Research Proposal for "Investigation on the structure of Jovian magnetotail based on MHD model"

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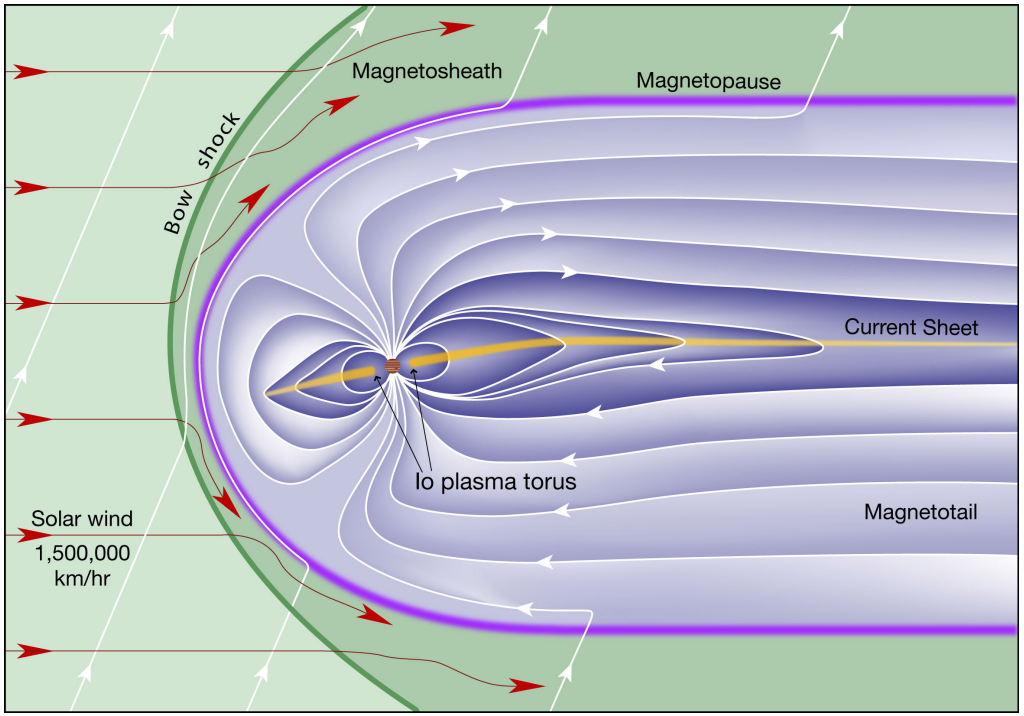
Outline

Section 1

Introduction

Introduction

Jupiter is the biggest planet in the solar system. It has an intrinsic magnetic field which interacts with the solar wind and forms the mangetosphere.



Introduction

Jupiter is so amazing.

1. It rotates so fast.
2. It is so big (planet, mangetosphere, magnetotail).
3. Its magnetic field is so strong.
4. It has a satellite called Io which can provide plasma.

Introduction-Missions

There are several flyby or orbiter missions of Jupiter:

1. Pioneer 10 (1973)
2. Pioneer 11 (1974)
3. Voyager Program (1979)
4. Ulysses (1992)
5. Galileo (1995)
6. Cassini (2000)
7. New Horizons (2007)
8. Juno (2016)

