

# Rings

11/23/2009

# Opening Discussion

- <http://www.youtube.com/watch?v=VfOSr6ArtOg>
- Have you seen anything interesting in the news?
- <http://www.youtube.com/watch?v=9z5k2Ph7EGw&>
- What did we talk about last class?

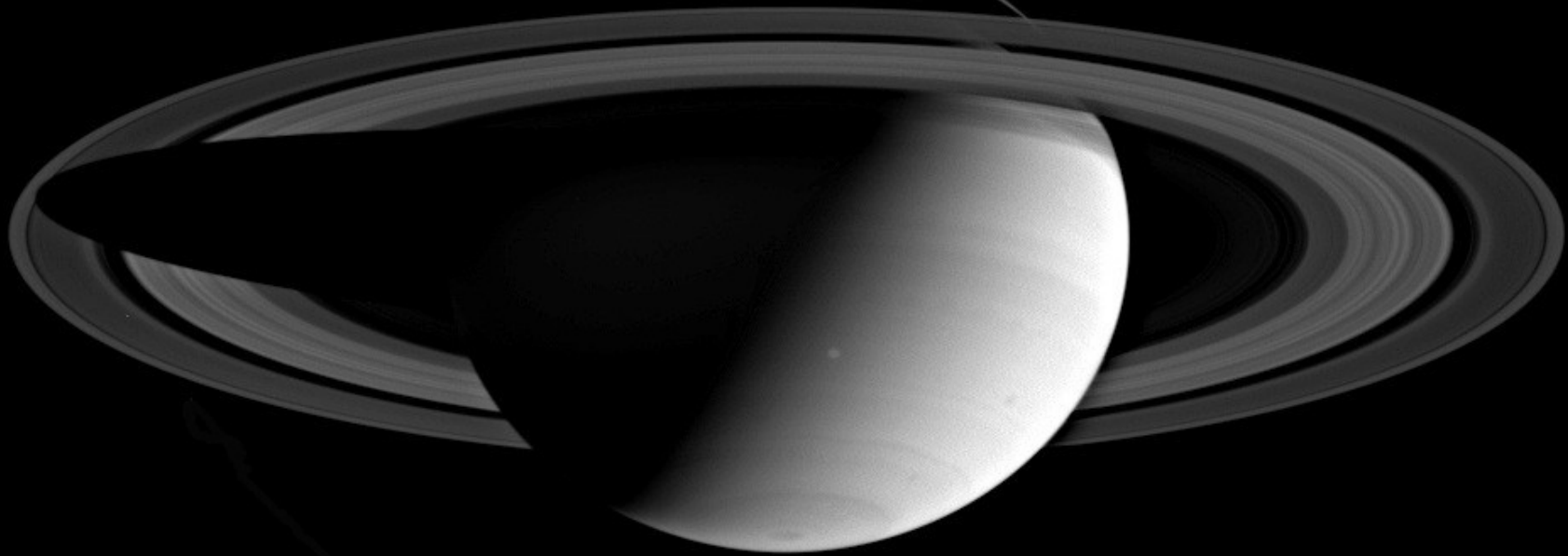
# Rings

- All four of the Jovian planets have rings.
- The nature of the rings varies significantly from one planet to the next.
- Saturn's rings are the only ones that were known until fairly recently and are the only ones visible from Earth unless you are using Hubble or one of the large ground based telescopes with adaptive optics.

