

Studying the interior evolution of rocky exoplanets using machine learning

Several models predict the interior structure of exoplanets, but very few discuss the interior evolution. One such model is VPlanet.

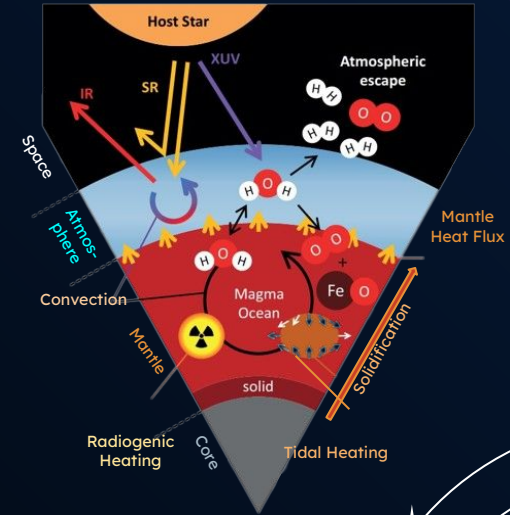


VPlanet
The Virtual Planet Simulator

A code written in C to simulate planetary interior evolution

IDEA

To produce a surrogate machine learning model to study the interior evolution of rocky exoplanets using VPlanet within 0.1 to 4 M_E .



MagmOc module of VPlanet models the interior of a terrestrial exoplanet (0.1 to 4 M_E) from the starting of its formation till the point when the atmosphere of the planet desiccates. It predicts the evolution of some basic properties such as temperature, planet melt fraction, iron oxide mass fraction, atmospheric pressure, water mass fraction in solid, melt and atmosphere, oxygen mass fraction in solid, melt and atmosphere.

Group 11
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Inspired by VPlanet, we aim to produce a surrogate model to predict the evolution using our ML algorithm and possibly go for a broader mass range.

Goals to achieve:

1. Generating datasets
2. Understanding Neural Networks
3. Applying different neural networks to get the best one suitable NN for our work
4. Designing and coding the NN framework
5. Training datasets on this NN
6. Plotting accuracy vs training curve for minimal parameter values
7. Adding additional parameters for accuracy
8. Extrapolating beyond quoted mass range and validation

Plan by midway: Upto point 3 and starting point 4

Expected results: Developing a ML model which can predict interior evolution of terrestrial planets given some basic input parameters over the time scale of molten planet stage.

Datasets: The model will be trained on VPLANet outlets.

Baselines to implement:

- Modeling minimal planet properties with minimal input parameters
- Taking insight of training performance and sensitivity of the model to the input parameters

Work division:

- Generating datasets - Chandan
- Understanding Neural Networks - Combined
- Coding and Building - Combined
- Data analysis and organizing- Combined
- Literature review - Maitrey
- Report Writing - Combined

Relevant papers:

[VPLANet](#)

[MagMoc](#)

[ML for interior structure](#)