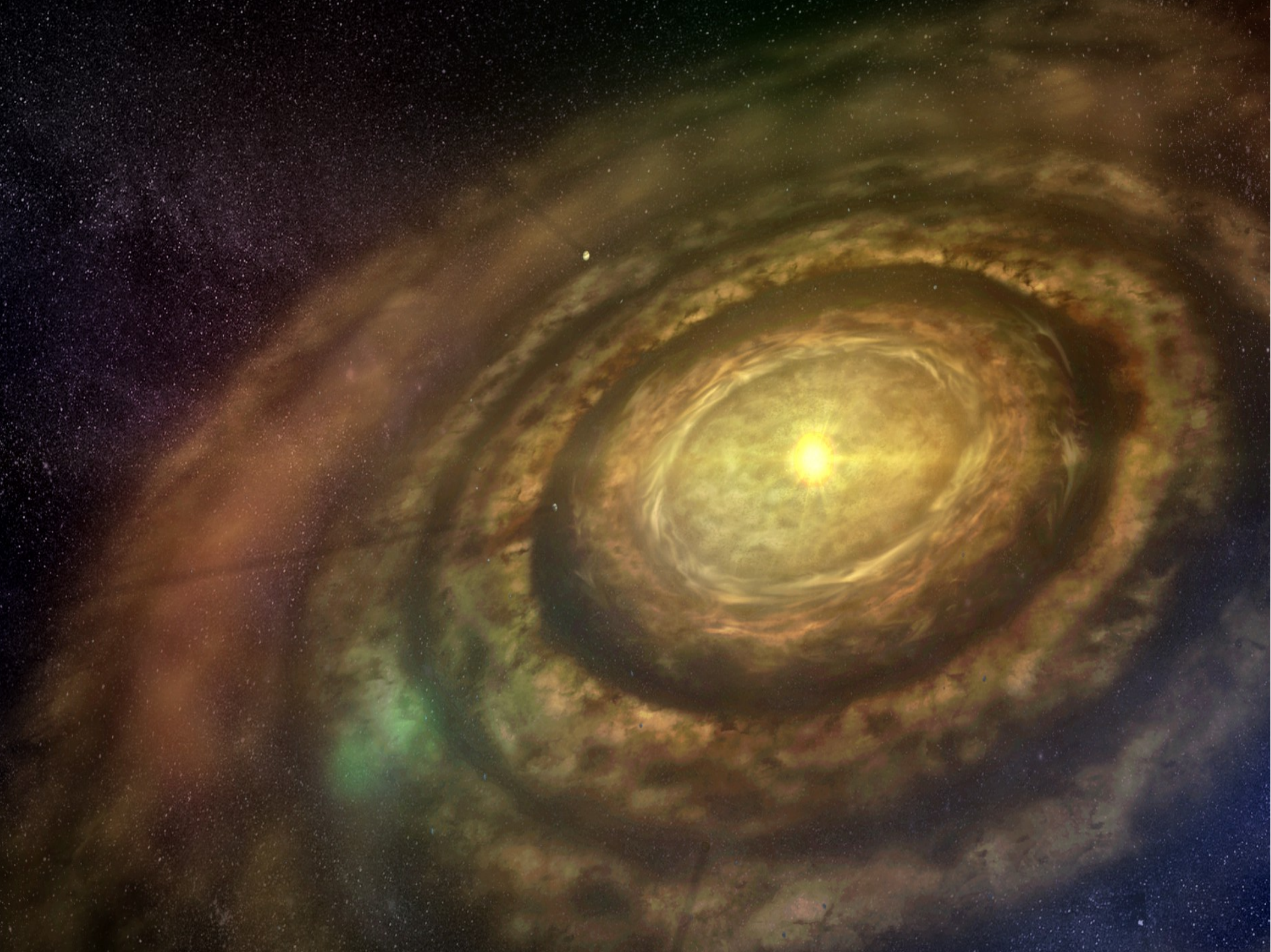

WHAT IS "DUST"?

- What do we mean when we talk about dust?