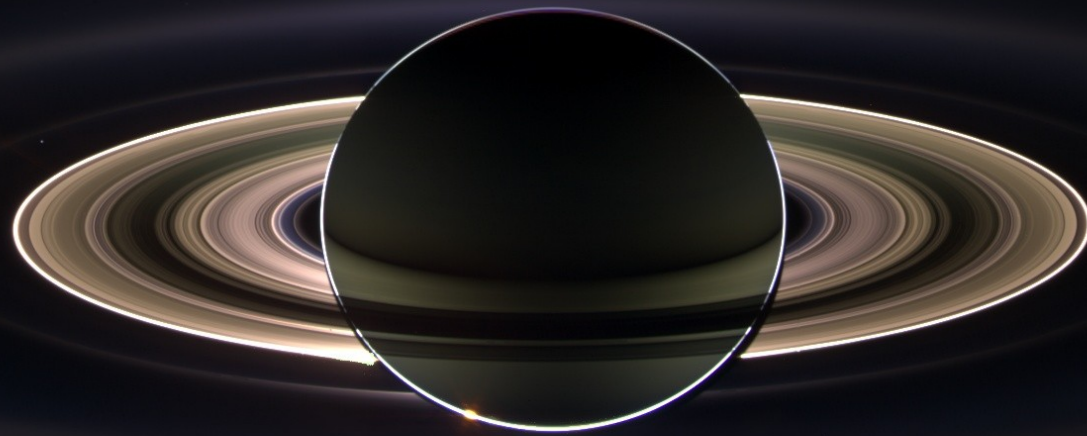
# Nature of Rings

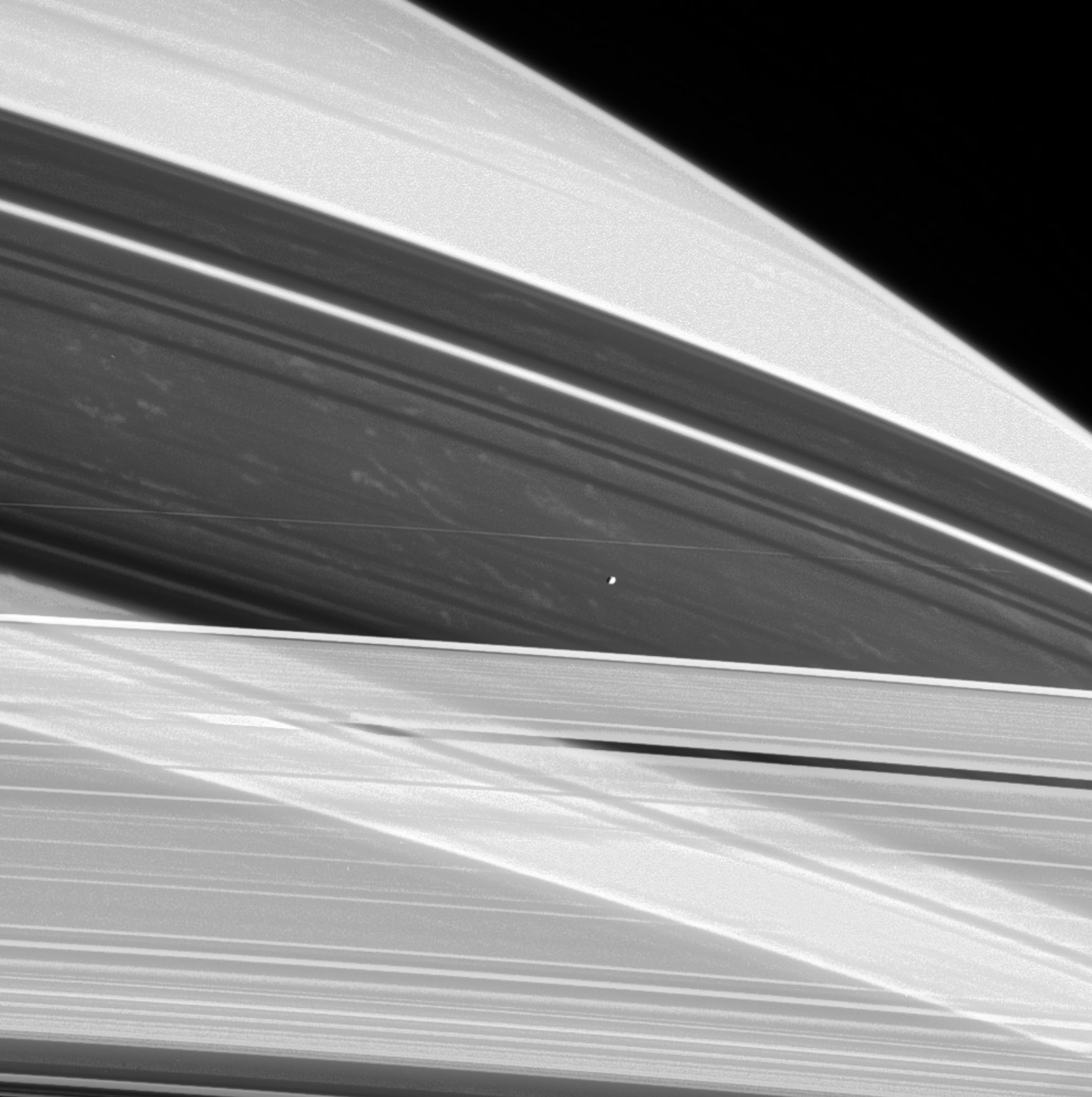
- Rings are collections of small particles in orbit around the planet.
- You can think of them almost like billions of tiny moons.
- Collisions circularize and flatten the distribution.
- The expectation was that diffusion would make the distribution smooth and homogeneous.
- This expectation has problems as we will see.

