The proto-stellar/proto-planetary disk may range from a few thousandths to a few tenths of a solar mass. Initially, 99% is gas by mass, 1% is solids (dust <1 μm).
Planets form in some 30-50 million years around stars like the Sun.

“Snow line” around 5 AU from star

Most giant planets expected to form close to the “snow line”...

Giant planets (like Jupiter)
The problem is that exoplanetary systems exhibit great diversity...

Many exhibit far more elliptical (eccentric) orbits than our own solar system.

Many appear to be at “dynamic capacity” - i.e. planets are packed as closely as allowed without creating instability...
Direct imaging of gas giant planets (at least as massive as Jupiter)

What are these planets doing here?!
Scattering of planets (“relaxation”) in dynamically active systems can lead to many properties of the observed distribution of orbits (also predicts ejection of planets altogether...)

We model with high-precision “N-body” (gravitational) simulations of many statistically identical realizations of particular initial conditions.

Highly non-linear problem
100 planetary systems, 10 initial planets each, evolved over 10 Myr (Scharf & Menou 2009)
We use Monte Carlo techniques to generate fake data (i.e. for an imaginary observer studying this population of planets at arbitrary time and relative orientation)

Issues include:

Dealing with the small numbers in the (interesting) “tail” of the planetary distribution

Mining the outputs: $10^7$ yr timelines, snapshots per year for 1000 objects, changes/events occurring on both on very short and very long timescales

Determining appropriate statistical questions to ask - e.g. what is conditional probability for outermost planets?