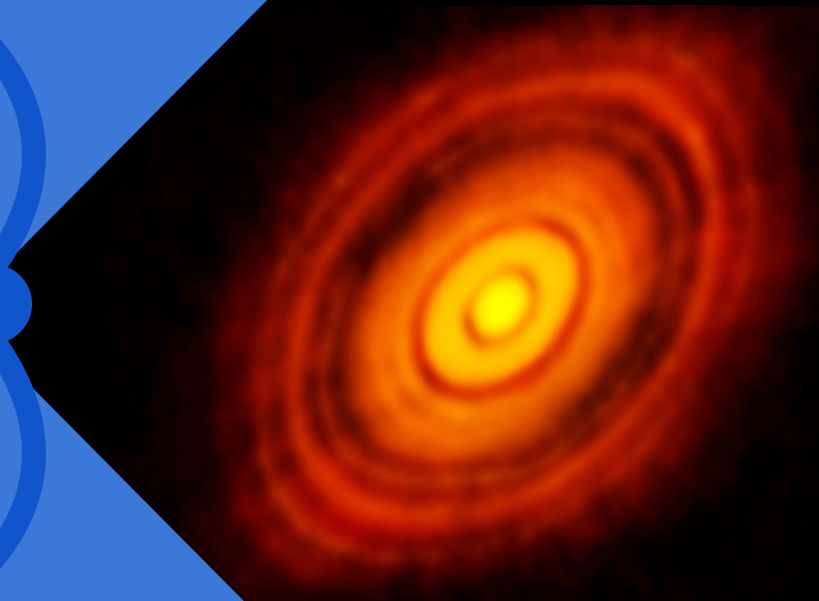# Young accreting protoplanetary disks

MEUNIER Ronan, PhD student
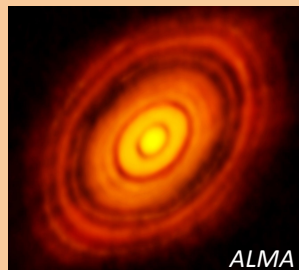
RAMSES SNO

November 24th 2025

Supervisors : Ugo LEBREUILLY and Patrick HENNEBELLE

ALMA

1

protoplanetary disk
(gas + dust)

ALMA

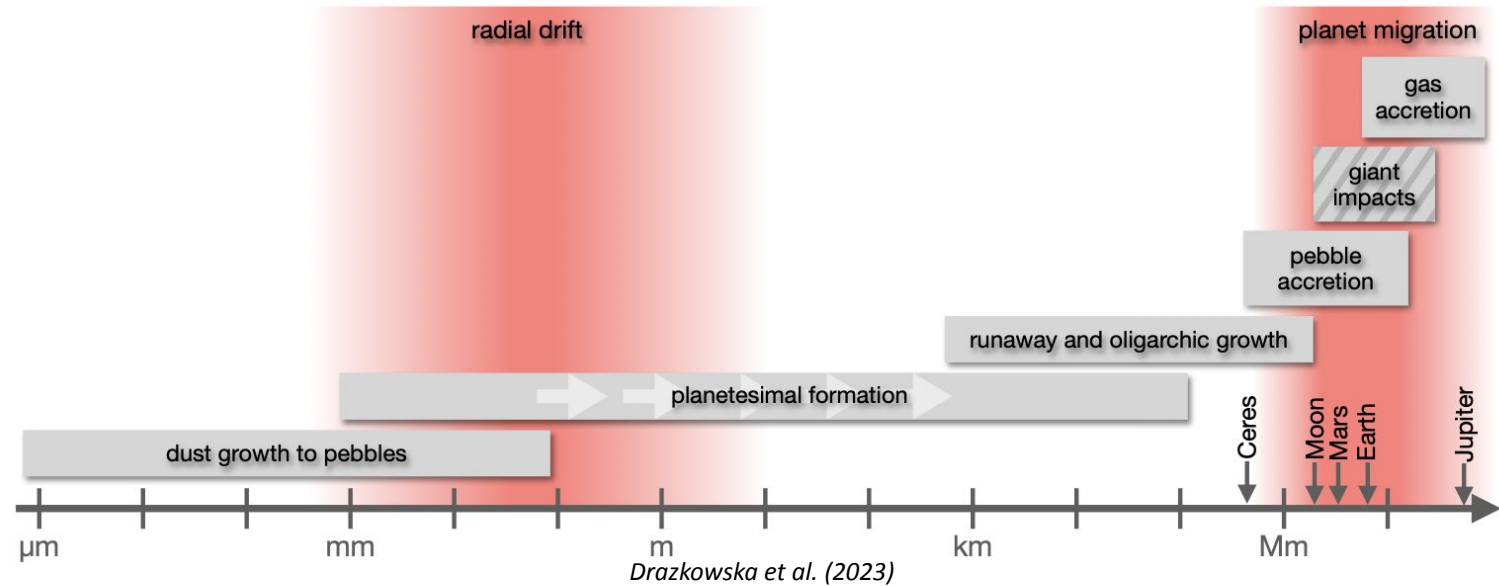## Where ?

