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Ringworld: Travellers' Tales from Saturn

Shane L. Larson

Utah State University

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RINGWORLD:
Travellers’ Tales from Saturn

Shane L. Larson
Department of Physics
Utah State University
s.larson@usu.edu

Clark Planetarium
Salt Lake City, UT
21 March 2009
Storyline

- Saturn Unveiled
- Emissaries
- Saturn up close
- Rings and Moons
Galileo Galilei

- In 1609, Galileo heard of the invention of the telescope
- By 1610, he had constructed one and observed the skies
- "I render infinite thanks to God for being so kind as to make me alone the first observer of marvels kept hidden in obscurity for all previous centuries."
- Stars, the Moon, Venus, Mars, Jupiter, and **Saturn**
Saturn through a telescope

- Initially Galileo didn’t know what he was seeing

- “Saturn has ears.”

- Galileo’s early scopes weren’t the greatest!

- In 1655 Christiaan Huygens observed Saturn and proposed “It is surrounded by a thin, flat, ring, nowhere touching, inclined to the ecliptic.”

- This is what Saturn really looks like through a telescope!

- But we wanted to see Saturn up close, and personal...
Saturn through a telescope

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The Sky Tonight
Pioneer 11

- Flew past Saturn on 1 September 1979, within 21,000 km
- Pioneer 11 was the first craft from Earth to ever visit Saturn.
- Nearly collided with previously unknown moon Epimetheus (~1000 km) as it flew through the system.
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Take a Grand Tour of the Gas Giants by using gravity boosts from one planet to another, slingshotting through the Solar System. Voyager 1 encountered Saturn on 12 November 1980, and Voyager 2 encountered Saturn on 26 August 1981.
Voyager 1 & 2

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Emissaries from Earth to the Stars

Pioneer and Voyager spacecraft carried our senses to the Outer Planets. They are outbound to the stars, carrying messages from Earth to the Galaxy. Pioneer plaque has instructions on how to find Earth, what we looked like. Voyager Record has greetings in 55 languages, 115 images of life on Earth, and 90 minutes of music – Earth's Greatest Hits.

Toward Aldebaran

~ Toward Sirius

Toward Aquila

Toward Ophiuchus
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- Pioneer plaque has instructions on **how to find Earth**, what we looked like.
- Voyager Record has greetings in 55 languages, 115 images of life on Earth, and 90 minutes of music – **Earth’s Greatest Hits**.

Cassini-Huygens

After flying past Saturn, we wanted to go back and stay!

Joint NASA/ESA mission

Launched 15 October 1997

Slingshots around Venus (twice) Earth and Jupiter, to arrive at Saturn on 1 July 2004

Dropped the Huygens probe on the moon Titan

Still operational
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http://saturn.jpl.nasa.gov/
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Portrait of a Ringworld

- Orbit is about 9.5x larger than Earth’s orbit
- Year is 29.6 Earth years long
- Day is 10hr 39min long
- Subtle atmosphere that shows storms and aurorae
- Rings!
- 61 confirmed moons! A veritable solar system unto itself
The atmosphere of Saturn is mostly hydrogen (~93%) and helium (~6.5%), with trace amounts of other stuff.

Using different kinds of light (infrared) reveals new details!
Clouds of Saturn

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The Polar Storms

- There is a **hurricane** locked on top of Saturn’s south pole
- There is a **hexagonal storm** on top of Saturn’s north pole
- The only storms, outside of the Earth, where an **eyewall** has been seen
Ring Panorama
Within the Rings of Saturn...

Almost all ice, so it's bright! Particles are ~1cm to 10m in diameter.

Saturn's ring system is large – 300,000 km in diameter – but may be as thin as ~10 meters at base!
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Encke Gap

Keeler Gap

136,780 km

F Ring

140,220 km
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“The scientific theory I like best is that the rings of Saturn are composed entirely of lost airline luggage.” -- Mark Russell
What is going on with the **thousands of individual rings**?

Big gaps are often caused by moons. Many ringlets arise from the combined gravitational tugs of all the moons in the Saturn system.

We see some moons keeping the rings in line – “**shepherd moons**”
Structure of the Rings

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Moons, moons, moons... 61 and counting!
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All bodies are to scale except for the eight small, starred (*) bodies whose sizes have been exaggerated by a factor of 5.
Titan

- Largest moon of Saturn
- Only moon with an atmosphere
- Only planetary body other than the Earth with liquid bodies
- Discovered by Huygens in 1655
- Discovery coded in an anagram, quoting Ovid:
  
  “Admovere Oculis Distantia Sidera Nostris” (They brought the distant stars closer to our eyes).

“A moon revolves around Saturn in 16 days and 4 hours.”
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Huygens
The Surface of Titan

Vast hydrocarbon lakes ("seas" named after sea monsters, "lakes" after Earth's lakes)

Weathered rocks and landscape

Possible subsurface oceans

The atmosphere and environment is considered "pre-biotic"—similar to the environment of ancient Earth, and conducive to the development of organic lifeforms
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Saturn is a place of endless mysteries and fantastic vistas. It challenges our **ingenuity and creativity**, and inspires us to **explore and understand**, not just Saturn, but ourselves and our place in the Cosmos. Because after all.... **it’s about life on Earth!**
Go outside, look up, and enjoy Saturn!

Questions?