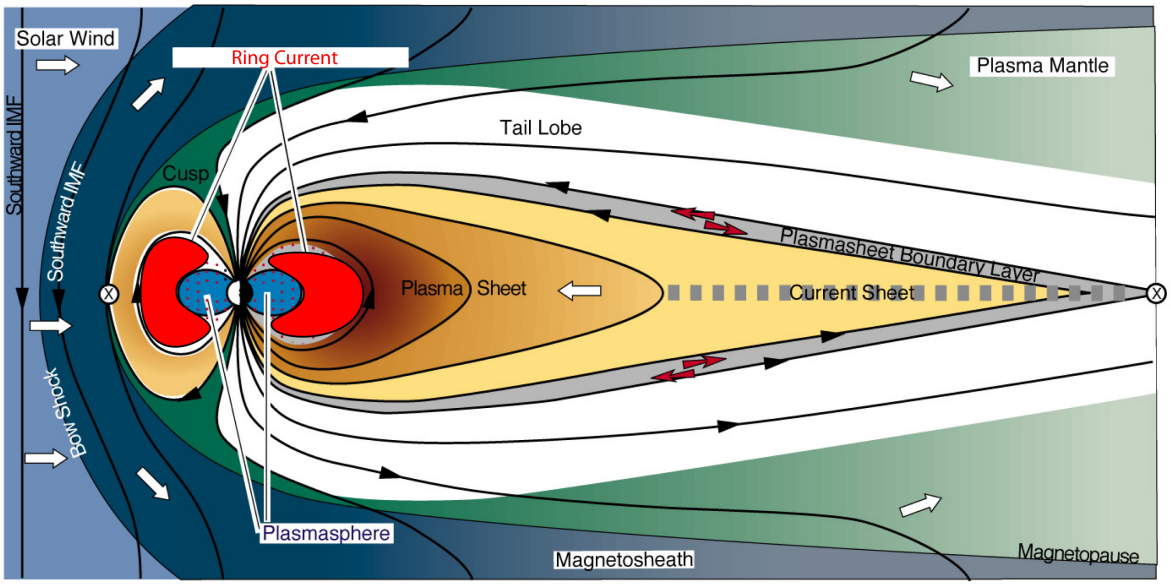
Introduction-Jovian Magnetotail Range

McComas *et al.*(2007) reported The New Horizons spacecraft has sampled the coherent Jovian magnetotail in situ to distances from 1600 R_J to 2500 R_J.

However, Scarf *et al.*(1981), Kurth *et al.*(1982), and Lepping *et al.*(1983) reported Voyager 2's entries into Jovian magnetotail at a distance of $\sim$ 7000 R_J

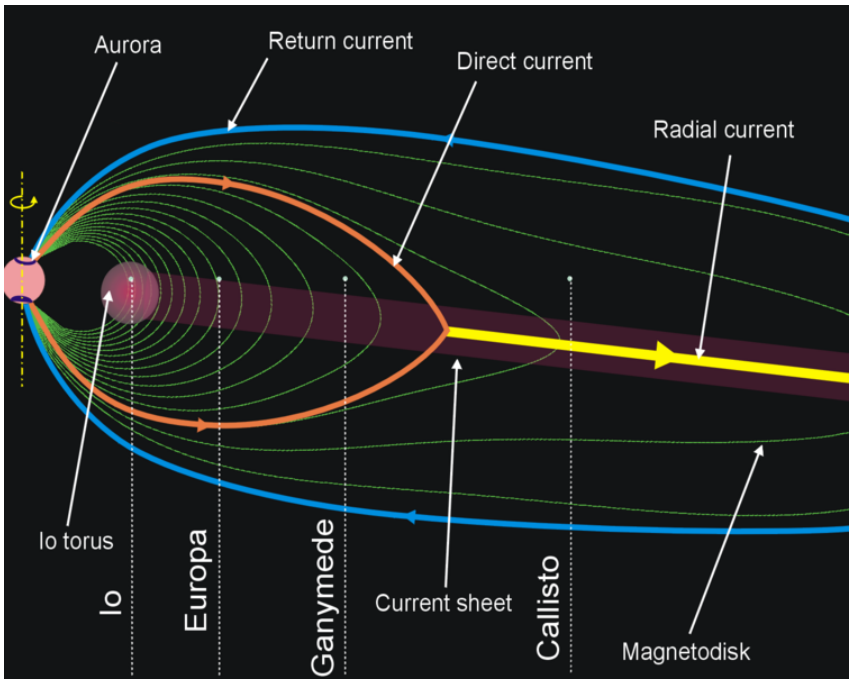
Introduction-Jovian Magnetotail Structure

1. Plasma Sheet
2. Plasma Mantle
3. Lobes
4. Current Sheet



Introduction-Jovian Magnetotail Structure

Behannon *et al.*(1981) showed that Jovian magnetotail contains a thin current sheet surrounded by lobes mostly devoid of plasma.



