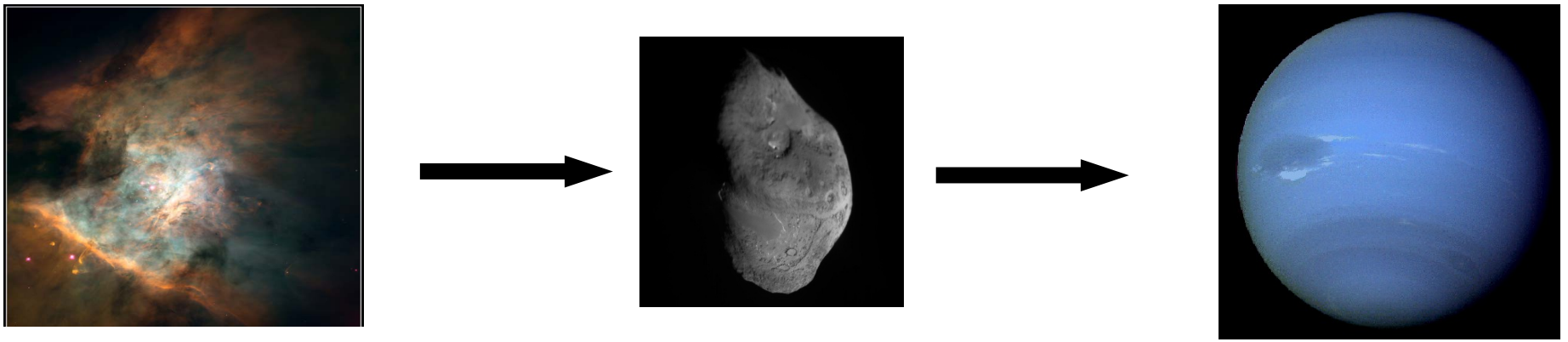
From stellar nebula to planetesimals & From planetesimals to planets

What is the chemical composition of planets ?



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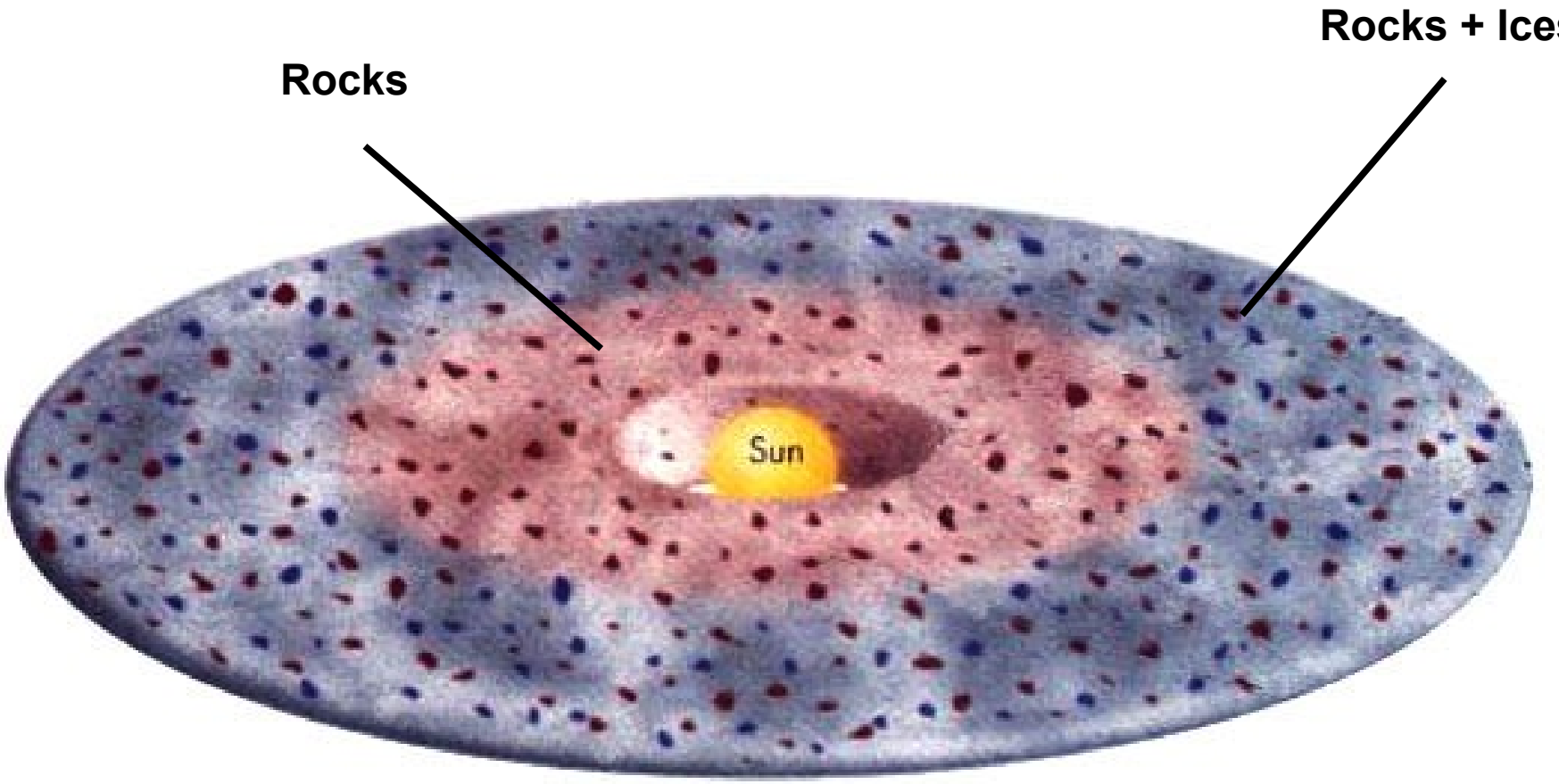
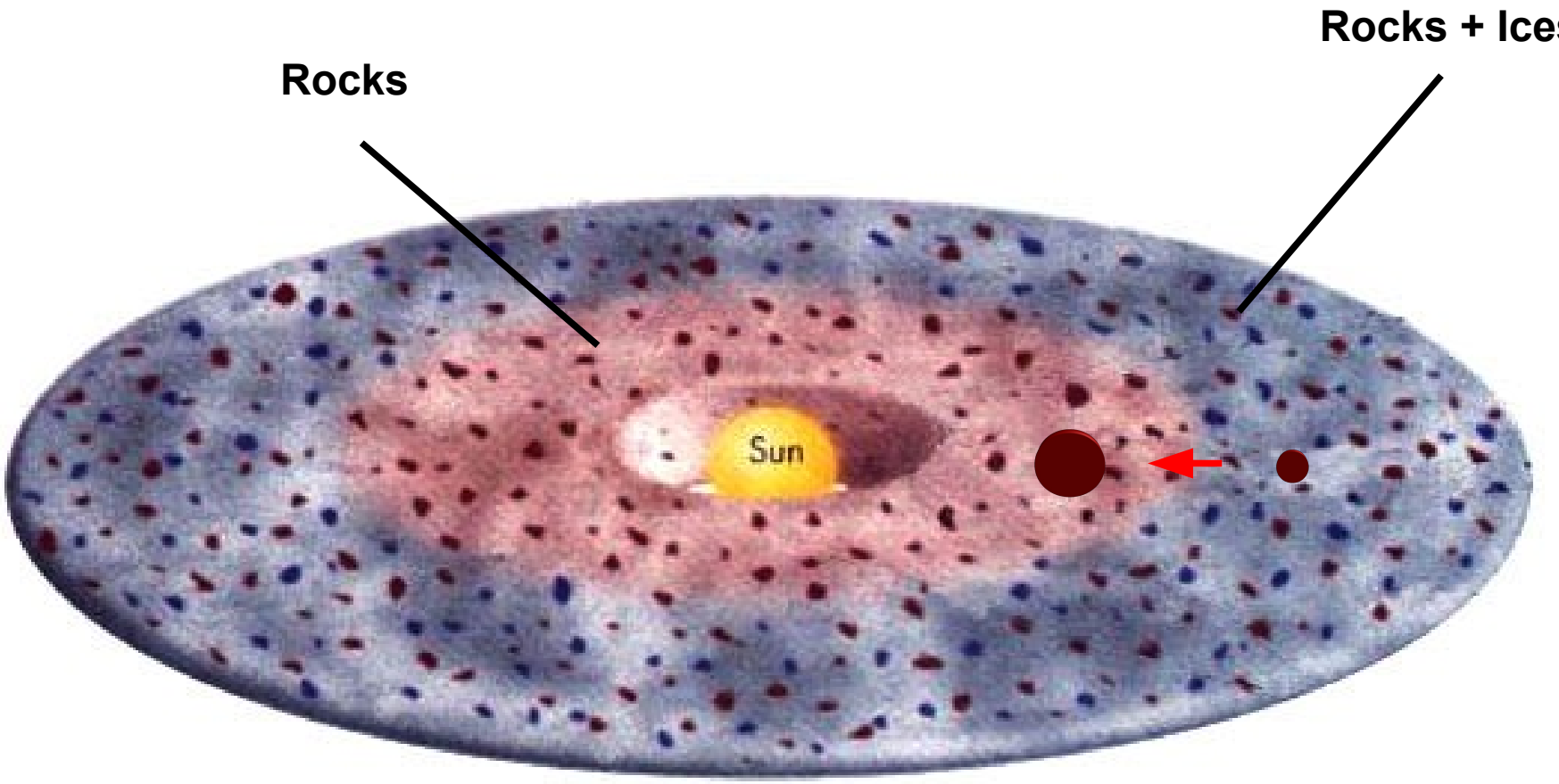
Center for Space and Habitability

Chemical composition of planetesimals



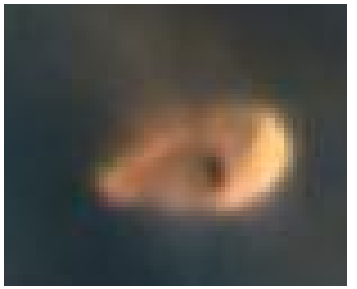
Chemical differentiation of the protoplanetary disk
Composition of planetesimals

Chemical composition of planets

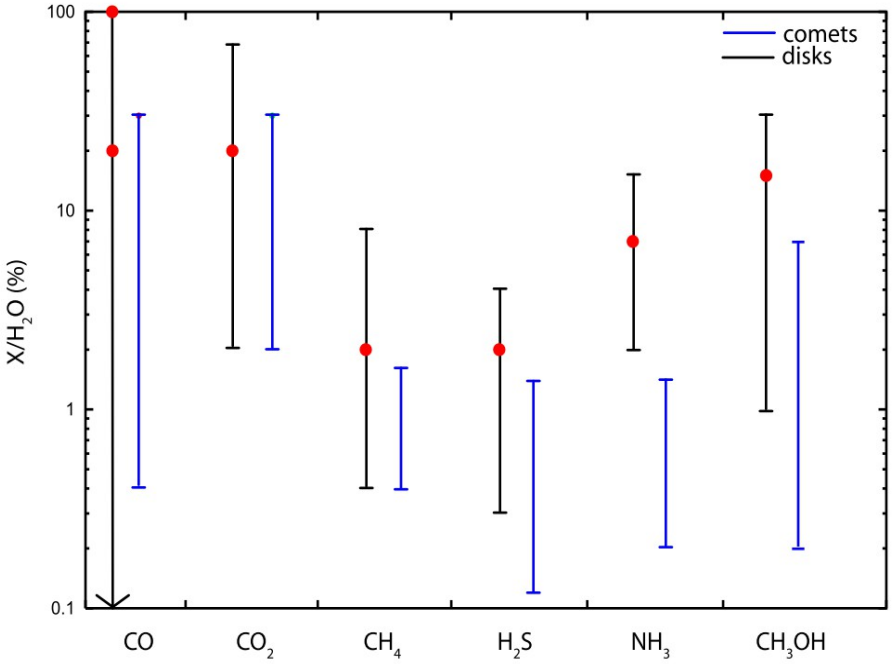


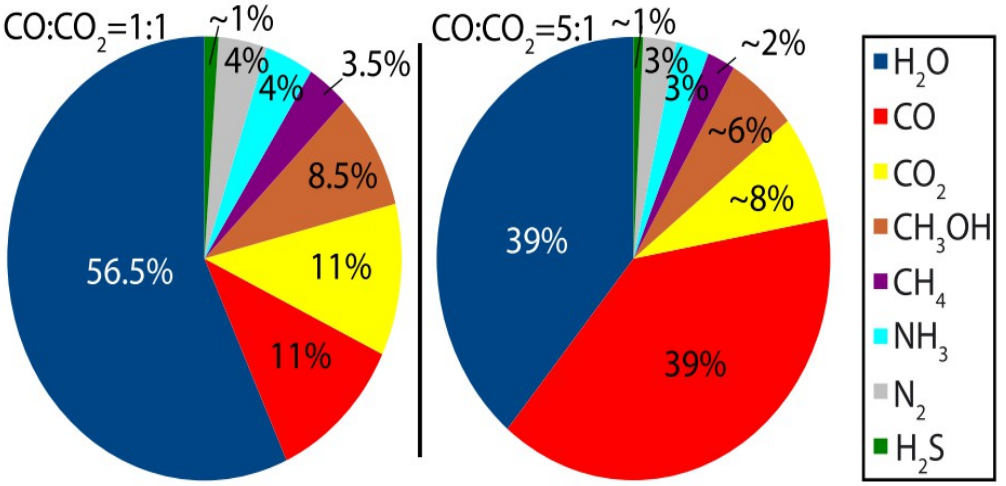
Formation, growth, and migration of planets

