Opening Discussion

- http://www.youtube.com/watch?v=VfOSr6ArtOg
- Have you seen anything interesting in the news?
- http://www.youtube.com/watch?v=9z5k2Ph7EGw&t=
- 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

<table>
<thead>
<tr>
<th>Moon</th>
<th>Diameter</th>
<th>Mass</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pan</td>
<td>35×35×23 km</td>
<td>5 x 10^{15} kg</td>
<td>0.41 g/cm³</td>
</tr>
<tr>
<td>Atlas</td>
<td>46×38×19 km</td>
<td>6.6 x 10^{15} kg</td>
<td>0.44 g/cm³</td>
</tr>
<tr>
<td>Prometheus</td>
<td>119×87×61 km</td>
<td>1.56 x 10^{17} kg</td>
<td>0.47 g/cm³</td>
</tr>
<tr>
<td>Pandora</td>
<td>103×80×64 km</td>
<td>1.36 x 10^{17} kg</td>
<td>0.49 g/cm³</td>
</tr>
<tr>
<td>Epimetheus</td>
<td>135×108×105 km</td>
<td>5.3 x 10^{17} kg</td>
<td>0.69 g/cm³</td>
</tr>
<tr>
<td>Janus</td>
<td>193×173×137 km</td>
<td>1.9 x 10^{18} kg</td>
<td>0.64 g/cm³</td>
</tr>
</tbody>
</table>

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