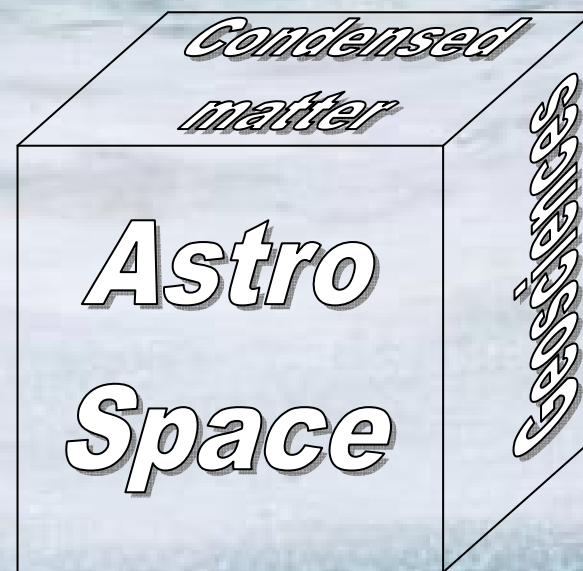


Center for Advanced Studies of Planetary Systems

CASPS





What do we know about planets?

- The current status of the Solar system
- 200+ exoplanets orbiting 180 stars
- Stars: temperature, mass, chemical composition, rotation
- Planets: orbital period, orbital radius, eccentricity, mass
- Occasionally, planetary radii

What is that we don't know

*The history of planet formation (even in the Solar system)
or to be more specific:*

How the gas cloud collapses into a disk?

How chemical stratification occurs in the disk?

What is the mechanism of dust particle formation?

What are the optical properties of dust particles?

How do these particles grow to comet-like bodies?

What is the role of magnetic fields?

Many groups are working in the field

Competition is fierce



An aerial photograph of a large, circular impact crater in a desert landscape. The crater is filled with water, and the water's surface is covered in concentric ripples. The water has a distinct color gradient, with a bright yellow-green center that transitions through orange and red to a deep blue at the outer edges. The surrounding desert floor is a light tan color with some darker patches and tracks.

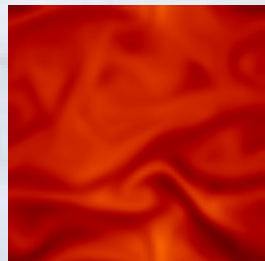
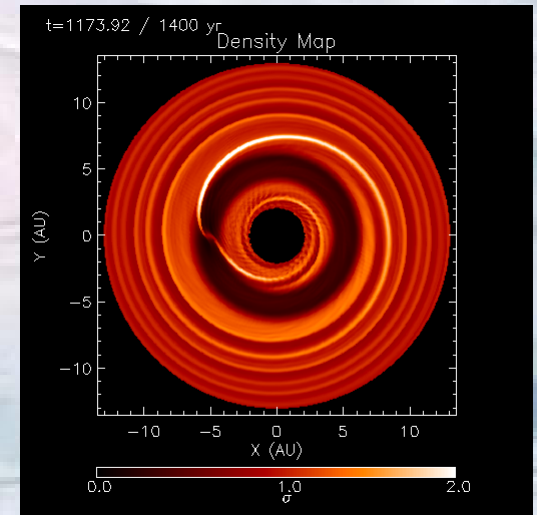
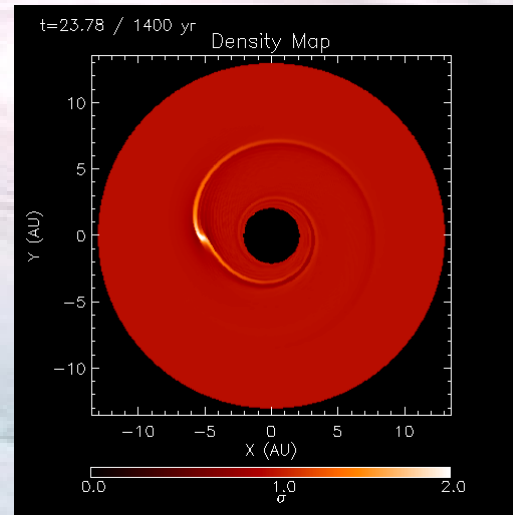
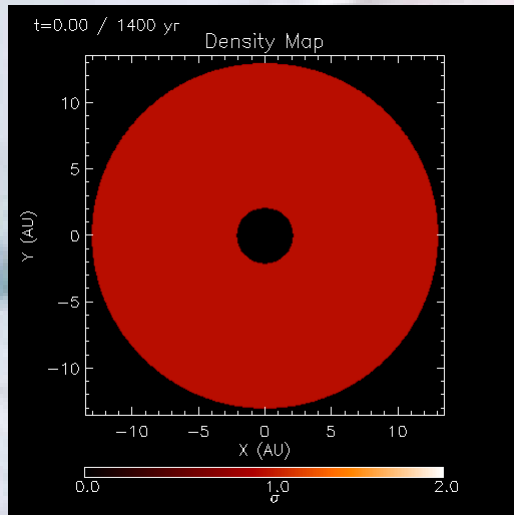
What can we do?