ISM and solar nebula compositions

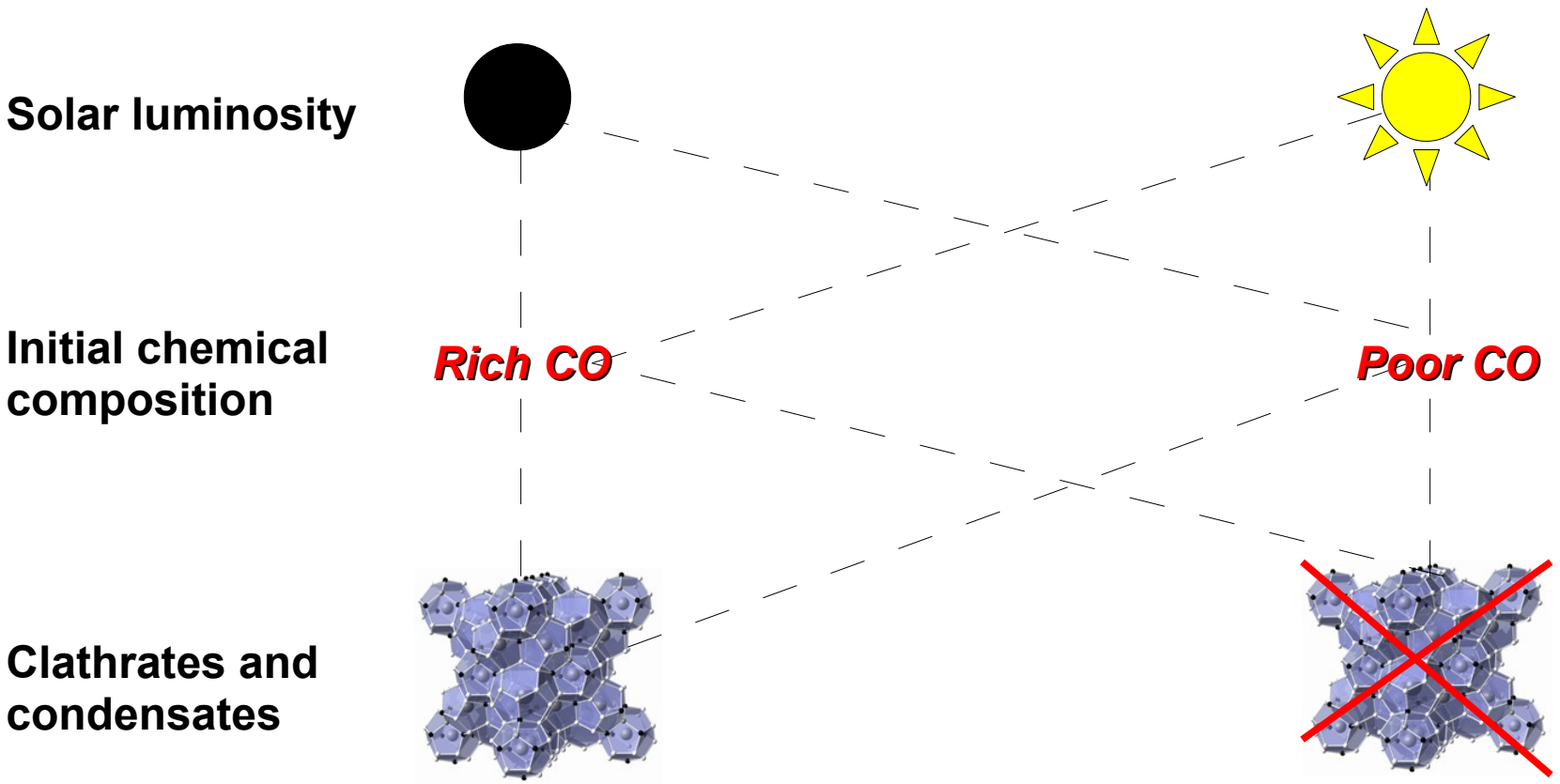


Abundances of species



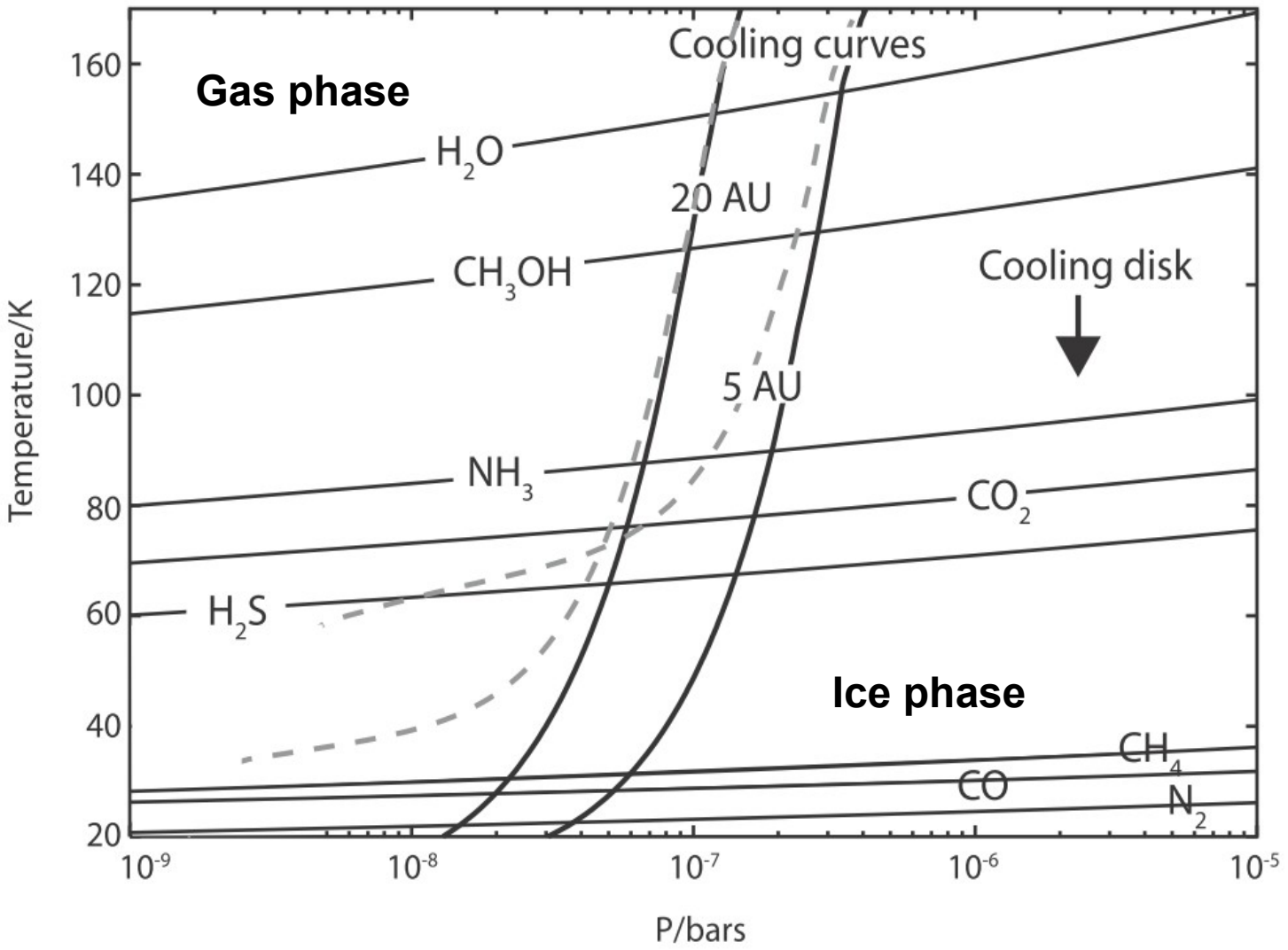


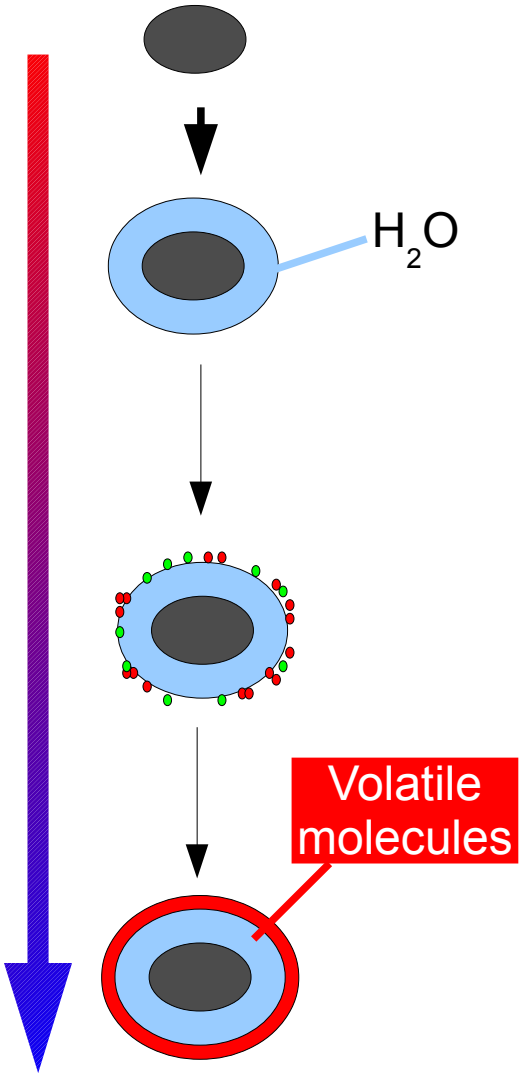
From disc to grains



8 different chemical compositions

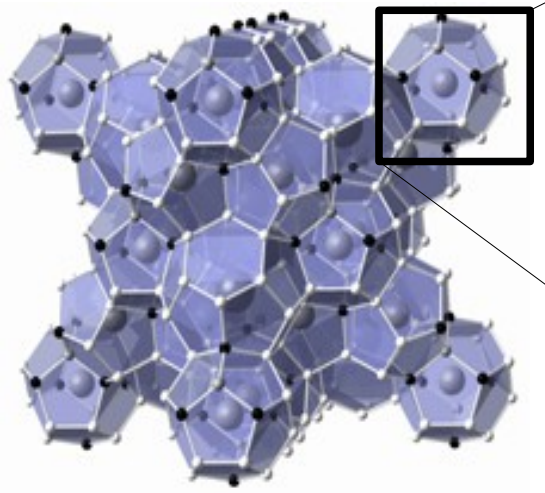
From disc to grains

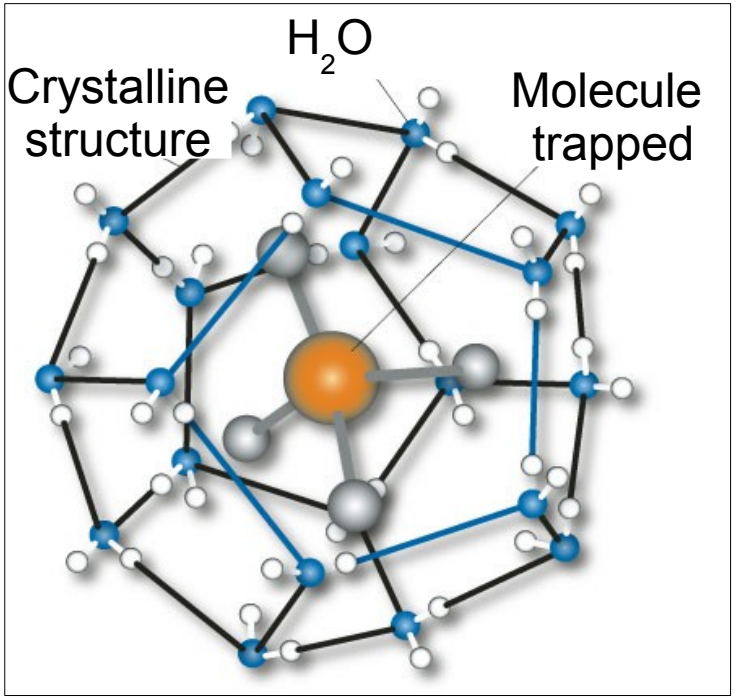




From disc to grains

Ice clathrate structure





Cage of water molecules can trap up to 17% of volatile molecules

