Sodium Velocity Maps on Mercury

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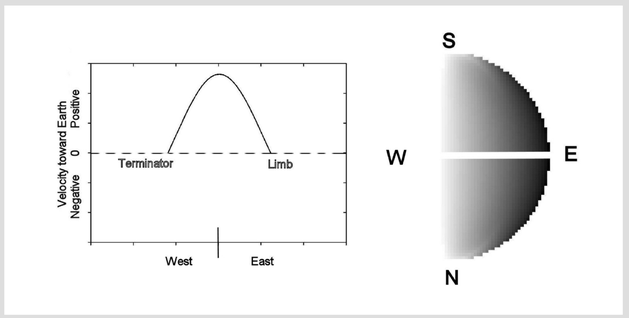
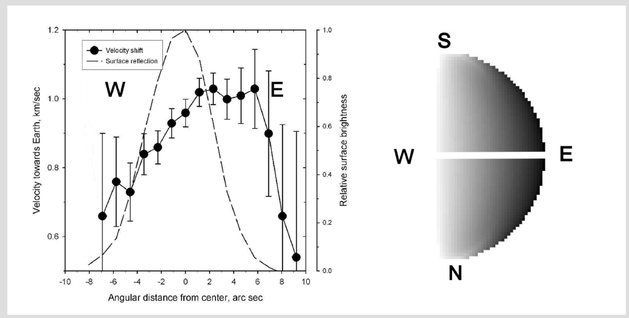
Introduction

Exospheric sodium atoms flow across the Mercury surface as a consequence of solar radiation pressure. To first order, the flow pattern is probably similar to laminar flow over a sphere. The earthward velocity vectors of the sodium flow can be mapped by measuring Doppler shifts (Potter *et al*. 2009)



Expected Earthward vectors, East-West slice



Observed Earthward vectors, East-West slice

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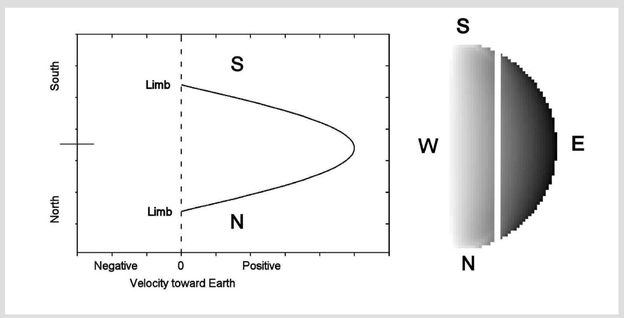
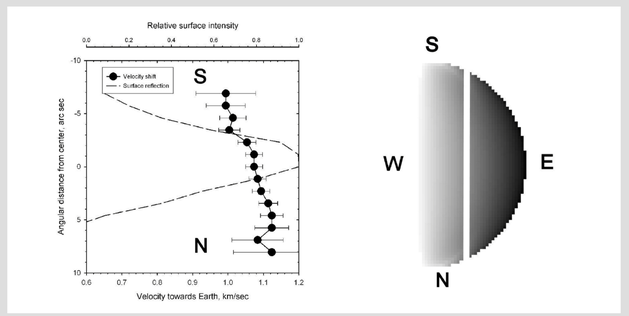


Expected Earthward vectors, North-South slice



Observed Earthward vectors, North-South slice

Observed velocity patterns bear some similarity to the expected patterns.
Deviations from the expected pattern could identify sources or sinks for sodium.

Objective

The objective of the current work was to measure two-dimensional maps of sodium velocities on the Mercury surface and examine the maps for evidence of sources or sinks of sodium on the surface.

Methods

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The McMath-Pierce Solar Telescope and the Stellar Spectrograph were used to measure Mercury spectra that were sampled at 7 milliAngstrom intervals. The velocity shift of the centroid of the Mercury emission line was measured relative to the solar sodium Fraunhofer line corrected for radial velocity of the Earth.

