

# Jupiter's Dusty Rings

Faint, dusty rings:

Made of micron-sized dark dust particles.

Mass is  $<10^{-12} M_E$

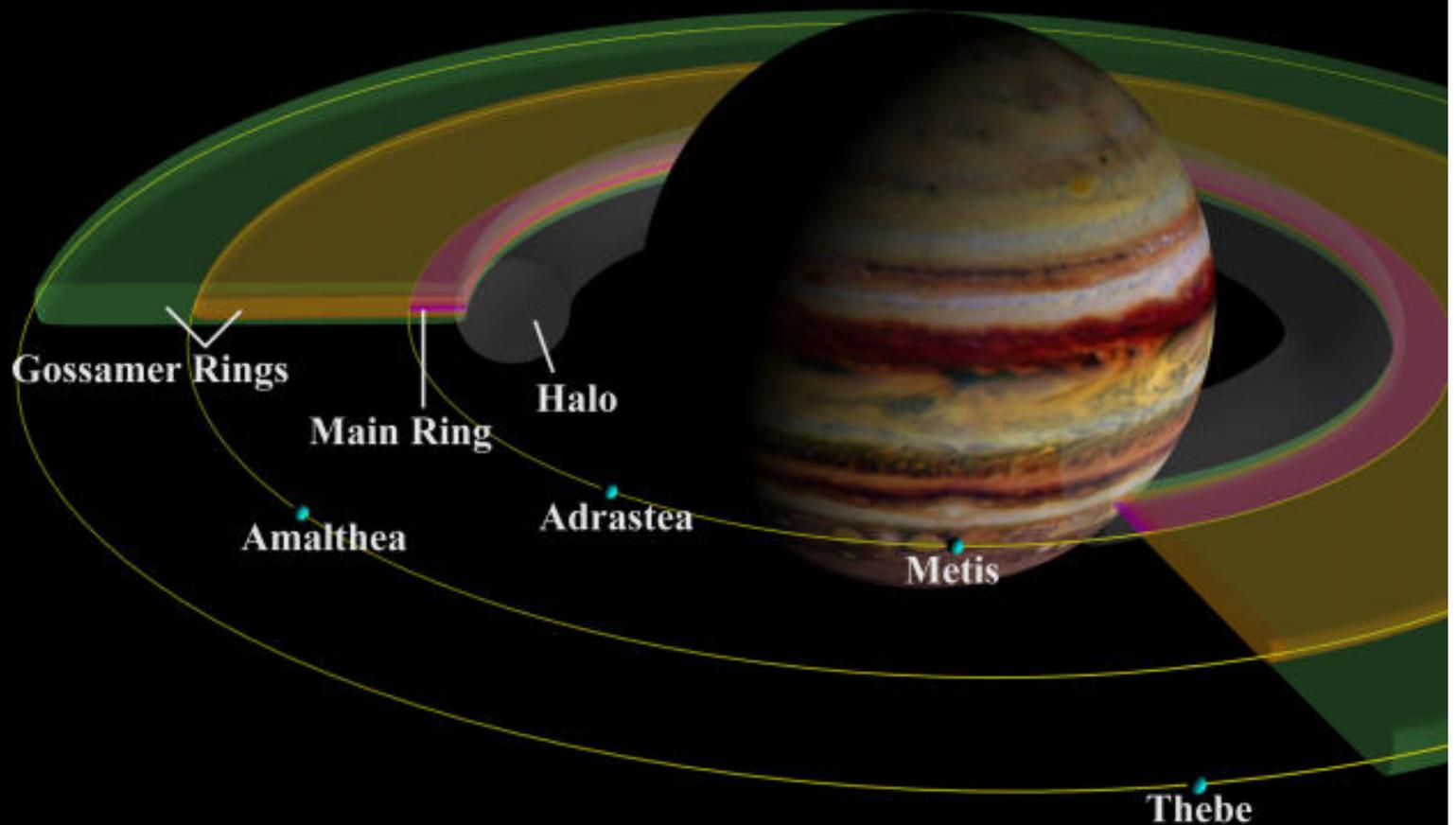
Sources:

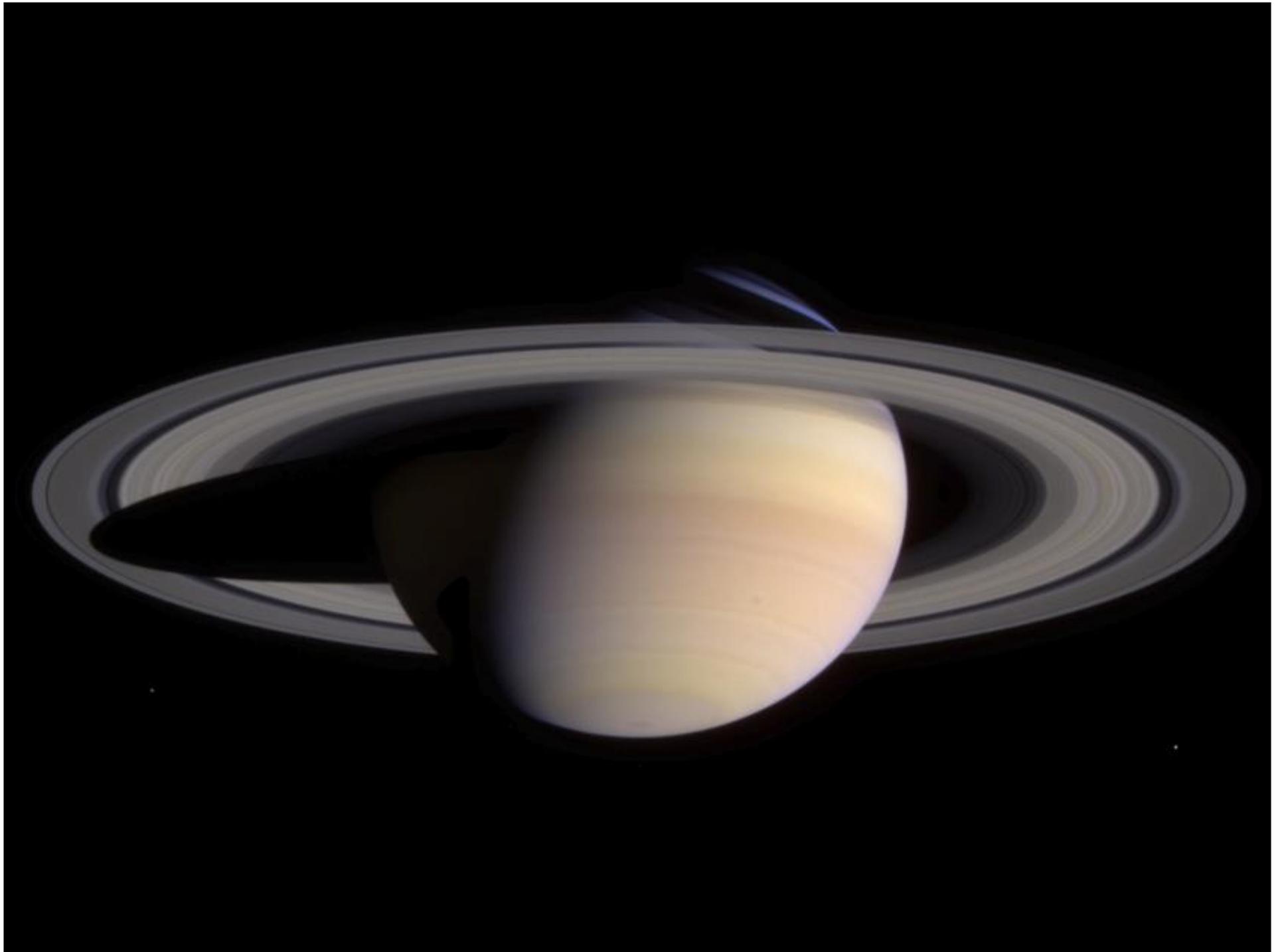
Material knocked off small moons by meteoritic impacts

