29. Rings
All Jovian planets have rings made of tiny “moonlets”.
Saturn’s Rings

Only 30 m thick, the rings are aligned with the equator.
Inside Saturn’s Rings

Icy moonlets have sizes of 0.01 — 1 m. Random velocities are small, so most collisions are gentle.
Cassini’s division is due to a 2:1 resonance with Mimas:

\[ P_{\text{Mimas}} = 2 \; P_{\text{Cassini}} \implies a_{\text{Mimas}} = \sqrt[3]{4} \; a_{\text{Cassini}} \]

Other moons and resonances create other structures.
Saturn’s Rings: Fine Structure

Colombo Gap

D Ring 74,500 km C Ring
Saturn’s Rings: Fine Structure
Saturn: “A” Ring Details

- Mimas
- 5:3 BW
- Mimas
- 5:3 DW
- Pan
- 1:1
- Epimetheus & Janus 7:6

Encke gap
Keeler gap
Saturn: “A” Ring Outskirts

Mimas 8:5 BW  Mimas 8:5 DW  Pandora 17:16  Keeler gap Daphnis 1:1

Vertical Structure
Origin of Planetary Rings

Ring formation may be *ongoing* or *catastrophic*.

— moonlet fragmentation
— tidal disruption of moon