The difference between the observed and calculated velocity shift was taken to be the velocity vector of the sodium relative to Earth. For each position of the spectrograph slit, a line of velocities across the planet was measured.

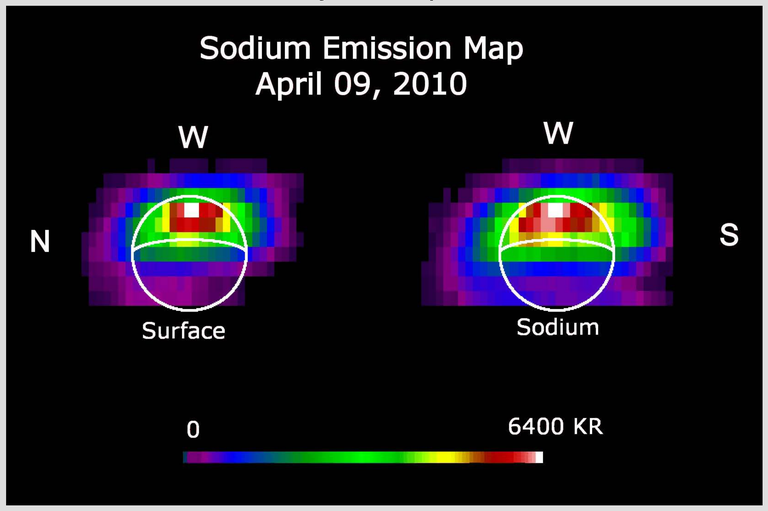
Then, the spectrograph slit was stepped over the surface of Mercury at 1 arc second intervals. The position of Mercury was stabilized by an adaptive optics system

The collection of lines were assembled into an images of surface reflection, sodium emission intensities, and Earthward velocities over the surface of Mercury

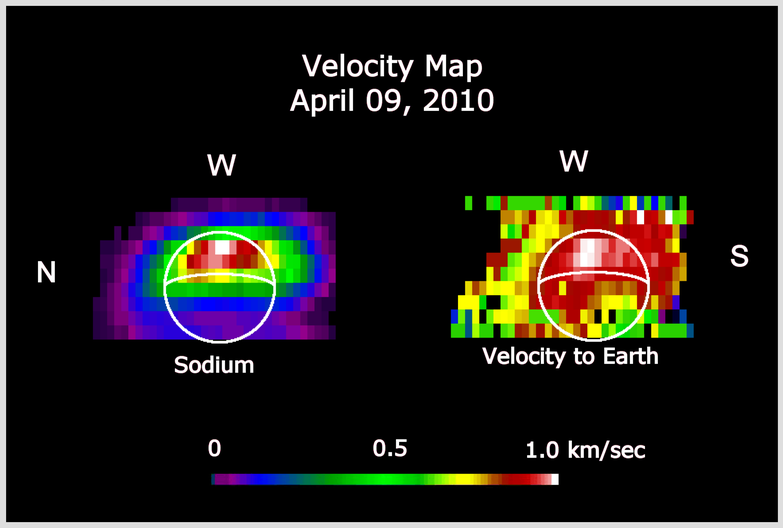
Observations were made each day during the period October 5-9, 2010. The dawn terminator was in view during that time.

Results

Surface reflection from Mercury is compared with sodium emission intensity



Velocity map is compared with sodium emission map



Conclusion

The velocity map shows patches of higher velocity in the southern hemisphere, suggesting the existence of sodium sources there. Leblanc *et al*. (2008) have published a velocity map that is similar.

The peak earthward velocity occurs in the equatorial region, and extends to the terminator. Since this was a dawn terminator, this might be an indication of dawn evaporation of sodium

A better sodium flow model is needed.

References

Potter, A.E. *et al.* Icarus, 2009, 204, 353-367

Leblanc, F., *et al*. Geophys. Res. Letters, 2008, 35, cite ID L18204

Acknowledgements

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