EVIDENCE FOR A NEW TYPE OF MOONLET WAKE NEAR ENCELADUS

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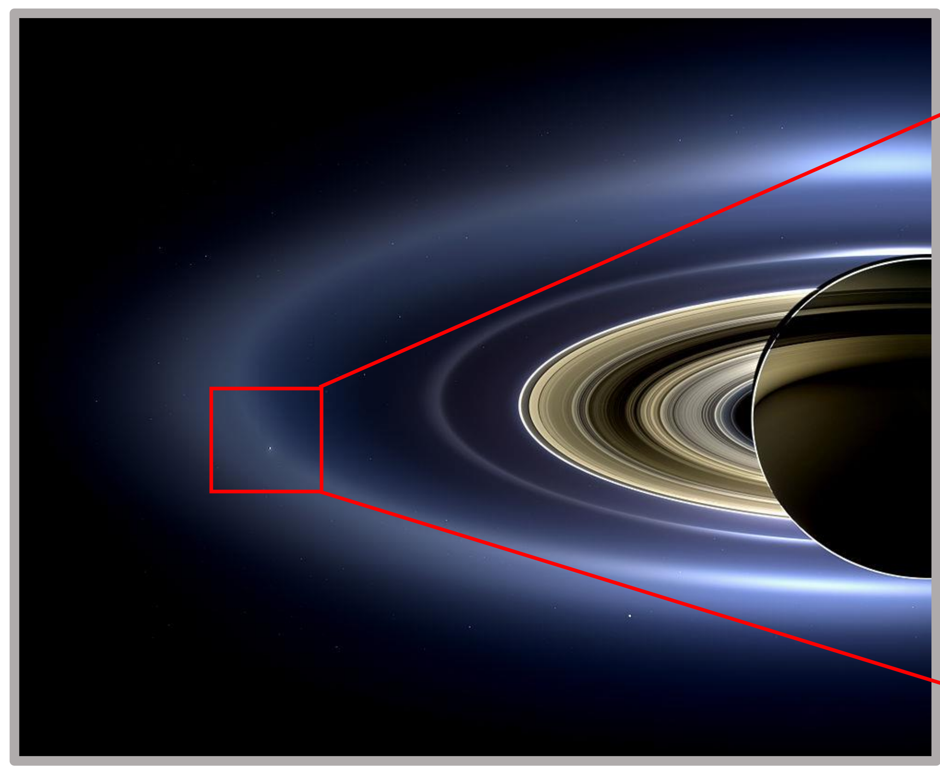