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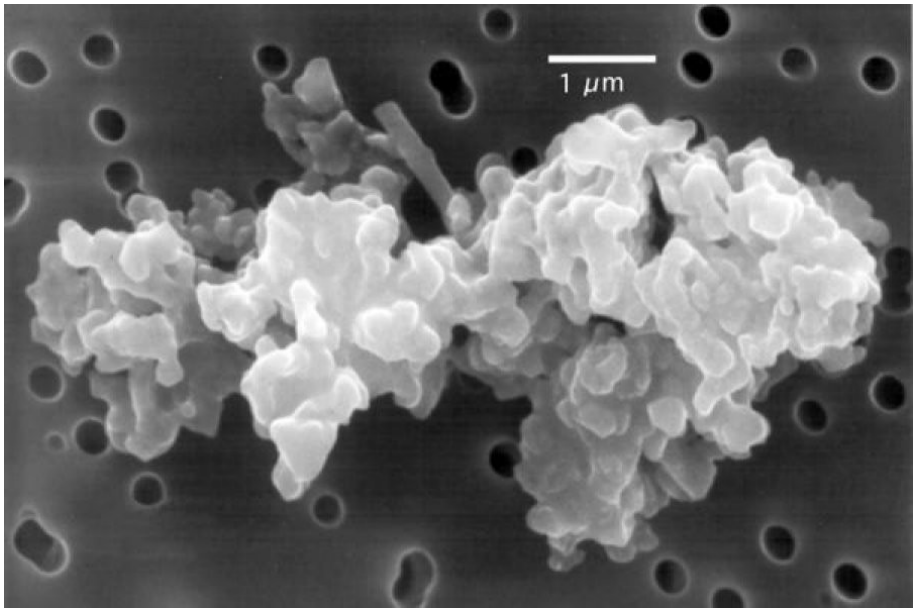


- Mostly composed of Si (silicates) and C.
- Why is important?

WHERE DO WE HAVE DUST?

- Planetary nebula
- Stellar wind
- Supernovae ejecta
- ISM (InterStellar Medium)

WHERE DO WE HAVE DUST?

- Planetary nebula
- Stellar wind
- Supernovae ejecta
- ISM (InterStellar Medium)

LITERALLY EVERYWHERE

(even in the solar system!)

DUST IN PLANETARY NEBULA

DUST IN PLANETARY NEBULA

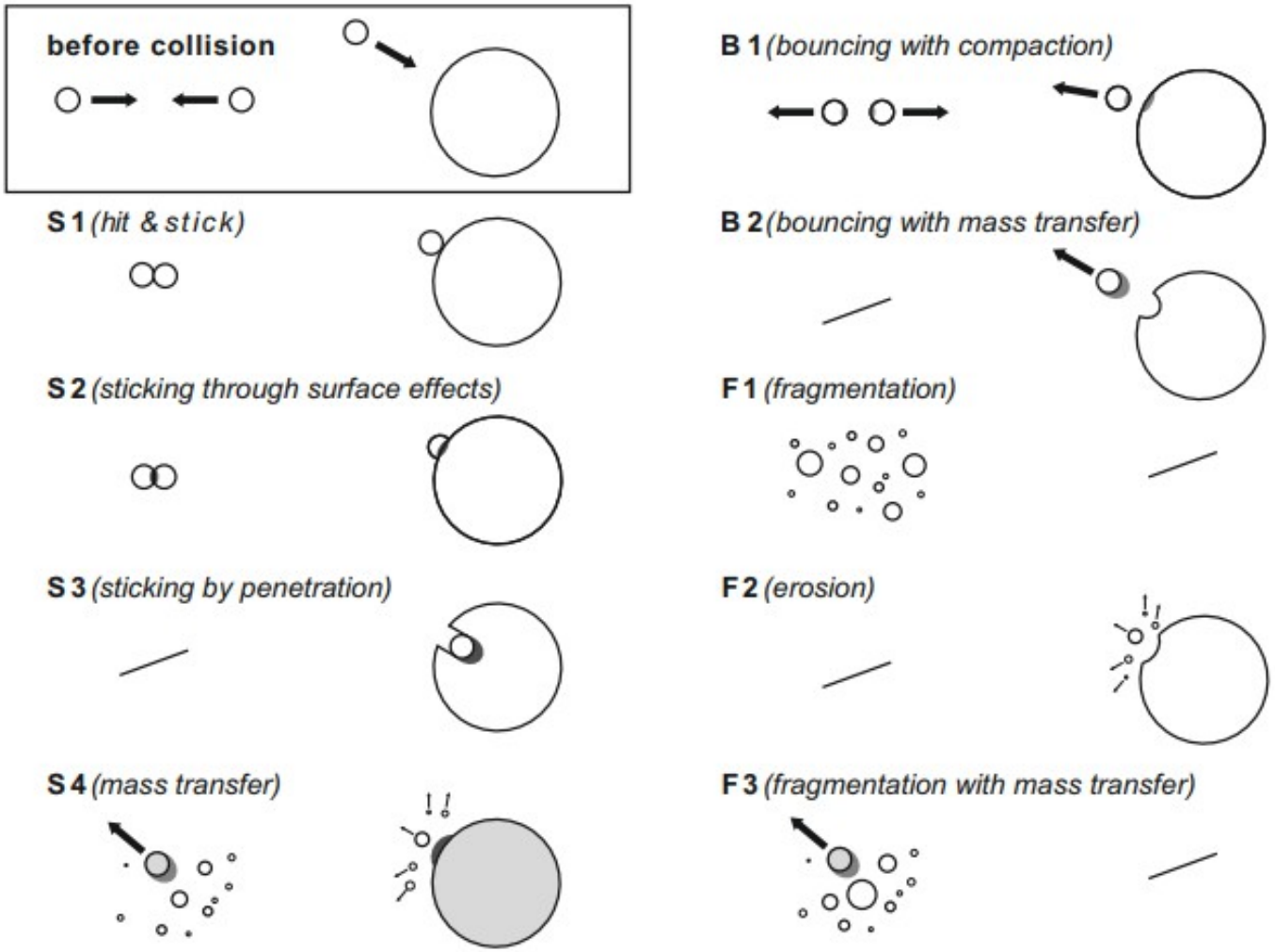
WHY IS IMPORTANT TO UNDERSTAND IT?

