

Study of the dynamics and morphology of the Mercury sodium exosphere

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Abstract

Since many years Mercury exosphere dynamics and morphology is a matter of discussion. Presently the new MESSENGER data from flybys are providing us with new precious information, but Mercury exosphere remains still not completely understood. Enhancement of sodium emission in one hemisphere with respect to the other or close to the polar regions have often been detected and interpreted in terms of different release processes efficiency or different IMF conditions and solar activity. They were also evidenced by the first two flybys of MESSENGER, while the third one shows an almost homogeneous emission coming from the disk. More recently, the variations in intensity of the sodium component emission have been interpreted as a consequence of the orbital path of Mercury, while crossing or being out of the more 'dusty' ecliptic plane, due to Mercury's orbit inclination. In the present work, sodium D lines observations performed at the Italian Telescope Galileo TNG and at the French Solar Telescope THEMIS in the Canary Islands are analyzed and discussed in relation with the external conditions and the present knowledge of the Hermean exosphere.

1. Introduction

Our team performed a series of ground-based observations of sodium exosphere of Mercury with both the TNG (years 2002–2009) and the THEMIS (years 2007-2009) telescopes.

1.1 TNG (Telescopio Nazionale Galileo) observations

TNG is a 3.58 m altitude-azimuth telescope equipped with an echelle spectrograph (SARG) at the Nashmyth focus B. The use of a narrow Na filter (60 Å) and a long slit (26.7" x 0.4") with a resolution of 115000 gives the possibility of a series of slit-observations of the disk of Mercury, including a remarkable part of the closest exospheric tail. Example of a 1 night observation is given in Figure 1, and for a better description see [1].

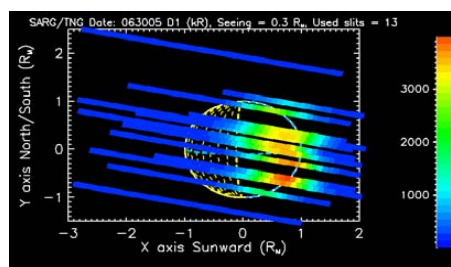


Figure 1: Sodium emission as measured from TNG in June 2005. The composition of the many slits can give a reasonable good map of the sodium emission at the moment of the observation.

1.2. THEMIS (Solar Telescope) observations

THEMIS is a Ritchey-Chretien solar telescope (0.90 m) in altitude-azimuth mounting with a 0.9 m primary mirror and a 15.04 m focal length. It works in the spectral range between 400 and 1000 nm and may observe at the same time the two D lines at 5890-5896 Angstroms.

After three years of campaign (2007-2009) the THEMIS dataset consists of 80 days of observations and almost 300 scans of the disk of Mercury at different IMF and solar conditions, phase angles, TAAs and other orbital parameters. An example is given in Figure 2, and for a better description see [2].

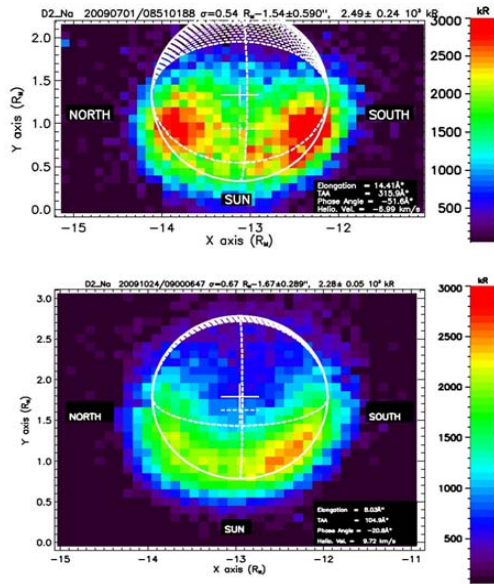


Figure 2: Sodium emission as measured from THEMIS in July (upper panel) and October 2009 (lower panel): two different patterns are clearly visible.

2. This work

Figure 2 clearly shows the occurrence of different patterns during different days. They generally evolve during the day in accordance with the many observations already performed in the past (see for example [3]); the dynamics shows two peaks patterns or one peak patterns with no clear relation with orbital parameters.

The analysis of the morphology and dynamics of the exosphere throughout many days of observations (up to 6-7 scans/day can be done) is now possible, and can be discussed in view of the solar and IMF conditions.

Results and considerations are shown and discussed in the present work.

References

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