



## **The rotational state of Mercury after four years of MESSENGER observations**

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We measured the rotational state of Mercury with orbital data from NASA's MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft. We use accurate co-registration of digital terrain models from stereo images (stereo DTMs) and laser altimeter data to measure the orientation of the rotation axis, the libration amplitude and the mean rotation rate with improved precision. In contrast to our previous study, we use the full four years of near-continuous Mercury Laser Altimeter (MLA) observations and stereo DTMs with a higher spatial coverage. We confirm a large libration amplitude and a mean rotation rate which is significantly higher than the assumed resonant rotation rate based on a perfect 3:2 spin orbit resonance. The estimated orientation of the rotation axis is consistent with the assumption that Mercury occupies a Cassini state. We compare our estimates with values based on Earth-based observations and MESSENGER radio science. Our results confirm that Mercury possesses a liquid outer core and we discuss further implications of our estimates on the interior structure of the planet.