Nebular Disk Model

Also called accretion disk model. A basic model which is widely accepted.

A collapsing interstellar cloud will begin to rotate rapidly through conservation of angular momentum.

Collisional interactions of cloud molecules evolve the shape to that of a flat, rapidly rotating disk. *(Solves #1, 2, 3, 4)*

As the cloud condenses, increasing pressure increases central temperature. At >1 million degrees, H fusion starts.

"A STAR IS BORN"

The disk reaches a stable equilibrium in its vertical structure (z direction). This represents a balance between the gas pressure outward and the gravitational force inward. *(Solves #6, 7)*

Unsolved problem: Loss of Sun's rotational angular momentum. *(#5)*

Solution: T-Tauri magnetic braking?

Chemical Evolution of the Disk

The initial disk temperature probably exceeded 2000 K. As the disk cooled, elements could condense from gaseous state to solid forms.

Refractory elements - those with high melting points were the first to condense.

Examples: Al, Ti, Ca, Si, Mg, Fe, Ni

Common minerals forms:

Enstatite $MgSiO_3$

Feldspars $CaAl_2Si_2O_8$

Olivine Fe_2SiO_4

Volatile elements - those with low melting points were the last to condense.

Examples: ices of H_20, NH_3, CH_4

Volatile elements were far more abundant than refractory elements.

Planets forming where it is cool, with lots of volatiles available, can grow larger.

➔ Gas giant planets!

Condensation temperatures [See Hartmann Figure 5-4]

Nebula temperature gradient [See Hartmann Figure5-5]