Captured debris from comets

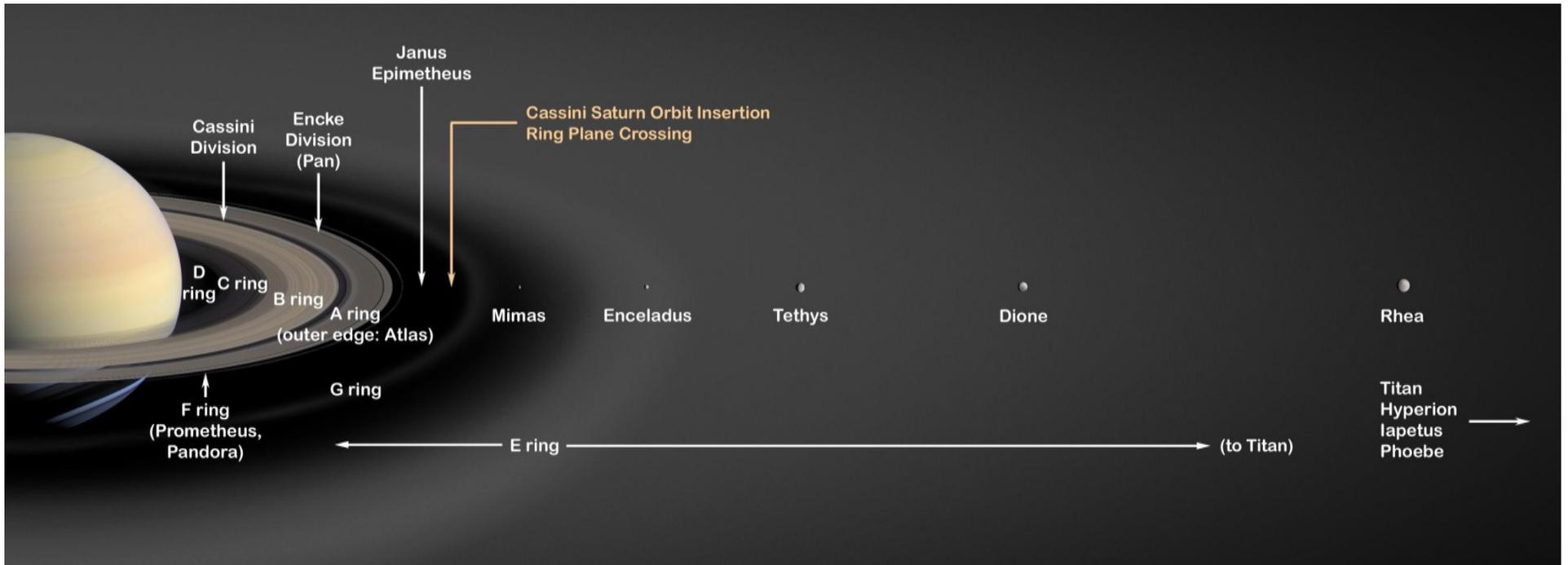


# Jovian Ring System (schematic)





# Saturn Ring System

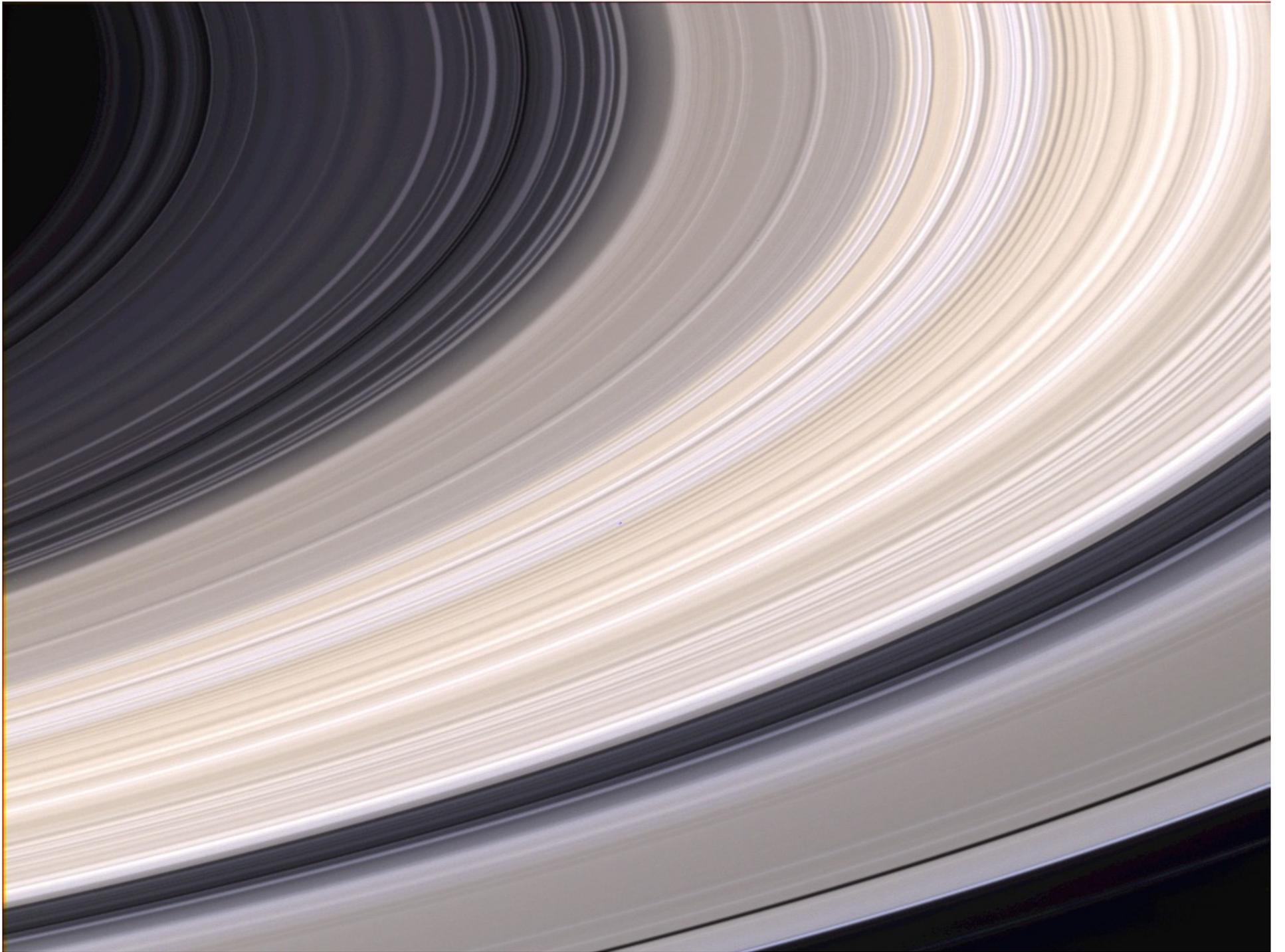


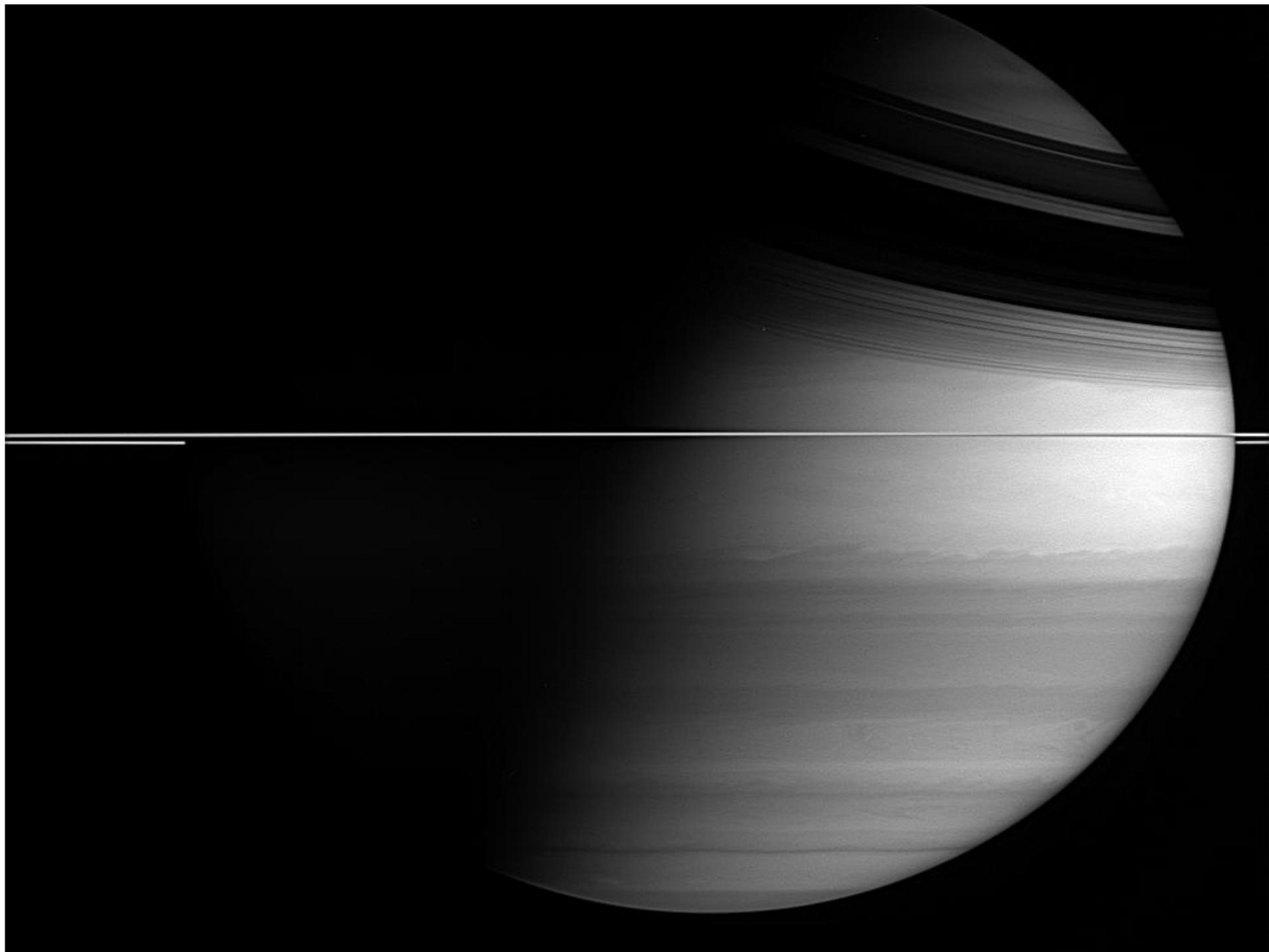
67,000 km to 140,000 km (1.1 – 2.3  $R_{\text{Saturn}}$ )

~30m thick

Water ice particles ~1 cm to ~3 m (pebbles to boulders)