There are a few areas where
we are *competitive* or even
better than the others.

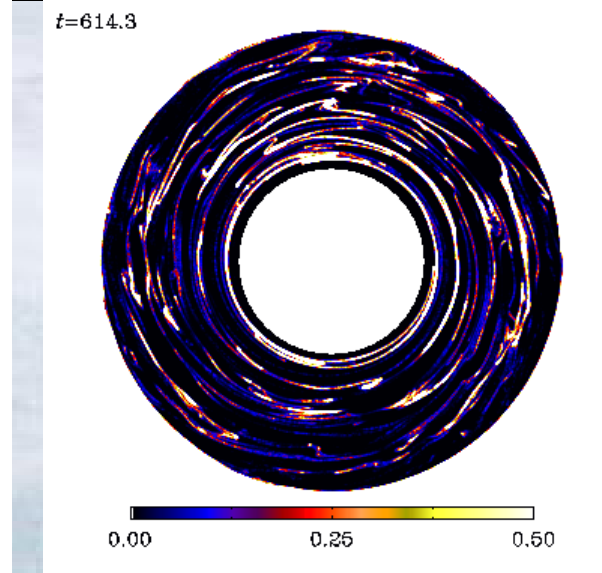
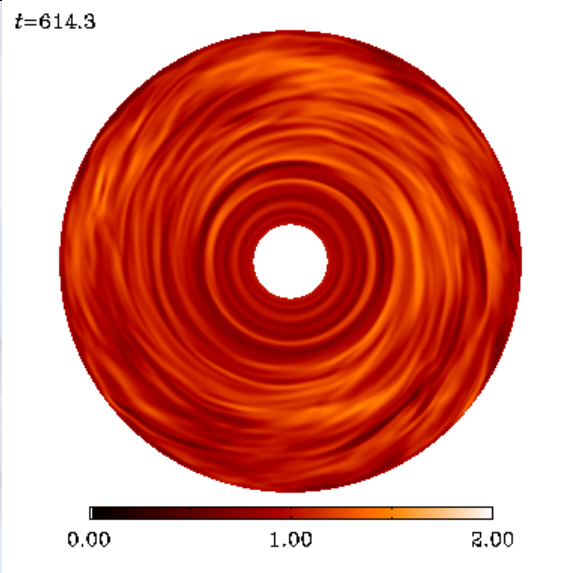
Here are a few examples...

