According to the giant impact hypothesis, a Mars size body hit the proto-Earth. The impact generated a debris disk around the proto-Earth, from which the Moon was accreted. A big challenge of this model is that the isotope similarities between the mantles of the Earth and the Moon cannot be explained. Pahlevan & Stevenson (2007) proposed that isotope can be exchanged between the disk and the mantle through the Earth’s atmosphere. This model requires the detailed thermodynamical models of the system, but it is not well known yet. Here, we investigated thermal structures of the disk and the Earth’s mantle after the impact based on SPH simulations, by looking at the entropy of the system. We found out the following results: (1) The disk has a remarkably uniform entropy. (2) The disk’s vapor fraction is 20% by mass. (3) The mantle is likely to be molten and stable to convection. The result (3) can be a potentially problem for the isotope mixing model. 

**Background**

The Moon forming process

- **protoplanet**
- **impact generated disk**
- **satellite formation**!

Problem: Most of the disk consist of the impactor-origin materials

**Pahlevan & Stevenson (2007)**

- Convection
- Exchange
- Uniform isotope ratios

**Motivation**

We need to identify the initial thermal state of (1) the Earth’s mantle (2) the disk

**Method**

**Smoothed Particle Hydrodynamics (SPH)**

- A Lagrangian method for fluid dynamics simulations
- Each particle have a same mass

\[ \frac{dN}{dt} = \frac{d^2}{dt^2} \]

- Momentum Eq
- Energy Eq

Entropy is independent of resolution

\[ \text{adiabatic expansion/compression} \]