# Saturn's Rings



# Lit from Behind



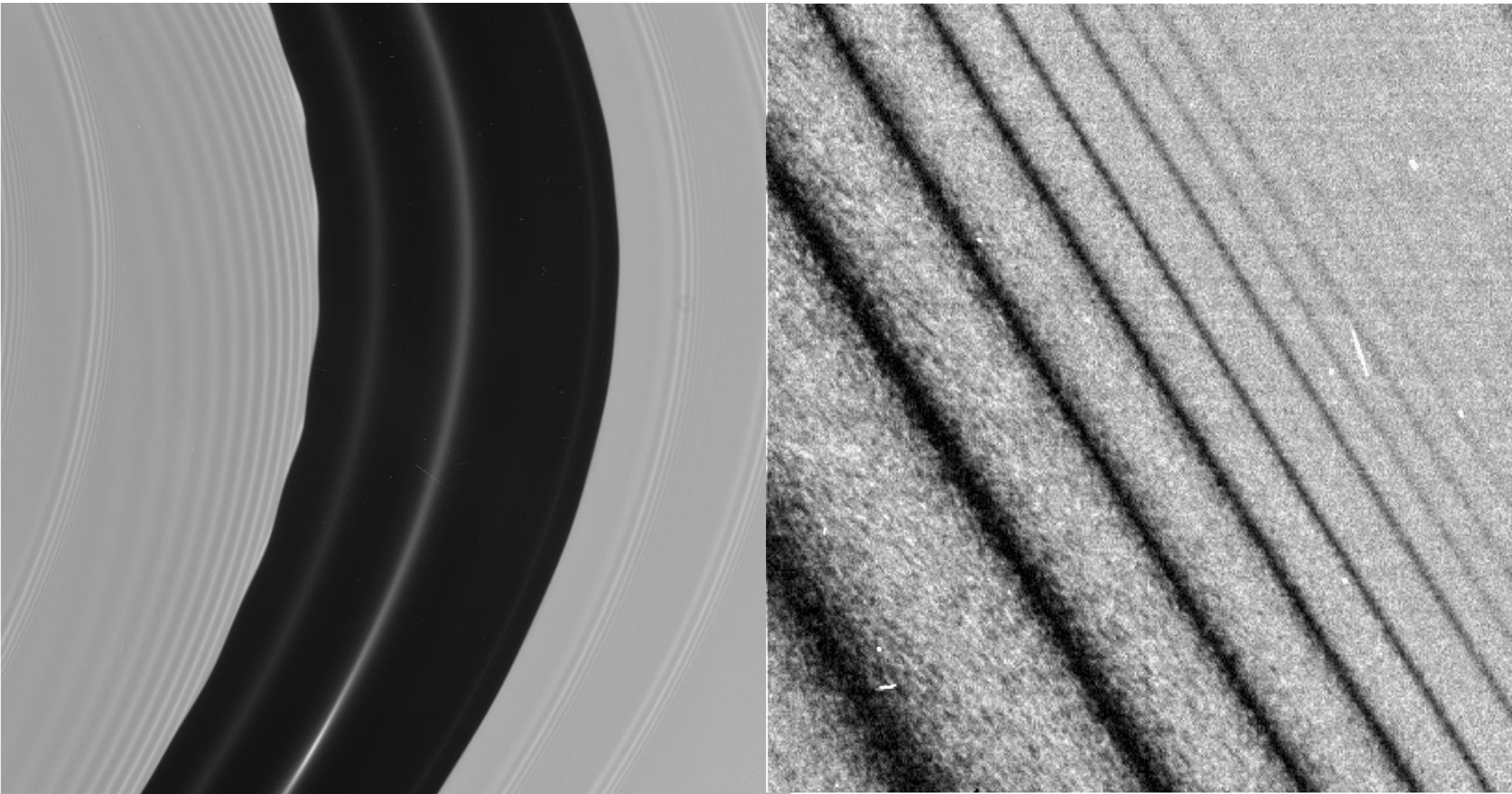






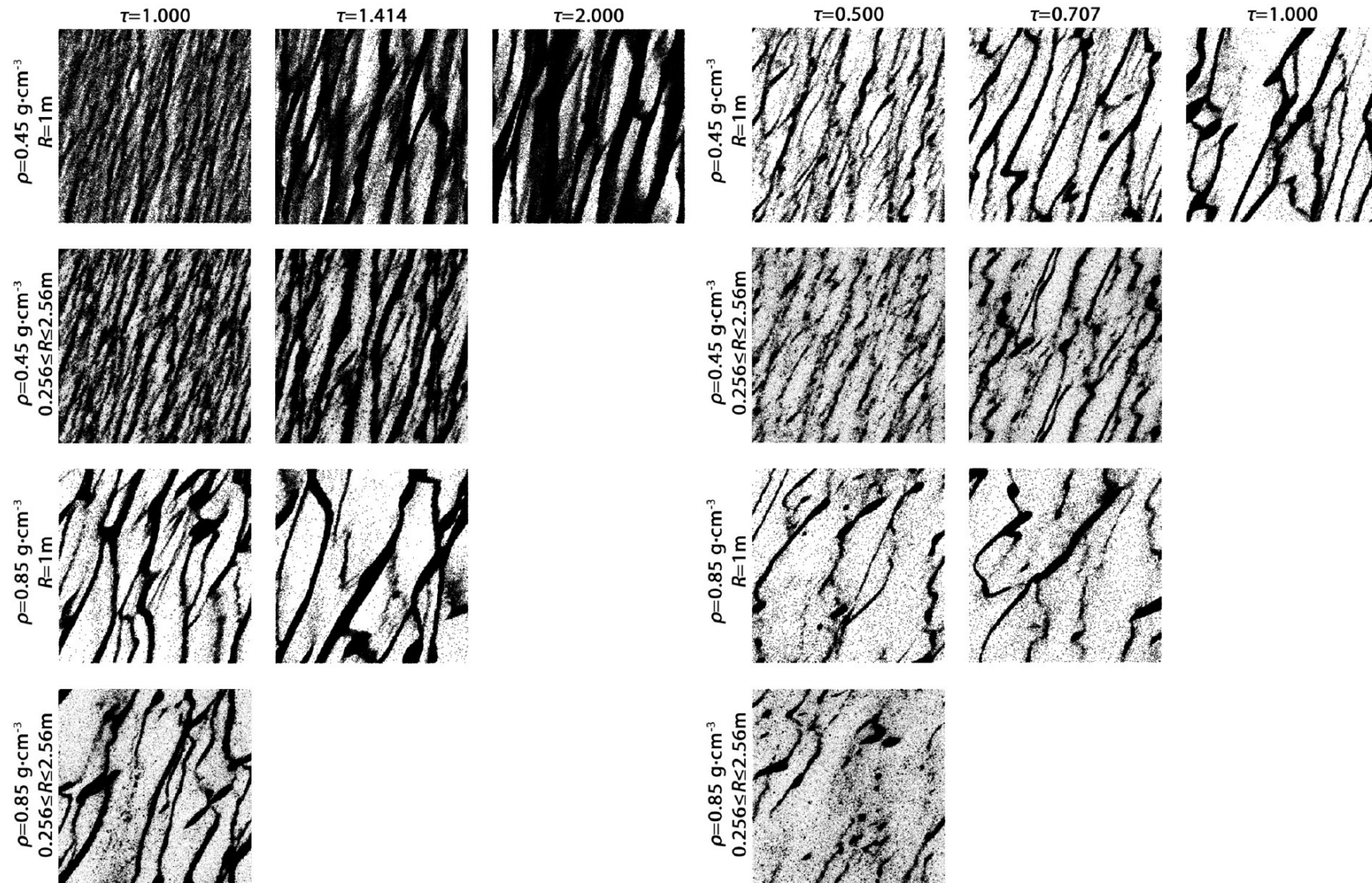
# Details

- Images from Saturn orbital insertion (SOI).

