Gas Accretion through a Circumplanetary Disc

SUMMARY.
Gas accretion is a central process in the formation of planets. The onset and duration of the runaway phase of gas accretion will decide whether a growing planet can become a gas giant. [1] A large fraction of the gas entering a planet's Hill sphere is thought to land on a circumplanetary disc (CPD) rather than on the planet directly. The CPD will therefore be important in mediating the accretion onto the planet. The goal of this METEOR is to study how a more physical treatment of accretion will influence the formation of gas giant planets. To this end, the student will perform simulations of accreting planets, analyse and document the result.

OBJECTIVES

- One main objective of this METEOR is to train the students to learn in autonomy, to identify what can help them to progress, to identify and correct their errors, to define a project related to a problem of their interest and to solve it.
- The student will learn skills related to simulations, programming and data analysis.
- The student will be able to use a state-of-the-art planet formation code (Fortran), perform simulations and analyse the result by means of self-written routines (Python).

INSTITUTE

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THEORY

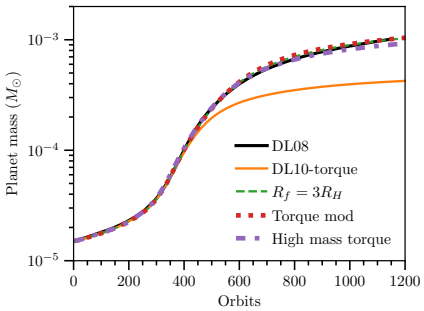
Planet formation is a complex field of research due to the large number of physical processes at play.

Planetary population synthesis provides a link between the statistical properties of the observed exoplanet population and the physical processes at play during formation. One such process, gas accretion, has a particularly important influence of the population of planets. This METEOR will cover

- Disc-limited gas accretion onto protoplanets
- Exploration of the role of the CPD

APPLICATIONS

The student will perform simulations of accreting planets using a 1D code and evaluate the results. The figure shows the evolution of a planet's mass when it is undergoing runaway accretion, for different accretion and migration models. [3]



MAIN PROGRESSION STEPS

- First two weeks: Introduction, initial setup, study of theory and model tests.
- Weeks 3-7: Running of simulations, analysis of results.
- Week 8: Preparation of the written report.
- Last week : preparation of the final oral presentation.

EVALUATION

- `Theory grade [30%]`
  - Written report
- `Practice grade [30%]`
  - Practical Work
  - Oral presentation
- `Defense grade [40%]`
  - Oral and slides quality
  - Context
  - Project / Personal work
  - Answers to questions

BIBLIOGRAPHY & RESOURCES

[1] D'Angelo, G. & Lubow, S. H. 2008, ApJ, 685, 560
[2] Benisty, Bae, Facchini et al., 2021, ApJ, 916, 1
[2] Marleau, Kuiper et al., 2017, ApJ, 836, 2
[2] Choksi, Chiang, Fung et al, 2023, MNRAS, 525, 2
[3] Schib, O., Mordasini, C., & Helled, R. 2022, A&A, 664, A138

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