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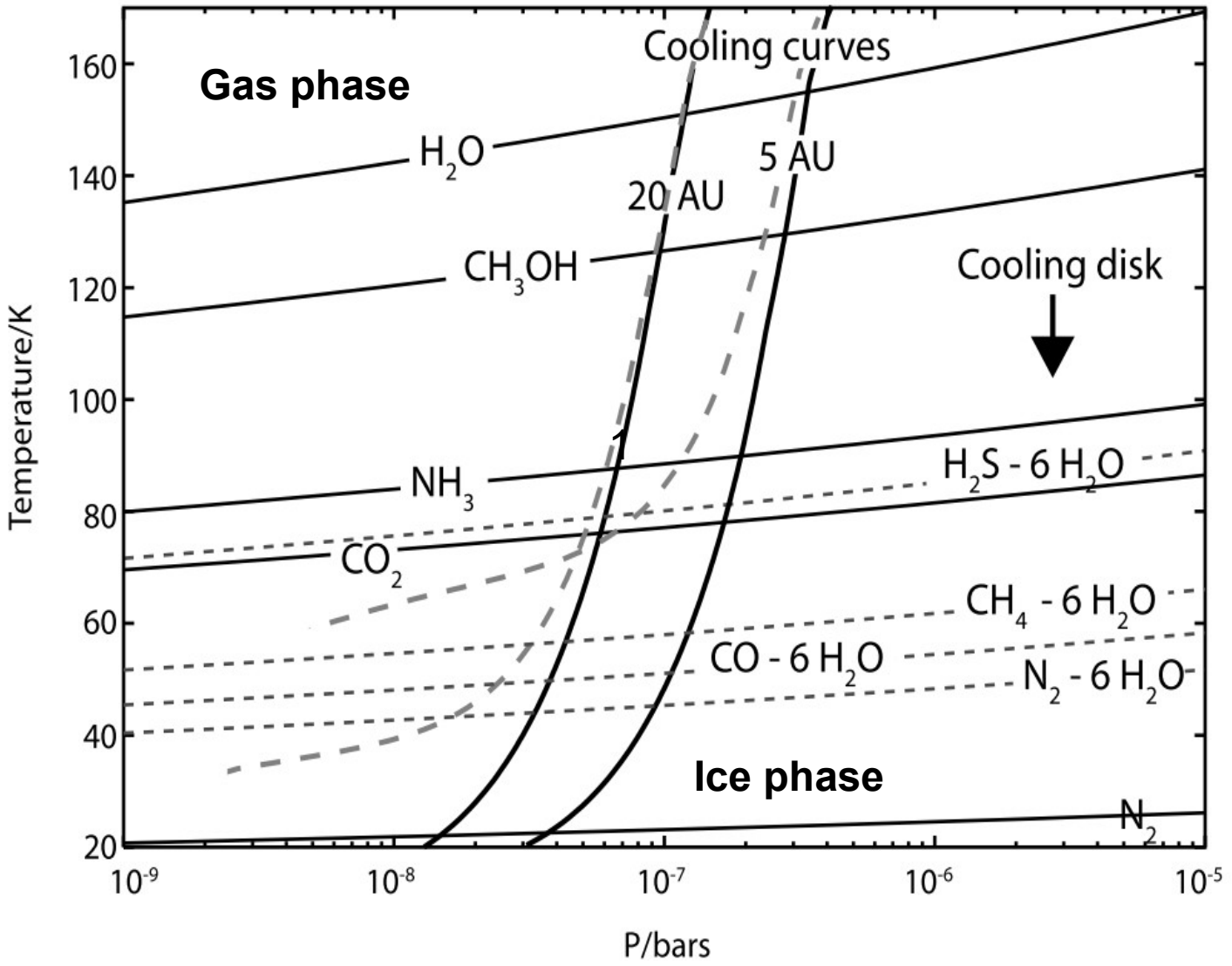
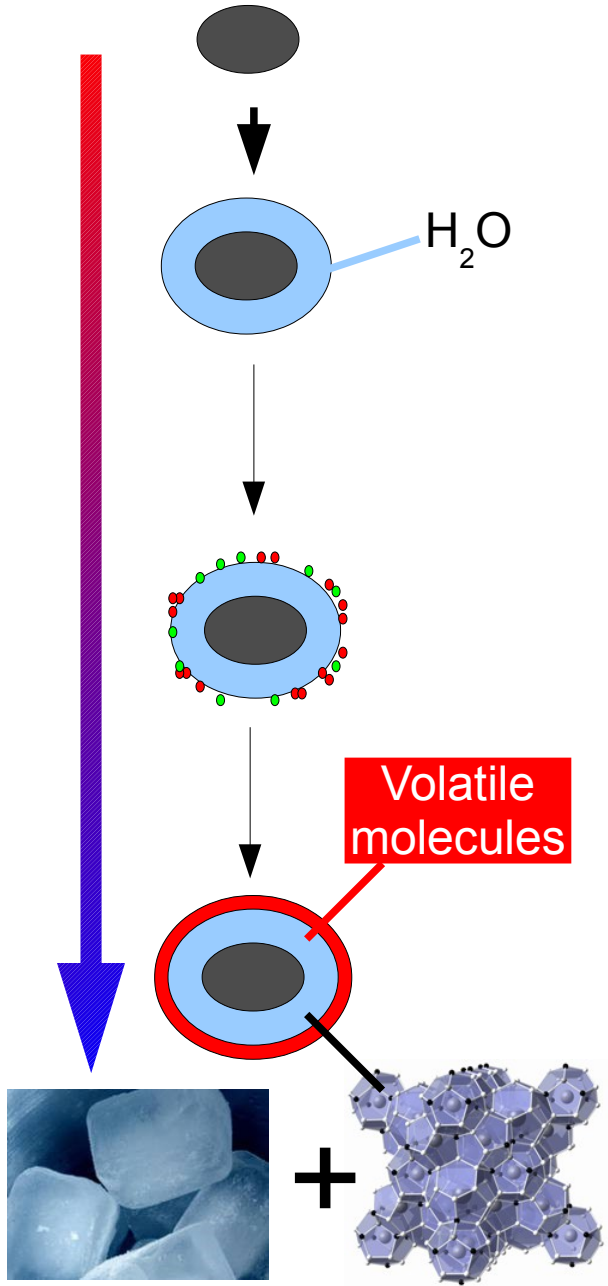
Conditions of formation:

- Total gas pressure > Equilibrium pressure of clathrates
- Temperature <-> Kinetic

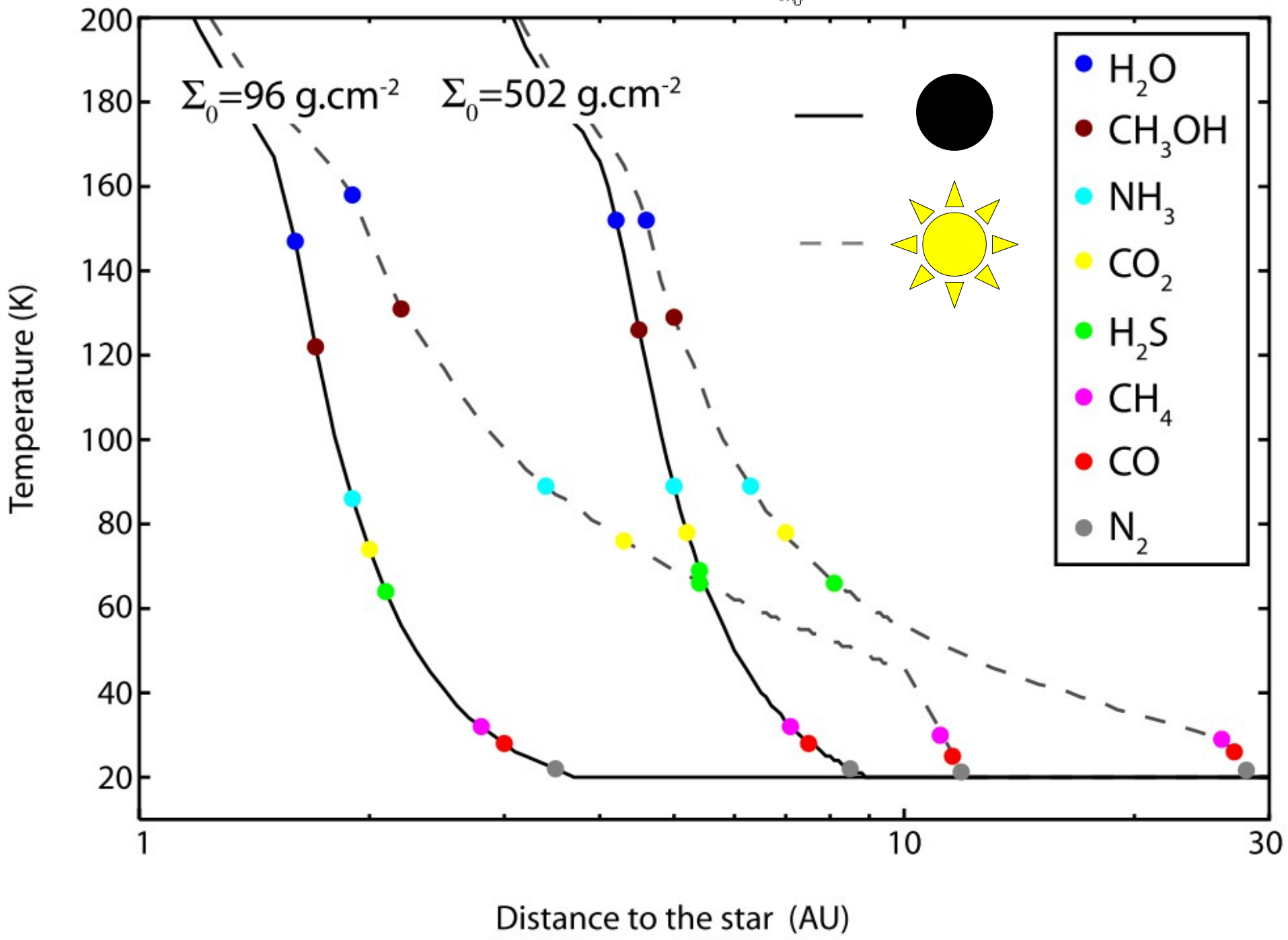
From disc to grains



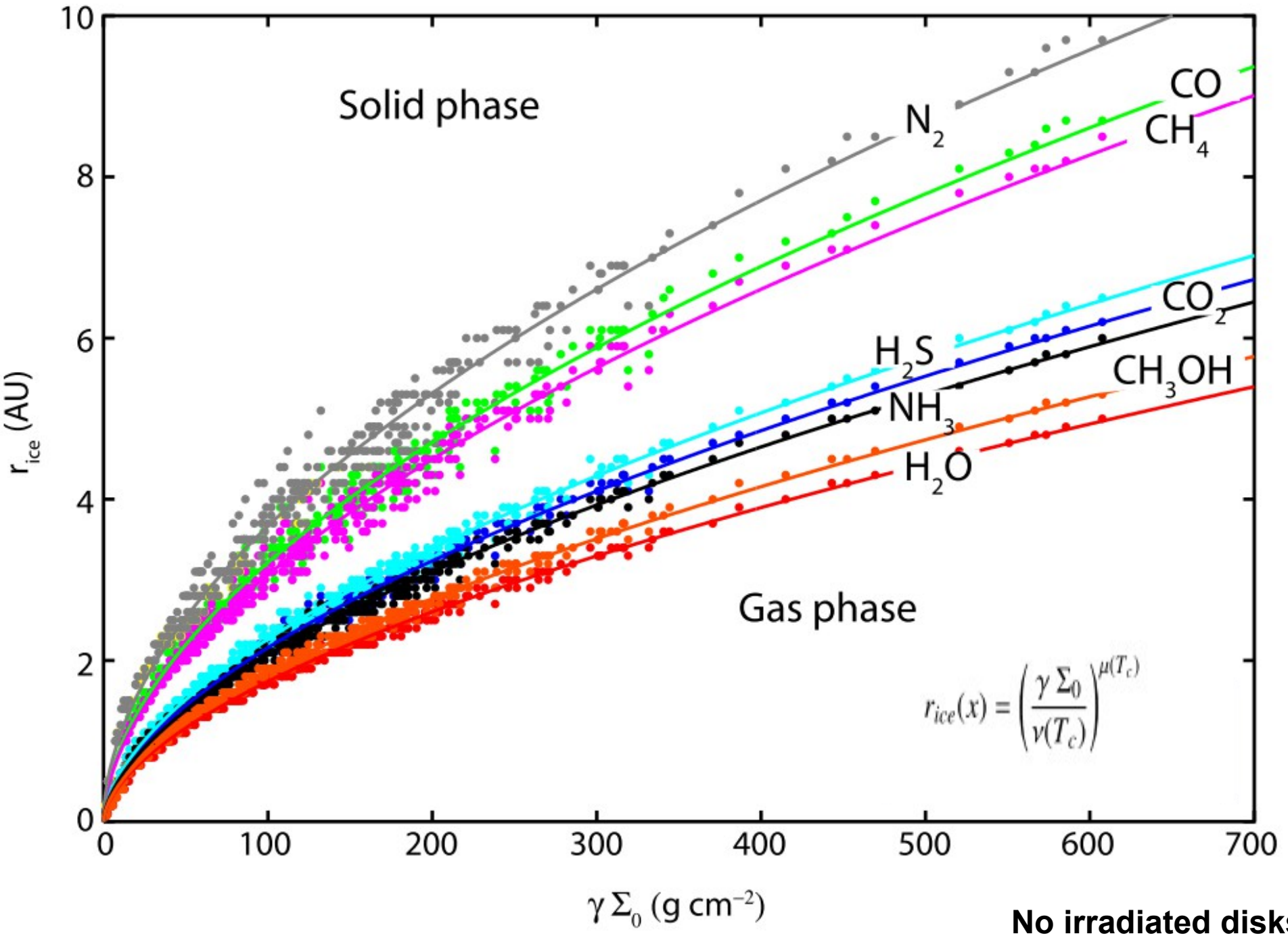


Temperature profile in the disc

$$\Sigma(r) = \Sigma_0 . \left(\frac{r}{a_0}\right)^{-\gamma} . e^{\frac{r}{a_{core}}^{2-\gamma}} \qquad (g\,cm^{-2})$$