3D MHD simulations of protoplanetary disks

Jupiter opening a gap in a disk

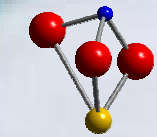


Gas density

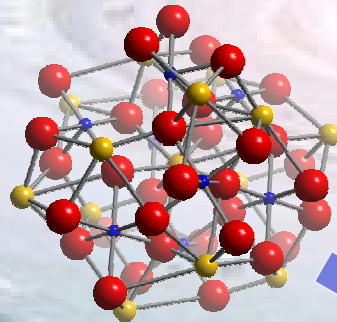


Density of solids

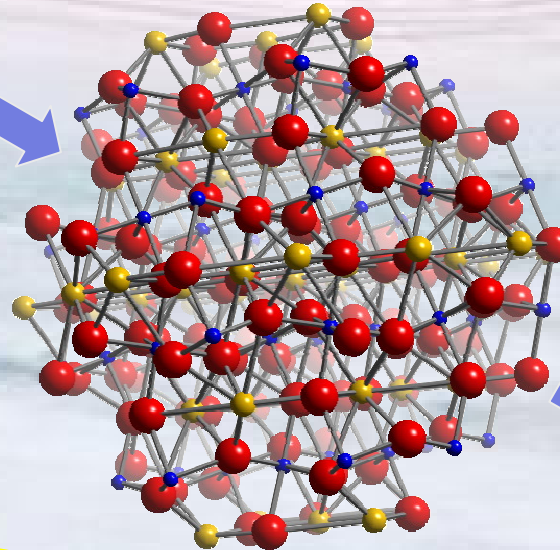
Initial conditions of planet formation



5 atoms

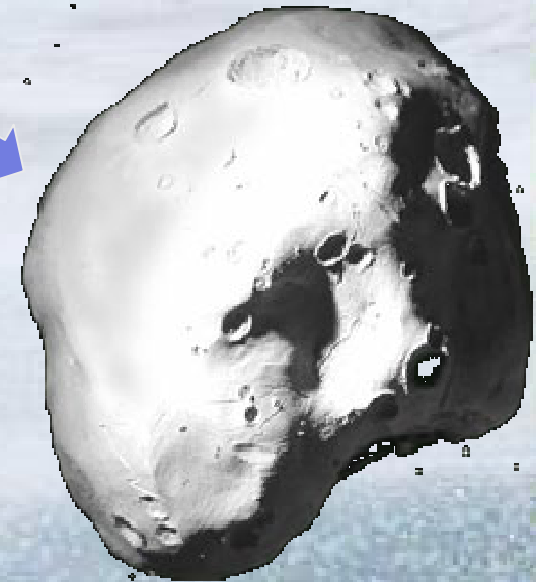


100 atoms



500 atoms

Planetesimal



How:

- Internal energies from density functional theory
- Geometry optimization (minimization of atomic forces)
- Molecular dynamics

What:

- formation energies & stability
- dielectric functions & spectra
- band gaps
- chemical bonds

Opacities

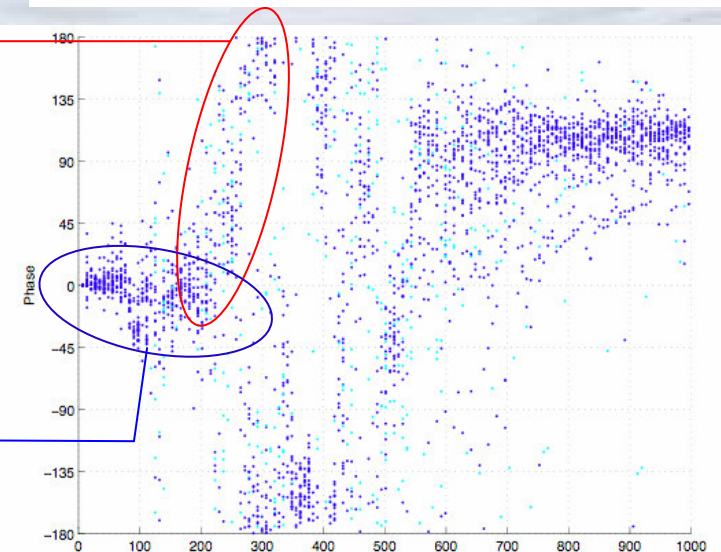
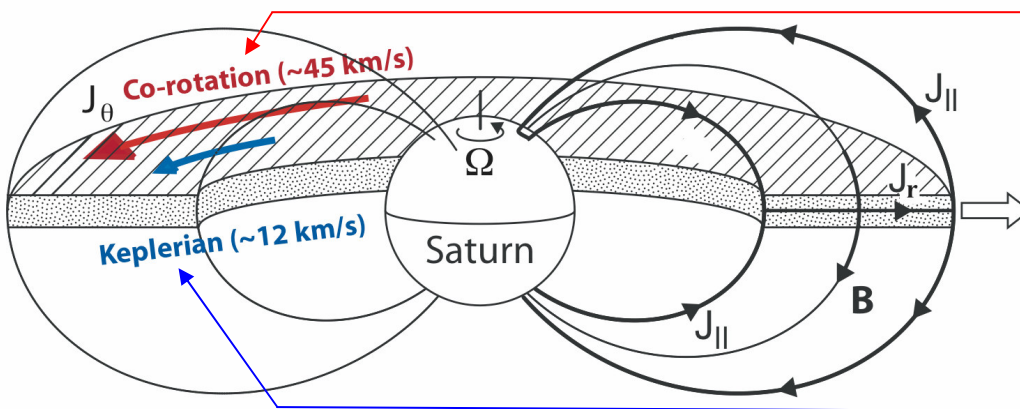
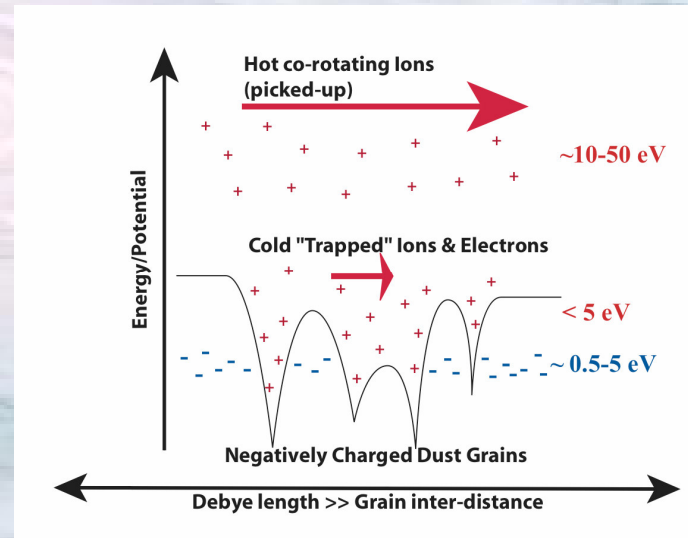
Planet growth