- External/internal regions
- Migration

When ?

- Long thought to be late
- Early according to some recent observations

How ?

- Conditions still unknown
- Multiphysics problem
- External interactions

Drazkowska et al. (2023)

Barriers :

- Radial drift
- Fragmentation barrier
- Bouncing barrier

Mechanism ?

Thesis

Topic :

    The dawn of planetary formation

Supervisors :

    Ugo LEBREUILLY and Patrick HENNEBELLE

Methodology :

    Simulation and theory with the 3D magnetohydrodynamic code RAMSES (Teyssier 2002)

Goals :

- Study of the hypothesis of rapid planet formation.

- Determining the conditions for planetary formation.

- Analysis of the architecture of young planetary systems.

Location :

    DAp / AIM (CEA Saclay)

First year

Goal :

Realization of self-consistent collapses of prestellar cores for planetary formation.

Points of interest :

- Understanding the physical phenomena at work at the disk scale (multiphysics).

- Obtaining initial conditions for planetary formation.

- New developments in the RAMSES code in preparation of the second year (local model of protoplanetary disks).

Second year

Goal :

Small-scale simulation for the study of planetary formation conditions.

Points of interest :

- Understanding the mechanisms at work in the formation of planetesimals.

- Extraction of statistical data and development of analytical models (parallel with star formation in galaxies).

- New developments in the RAMSES code in preparation of the third year (planetary formation subgrid model).
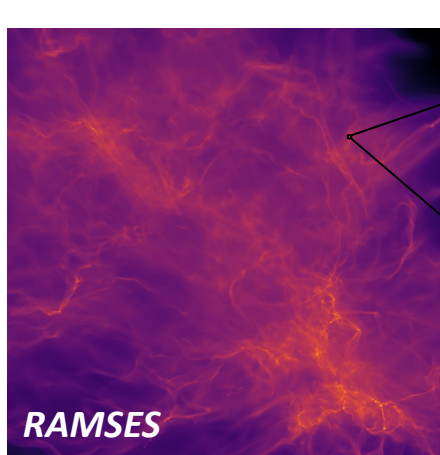
Third year

Goal :

Study of the small-scale consequences in the self-consistent collapses of prestellar cores.
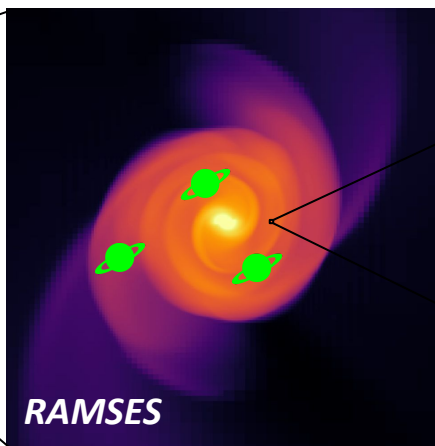
Points of interest :

- First 3D planetary formation simulations thanks to the parameterization of small-scale simulations.

- Towards an unified model of the formation of disks, stars and planets.
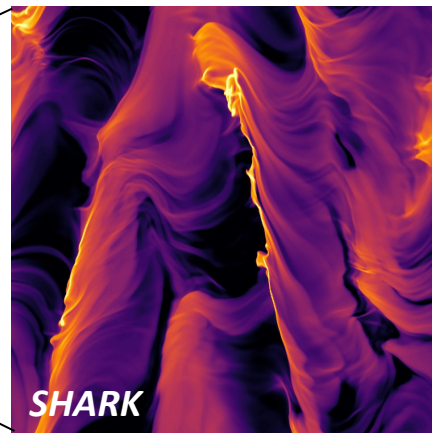
- Generalization to a population of disks.

Conclusion

Large scales
Disk formation

RAMSES

Intermediate scales
Planet formation

RAMSES

Small scales
Planetesimal formation

SHARK

Thank you for your attention