- Radiation blocker
- Stellar wind
- Planetary formation

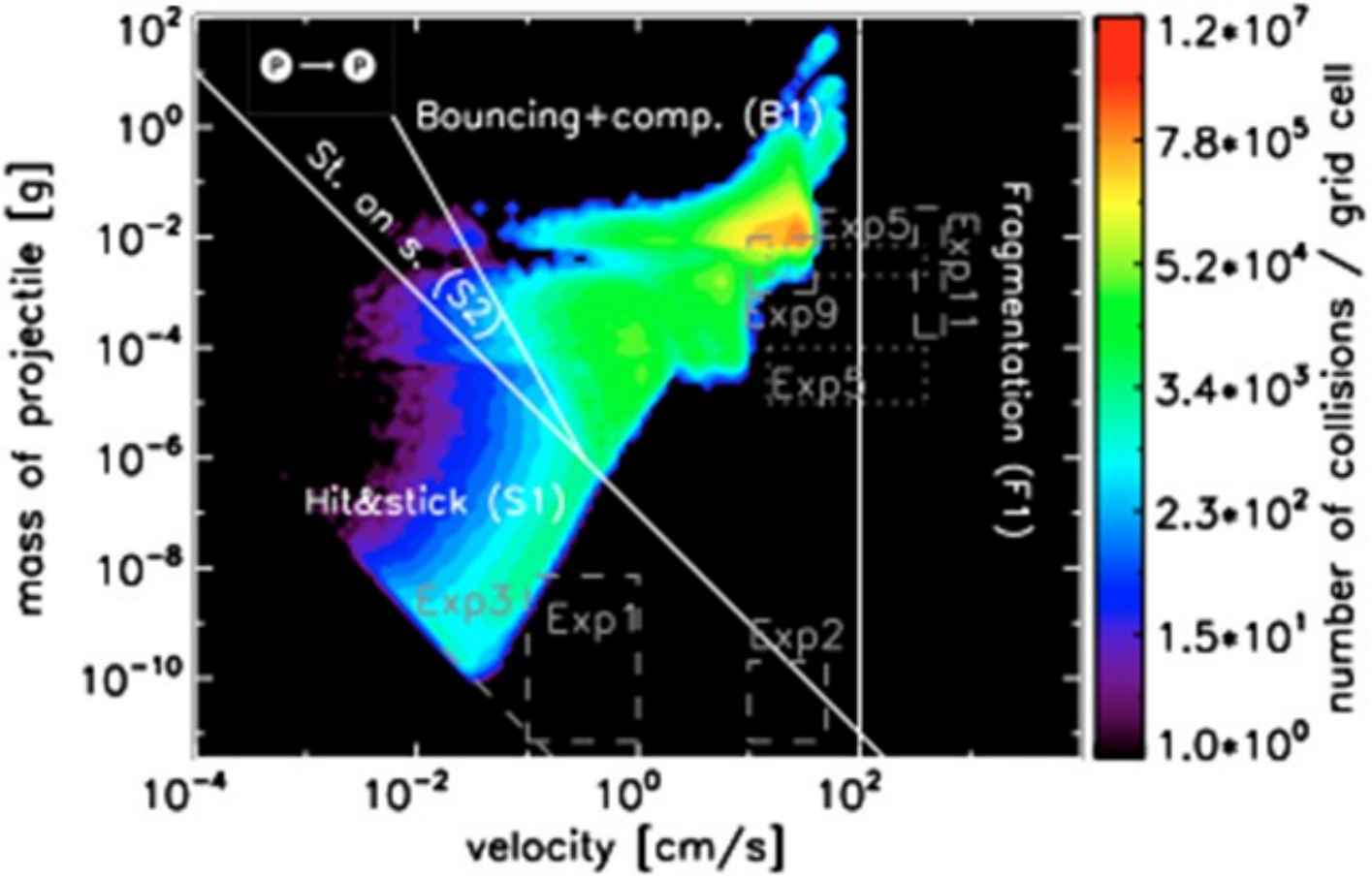
GRAIN GROWTH

- Grains grow by collision.
- But they can also break by collision.
  - In one or more pieces!
  - But also transfering matter one to the other...
- They can also bounce off.
- But there is still a lot that we don't know.