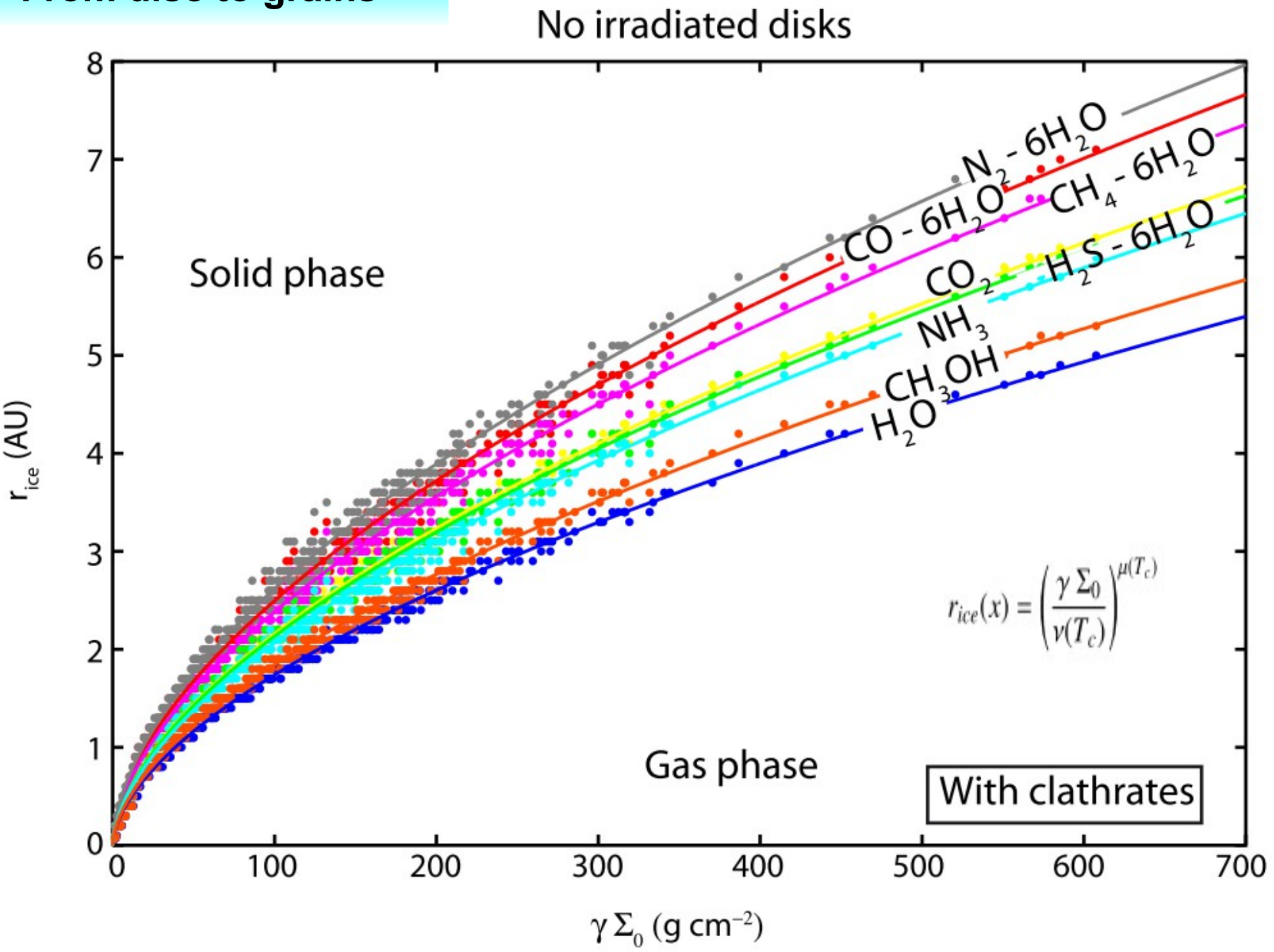


From disc to grains

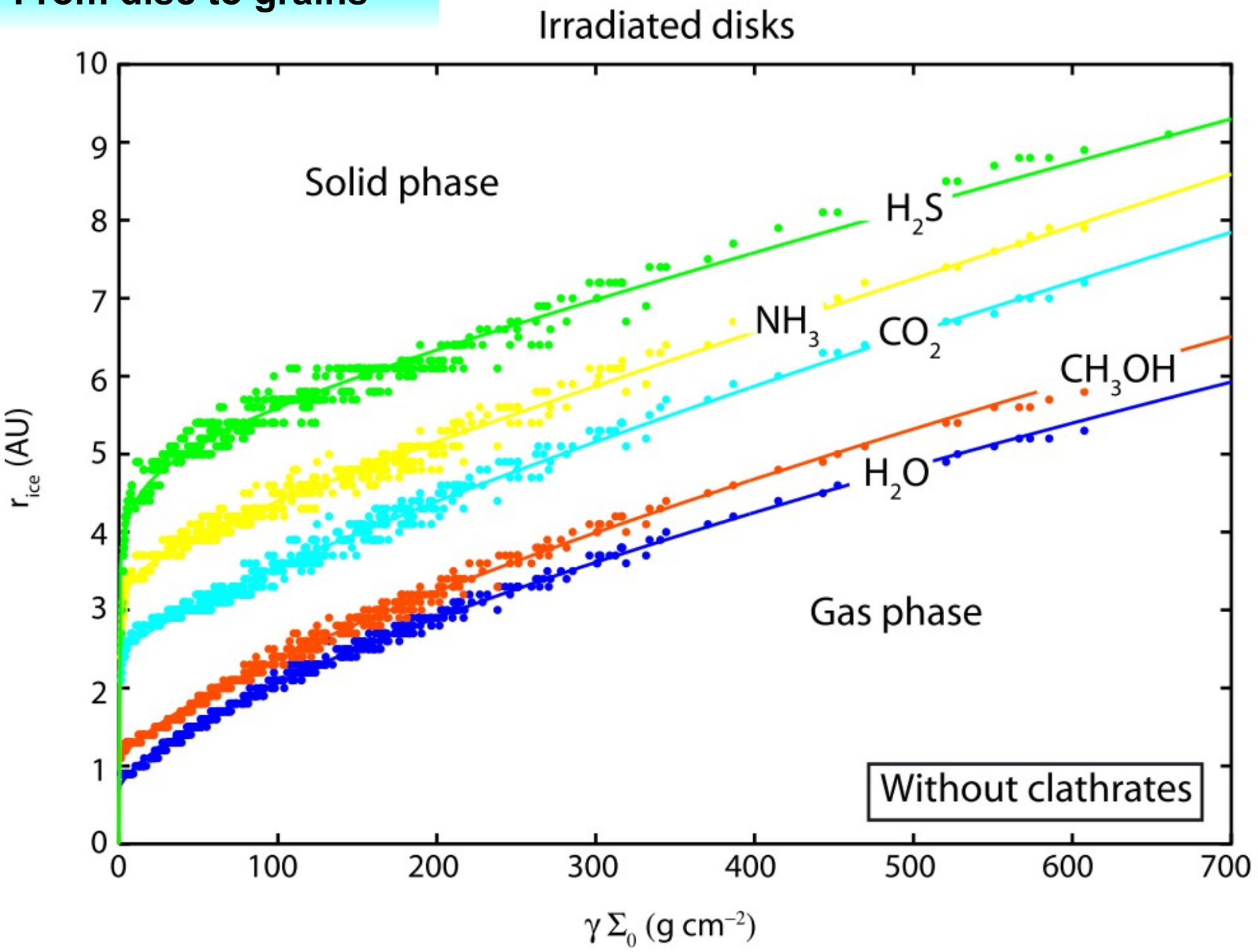


No irradiated disks

From disc to grains

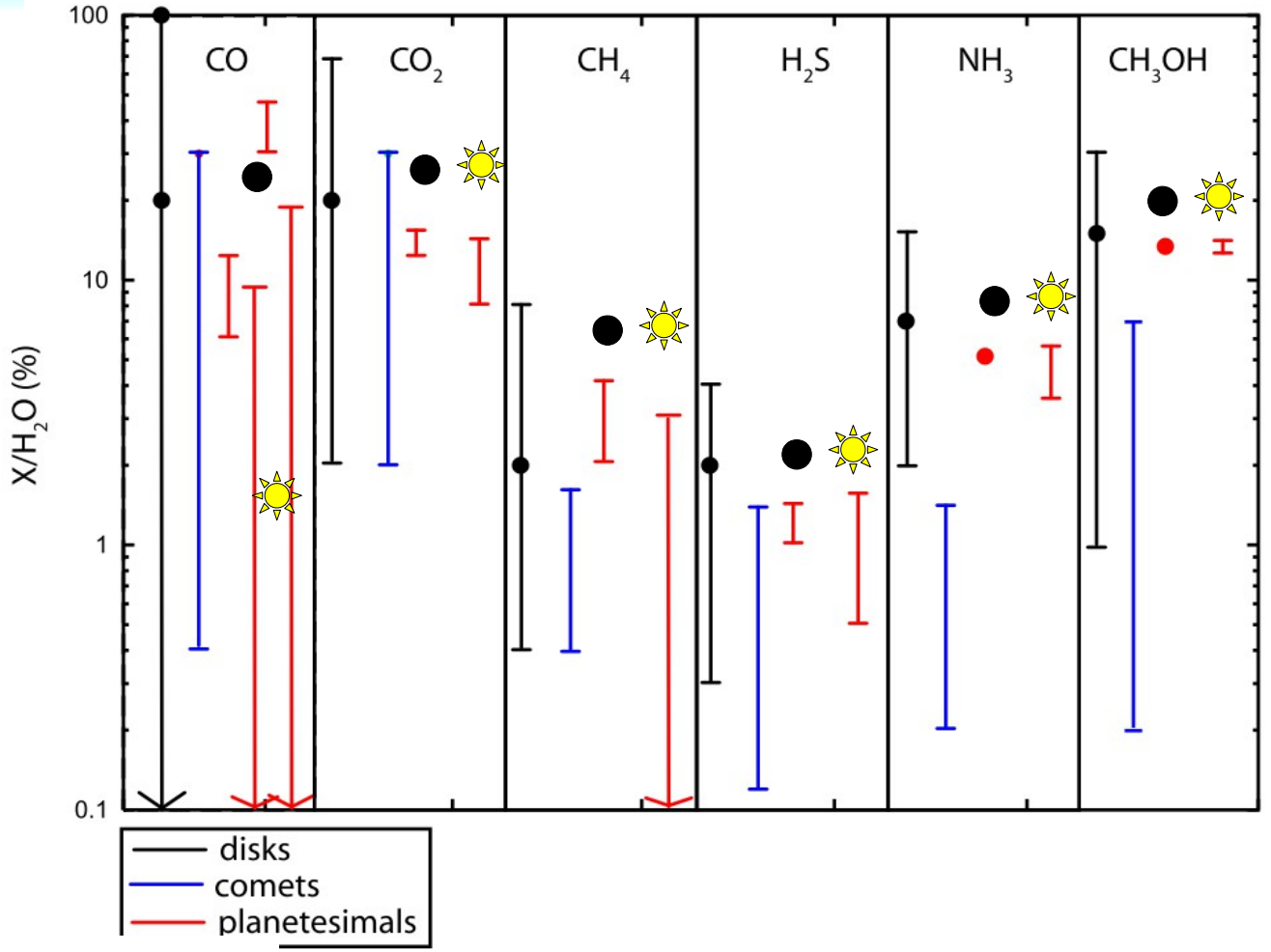


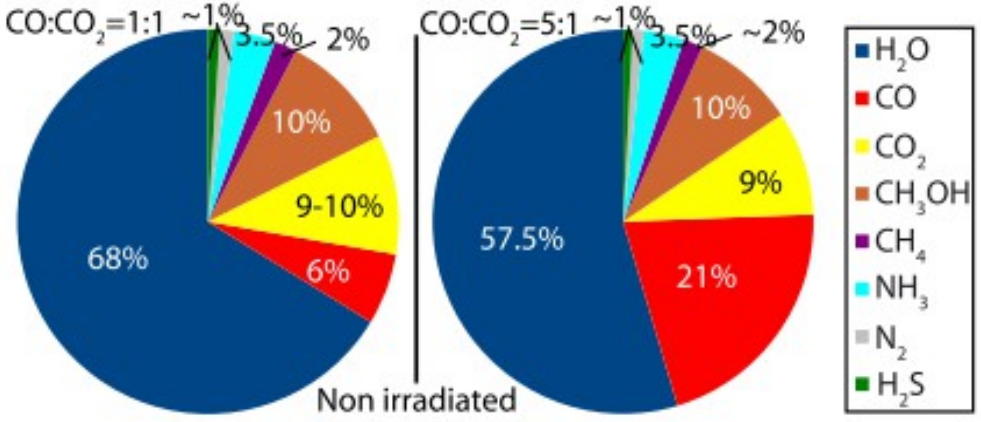
From disc to grains

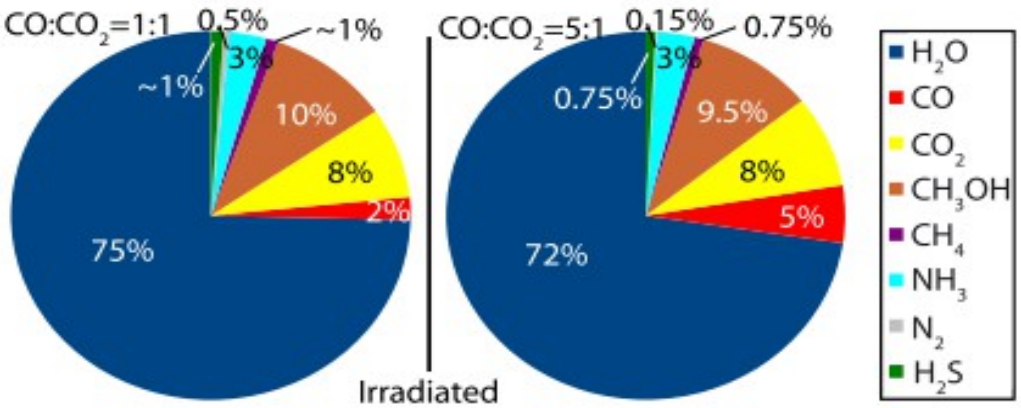


From disc to grains

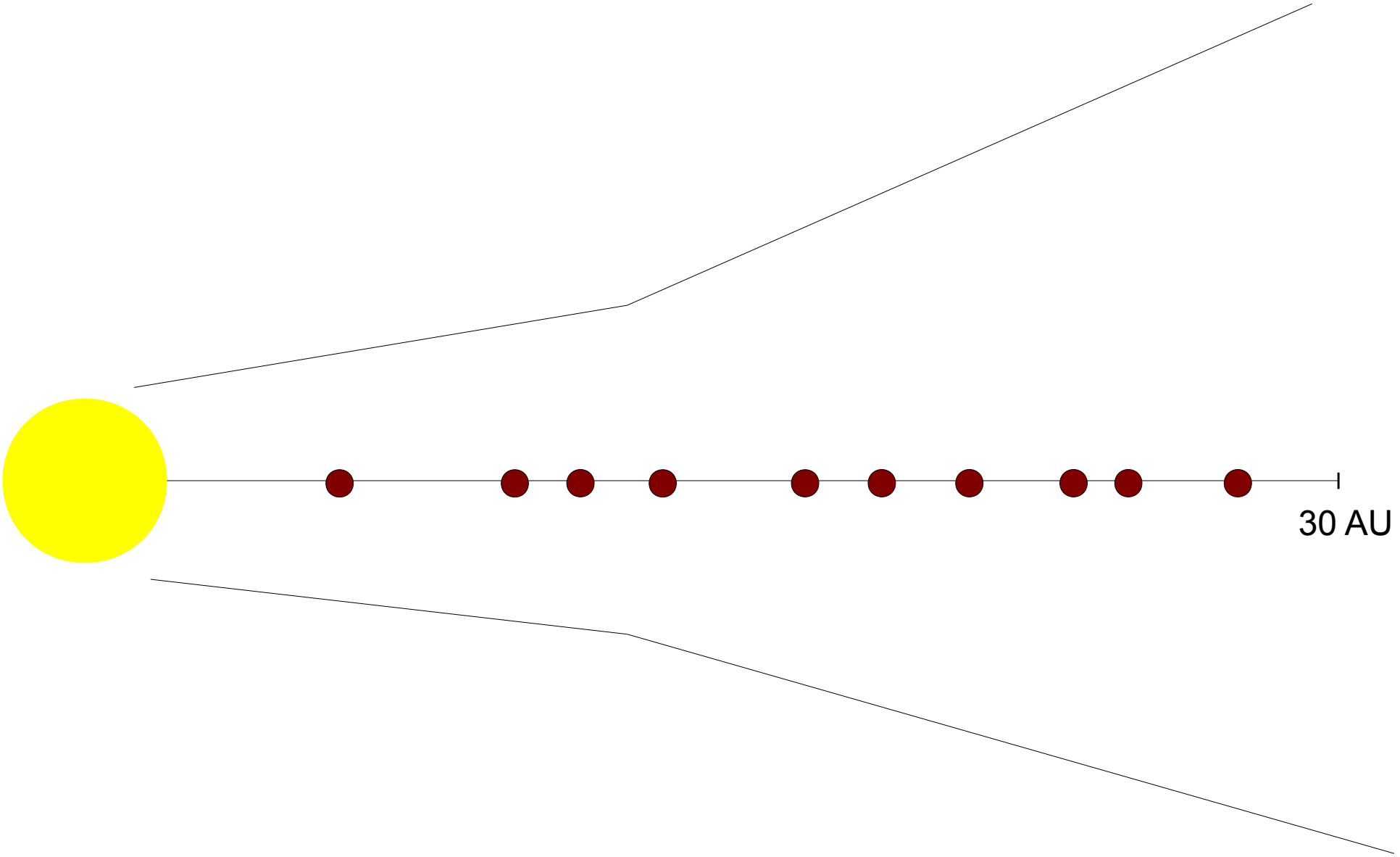
Average molar ratio of species in planetesimals





