



Mercury's rotational state from combined MESSENGER laser altimeter and image data

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With orbital data from the MErcury Surface, Space ENvironment, GEOchemistry, and Ranging (MESSENGER) spacecraft, we measured the rotational state of Mercury. We developed a novel approach that combined digital terrain models from stereo images (stereo DTMs) and laser altimeter data, and we applied it to 3 years of MESSENGER observations. We find a large libration amplitude, which in combination with the measured obliquity confirms that Mercury possesses a liquid outer core. Our results confirm previous Earth-based observations of Mercury's rotational state. However, we measured a rotation rate that deviates significantly from the mean resonant rotation rate. The larger rotation rate can be interpreted as the signature of a long-period libration cycle. From these findings we derived new constraints on the interior structure of Mercury. The measured rotational parameters define Mercury's body-fixed frame and are critical for the coordinate system of the planet as well as for planning the future BepiColombo spacecraft mission.