Main rings are inside Saturn's Roche Radius for icy bodies







Earth from Cassini  
2013 July 19



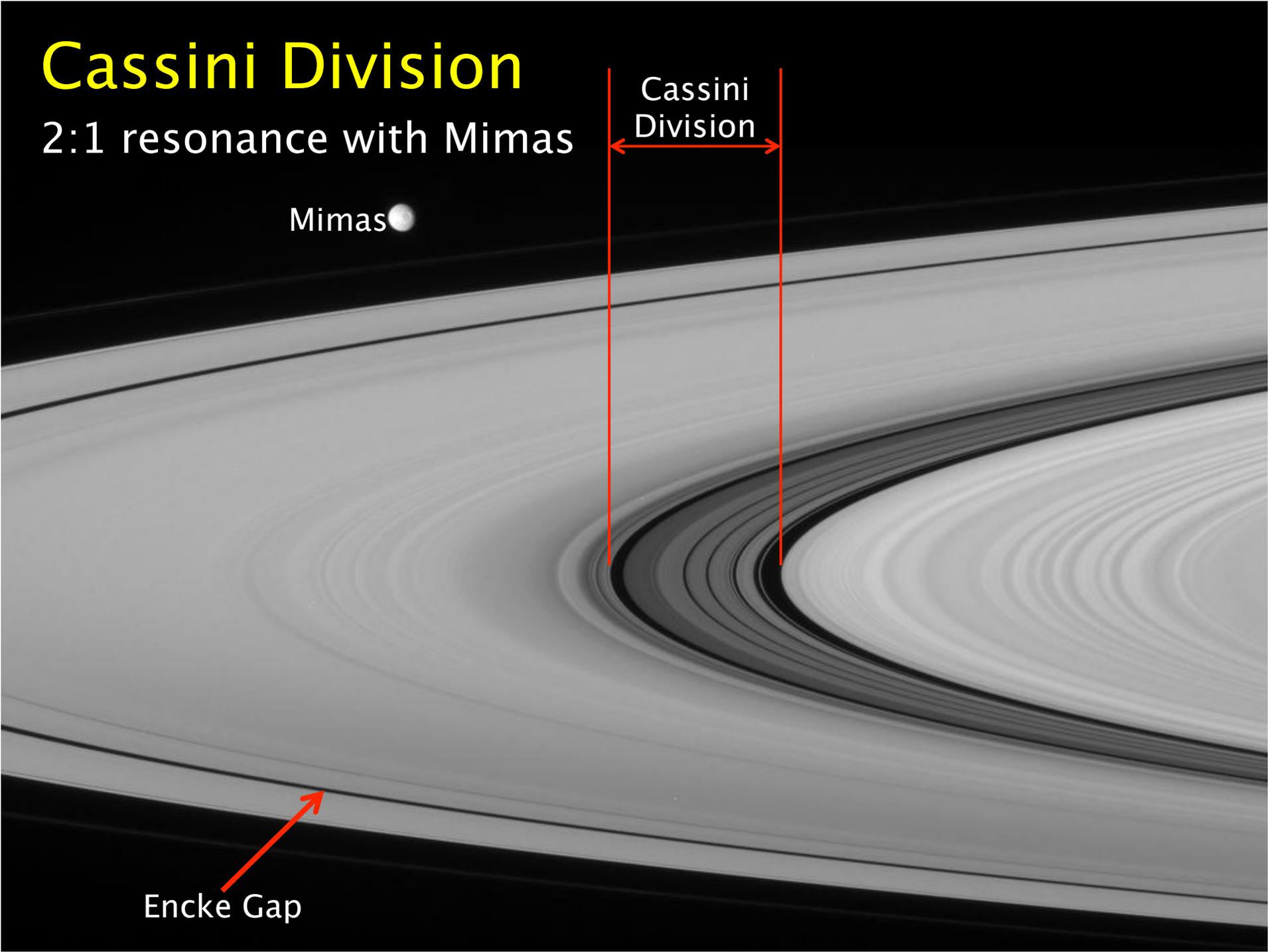
Saturn's Rings backlit by the Sun (Cassini)

# Cassini Division

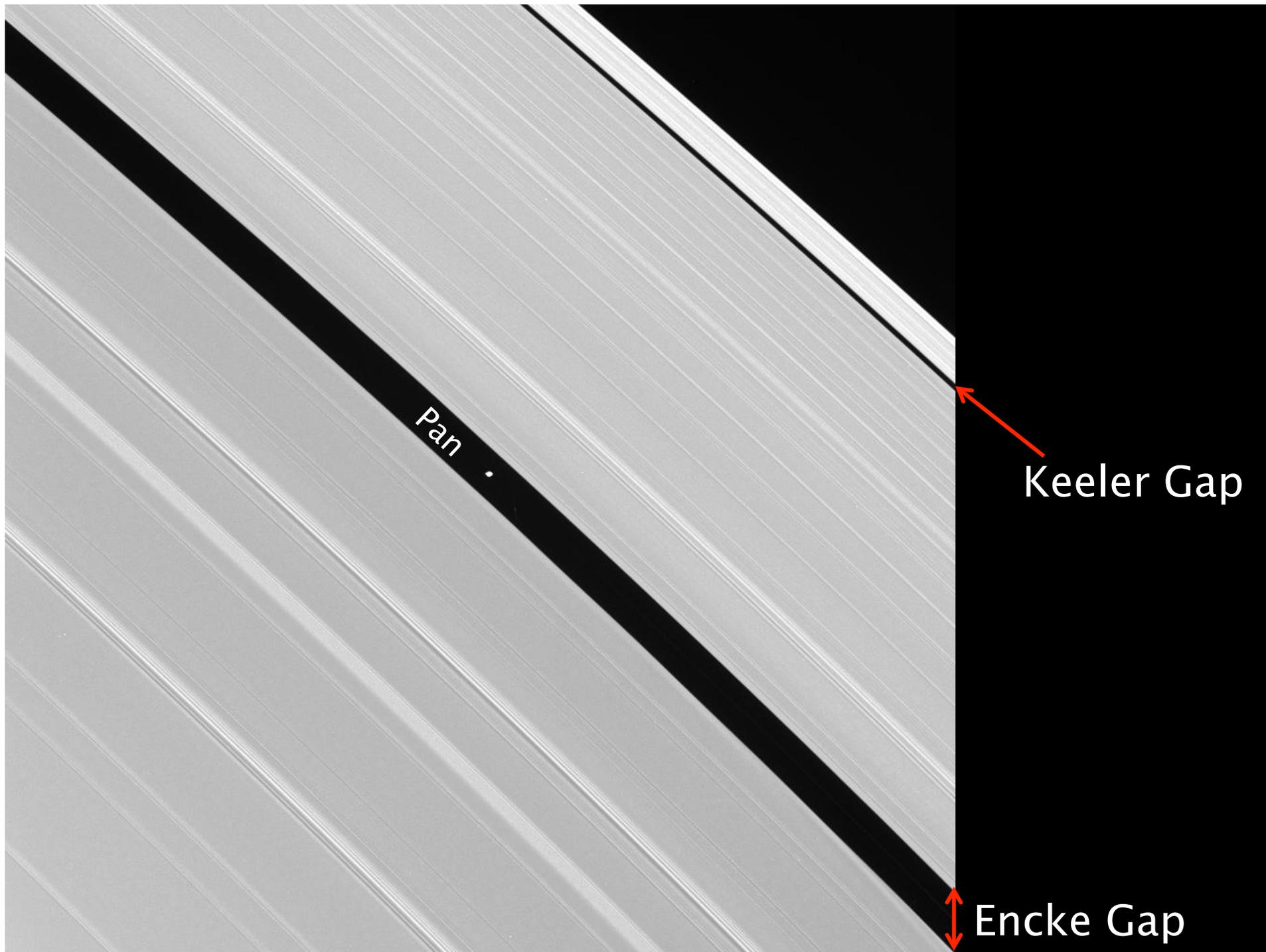
2:1 resonance with Mimas

Mimas 

Cassini  
Division



Encke Gap



Pan .