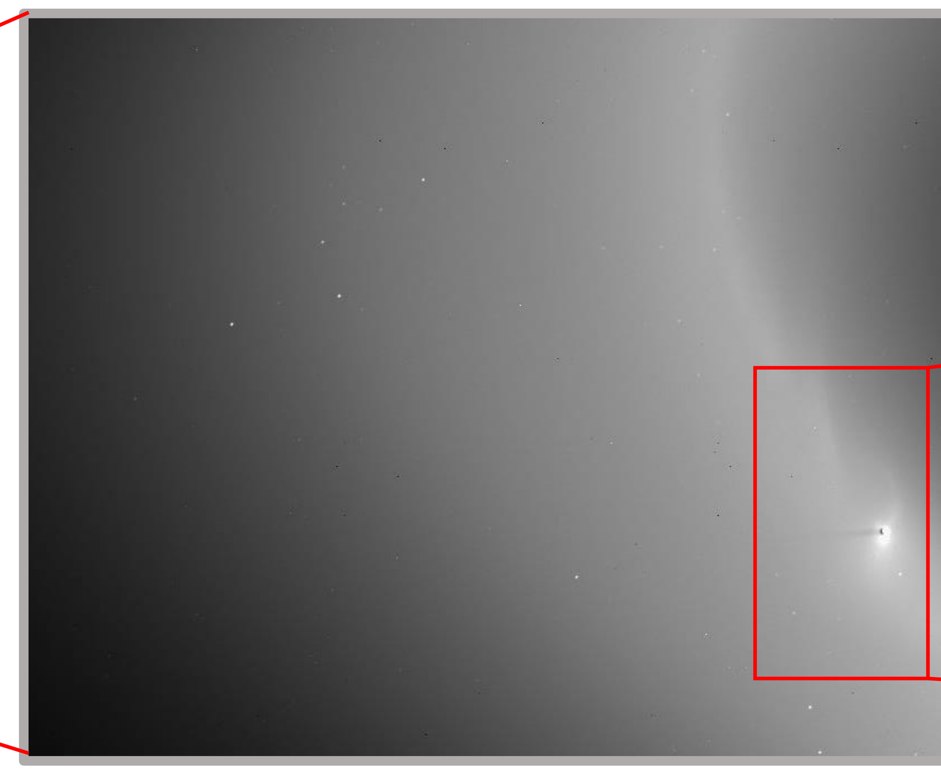
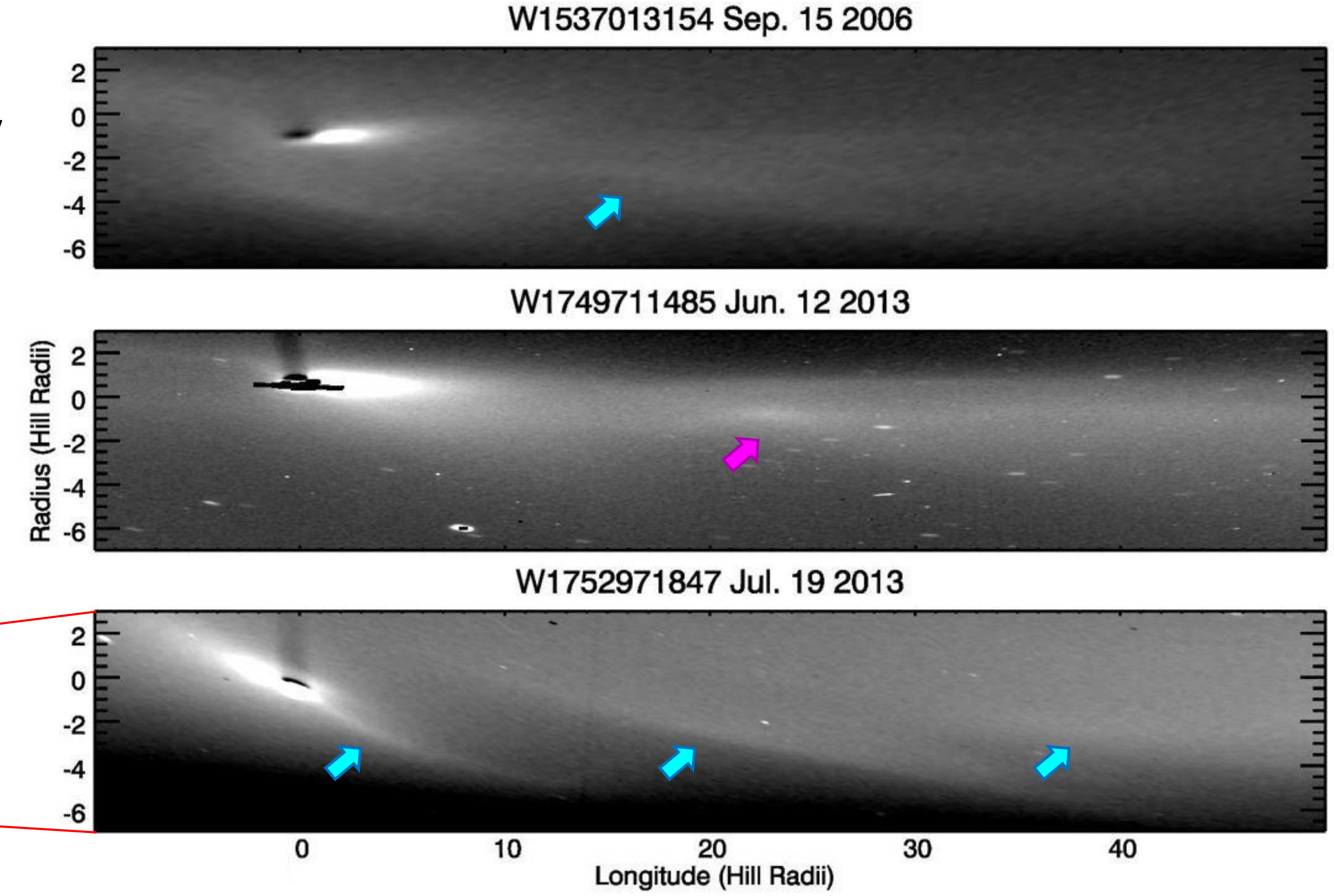
Structures in the E Ring near Enceladus