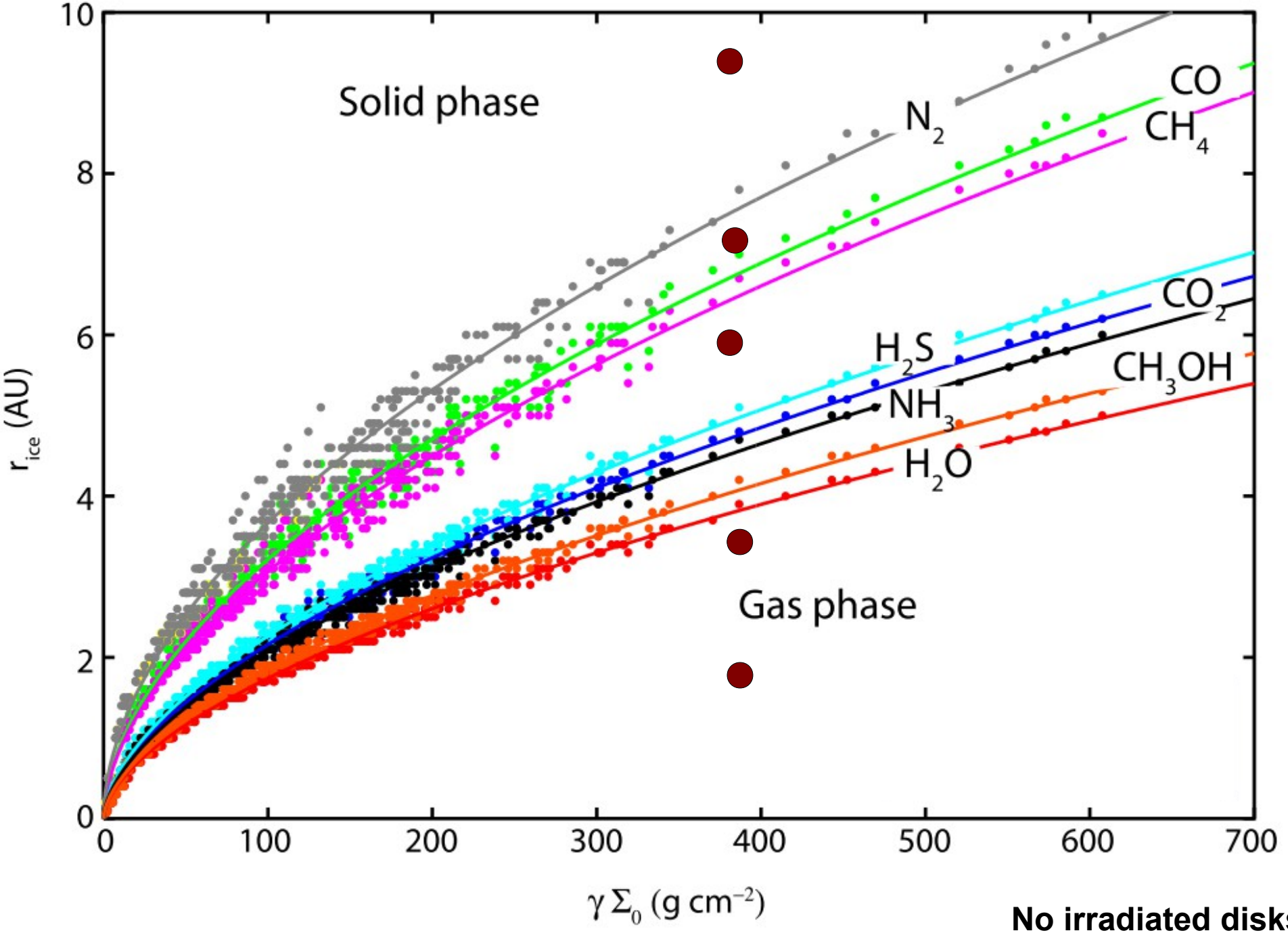


From planetesimals to planets



About 500 simulations with 10 planets with different initial positions

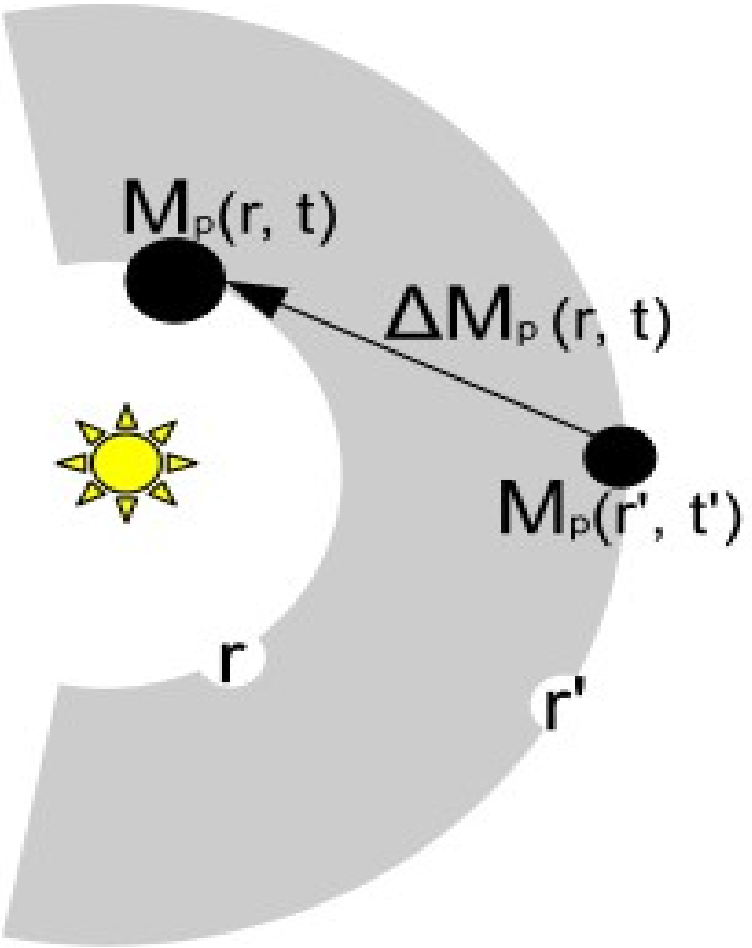
From planetesimals to planets



No irradiated disks

From planetesimals to planets

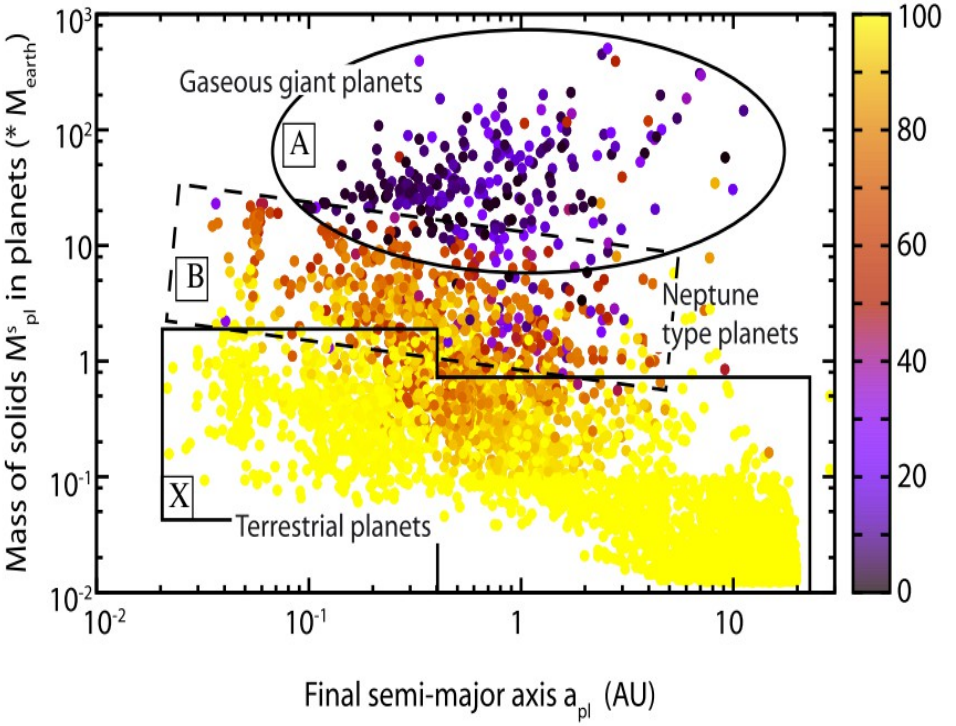
Growth of planets by accretion of gas and planetesimals

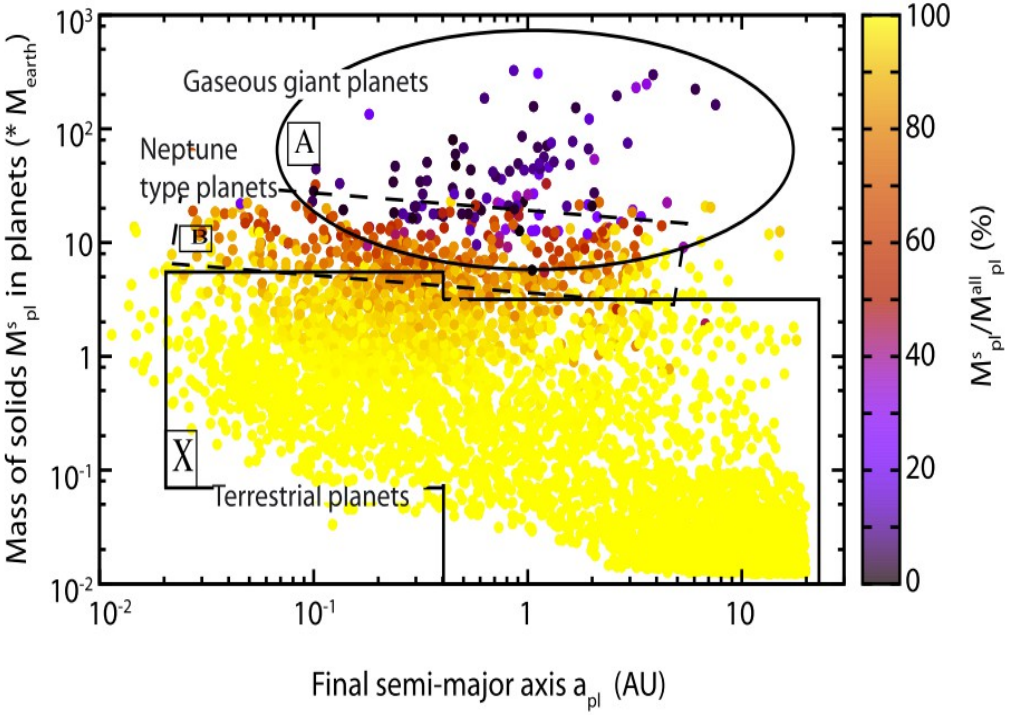


About 500 simulations with 10 planets with different initial positions

From planetesimals to planets

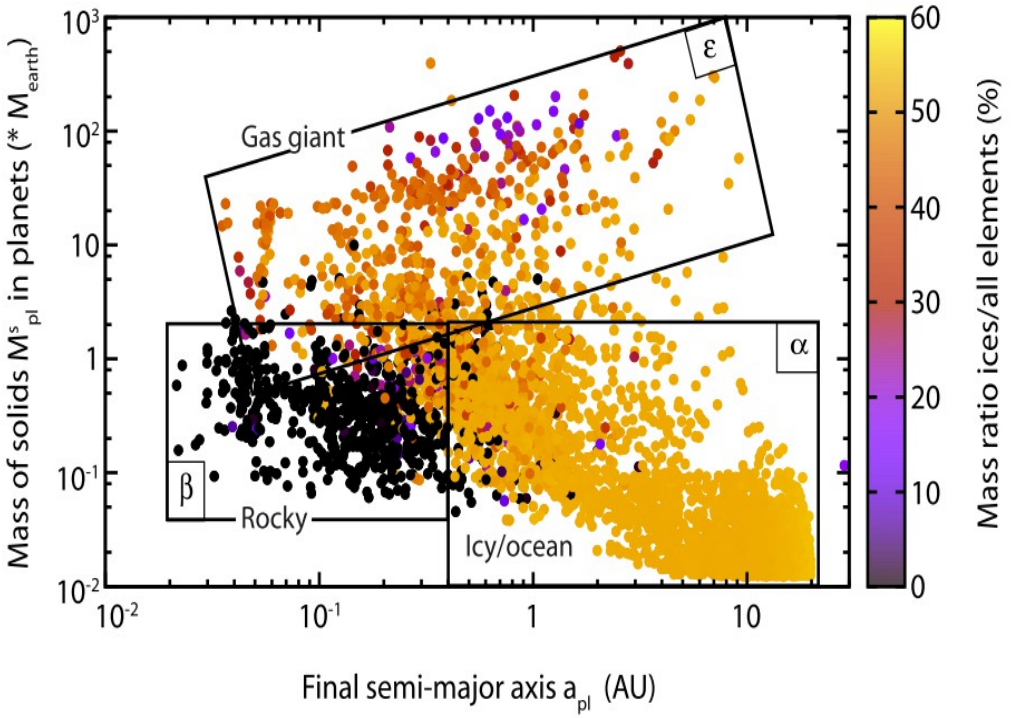
Solid/(solid+gas)

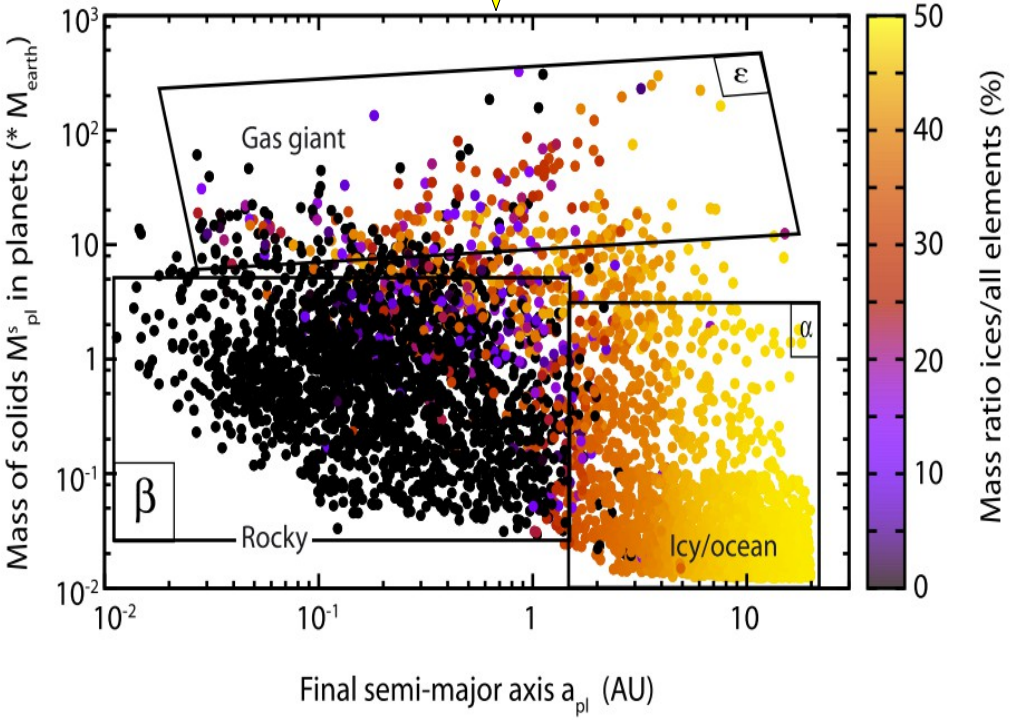


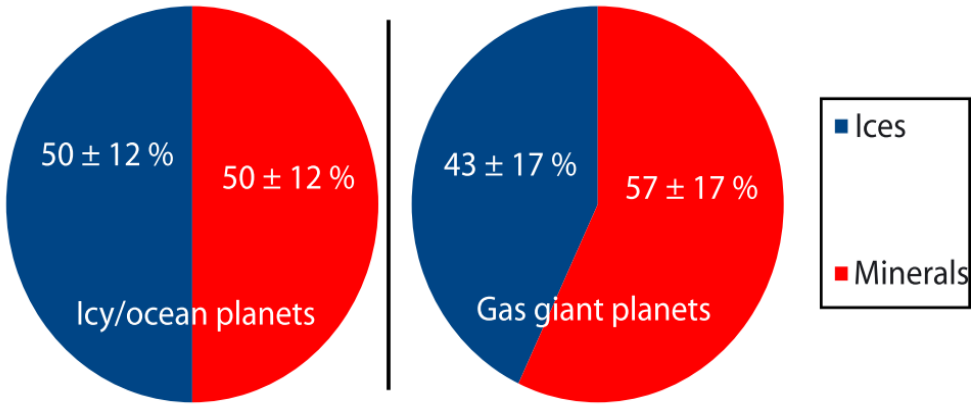


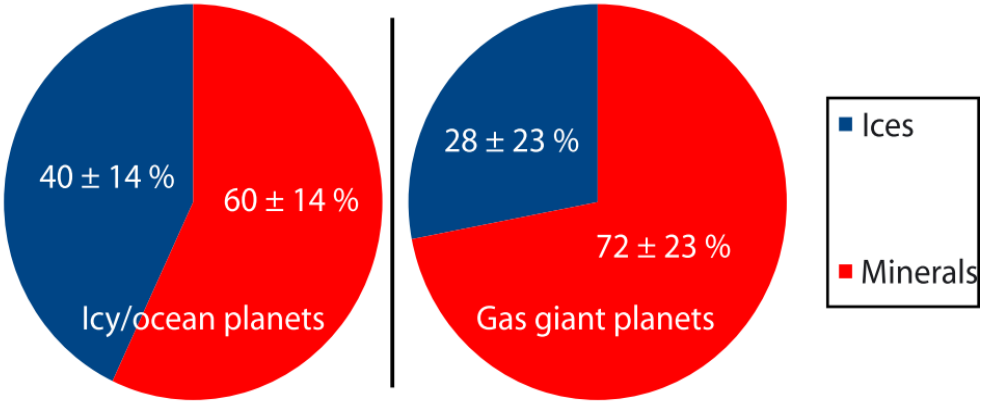
From planetesimals to planets

Ices/ (Ices+rocks)