Introduction-Solar Wind

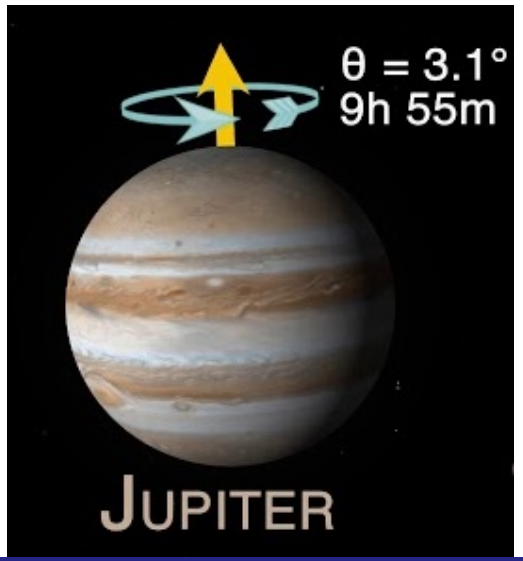
Interactions between a planet's magnetosphere and solar wind can be seen in Dungey Cycle(from my first report 2023.2.1).

By analyzing the data from Galileo. Tao *et al.*(2005) proposed the response of the Jovian magnetosphere to solar wind dynamic pressure enhancements can be explanied plausibly by a burst of magnetotail reconnection and a change in the position of the current sheet.

Introduction-Fast Rotation

Jupiter is a rapid rotator, the effects of rotation are seen in numerous features, including the development of anisotropy in the plasma distribution.

We explain the Jupiter's magentosphere's formation as Dungey Cycle + Vasyliunas Cycle(Fast Rotation).



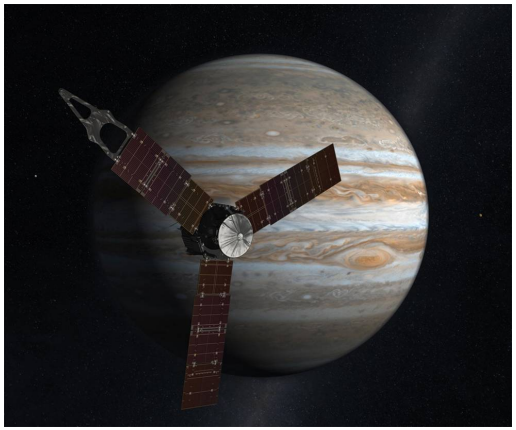
Section 2

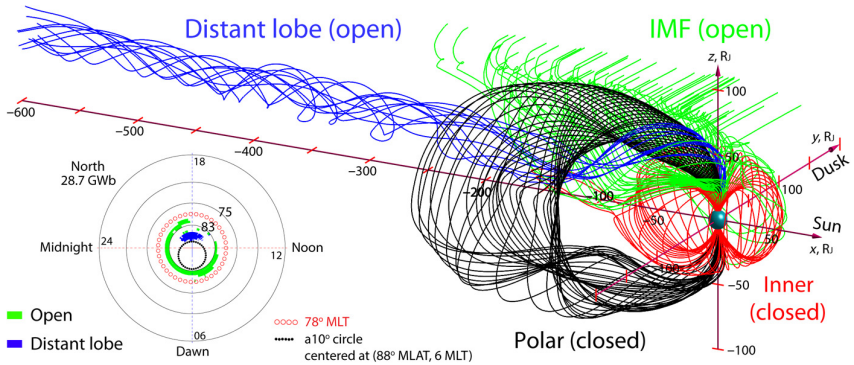
Review of Previous Studies

Review of Previous Studies

Observation ⇔ MHD simulation

- Observation: Inflexible, Part, Precise
- MHD simulation: Flexible, Global, Need to be revised by observation data