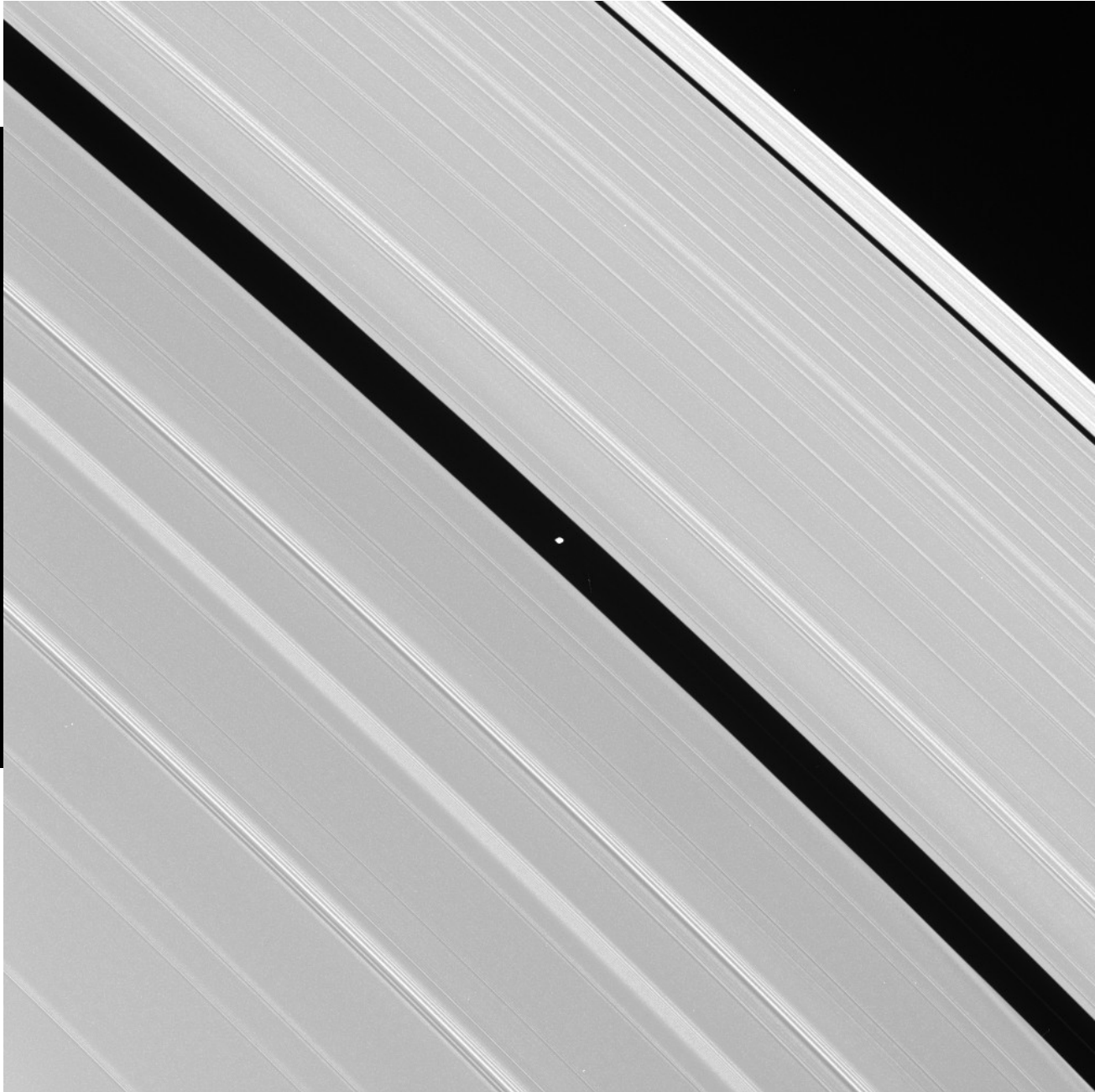
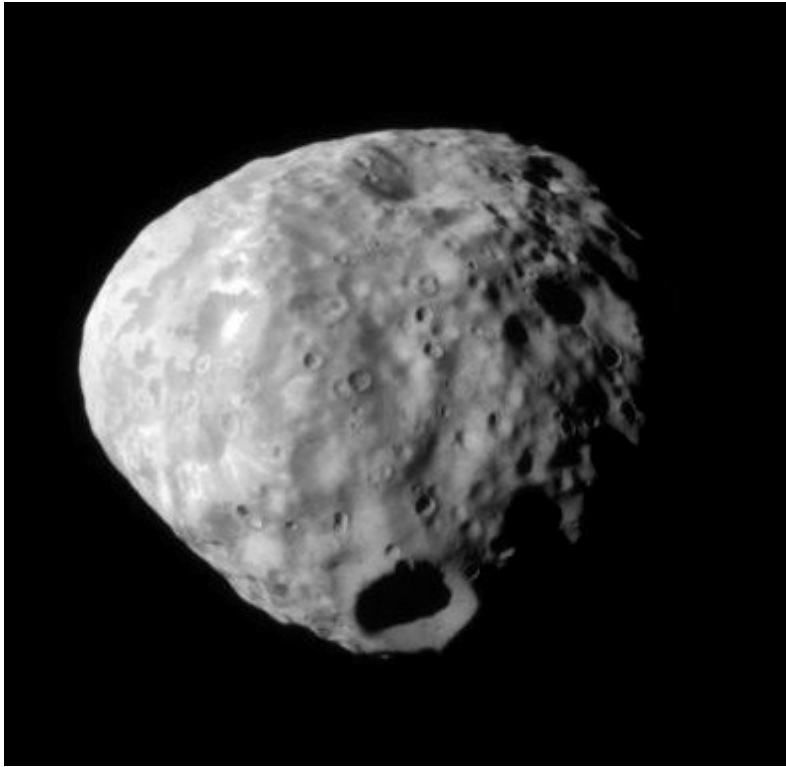