Enceladus' geologic activity ejects µm-sized water ice particles that form the majority of the E ring. Observations made by the Cassini mission reveal localized variations in the ring's brightness near Enceladus. Some variations could be concentrations of material launched from specific geysers called tendrils (Mitchell et al. 2015, Icarus). However, some of the larger-scale patterns could also represent "moon wakes", organized disturbances in the orbital properties of ring material produced by Enceladus' gravitational field.

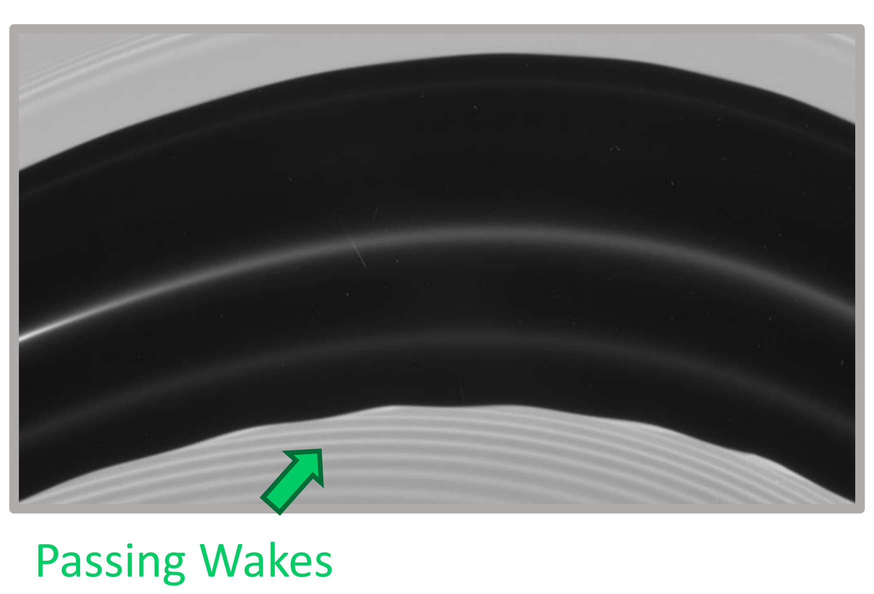




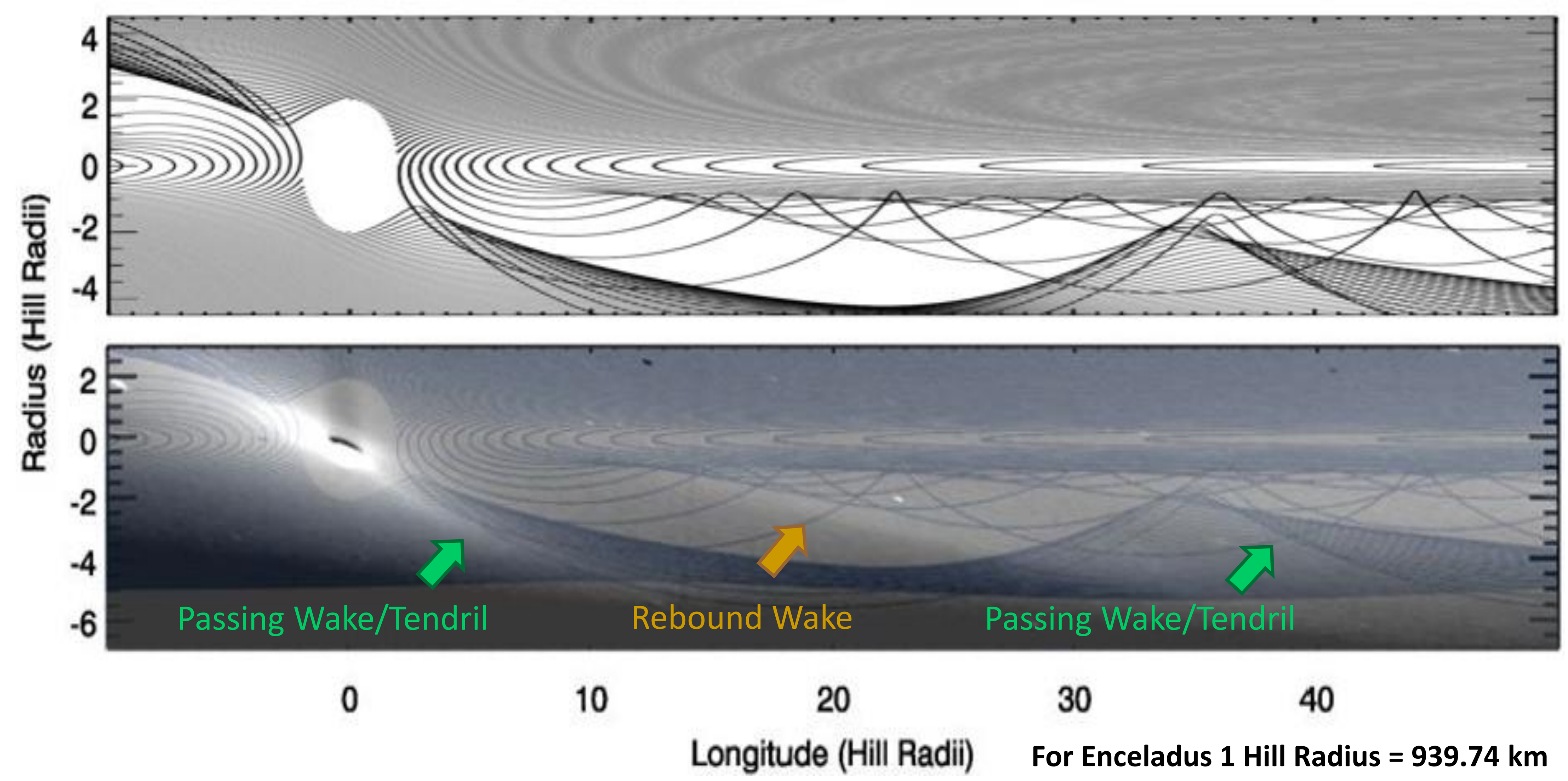


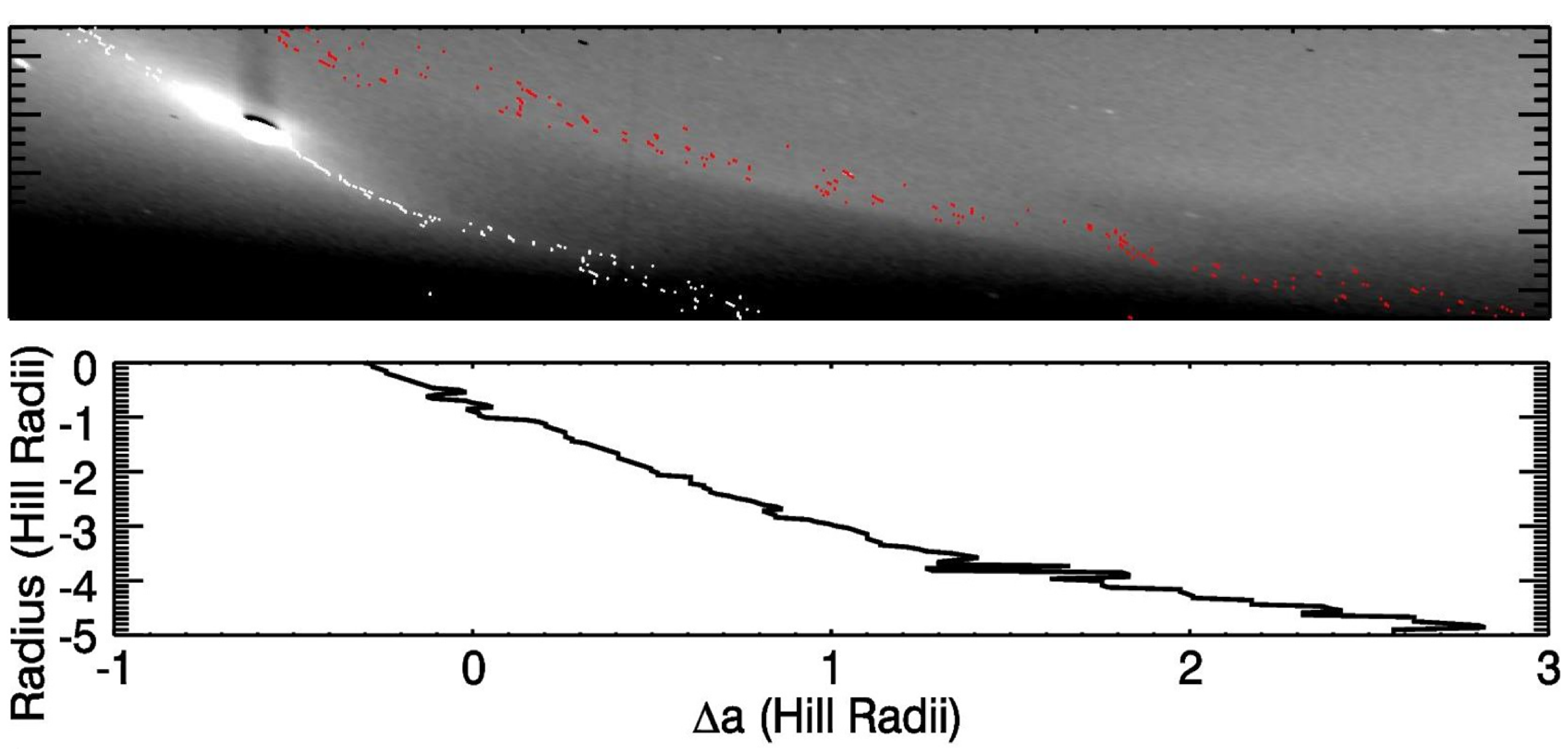
Different Types of Moonlet Wakes near Enceladus

The trajectories of various ring particles that orbit Saturn and are perturbed by Enceladus can be computed using Hill's Equations. Trajectories that start close to Enceladus' orbit