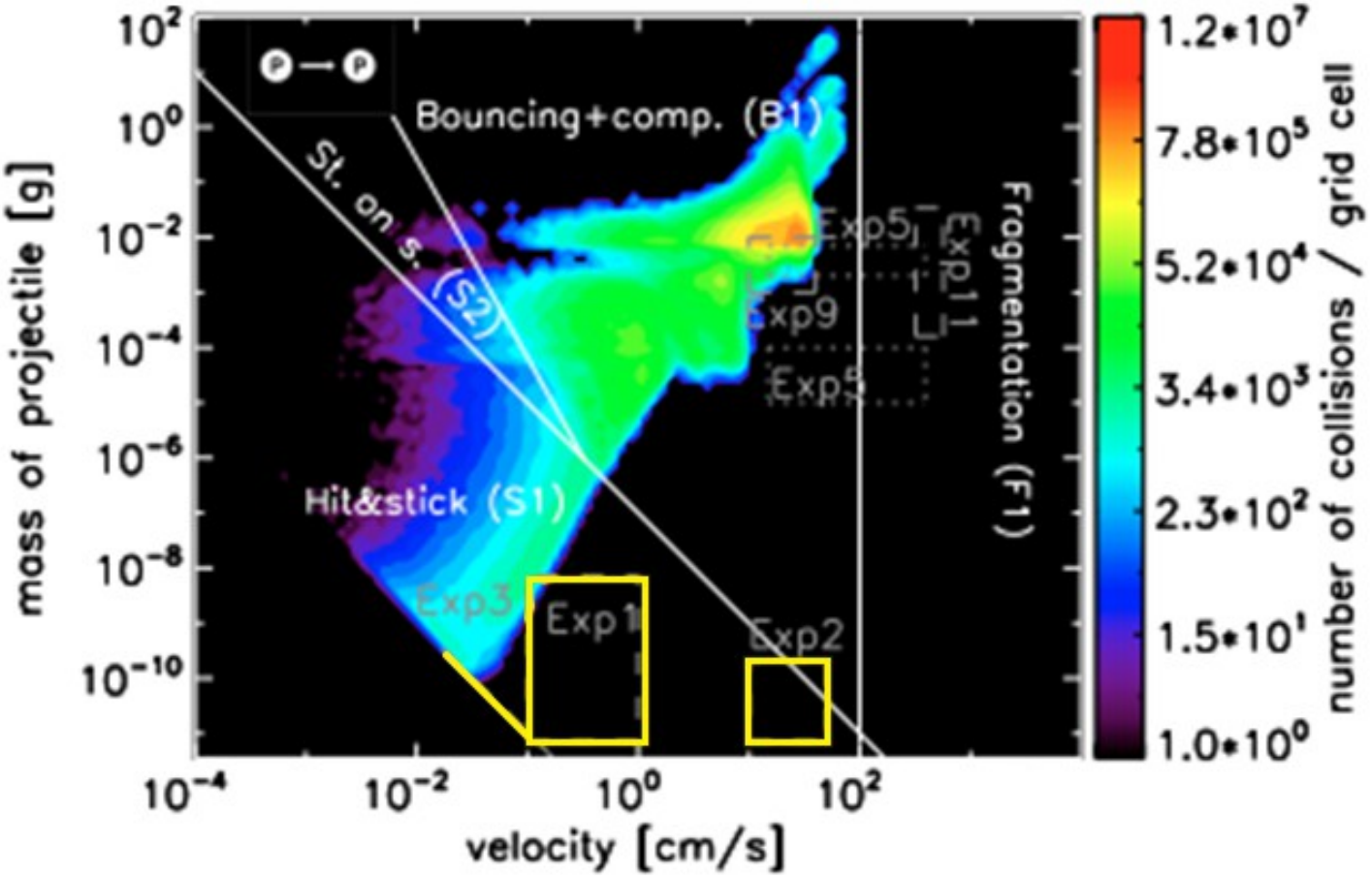
EFFECTS ON GRAINS



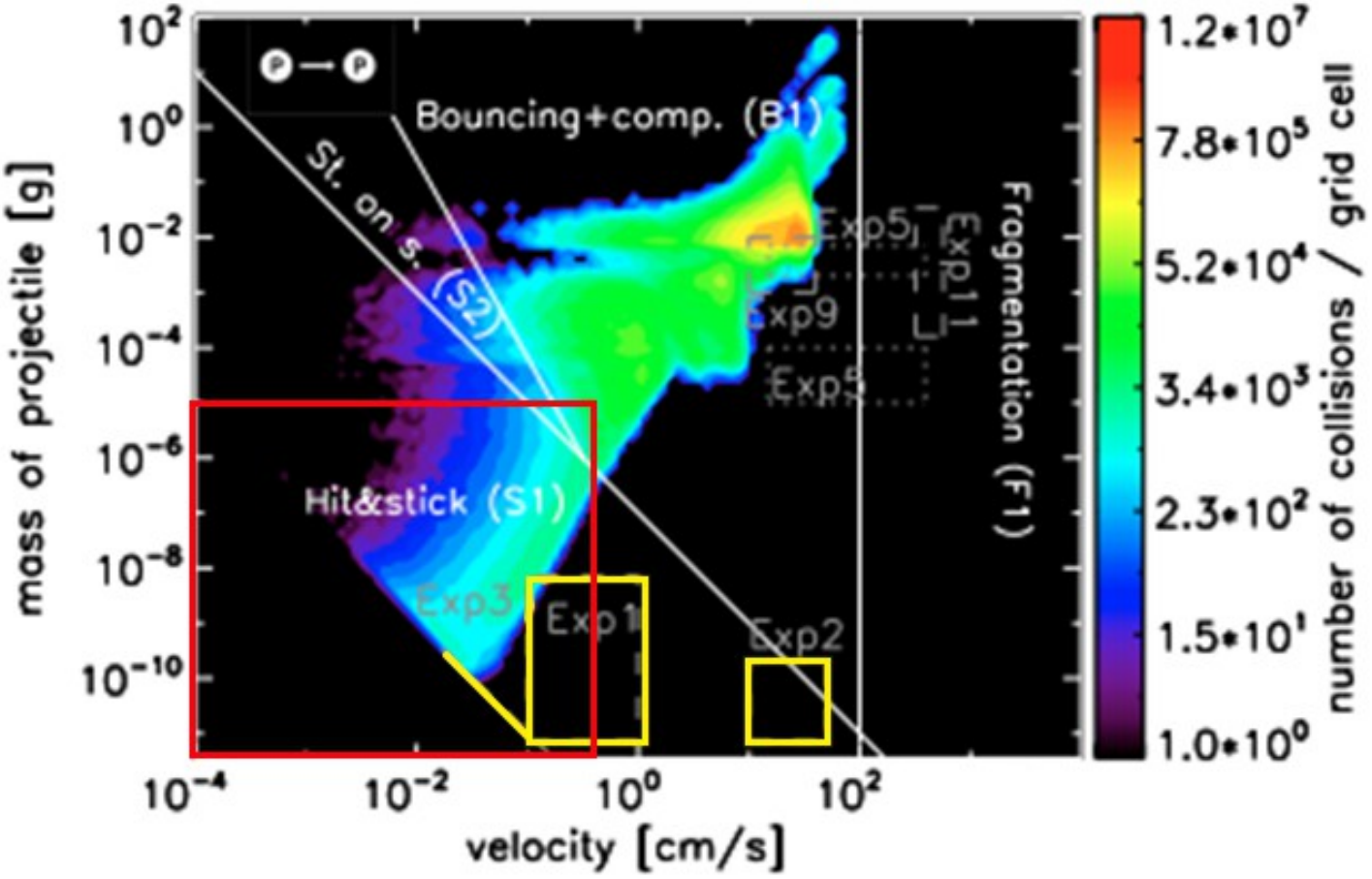
GRAIN COLLISIONS



GRAIN COLLISIONS



GRAIN COLLISIONS



WHAT DO WE WANT TO KNOW?

