Internship for a Master Student / Stage Master M2 (2024/25)

Topic: Exploring the interiors of ice giant planets with atomistic simulations

The interiors of ice giant planets such as Uranus and Neptune are dominated by water-rich molecular mixtures at high temperatures and pressures. Current interior models aiming at modeling the planets' composition in agreement with observations assume a three-layer structure and simplify the complex mixture by using water as surrogate. The resulting interior structure models for Uranus and Neptune suggest that the peculiar, non-dipolar magnetic field geometries observed by Voyager 2 in the 1980s, might be connected to the presence of superionic water inside the planets. This exotic phase is characterized by mobile hydrogen ions that diffuse through a lattice of oxygen ion and has a high protonic conductivity while the electronic conductivity is almost neglectable. However, the models fail to give a convincing description of the planets' thermal evolution and hence, more realistic models based on accurate equations of states for other materials are required. In this project we will explore C-H-O mixtures, that are similar to water, but widely unstudied at planetary conditions.

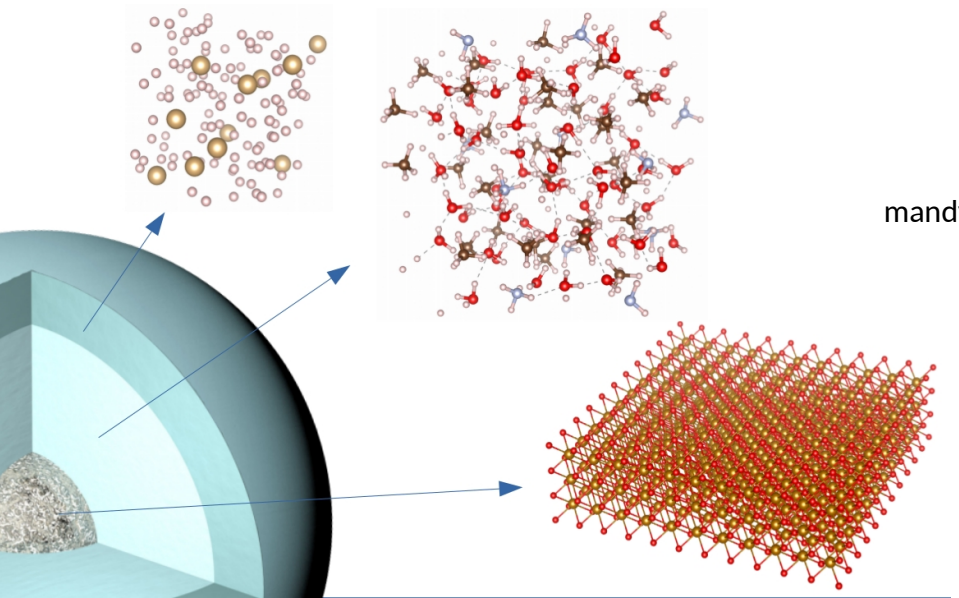
What will you learn?

The internship offers the possibility to learn the foundations of the atomistic simulation technique we apply in our research – density functional theory molecular dynamics. We will compute thermodynamic, structural, and transport properties of C-H-O mixtures using high-performance computing clusters. At the same time, you will gain some insights on planetary modeling and high-pressure experiments (e.g. at LULI 2000).

What do you need to know?

1) most importantly interest in this project
2) fundamentals of quantum physics, computational physics, and/or plasma physics
3) experience with coding (e.g. python, C/C++, Fortran), data handling and/or machine learning would be highly appreciated

The project can be adapted to the candidate's knowledge and interests and has a time frame of 2-6 months. Please don't hesitate to reach out!



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