

Internship for a Master Student / Stage Master M2 (2025/26)

Topic: X-ray Thomson Scattering of Warm-Dense Carbon

Understanding the behavior of **carbon under extreme pressures and temperatures** is crucial for **inertial confinement fusion (ICF)** experiments and for interpreting data from facilities such as the **National Ignition Facility (NIF)**. In these conditions, carbon enters the **warm dense matter (WDM)** regime, where its electronic and structural properties strongly affect energy transport and X-ray diagnostics.

Project Description

This internship aims to **model warm-dense carbon** and compute key quantities relevant for **X-ray Thomson scattering (XRTS)** analysis at NIF.

The student will:

- **Perform DFT-MD simulations** of carbon at conditions relevant to ICF experiments.
- **Calculate the electrical conductivity** from these simulations using the Kubo–Greenwood formalism.
- **Compute the electronic structure factor** $S(q,\omega)$, which determines the XRTS signal.

Candidate Profile

- Master's student in physics, materials science, or a related field.
- Interest in **high-energy-density physics**, **fusion research**, or **computational modeling**.
- Basic knowledge of statistical physics and condensed matter or plasma physics.
- Familiarity with Linux and Python is helpful; experience with DFT codes is a plus.

Expected Outcomes

The student will gain hands-on experience with **first-principles simulations** of matter under extreme conditions and contribute to the analysis of **XRTS data from NIF experiments**. The results will help improve our understanding of transport and structure in warm-dense carbon, directly supporting ongoing ICF research. The results may form the basis for a future publication or PhD project.

Contact

Mandy Bethkenhagen
LULI - École Polytechnique / Sorbonne University
mandy.bethkenhagen@polytechnique.edu