- How much grains grow in size? How fast?
- How the shape of the particles changes grain growth?
- Is rotation of the particles influding in this?
- How interaction with ices affects the grain growth?

WHERE TO PUT THIS?

- Small velocities.
- Long time of experiment (around 1 month).
- No external forces.

IMPOSSIBLE ON EARTH!!!!!

Then, let's go to space.

WHERE TO PUT THIS?

- Impossible on rockets (big acceleration)
- Impossible on ISS
  - ISS drag
  - Reorienting panels

Let's go on our own!!

MAGRATHEA

BUILDING PLANETS

OBJECTIVE OF THE MISSION

- Understand the physics of dust growth at low velocities (<5 mm/s) in protoplanetary disks by observing the evolution of dust size and shape in micro-gravity over long time scales.
- For that, we will simulate similar physical conditions to protoplanetary disks.
- We will use silicates to simulate grain growth by collisions.

WHAT DO WE WANT TO MEASURE

- Sizes of the particles before and after collision.
- Relative velocities of incoming particles and products.
- Composition.
- Rotational velocities.

WHAT DO WE WANT TO KNOW?

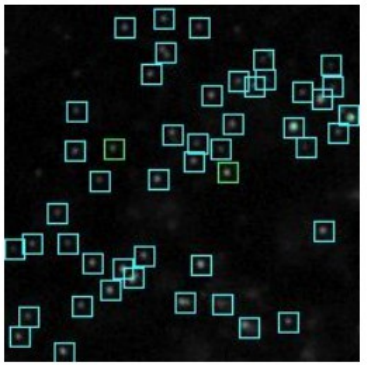
- How much grains grow in size? How fast?
- How the shape of the particles changes grain growth?
- Is rotation of the particles influding in this?
- How interaction with ices affects the grain growth?

MEASUREMENT INSTRUMENTS

Particle Tracking Camera (P-CAM)

Heritage: Phoenix (MARDI)
Mass: 1.5 kg
Power: 4 W
Data rate: 5.4 Mb s^{-1}
Volume: 70x70x70 mm

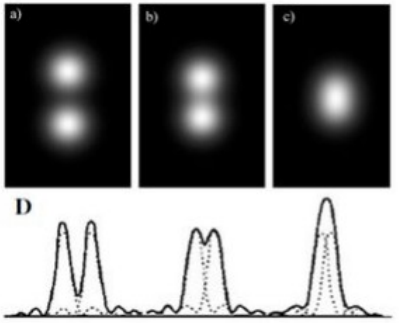
Particle tracking



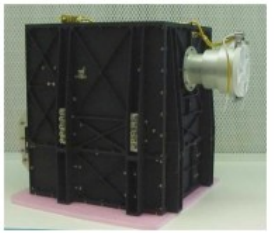
Optical Microscope (OM)

Heritage: Rosetta (CIVA-M/V)
Mass: 1.1 kg
Power: 1 W
Data rate: 0.075 Mb s^{-1}
Volume: 70x50x91 mm

Optical microscopy

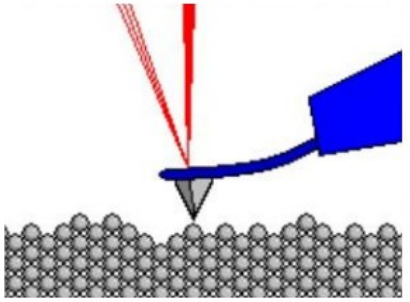


Atomic Force Microscope (AFM)

