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# Ground-Based BepiColombo Support with the Rapid Imaging Planetary Spectrograph (RIPS)

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## Abstract

Coupling between Mercury's exosphere and magnetosphere is complex and poorly understood. Accordingly, this will be a focused topic study for BepiColombo instruments like MSASI, PHEBUS, SERENA and others. The mission's two orbiters have tight operational constraints, however, largely due to the extreme thermal environment. Ground-based imaging of the exosphere lends valuable support to this effort by offering a global synoptic view of the measurements made *in situ.*

We present "first light" results from the Rapid Imaging Planetary Spectrograph (RIPS). This instrument uses extremely high cadence to overcome the blurring effects of the Earth's atmosphere. The technique easily resolves the brightness enhancements observed near Mercury's magnetic cusps, which are potentially sensitive to particle precipitation and space weather effects. Global sodium and potassium imaging are viable by reconstruction from thousands spectra while scanning over the disk. First results on March 15, 2018 show clear enhancements of comparable brightness near the northern and southern cusp footprints and are broadly consistent with adaptive optics results (Baumgardner et al., 2008, Schmidt et al., 2016)

## 1. Exosphere Observations

Ground-based observations of Mercury are intrinsically difficult due to its proximity to the Sun. The single-point measurements from the MESSENGER/MASCS instrument paint a very static picture of the exosphere with only seasonal variations (Cassidy et al., 2015). Ground-based measurements instead suggest a very dynamic exosphere that is strongly coupled to the magnetosphere (e.g., Potter and Morgan, 1990; Leblanc et al., 2009). This inconsistency can most likely be attributed to a combination of the difficultly of ground-based observations of objects in close proximity to the Sun, and the limited viewing geometry provided by the MESSENGER orbit.

RIPS will be able to monitor the sodium and potassium exospheres when Mercury is well separated from the Sun. First light results produced a spectral resolution of ~80,000, which is ideal for separating potassium emissions from telluric absorption, utilizing the planet's Doppler shift. Cross-sections of emissions in the tail structure are also viable within a given night, provided the telescope pointing is stable on minute timescales. The instrument will be installed on the AEOS 3.7m telescope in June and on the McDonald 2.1m telescope in December 2018.

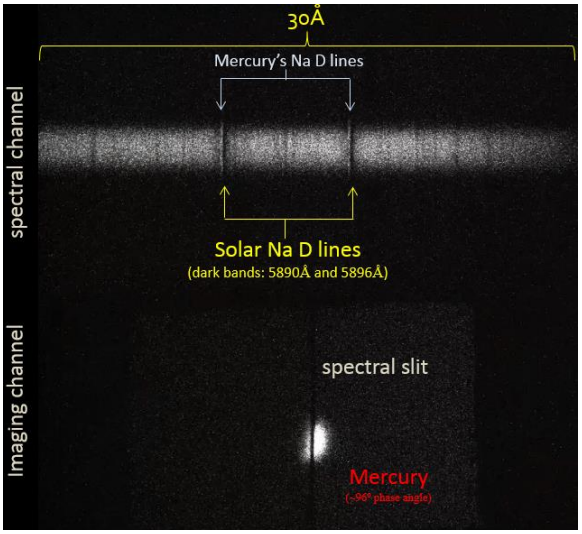


Figure 1: Characteristic 0.05 second frame from the Perkins 1.8m telescope on March 15, 2018. Over the 15 min, nearly 5000 such frames were taken, allowing excellent reconstruction of the exosphere from the top ~2% of frames with best spatial registration.

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