

#### Saturn and Titan: solar wind influence

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Images: NASA/JPL-Caltech/Space Science Institute

## Contents



- Current density in Saturn's magnetosphere:
  - how does the solar wind influence current density?
  - is this similar to Jupiter or Earth?
  - what seasonal effects can we see?

• Flux ropes in Titan's ionosphere:

does the solar wind influence production?
where do we find flux ropes?



• Saturn is a rotationally dominated magnetosphere with internal plasma sources.



- Seasonal bowl [Arridge+ 2008 (image above)]
- Titan's orbit is at 20 R<sub>s</sub>
- Titan can be located outside of the magnetopause or bow shock depending on solar wind conditions

# Current Density Planetary Physics University

- Stretched field with current sheet in washer shape
- Aperiodic waves on Saturn's current sheet used



Fit a **modified Harris** model to extract **scale height** and **field values** of the current sheet

Wave values also extracted via use of Gaussian wave function. [Martin & Arridge, 2017]





#### Current density

Current sheet current density calculated using Ampere's law and the Harris current sheet:





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#### Current density from model results

- $\frac{\partial Dz}{\partial x}$  Difference of difference o
- Differential found by fitting polynomial to radial distribution of differenced magnetic field (output of model)







### Current density







#### Current density – temporal vs. spatial





The Sun's influence Planetary Physics University







- Flux ropes are **twisted bundles** of magnetic field
- Found **all over** the solar system: **ionospheres**, magnetopauses, solar wind, solar surface, magnetotails
- **85 flux ropes have been detected** at Titan using the Cassini magnetometer [Dougherty+ ,2004] during **all** Titan flybys



Flux rope diagram: Wei et al. (2010)

#### Flux rope stats





- Cassini trajectory bias
- Force free flux rope model



## Flux rope location Planetary Physics University



# Flux rope location Space & Lancaster







- Make use of AIKEF Hybrid model (Simon 2009, 2010, 2011 ..., Feyerabend 2015, 2016)
- Test **magnetopause crossing** (change in MF direction and flow)
- Test **current sheet crossing** (change in only direction of MF)
- Explore statistics of **dipolarization** events and flux ropes.



#### Summary

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- Flux ropes in Titan's ionosphere:
  - how does the Sun influence production?
    - Position of magnetopause and reconnection in tail
    - Use of model to further this
  - where do we find flux ropes?



- Mainly on the day side of Titan in the nose of Saturn's msphere
- Post midnight area on night side of Titan
- Current density in Saturn's magnetosphere:
  - how does the Sun influence current density?
    - Confinement of magnetic field by SW induces negative radial currents in post noon and stronger positive pre noon.
    - Differentiating spatial vs. temporal changes
  - is this similar to Jupiter or Earth?
    - More more like Jupiter than Earth