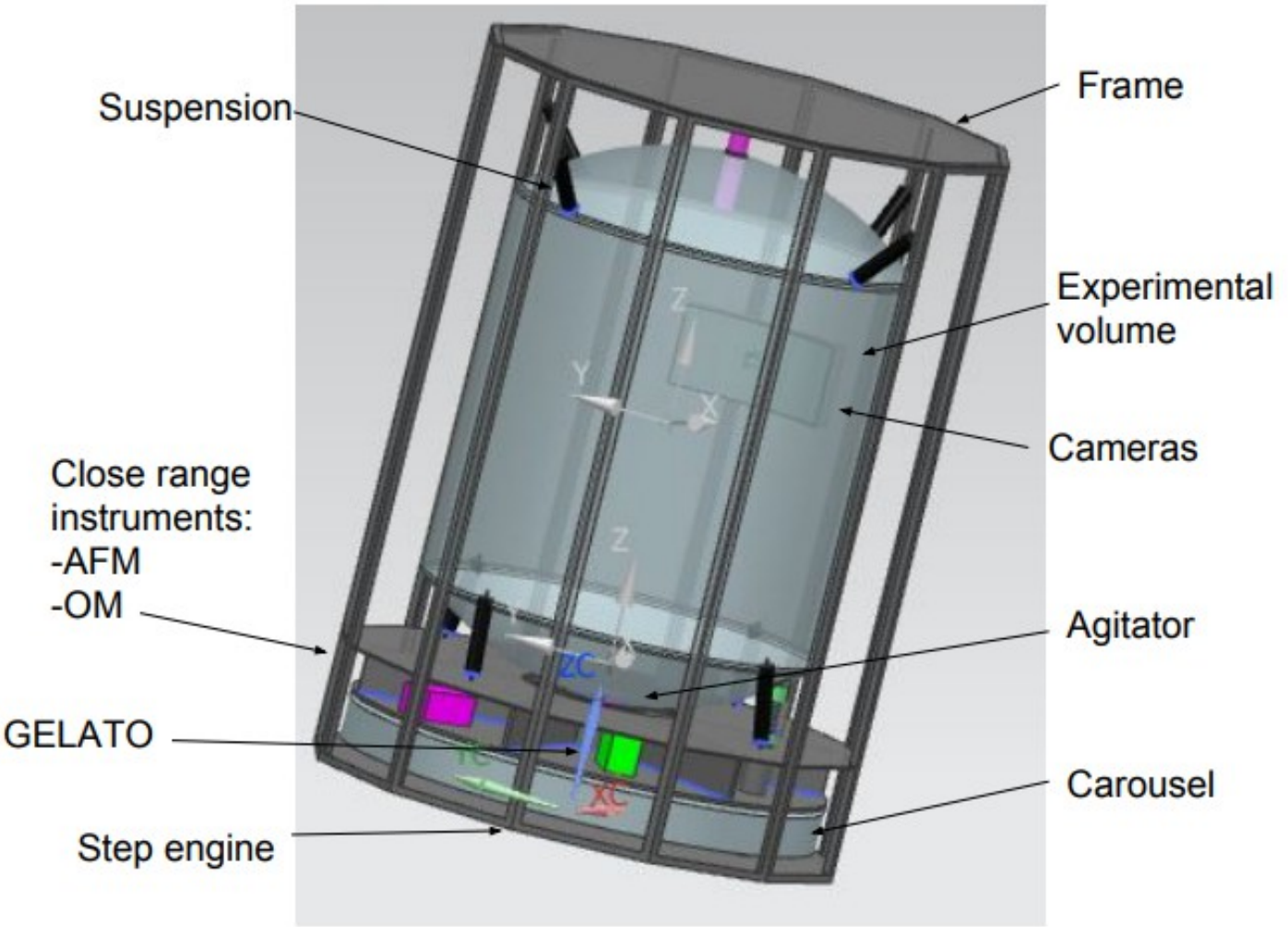


Heritage: Rosetta (MIDAS)
Mass: 8.3 kg
Power: 17 W
Data rate: 0.001 Mb s^{-1}
Volume: 300x250x100 mm

