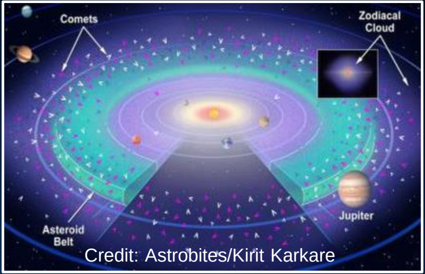
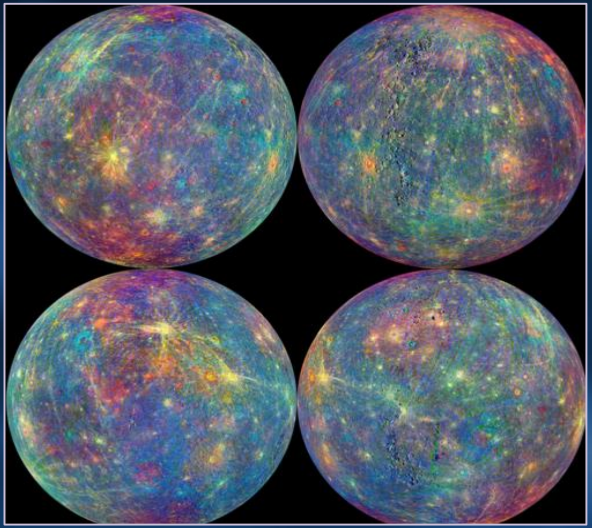
Densest at Dawn: A slow orbit might contribute to build-up in Mercury's exosphere



The **zodiacal cloud,** a disk of dust orbiting the inner part of the solar system, primarily between the Sun and Jupiter, is fed mostly by comets when they are traveling close to the Sun and by dust from collisions in the asteroid belt. An artist's rendering of the zodiacal cloud is seen in the image to the left. Studies on the role dust plays in our space environment has helped us understand fundamental questions about space. **NASA heliophysics scientists** working at the Goddard Space Flight Center modeled dust at Mercury's orbit in an effort to explain a significant observation made by **NASA Planetary Division's MESSENGER mission.**

MESSENGER had found that Mercury's thin atmosphere, called an *exosphere*, was densest in the dawn region. These results were produced using **MESSENGER's Ultraviolet and Visible Spectrometer's** observations of magnesium (Mg) and calcium (Ca). Mg and Ca are elements known to be associated with ablation of the surface, suggesting that some process affecting these elements was occurring non-uniformly on the planet. Follow-on studies have examined possible causes, including impacts by micro-meteoroids like the zodiacal dust, but they have not fully answered all of the scientists' questions.

The dust from the micro-meteoroids analyzed came from a **retrograde orbit** around the Sun, which means that when the micro-meteoroids hit Mercury, they had higher velocities than if the collisions were traveling in prograde orbit. Mercury's rotation is much slower than its orbit meaning that the part of the planet at dawn spends a disproportionately long time in the path of these retrograde micro-meteoroids. These repeated high-velocity impacts could allow the exosphere to build up over that sector of the planet and produce the observed distribution.



Data on Mercury's atmosphere and surface from two MESSENGER instruments is combined in this image. Image Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

This study examined the contribution of dust produced by Jupiter-Family and Halley-Type comets to a non-uniform bombardment of Mercury using modeling. It suggests that the retrograde orbit of the micro-meteoroids combined with the planet's slow rotation could produce the observed asymmetry in Mercury's exosphere.

This study illustrates the importance of studying space as an integrated system. The NASA Planetary Division, who launched the MESSENGER mission, also funded the modeling study led by NASA Heliophysics scientists.