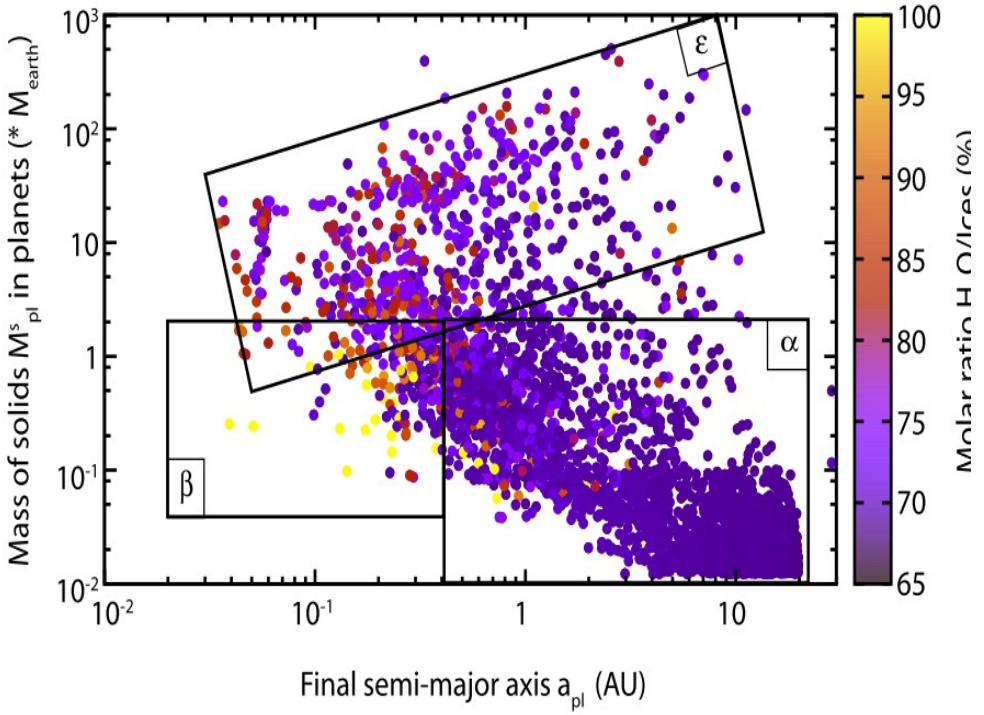


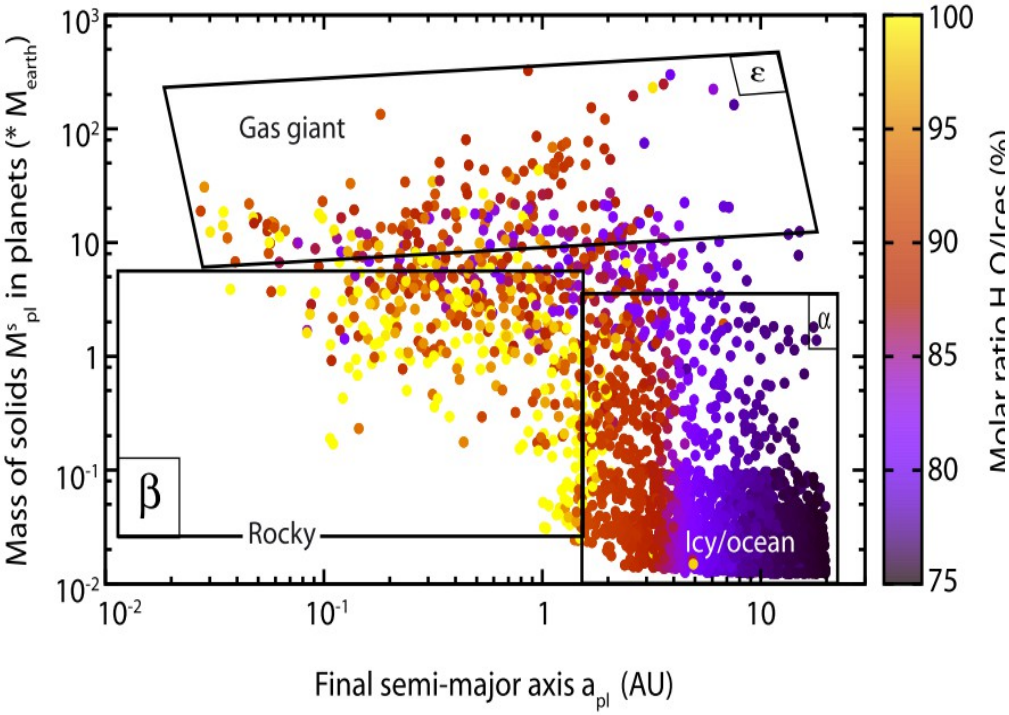


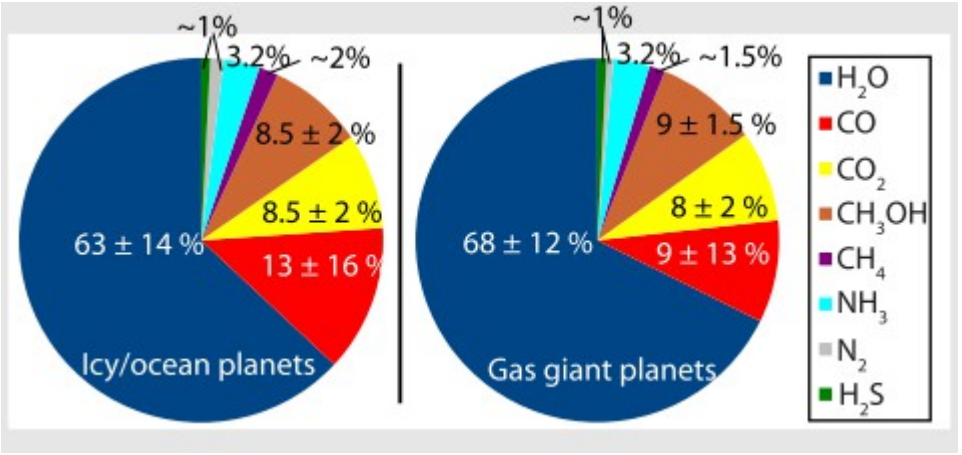
Ice/rock=1±0.3 **Ice/rock=0.8±0.5** **Ice/rock=0.7±0.4** **Ice/rock=0.45±0.45**

