

Uses a clear, concise title that is easily understood by a broad audience.

Objective of the project is explicitly stated (but could have used a more informative header).

Simple, informative figures highlight the major results from computation and simulations. The figures do not try to pack too much information into each panel.

This poster is a good example of using a minimum amount of text while still effectively communicating main ideas.


It is designed with the understanding that it requires the presenter to explain further technical details.

Thank you to Mar Vaquero for use of this poster.



The Hixon Writing Center at Caltech

National Aeronautics and Space Administration



## Saturn Rings Tour

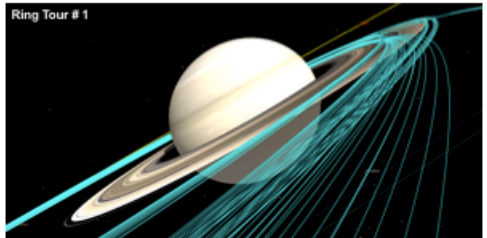
**Principal Investigator: Mar Vaquero (392C)**  
**Co-PI: Juan Senent (392P)**  
**Program: Spontaneous Concepts**

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**Project Objective**  
To understand the nature of and characterize flyby trajectories to support a potential future mission to observe the rings of Saturn at close range.

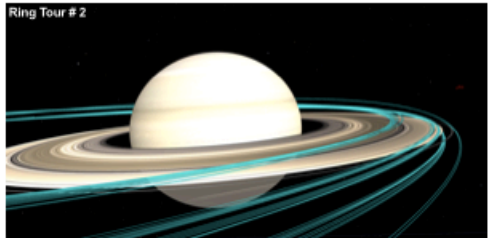
**Results FY 15/16**

**Ring Tour # 1**

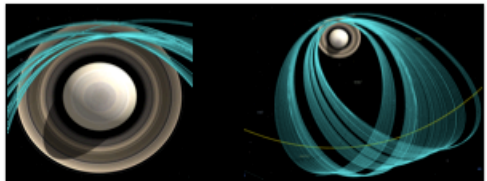


This ballistic (no delta-V) 2-year tour features 64 passes above the rings, 4 targeted Titan flybys and multiple non-targeted flybys of Enceladus (10), Dione (4), and Rhea (5). Each orbit – between 8 and 10 days long – features low relative velocity passes over the rings, ranging from 1.5 to 3.0 hours in length.

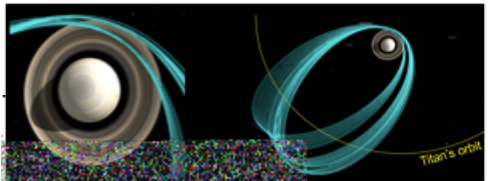
**Ring Tour # 2**



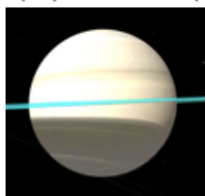
This alternate tour features at least two ring passes per month (42 total), either above or below the ring plane over the span of 1.5 years. There are 4 targeted Titan flybys and multiple non-targeted flybys of Enceladus (6), Dione (1), and Rhea (3), allowing for additional icy moon flyby science.

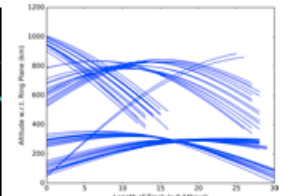


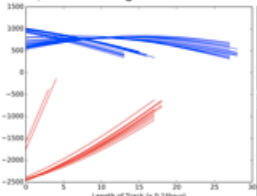
The tour offers broad coverage of the F, A and B rings by exploiting Titan gravity assists; no new technology needs to be developed to achieve this mechanism. In fact, this trajectory could have been flown by Cassini in March 2016.

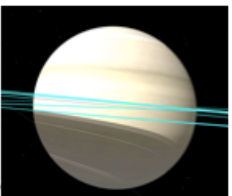


By using a small delta-V maneuver, it is possible to change the plane of the orbit; this 1.5-year tour covers different ranges of the F, A and B rings from above and below, thus maximizing science return.









Efforts were dedicated to maximize the time spent over the rings while minimizing the number of flybys. To achieve optimal science results, the orbital inclination is maintained below 0.45 degrees, resulting in passes ranging in altitude from 6 km to 1,006 km.

Even with a simplified architecture and operations schedule, it is possible to explore the rings from above and below under different lighting conditions. This tour features 42 close passes, from -2,467 km to 1,011 km in altitude.

D Ring  
74,500

C Ring  
92,000

B Ring  
122,200

A Ring  
136,780

F Ring  
140,200


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**Benefits to NASA and JPL**

- Could enable a Saturn ring-focused Discovery or New Frontiers class mission
- Solar powered spacecraft with a CBE dry mass of ~1000 kg and a 20-80 kg instrument payload for a 2-4 year science tour (depending on mission cost)
- Does not require new technology
- Based on a simplified architecture and operations schedule

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Cassini's closest image of the rings taken from 24,884 km; ~400 m/pixel

Our concept could allow images from 800 km or closer, resulting in a resolution of 7 m/pixel or better with modern cameras

Poster No. RPC-181

Listing PI first is a formatting requirement for this JPL poster session.

Major significance of the work is clearly stated alongside visual data that highlights the project's improvement on existing methods.