

We have developed the first classification scheme for protoplanets, in hope of gaining a fundamental understanding of the planetary phenomenon in general. A dynamical stability analysis has been performed to determine physically significant states in the evolution of a planet.

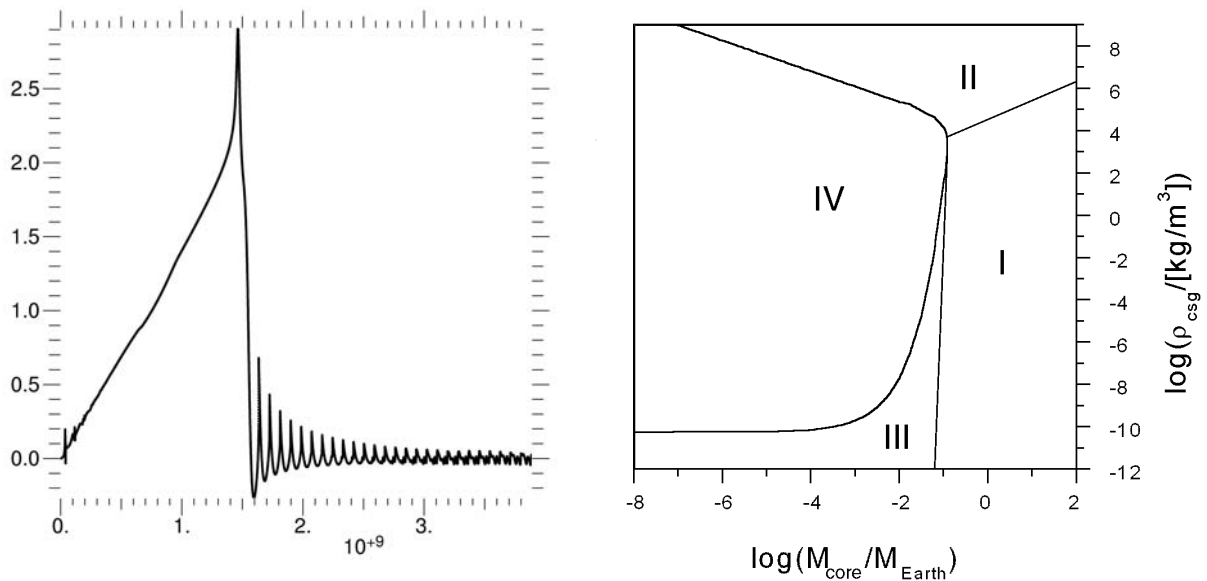
The scheme provided us with the mapping of all possible protoplanetary hydrostatic equilibria (A&A, accepted). Our model predicts two types of envelope equilibria: 'uniform', with density of envelope gas dropping weakly with increase in radial distance, and 'compact', having a small, but very dense gas layer wrapped around the core, and very low gas density further out. Each of those types can be self-gravitating.

A hydrodynamical code has been built to distinguish the stable protoplanetary equilibria from the unstable ones, and to study possible dynamic transitions between any pair of hydrostatic equilibria.

Stability analysis of the hydrostatic equilibria is done for both subsonic and supersonic perturbations.

The envelope-gas-dynamics of about fifty characteristic protoplanetary models, selected from the hydrostatic solution-set, was integrated over one hundred sound crossing times.

The initial analysis shows that some equilibria are very stable, some are unstable both for subsonic and supersonic perturbations. There are also states of "intermediate-stability" dynamical behavior.



**Left:** Time evolution of the gas Mach number at the outer envelope boundary for the unstable model (Class IV)

**Right:** Classification of the hydrostatic protoplanetary models, according to the initial parameters

In summary we find protoplanets of Class I, II and III to be unconditionally stable, while the nonlinear growth of the unstable Class IV depends on the initial perturbation (cf. Pečnik and Wuchterl, A&A 2004).

Further investigation of the quasi-stable region (models on the border of Class III & IV) might provide important insight into the evolution of the planetary bodies.