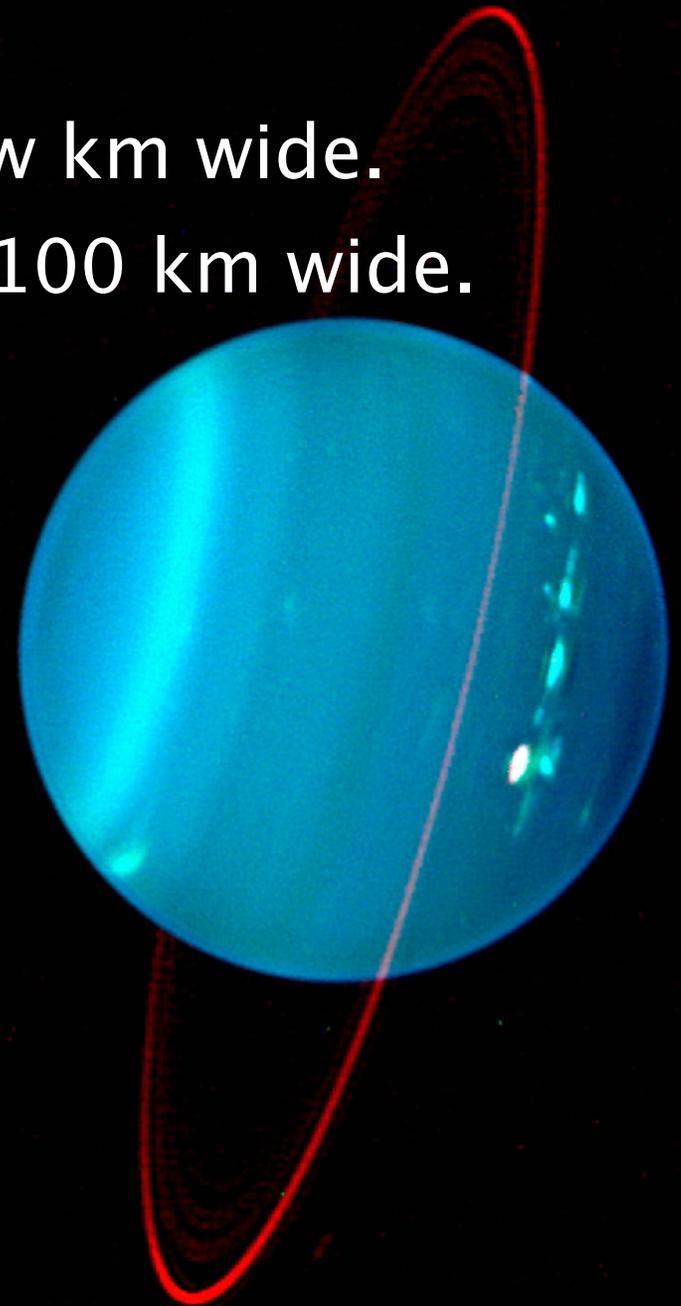
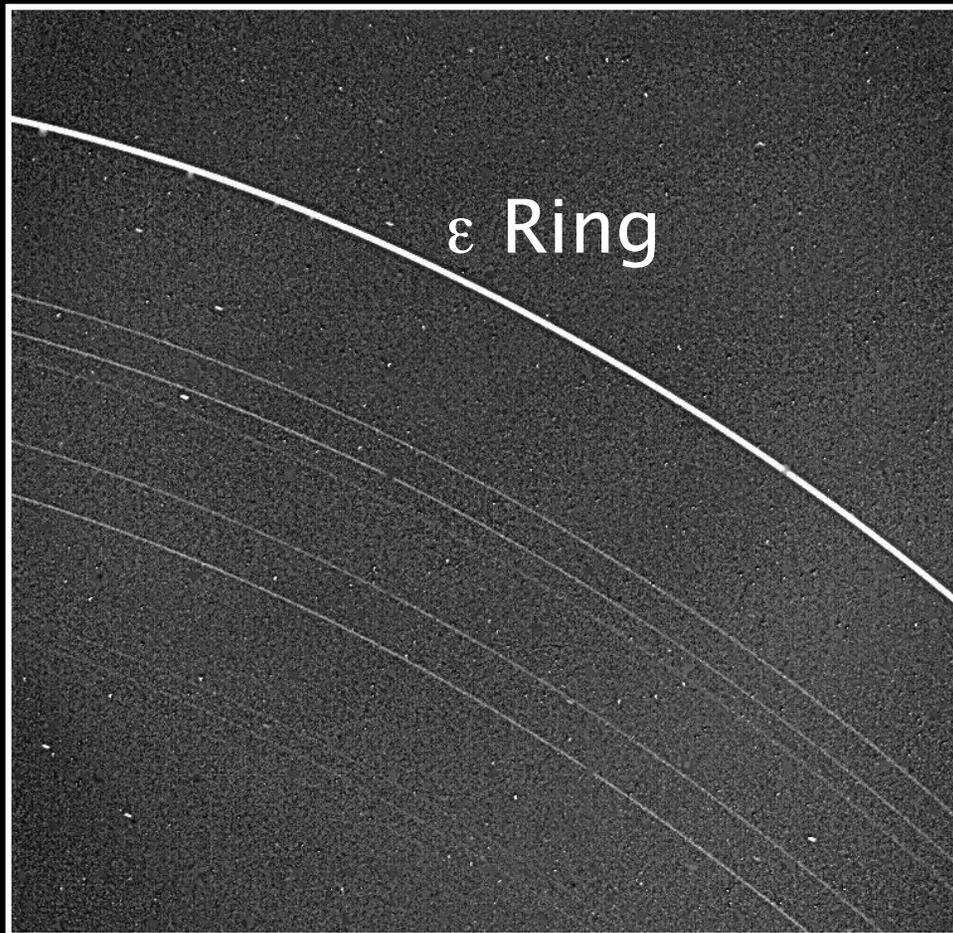
Keeler Gap

Encke Gap

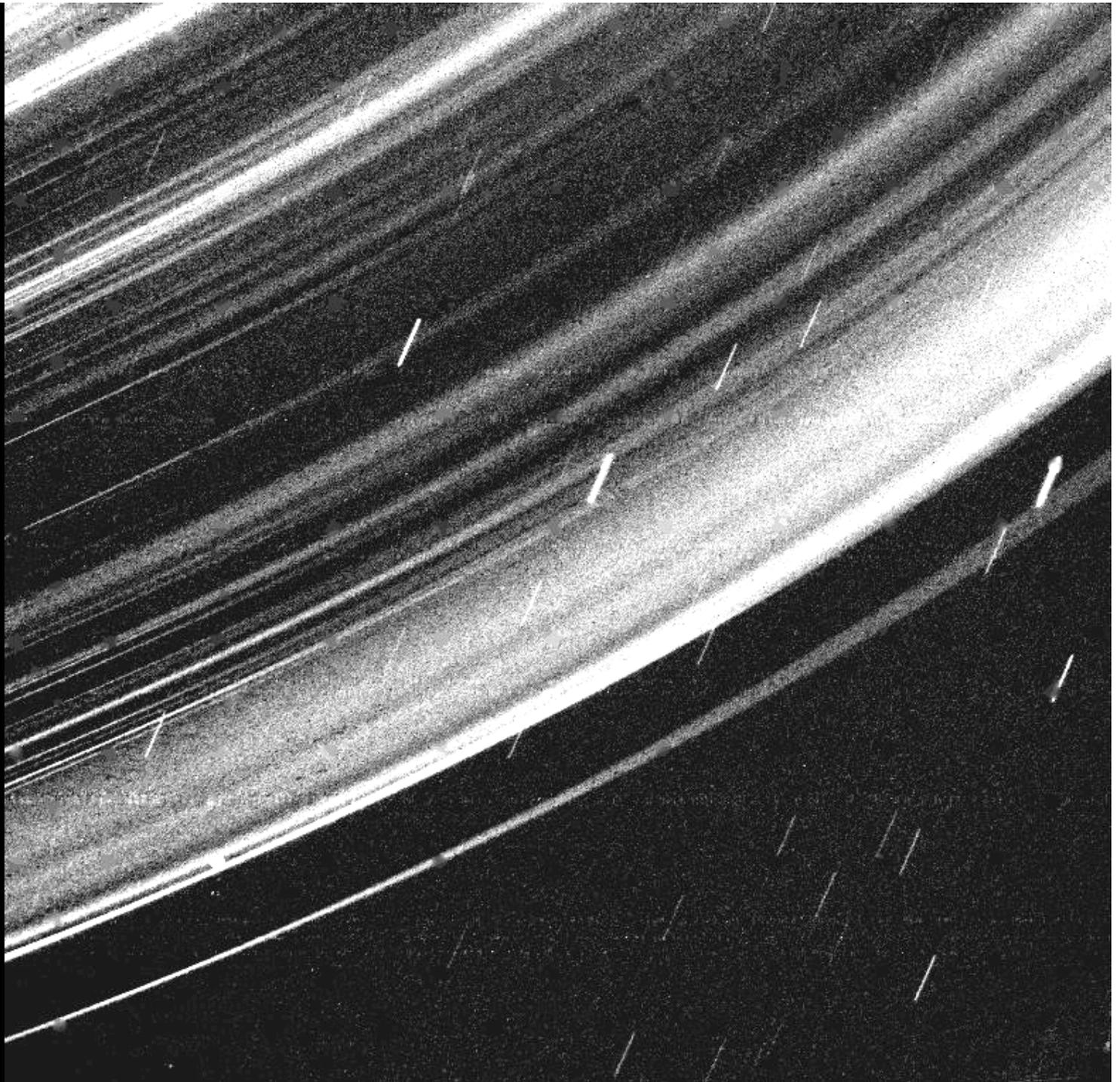
# Thin Rings of Uranus

Dark, narrow rings only a few km wide.