# Gravity Wakes

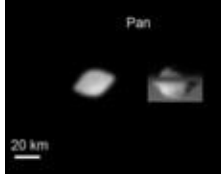
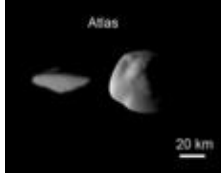
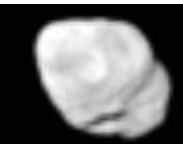


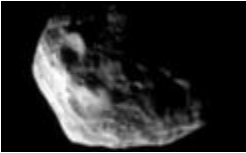
- Gravity between particles causes clumping.



# Moons and Wakes

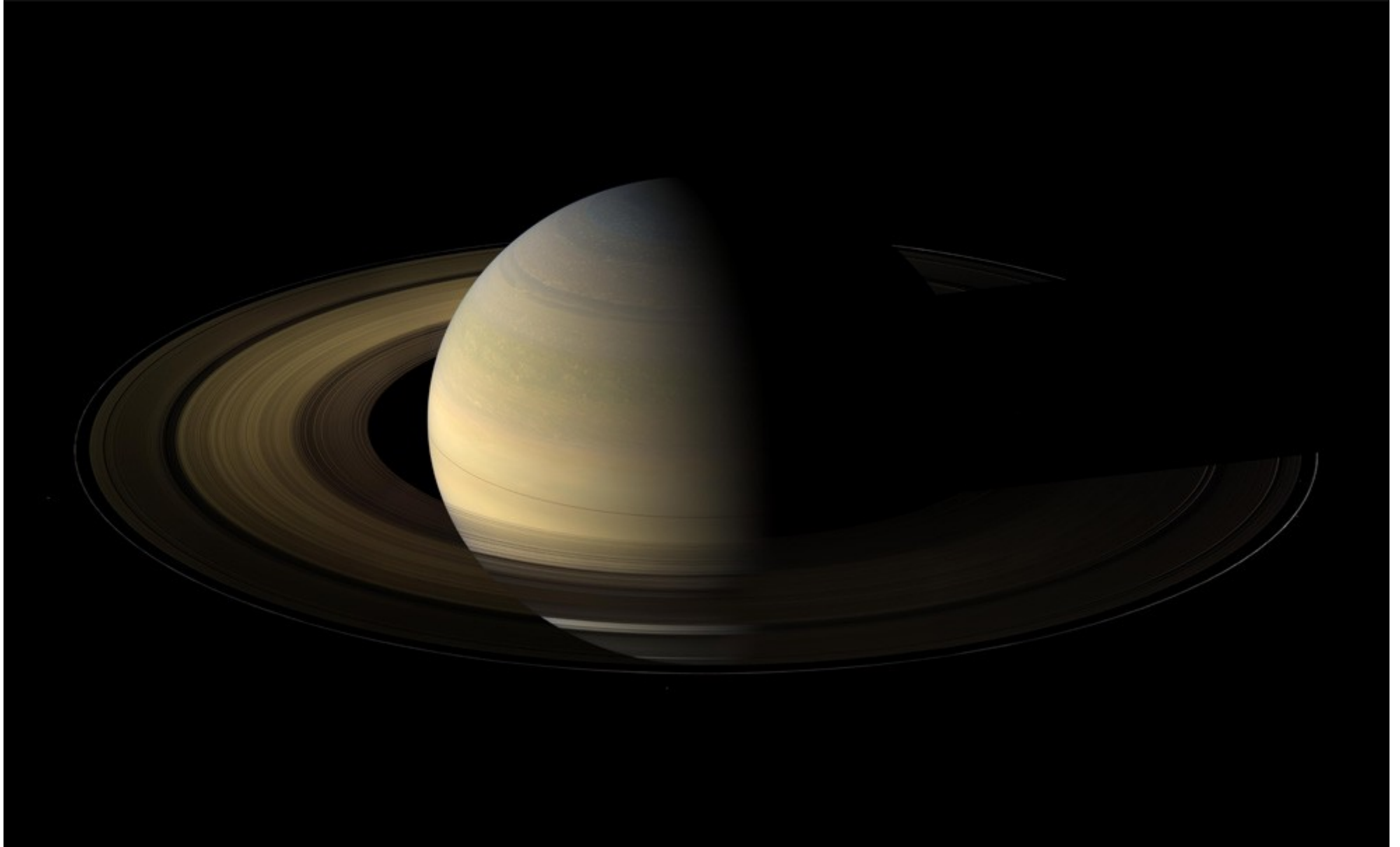


# Small Moons of Note

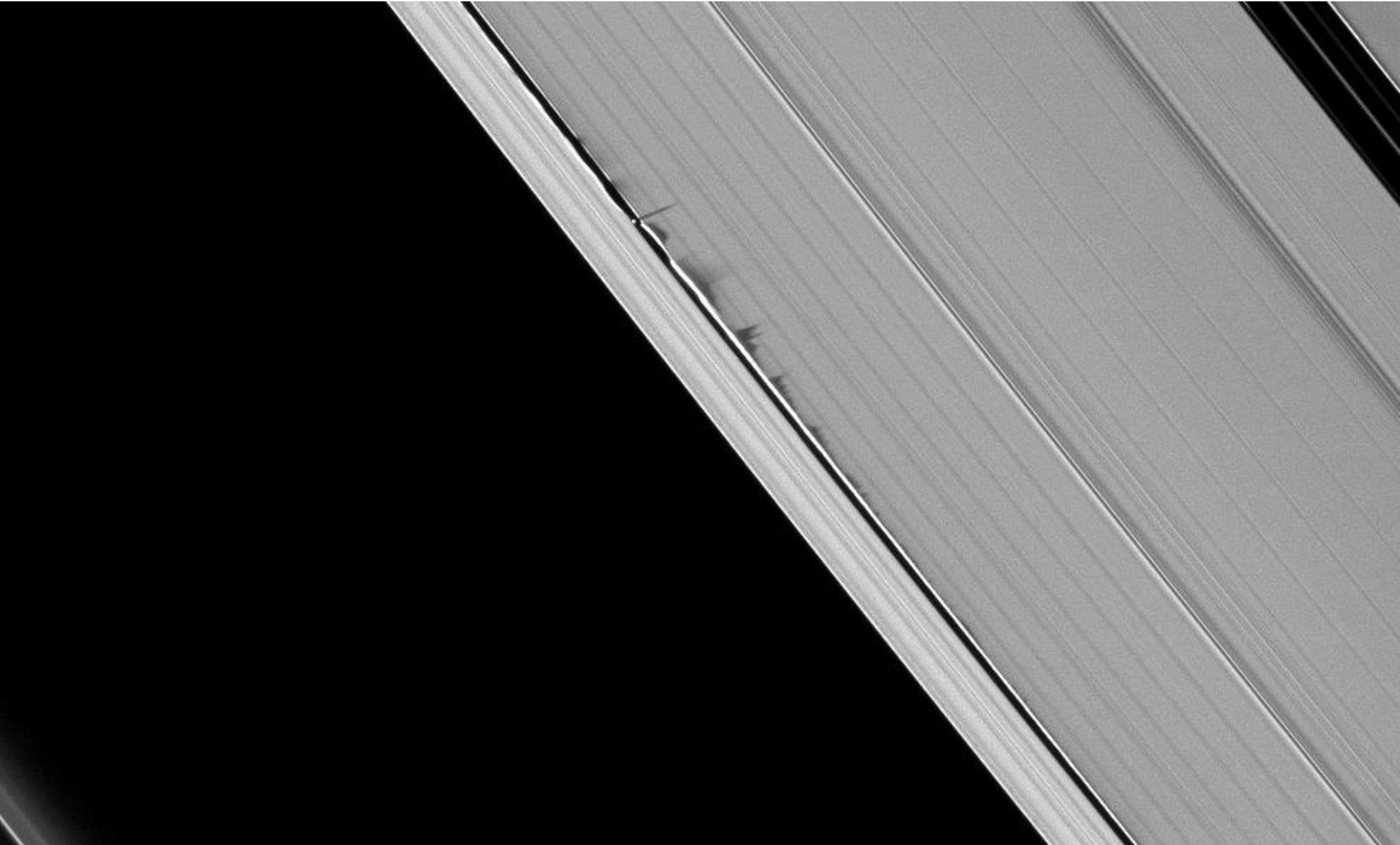
Pan		35×35×23 km	$5 \times 10^{15}$ kg	0.41 g/cm <sup>3</sup>
Atlas		46×38×19 km	$6.6 \times 10^{15}$ kg	0.44 g/cm <sup>3</sup>
Prometheus		119×87×61 km	$1.56 \times 10^{17}$ kg	0.47 g/cm <sup>3</sup>
Pandora		103×80×64 km	$1.36 \times 10^{17}$ kg	0.49 g/cm <sup>3</sup>
Epimetheus		135×108×105 km	$5.3 \times 10^{17}$ kg	0.69 g/cm <sup>3</sup>
Janus		193×173×137 km	$1.9 \times 10^{18}$ kg	0.64 g/cm <sup>3</sup>

- Inner icy moons differ from others. Resonant torques induce waves in rings.

