dayside data to explain the transport of the Na atoms from the dayside exosphere into the tail. The very-high spectral resolution data obtained from the ground allow for Doppler shift measurements and upper limits on flow velocity. Such measurements can help explain the UVVS data, which suggest that most of the Na atoms near the poles exist at low energy and that Na in the tail originated from a high-energy source.