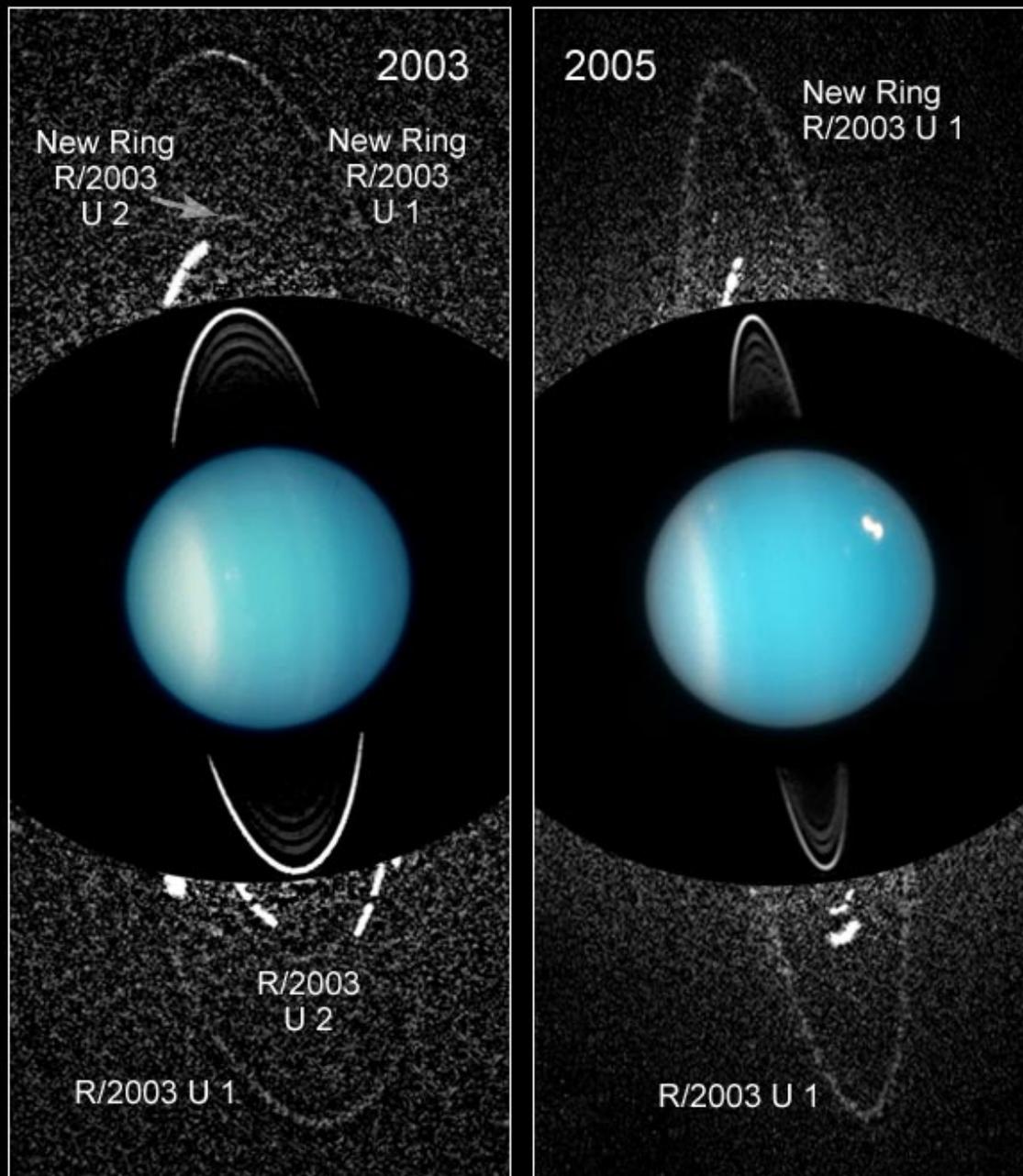
Wide “epsilon ring” is only ~100 km wide.



Uranus'  
Rings  
back-lit  
by the  
Sun  
(Voyager 2)



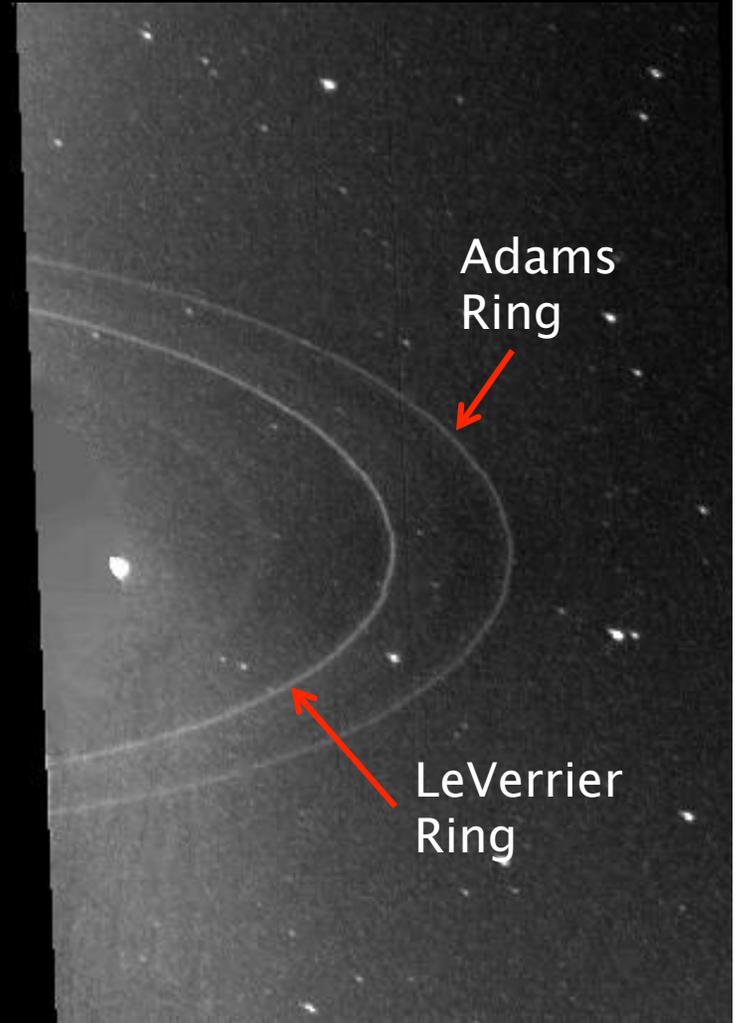
# Uranus ■ HST ACS/HRC



# Neptune's Rings



Galle  
Ring



Adams  
Ring

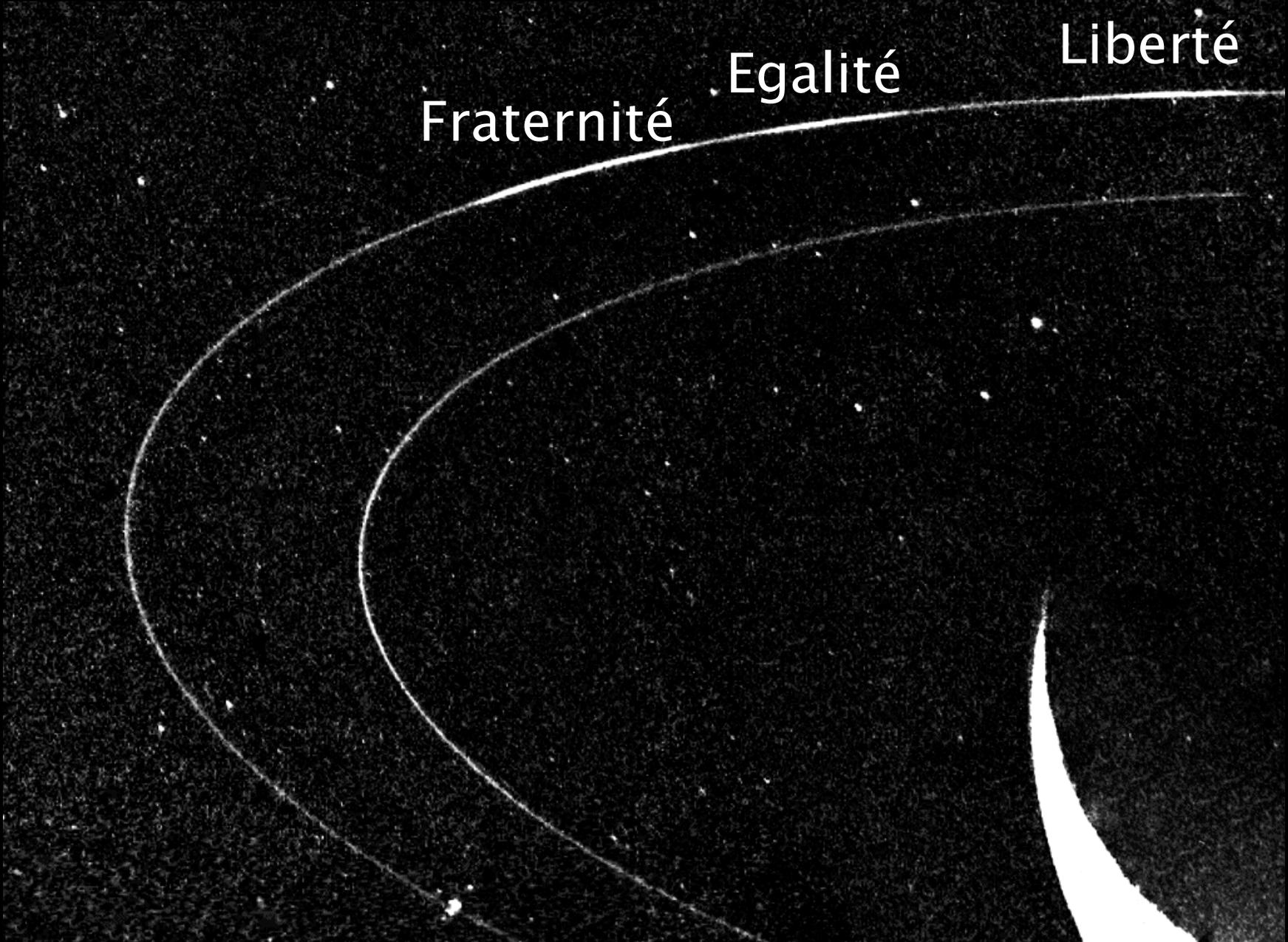
LeVerrier  
Ring

# Arcs in the Adams Ring

Fraternité

Egalité

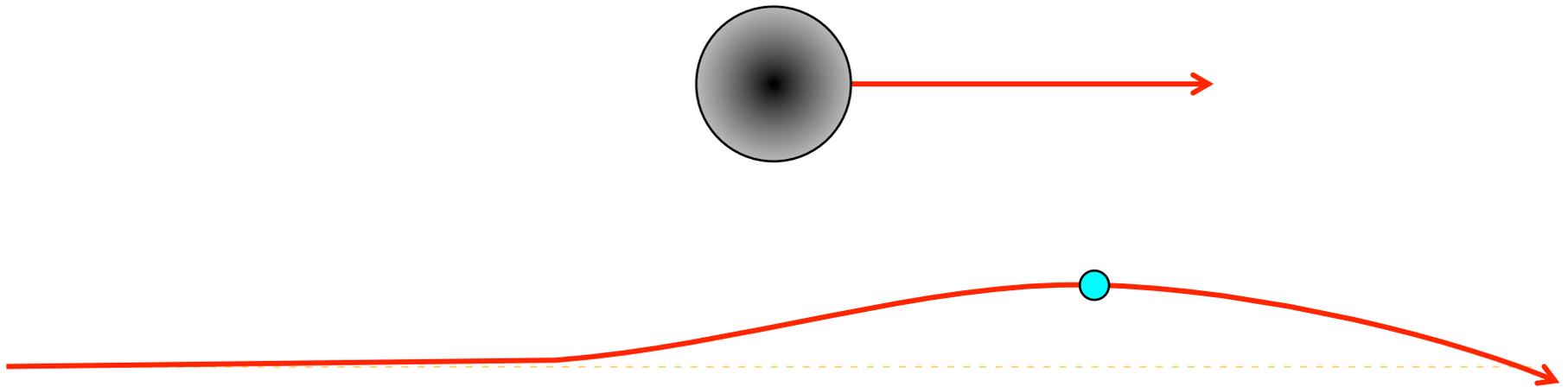
Liberté



Iceball-moon encounter:

Iceball on an inner (faster) orbit

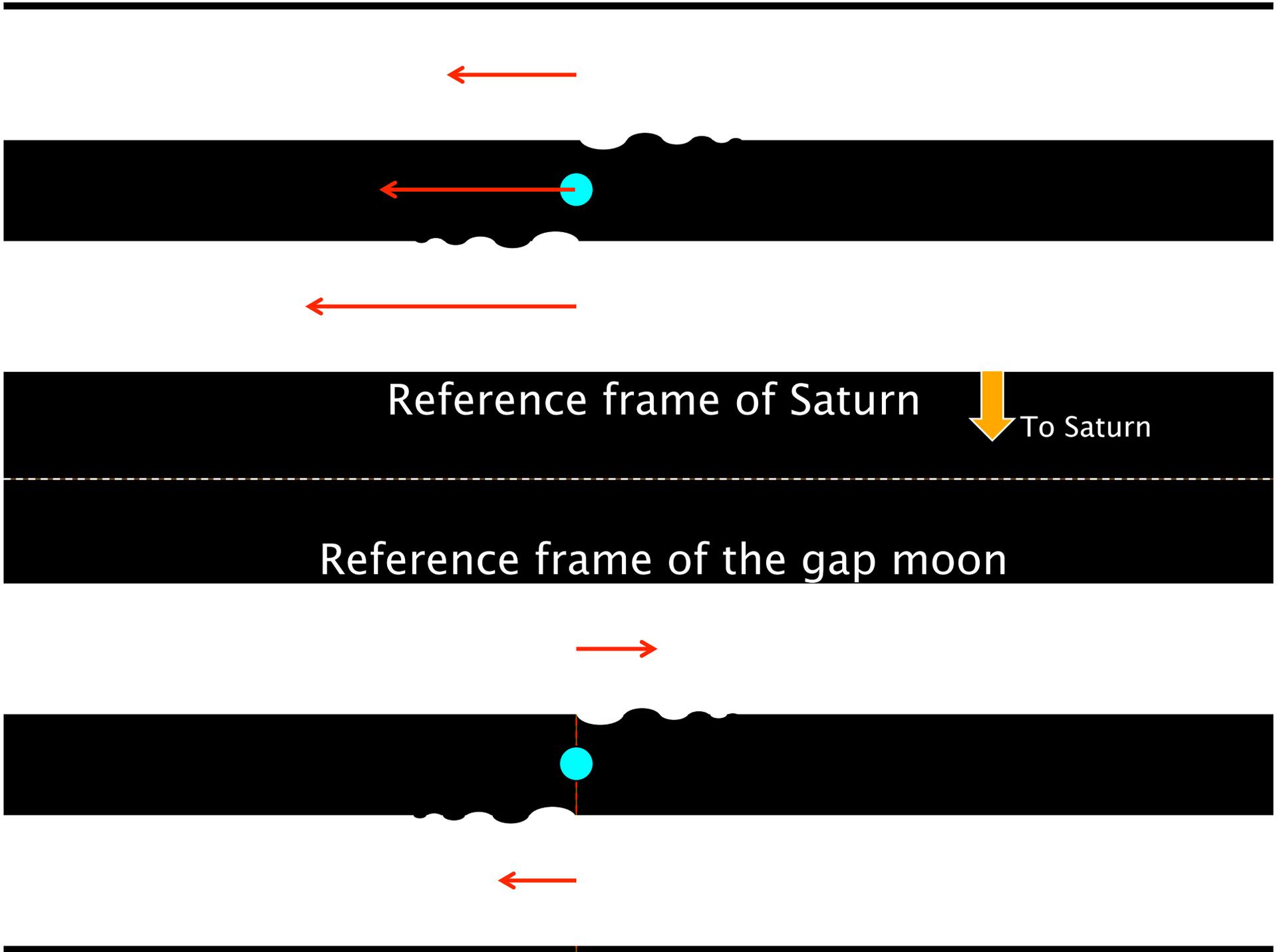
Overtakes the moon and is deflected towards the moon



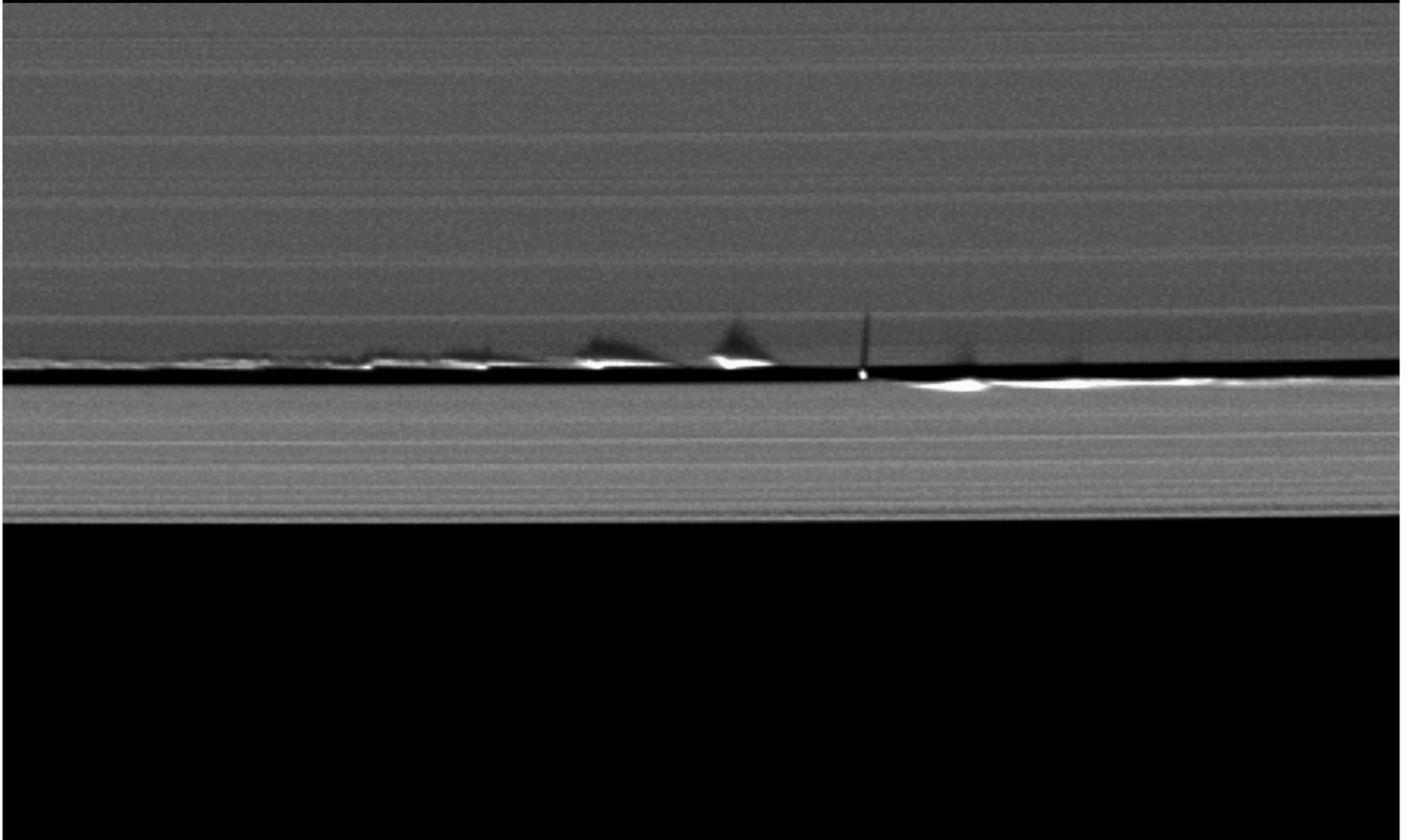
After the encounter, the ice ball falls back and oscillates around its original orbit

But as it passes back into the ring, it hits other iceballs, damping the oscillation