# Ring Plane Crossing

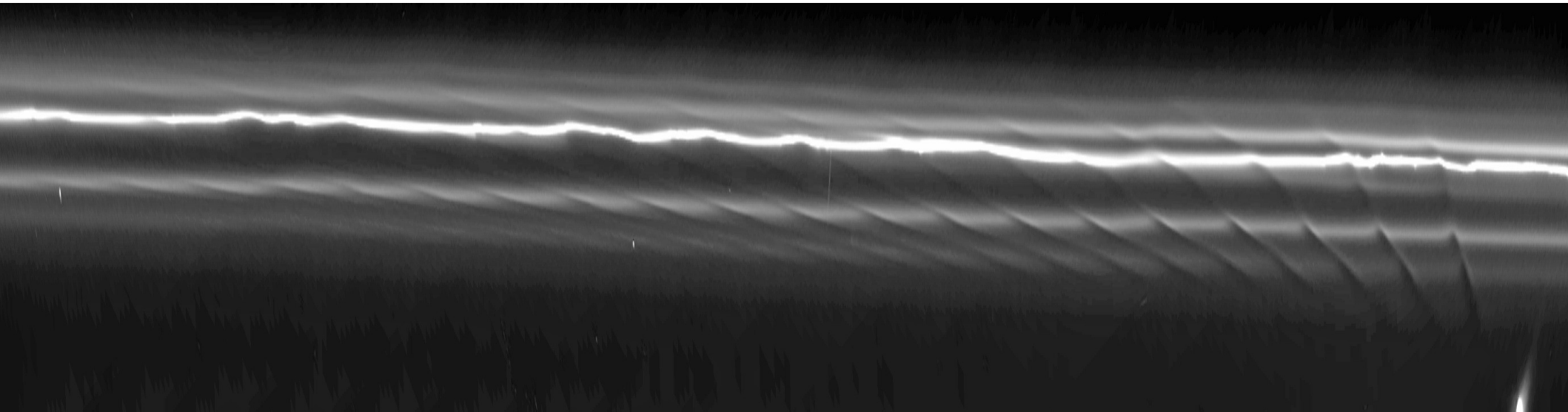


# Vertical Features



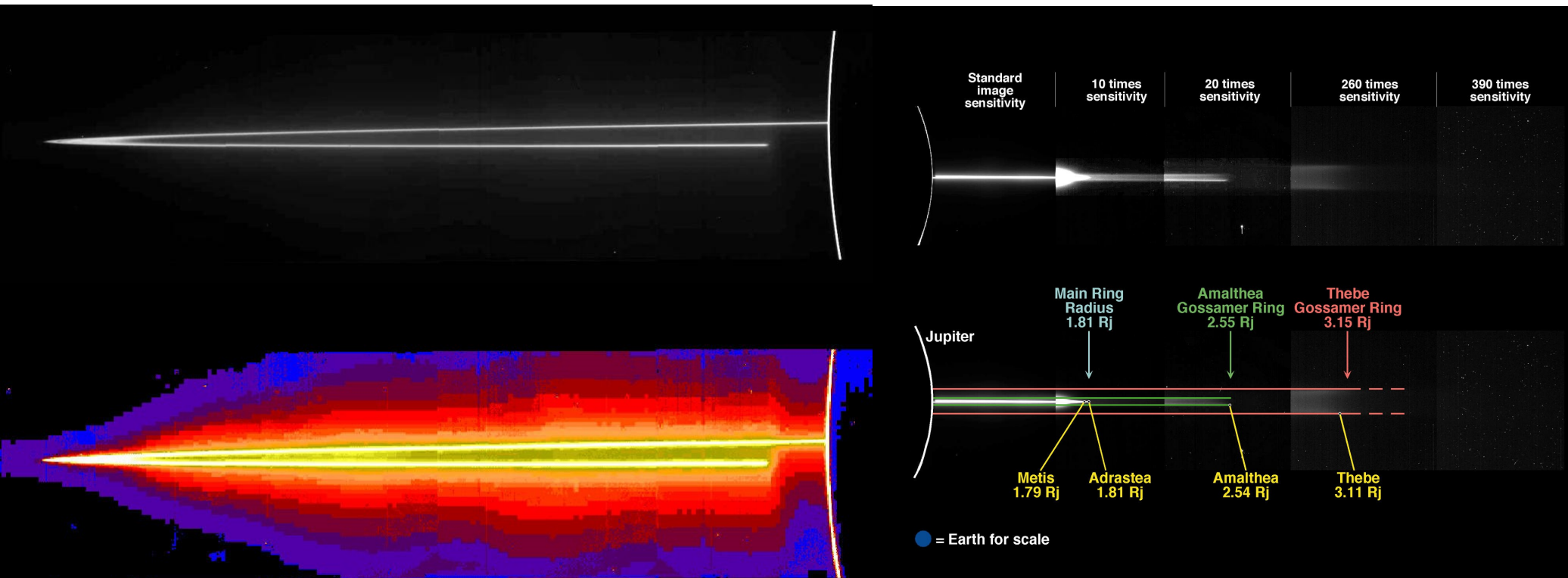
# F Ring

- Saturn has one narrow ring called the F ring.



