Class Project Abstract

The thermodynamic properties of hcp-iron (ε-Fe) are essential for investigating the internal structure and dynamic properties of planetary cores. Despite their importance to geophysics and planetary astronomy, experimental investigations of ε-Fe at relevant conditions are still challenging. Pioneering works measuring the equations of state (EoS) of ε-Fe include diamond anvil cells (DAC) and shock-wave experiments up to 300 GPa. A recent ramp compression experimental investigation15 of the density-pressure EoS of ε-Fe reached 1400 GPa under unconstrained temperatures.

Data:

Here, the data from multiple experiments on ε-Fe of the volumes (or, density) vs. pressures will be used to illustrate the experimental measurements. I will use data from 7 (or more) experiments in this project, and the total data points will be more than a hundred.

Objective:

There are several equations of state(EoS) functions, i.e., Birch-Murnaghan 3rd EoS and Vinet EoS. The fitting parameters (which makes physical sense as bulk modulus, etc.) using each EoS function will be compared, and I will measure the fitting performance with their uncertainty.

From several pieces of literature, I found that people were directly putting the fitting parameters into the EoS equation, and then extrapolate the pressure range into even exoplanetary region (over 1000 GPa). I will also address the reliability of this kind of extrapolation.

Moreover, I will compare the first principle calculations and experimental measurements, which was what I have been working on.

Method:

Use different EoS models to find which model fits the best of the experiments.