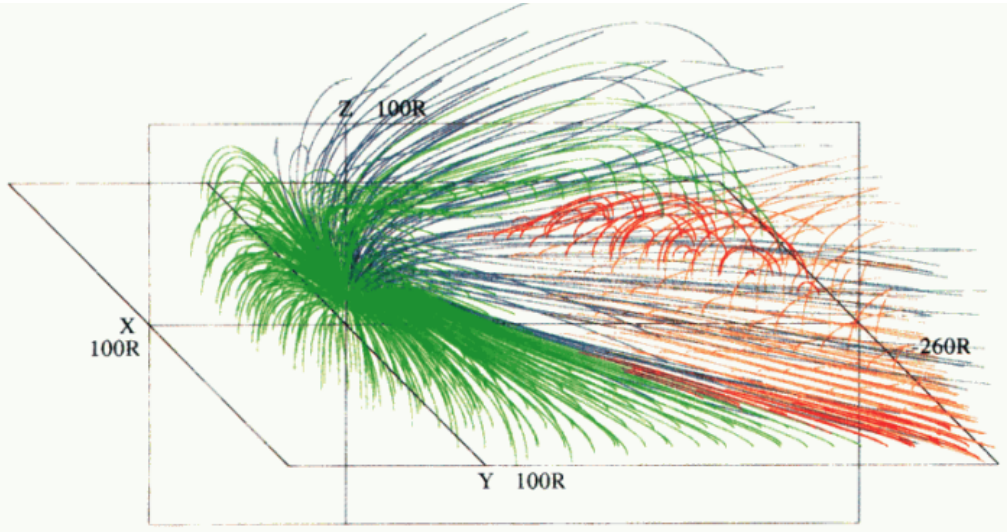




Review of Previous Studies

Ogino *et al.*(1998) first applied a 3D global MHD simulation to Jupiter.

However, the model was then proved to be wrong. After it was updated, it became the Open-GGCM.

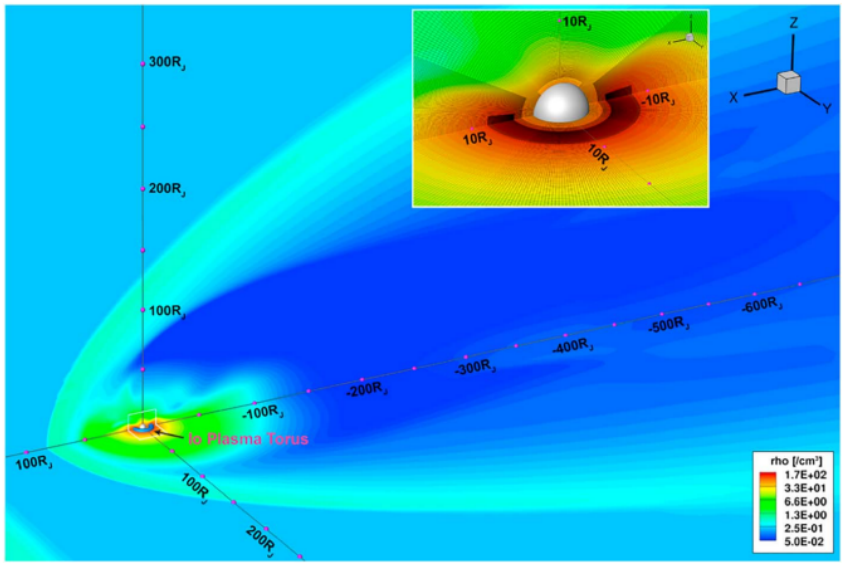


Review of Previous Studies

Chané *et al.*(2013) introduced a new model for Jupiter. But it is also disputed.