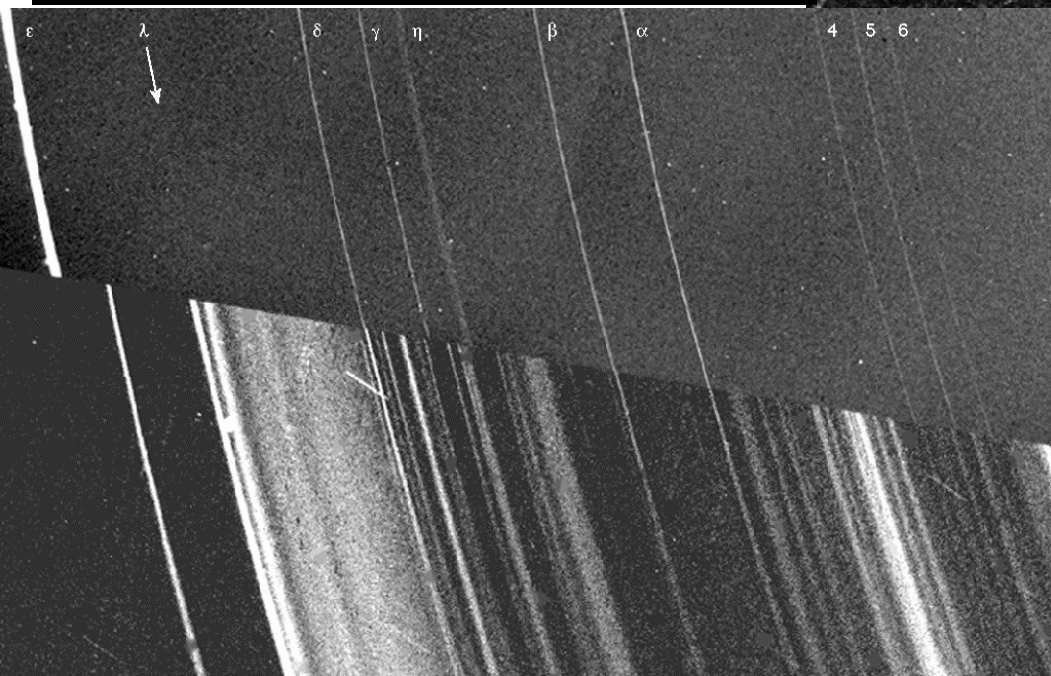
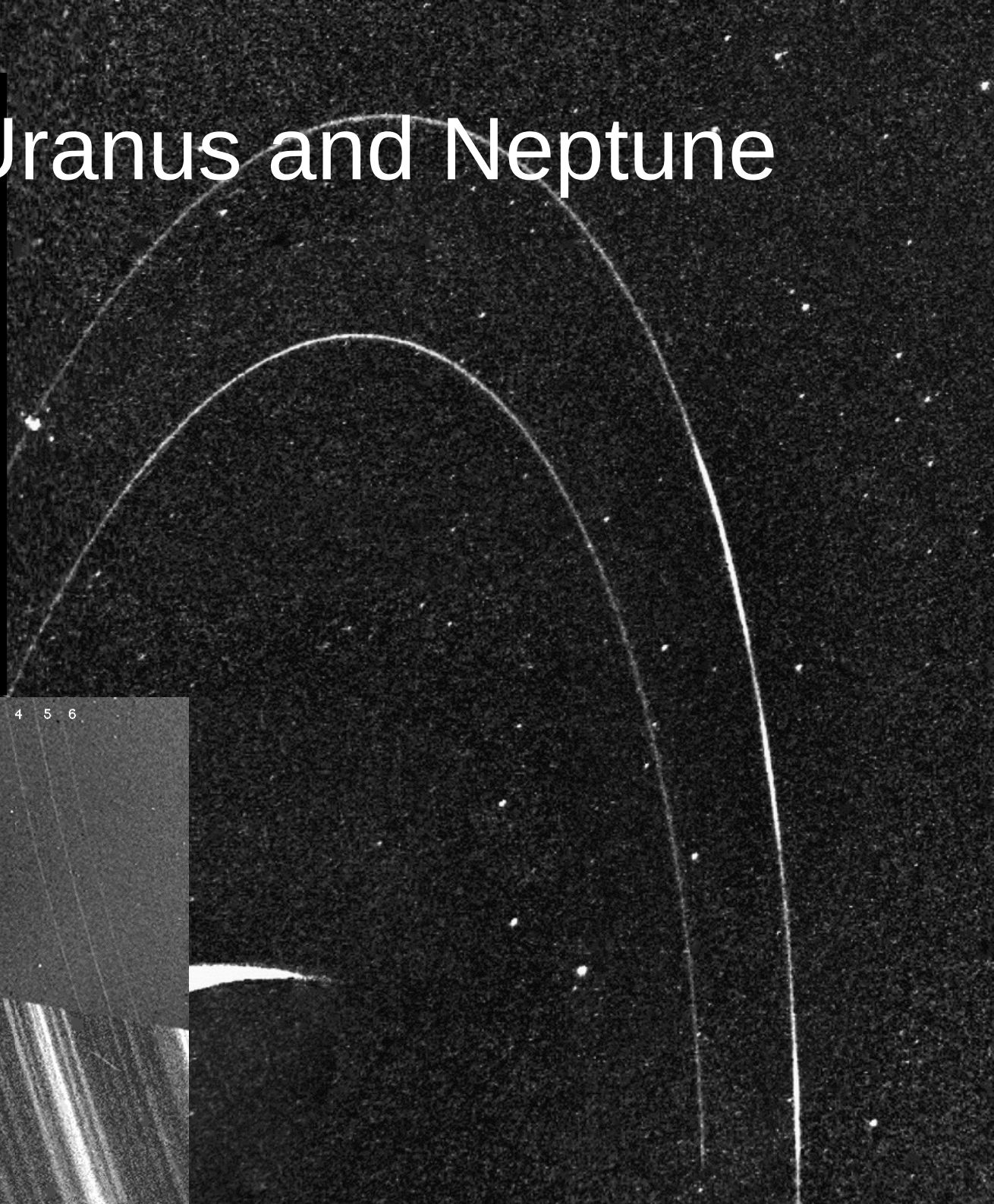
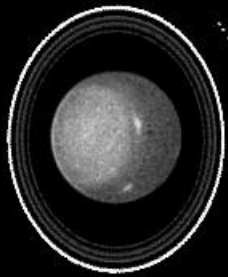
# Jupiter's Rings

- Jupiter's rings are thin and dusty. They are formed by particles that have been knocked off some of the smaller, inner moons.





# Rings of Uranus and Neptune



# Minute Essay

- Do you have any questions about planetary rings?
- I will be here talking about small bodies in the Solar System on Wednesday. If you can be here you should. If you can't be here then enjoy your Thanksgiving weekend.