Gas Accretion onto Eccentric Planets

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] If a protoplanet becomes eccentric, there will be a mismatch between the specific angular momentum of the planet and the gas it accretes. [2] This effect is currently not treated correctly in 1D models of planet formation that are used in population synthesis studies. 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).

PREREQUISITES

Preparatory MAUCA courses (not mandatory):

- General Astrophysics
- Dynamics and Planetology

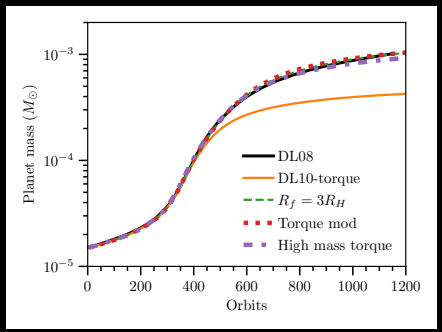
THEORY

This METEOR will cover

- Disc-limited gas accretion onto protoplanets
- Eccentric Keplerian orbits

APPLICATIONS

The student will perform simulations of accreting planets on eccentric orbits with a 1D code that includes an n-body integrator. By varying parameters like the initial location of the planet and the orbital eccentricity, the student will study the influence of gas accretion on the subsequent orbital evolution of the planet. 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

- Practical work (40%)
- Written report (40%)
- Oral presentation (20 %)

BIBLIOGRAPHY

[1] D'Angelo, G., & Lubow, S. H. 2008, ApJ, 685, 560
[2] Kikichi, Higuchi & Ida, 2014, ApJ, 697, 1
[3] Schib, O., Mordasini, C., & Helled, R. 2022, A&A, 664, A138

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