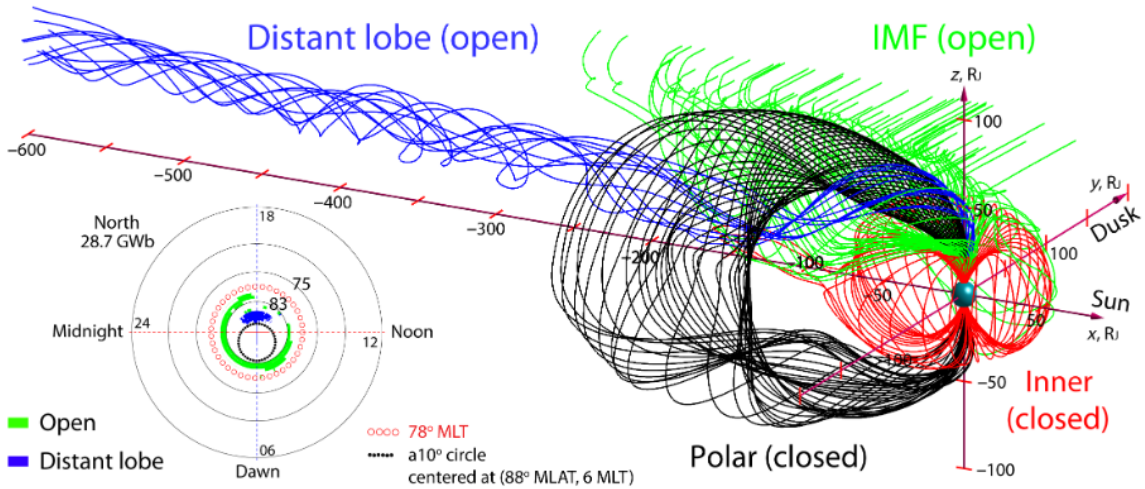
Review of Previous Studies

Sarkango *et al.*(2019) introduced a new global MHD model for Jupiter's magnetosphere that self-consistently includes the Io plasma torus at the right location.



Review of Previous Studies

Zhang *et al.*(2021)(one of my tutor) investigated the magnetic topology of Jupiter's polar cap by using a newly developed global MHD model of the jovian magnetosphere, including its interactions with the interplanetary medium, the effect of mass loading from the volcanic moon Io, and ionosphere-magnetosphere coupling.

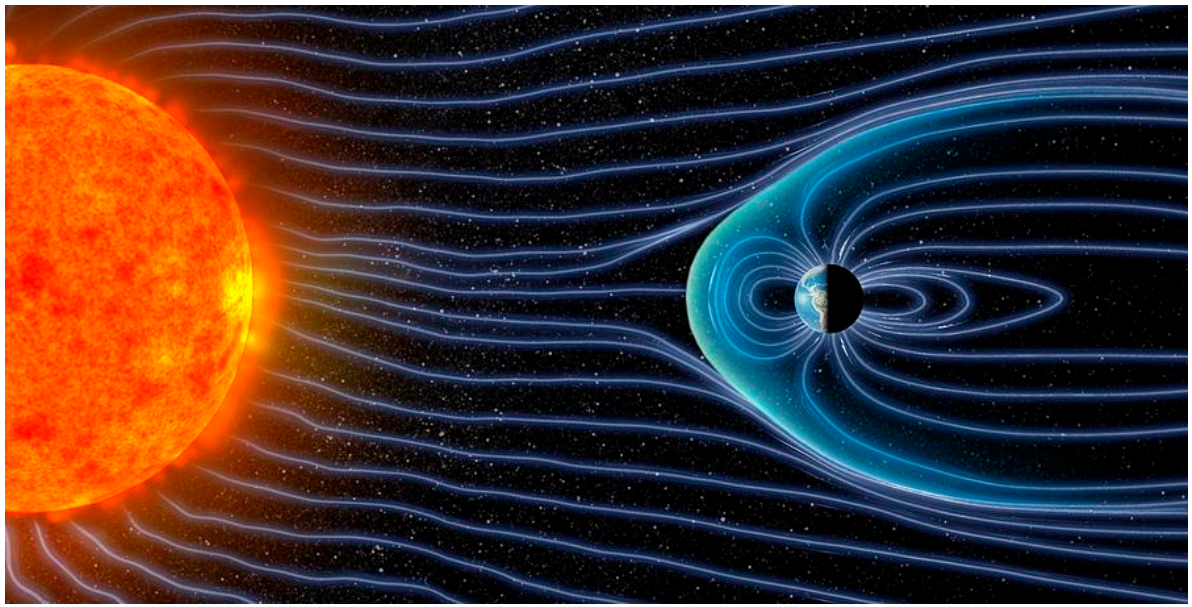


Section 3

Motivation

Motivation

The magnetosphere in many cases(Earth *etc*.), it is like a drop. However, why Jovian magnetosphere is like a tube? Why Jovian magnetosphere hinders the solar wind even to the orbit of Saturn?



Motivation

With these questions, I will do this research.

