Using equations of state to construct Jupiter models

F. Debras[1,2], G. Chabrier[1,2]

[1]*ENS de Lyon, Lyon, France*
[2]*University of Exeter, Exeter, United Kingdom*

In 2016 the NASA satellite Juno entered in orbit around Jupiter, leading to observations of the gravity field of the planet with extreme precision. The previous models of Jupiter have all been invalidated by these new data, and our understanding of the planet has been challenged.

A new global picture of the planet has been drawn, including a diluted core and composition gradients, but we still don't understand the internal structure of Jupiter precisely. The total mass of metals for example is poorly constrained.

In this talk, I will show how important are precise equations of state of hydrogen, helium [1] and heavier elements (such as water) to construct Jupiter models. I will show the degeneracy of interior structures from the sole observations of gravitational data, and discuss the impact of equations of state on the physical parameters. A particular emphasis will be made on how to construct models of the planet [2], and notably the possible presence of layered convection, creating entropy and composition gradients in the planet.

Following this discussion, I will present our new models of Jupiter [3] and their physical implication on the metallization pressure of hydrogen and the hydrogen-helium phase separation.

REFERENCES

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[2] F. Debras and G Chabrier, *"A complete study of the precision of the concentric MacLaurin spheroid method to calculate Jupiter's gravitational moments"*, Astronomy and Astrophysicis,609,97 (2018).
[3]F. Debras and G Chabrier, *"New models of Jupiter in the context of Juno"*, in prep.