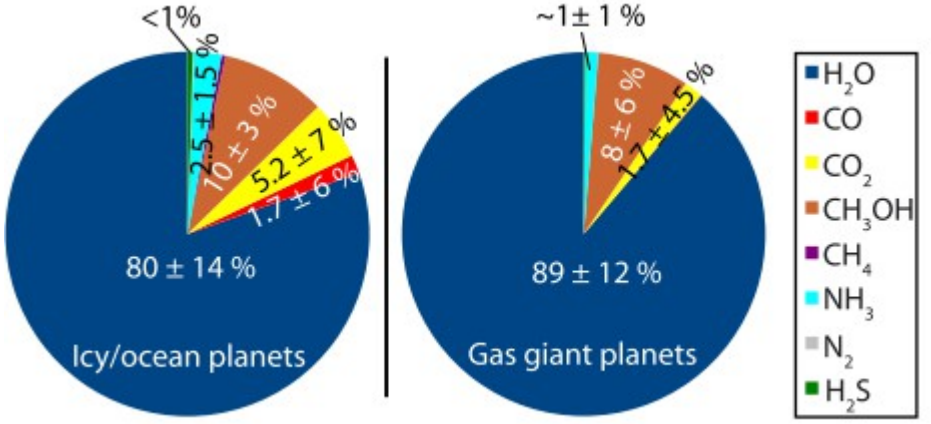
From planetesimals to planets

H2O/all ices



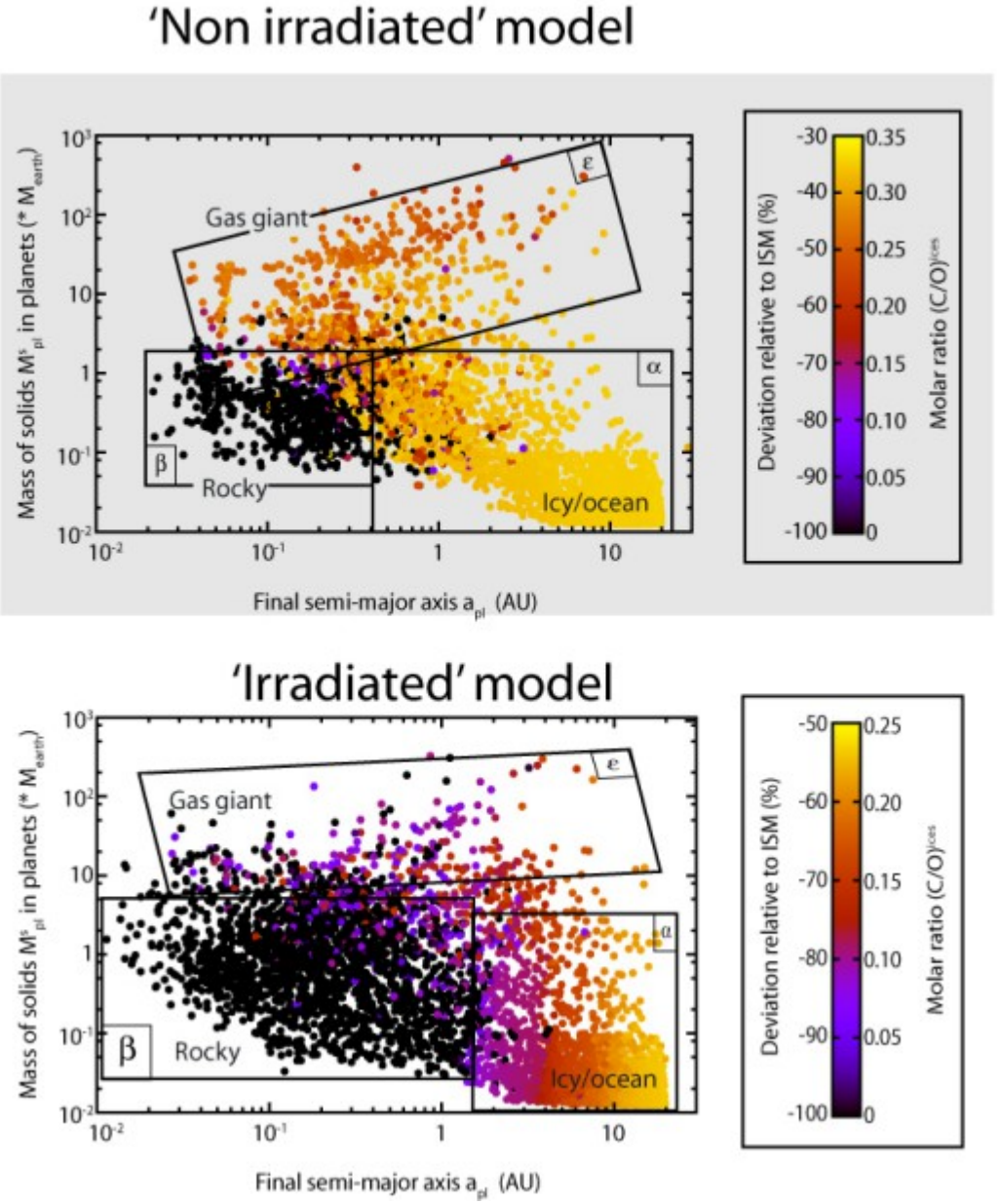




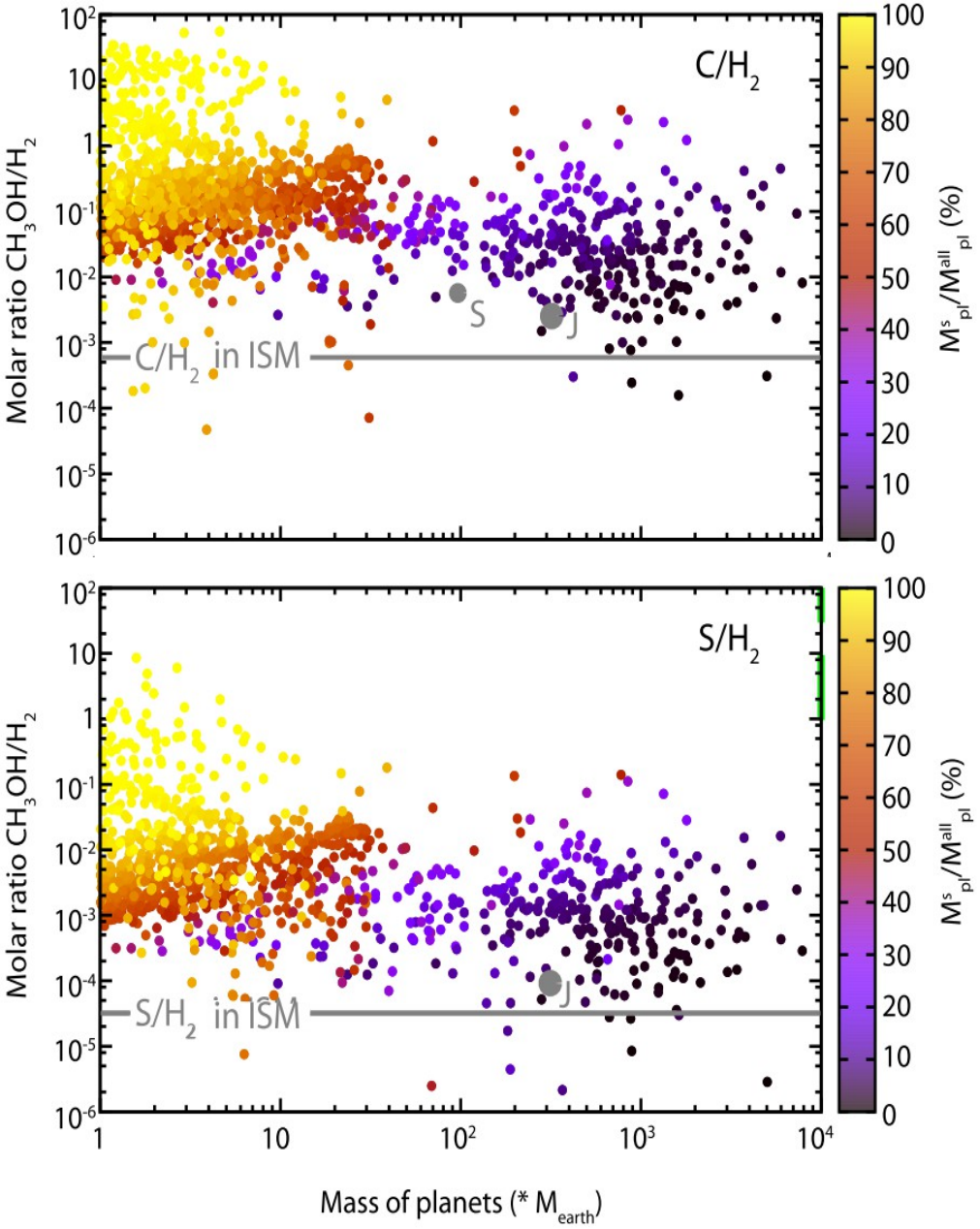


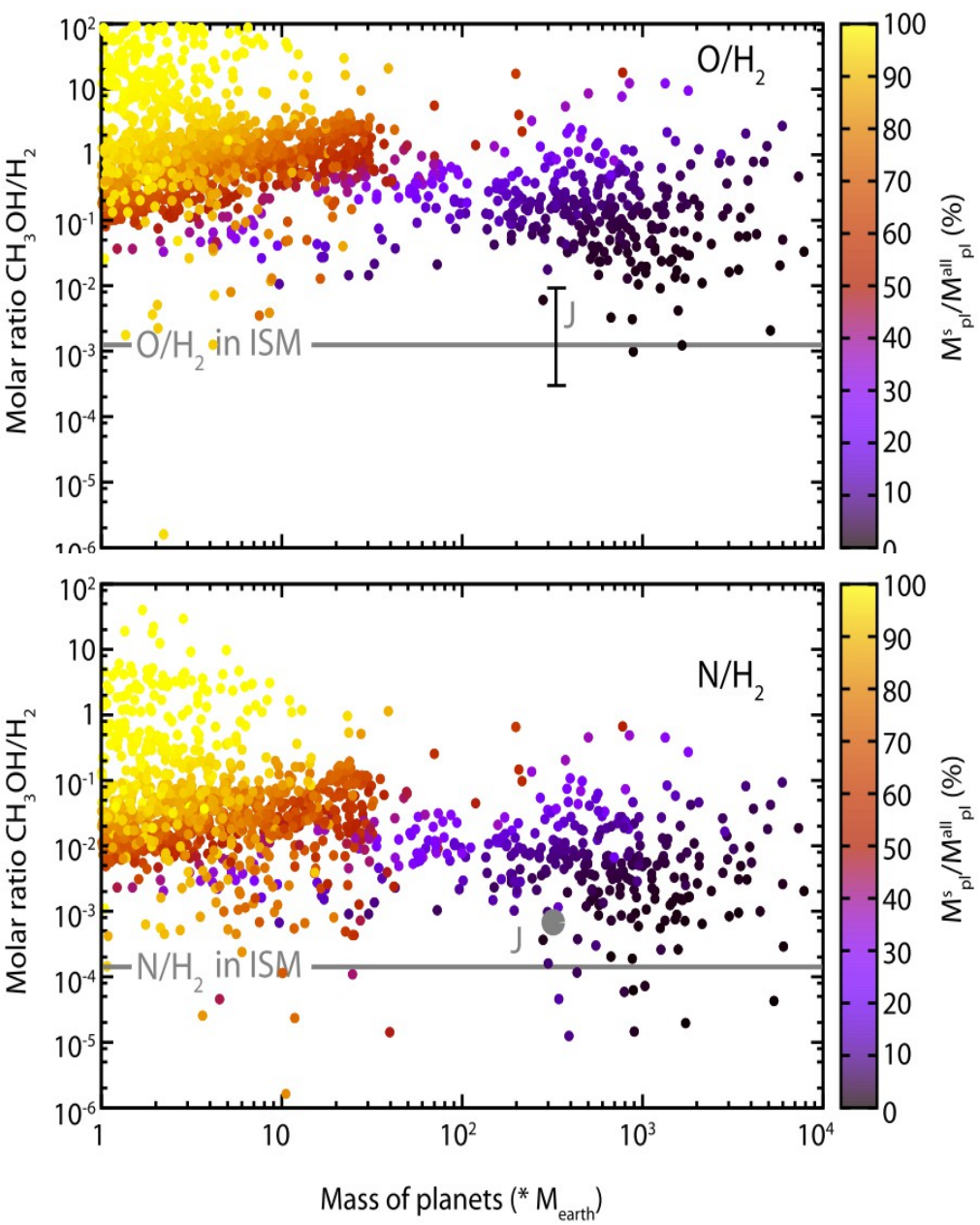
From planetesimals to planets

C/O in Ices

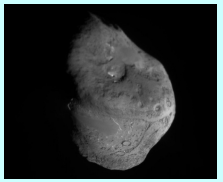


From comets to planets





Conclusions

Calculations: Ice line positions

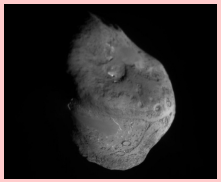
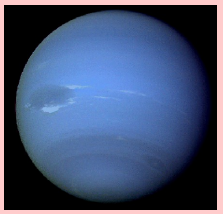
Abundances of species

Ice/rock mass ratio

Function of

- Surface density of discs
- Irradiation
- Distance to the star
- Structure of water ice
  => trapping of species

→ In good agreement with comets