Section 4

Research Design

Research Design

The key questions to be solved in this research :

1. Why jovian magnetotail stretches so long?
2. What is jovian magnetotail's structure?
3. What will happen if the conditions (solar wind *etc.*) change?
4. How to form the jovian magnetotail? (physical process)

Research Design

In this research, I will :

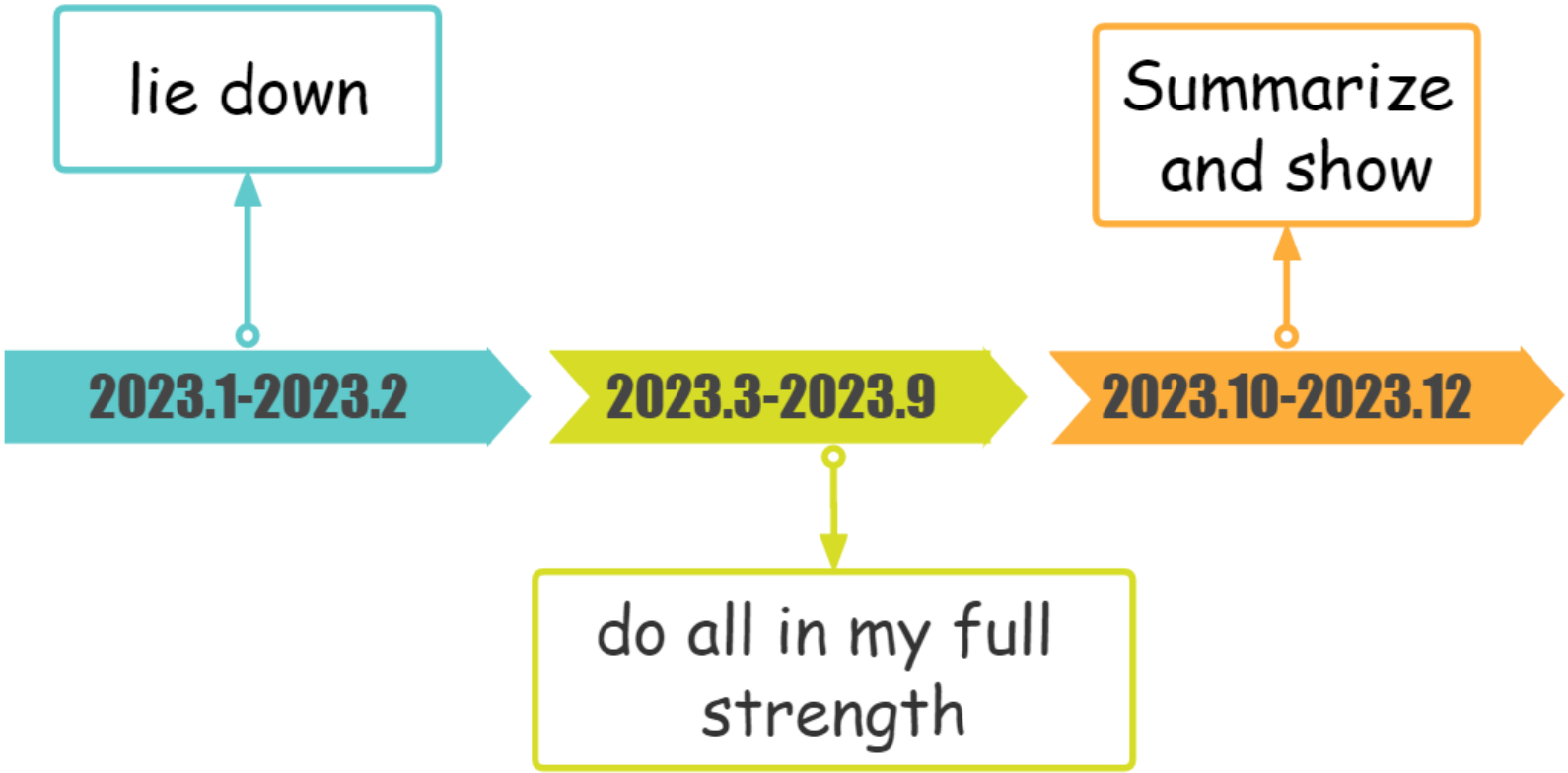
1. Run the Jupiter's model(computational power: Sugon Server)
2. Data analysis and visualization
3. Discussion through physical process
4. Summarize the results

It is also needed to read papers and gain basic scientific research skills during the whole research.

Section 5

Timeline

Timeline


lie down
2023.1-2023.2
2023.3-2023.9
do all in my full strength
2023.10-2023.12
Summarize and show

References

Thanks

Thank you for listening!