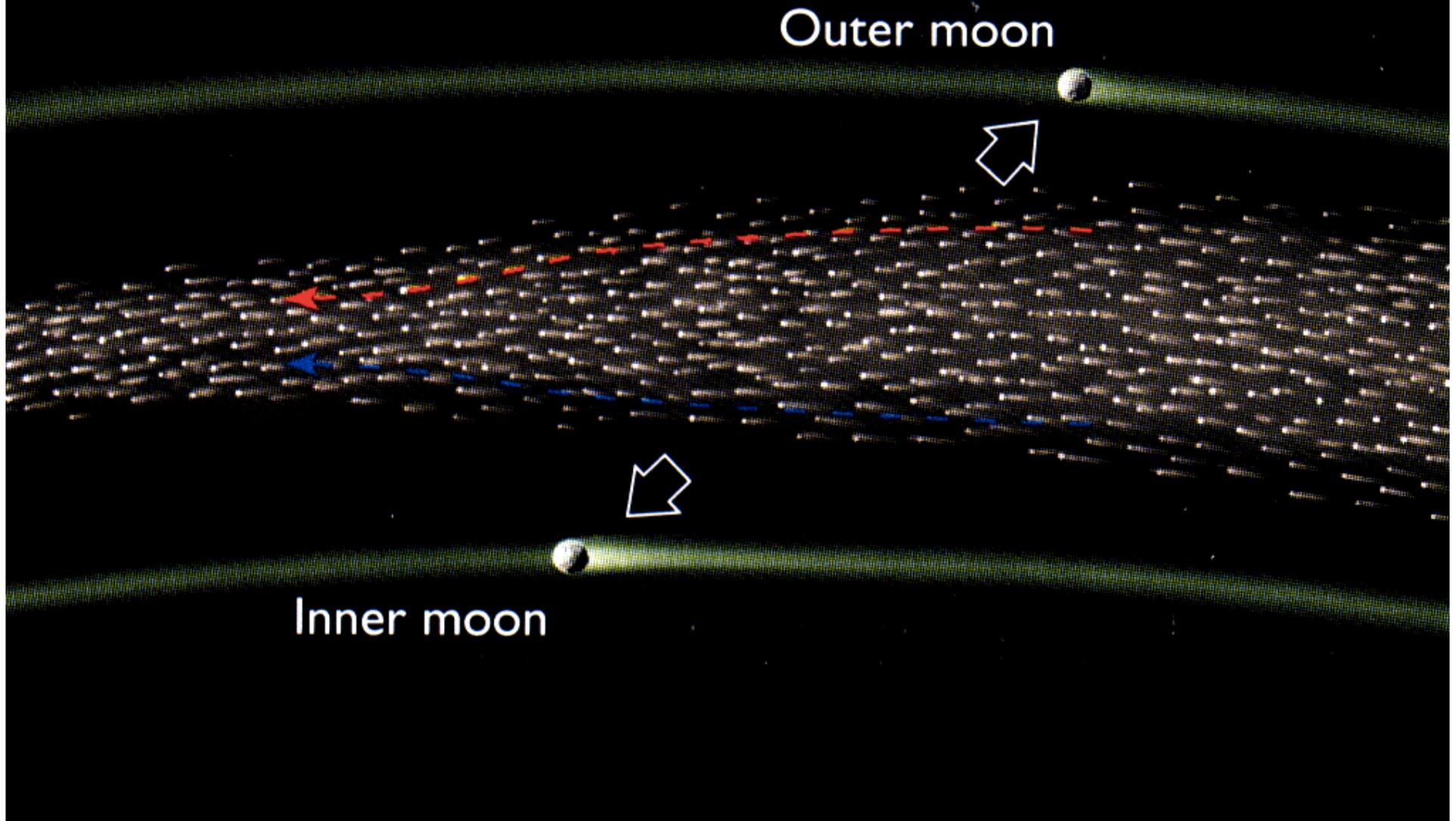
By the next encounter, it is back on its original orbit



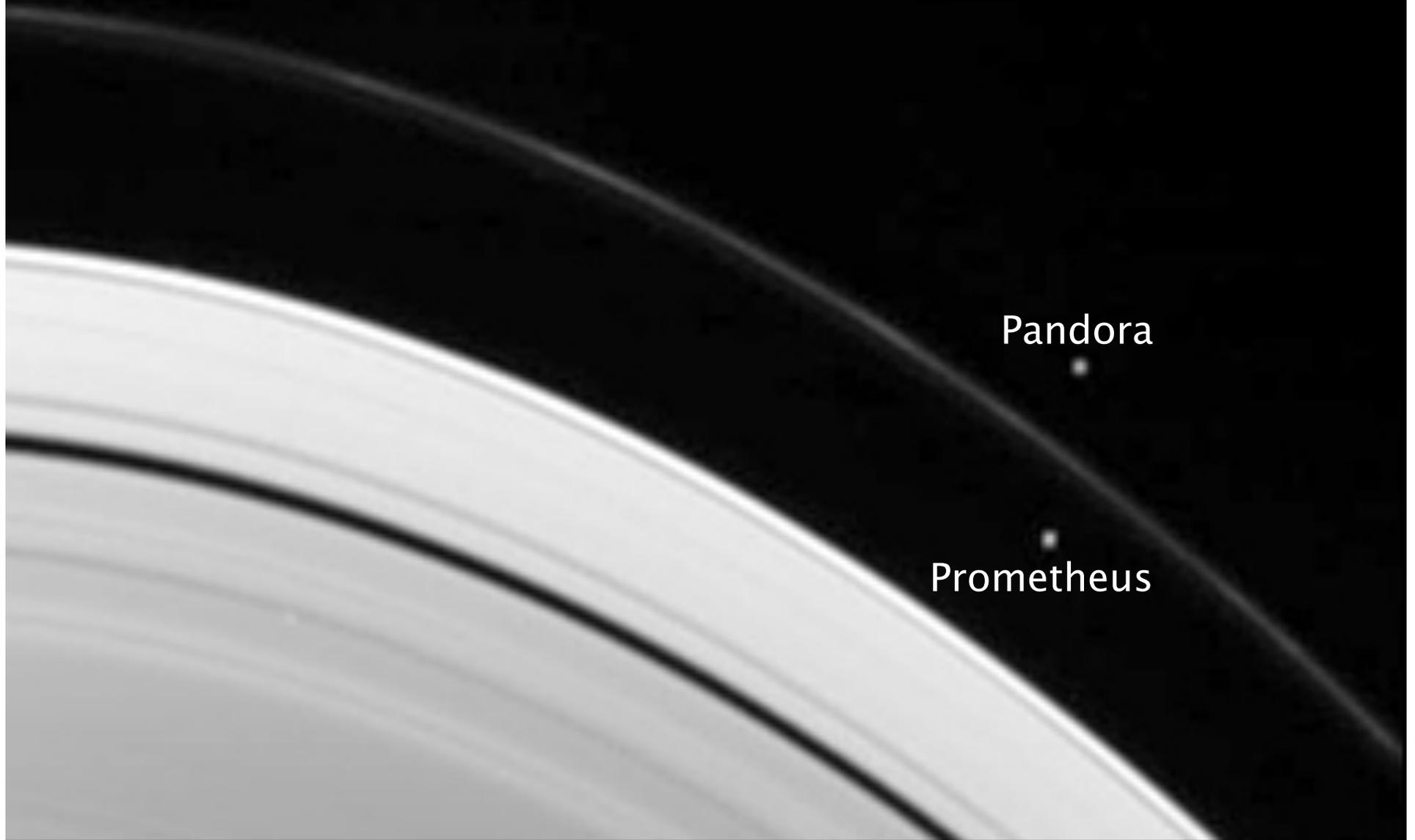
Keeler Gap - cleared by small moon Daphnis



Thin rings can be gravitationally confined by a pair of “**shepherd moons**”