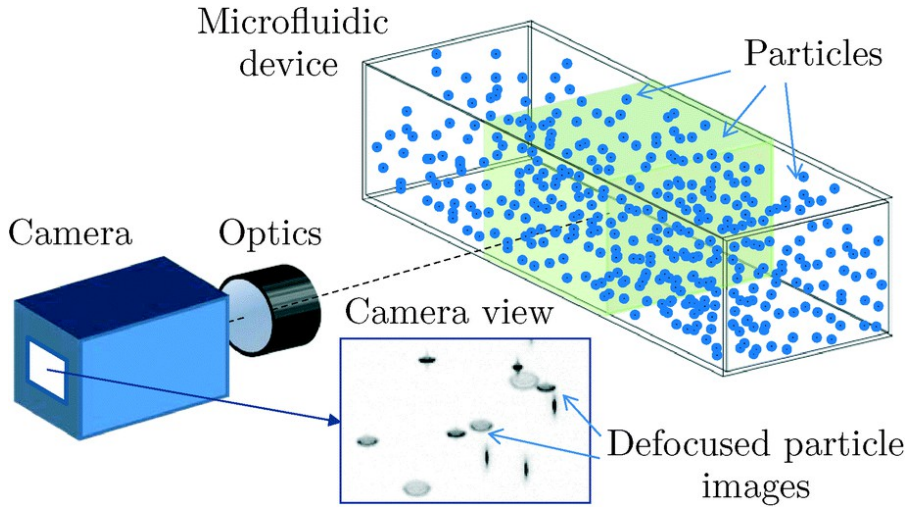
Atomic force microscopy

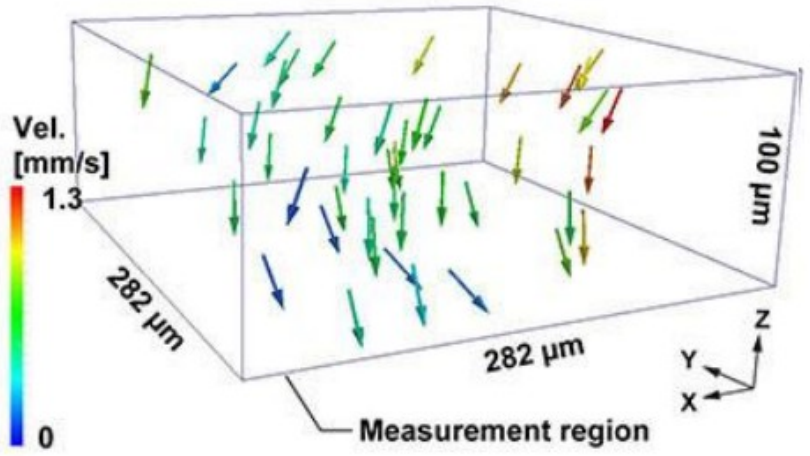


EXPERIMENTAL SETTING DESIGN



PARTICLE TRACKING

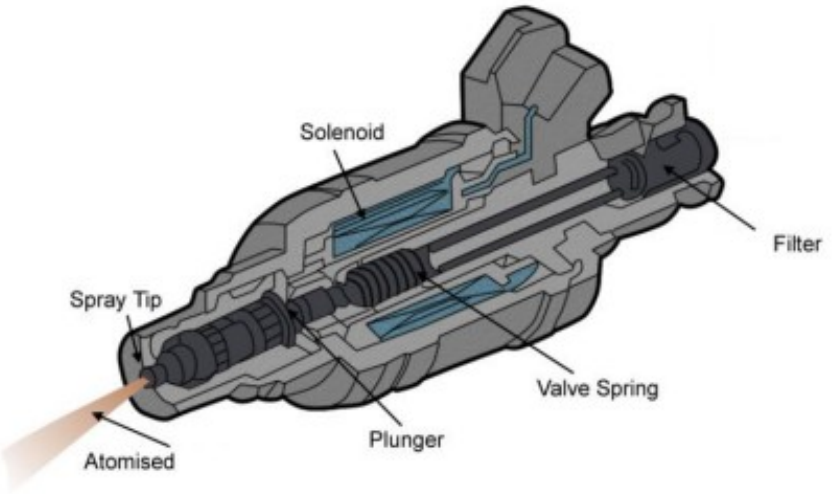




- We are recording 24h/day for 30 days with 3 cameras.
- Huge amount of raw data (around 22 TB/day).
- On-board data processing.
- Reduced to 17 Mb/s.

GELATO

- Injects gaseous H_2O.
- Applies ice layer to the grains.
- Based on fuel injectors
- In development.



GRAIN GRABBER

SKF

PI Motion Position

- Collects the samples for the microscope.
- Linear actuator or piezo actuator.
- In development.

CONCLUSIONS

- We have understood the theoretical mechanisms of grain growth.
- We have understood why do we need to understand it.
- We have created a mission to analyze grain growth.
- Some of the technologies and ideas are new.
- Work still on progress...

THE FUTURE OF THIS

- We are still developing some of the ideas.
- We are still refining the calculations.
- We plan to try to publish soon a paper on it.

THE END