Abundances of species

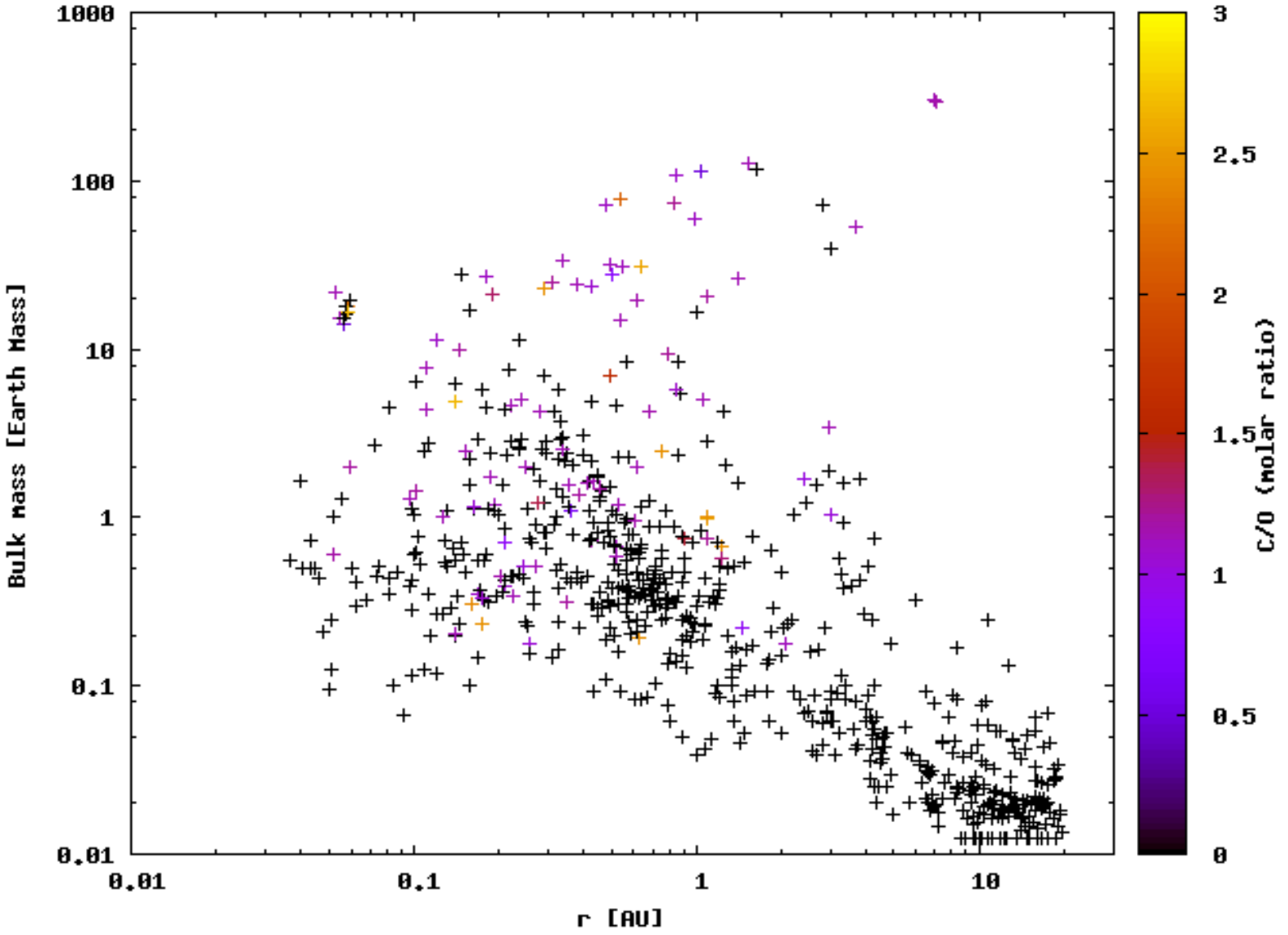
Ice/rock mass ratio

Function of

- Distance to the star
- Position in the disc
- Mass of planets

→ In good agreement with Jupiter, icy moons and dwarf planets

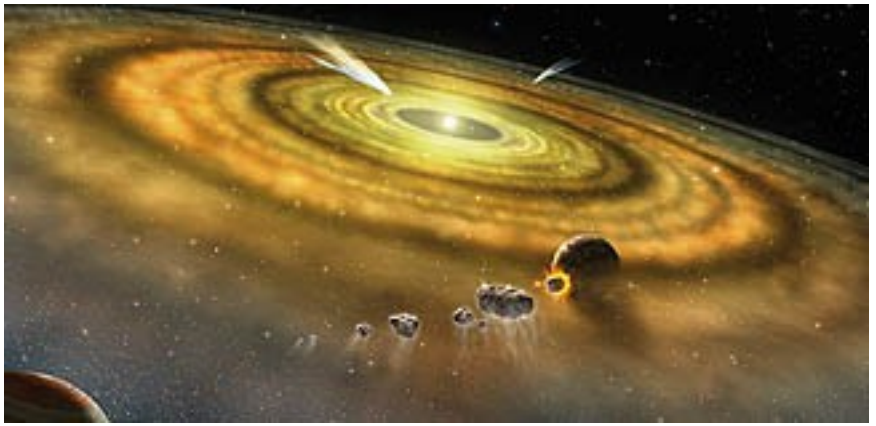
Current and Futur works



Current and Futur works

Studies for exocomets and exoplanets

- Phydico-chemical evolution of planetesimals during their migration in the disk
- Different C/O ratio in volatile molecules
- Different Stellar luminosity and mass



What is the abundance of species in gas and ice phases in the discs ?

What is the abundance of species for different abundances of C and O in discs ?