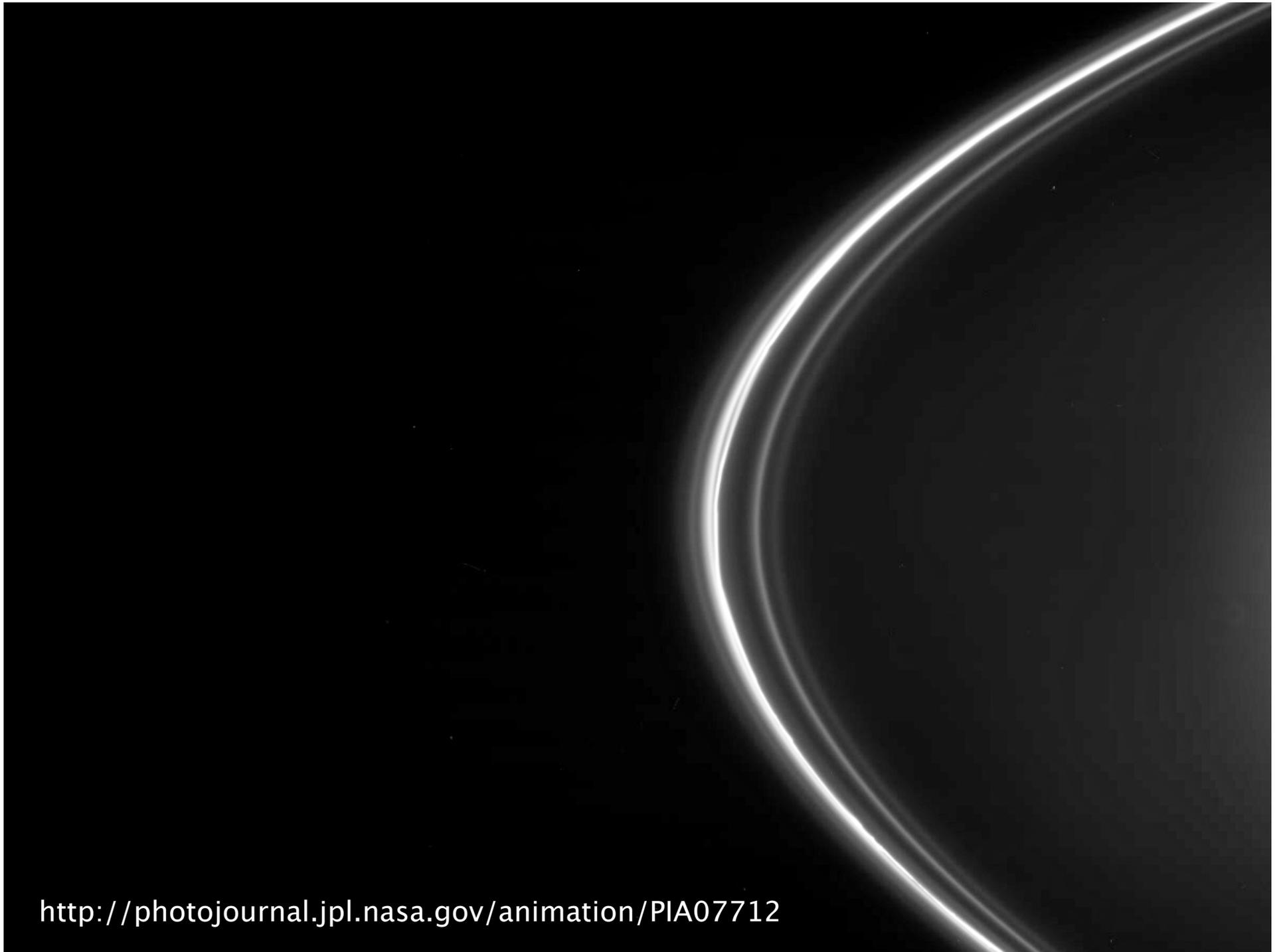


# Shepherd moons of Saturn's F-ring



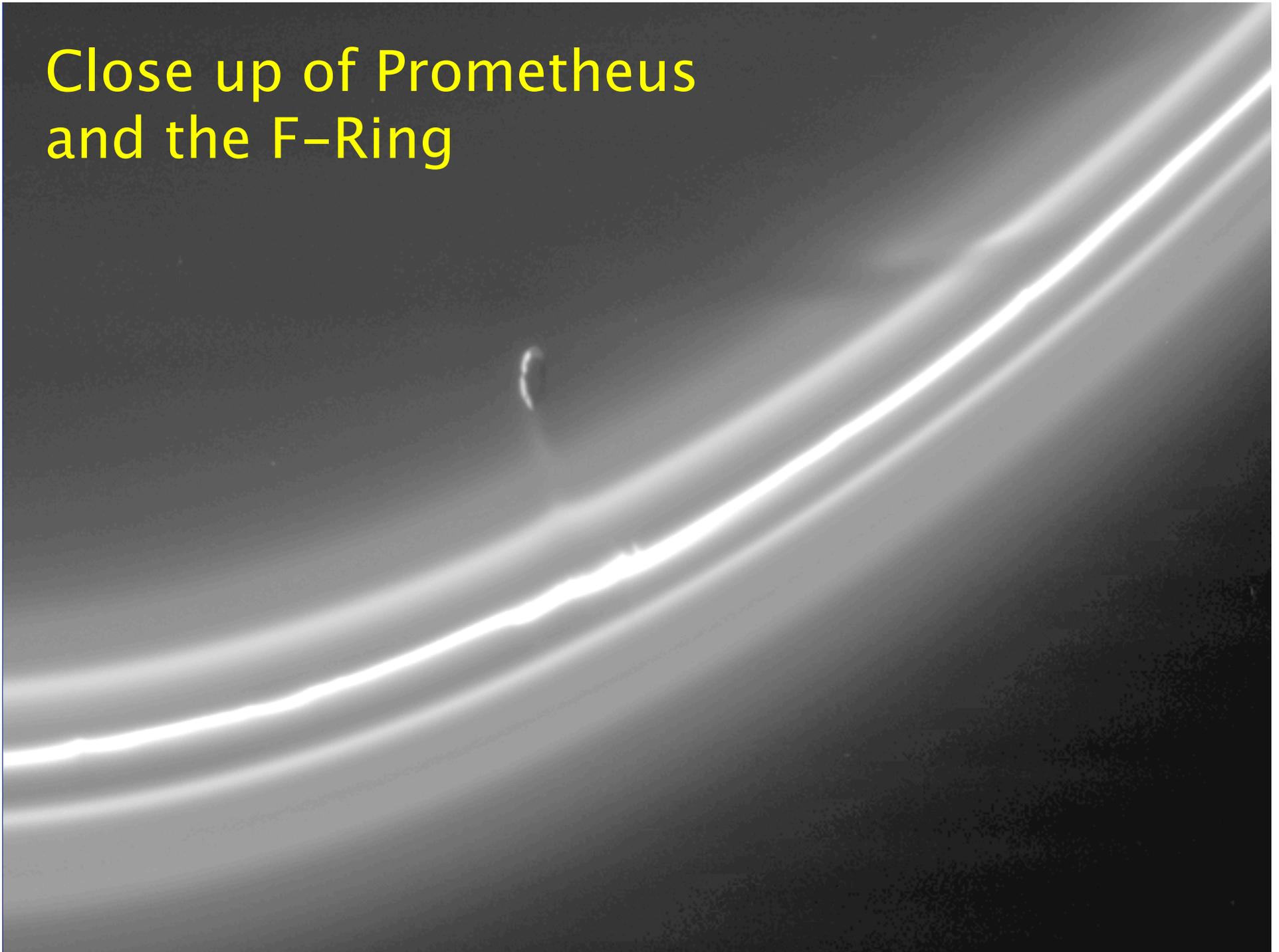
Pandora

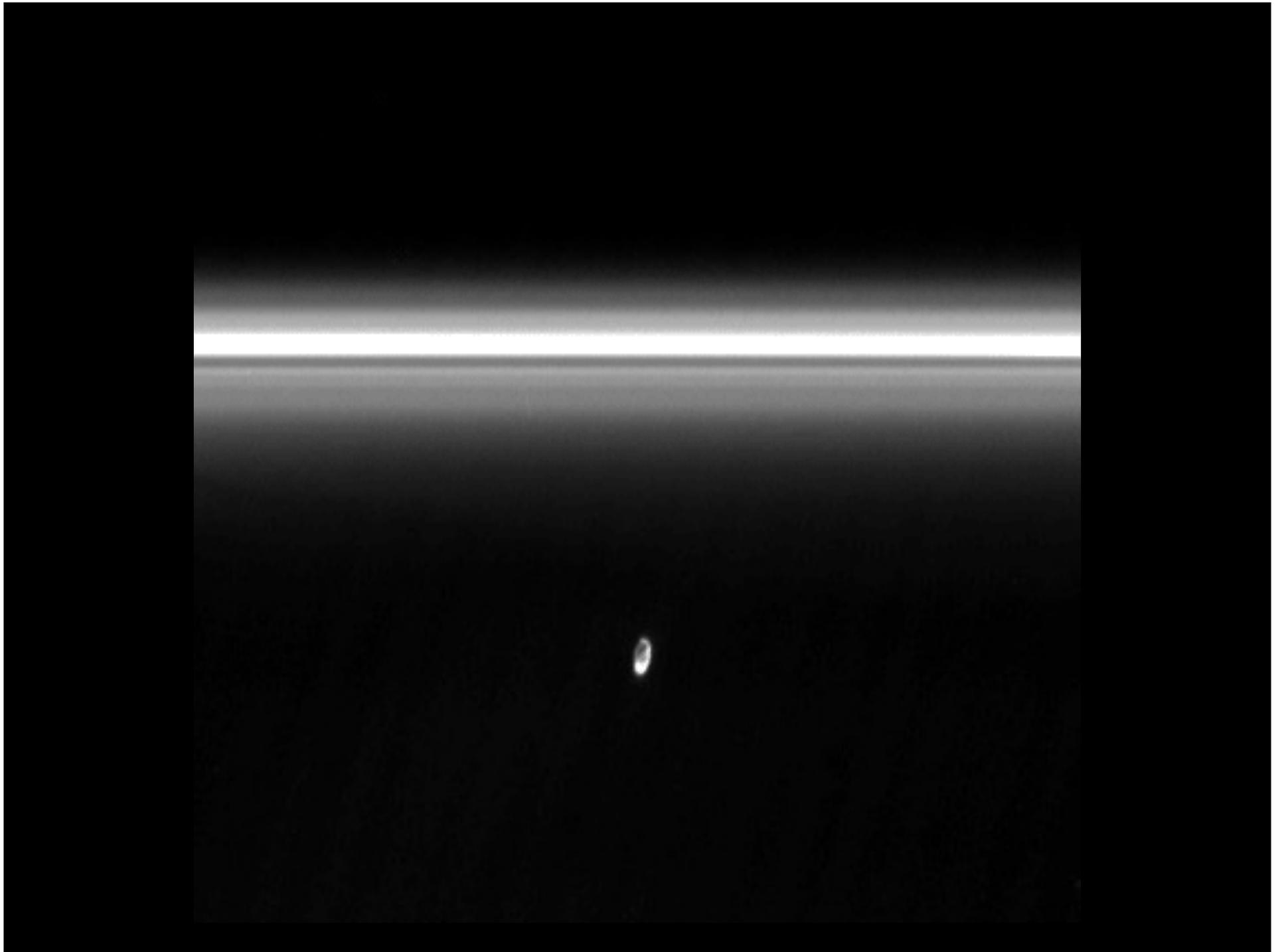
Prometheus



<http://photojournal.jpl.nasa.gov/animation/PIA07712>

# Close up of Prometheus and the F-Ring





# Shepherd Moons of Uranus' Epsilon Ring