Observations

Chemistry and dust/gas interaction with magnetic fields



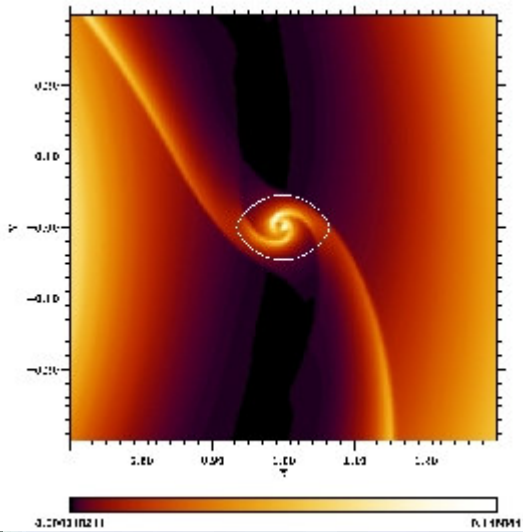
- Saturn rings offer a proxy to disk dynamics
- Cassini probe detected several streams created by gas-dust-field interaction
- Opportunity to calibrate numerical models



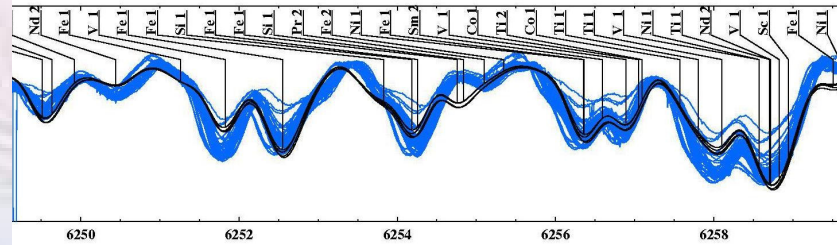
Small bodies in the Solar System

- Comets as a link to planetary building blocks
- History of water delivery to the inner Solar system
- Asteroids as test particles to understand orbit evolution

Confronting the observations: RT and atomic/molecular data



Numerical models

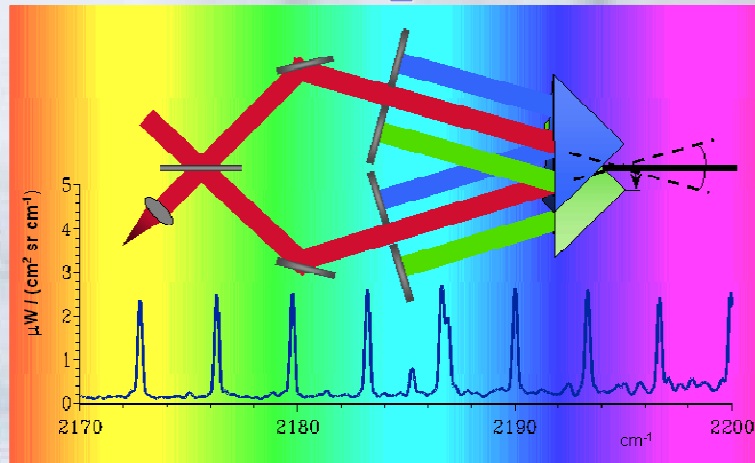


Comparing
observables



Observations

Atomic and
molecular data



An aerial photograph of a large, circular impact crater in a desert landscape. The crater has a distinct multi-colored ring structure, with a bright yellow center, followed by concentric rings of orange, red, and brown. The surrounding terrain is a flat, light-colored desert floor.

What are we going to do?

- **Research on planets**
- Organize and support scientific meetings
- Help high-quality education in schools and universities
- Coordinate national planetary research
- Respond to the public interest to the field

What do we need?

- Science drivers (särskild forskare)
- Long-term visitor program (visiting professor)
- Dedicated manpower (postdocs and PhDs)
- Equipment (parallel computing, data storage, visualization)
- Budget for travel/meetings/schools

Collaboration network