exhibit horseshoe motion (they turn around before reaching Enceladus), while trajectories that start further away pass by the moon.



Places where trajectories become tightly packed, known as "wakes", should correspond to regions of high density. The most obvious wakes involve material passing by the moon, and such wakes have been observed previously in other rings. For the E ring, two of the bright features are at the expected locations for wakes in material with passing motion, but another structure lays between the two where one would expect a wake for particles on horseshoe orbits to exist.





We can confirm this structure consists of material on horseshoe orbits by measuring the longitudinal distance d from Enceladus to the wake, and then estimating the semi-major axis separation between the wake material and Enceladus using the formula $3\pi\Delta a = d$. This result is plotted to the left for the July 2013 image, and the numbers are less than the semi-major axis difference that marks the boundary between horseshoe and passing motion: $\Delta a_{crit} \approx 3.46\ R_{H,enc}$ (Dermott and Murray, 1981 Icarus; Murray and Dermott, 1999 Solar System Dynamics). (Note: by contrast, the features near the expected passing wake location are not at exactly the right place and so are likely tendrils.)

If it is not a tendril, then it is the first known example of a "rebound" wake for particles on horseshoe orbits. This feature implies that there is material executing horseshoe motion with respect to Enceladus. Since the E ring material originates from Enceladus, it is not yet clear how their orbits could evolve onto such trajectories.

Some of the text in this poster has been changed since the meeting to reflect results of further analysis .