Internship offered in M2
2018-2019

Responsible for internship

Name: Frédéric DATCHI & Sandra NINET

Location : IMPMC - 4 place Jussieu, 75005 Paris – Coul. 23-24, Et. 3

Group: PHYSIX

E-mail: **frederic.datchi@sorbonne-universite.fr**
sandra.ninet@sorbonne-universite.fr

Telephone : +33 (0)1 44 27 45 06 / 44 59

Group website:

Internship topic: *Probing the oceans of Ice Giants by Brillouin and Raman spectroscopies*

Water and ammonia are major components of the mantle of the giant icy planets Neptune and Uranus, as well as several moons of Jupiter and Saturn. Current models of these bodies generally assume the presence of oceans buried beneath the atmosphere or an outer shell of ice. In Neptune and Uranus, this ocean would be submitted to pressures (P) ranging from 10 to more than 100 GPa (=1 Mbar) and temperatures (T) from 2000 K to 4000 K [Redmer et al, Icarus **211**,798 (2011)]. At these conditions fluid water and ammonia are expected to be partly ionic and electrically conductive, and this liquid shell is thought to give rise to the unusual, non-dipolar and non-axisymmetric, magnetic field of these planets. The most important input for interior models are the thermal and caloric equations of state $P(V, T)$ and $U(V, T)$, respectively, for the relevant materials. To date however, the experimental data on ice mixtures under high pressure is very limited. Our group is one of the world leaders in the experimental and theoretical investigations of ices under extreme P-T conditions. Our recent studies have highlighted remarkable pressure-induced phenomena, such as ionic [Ninet et al, Phys. Rev. B **89**, 174103 (2014)] and superionic ammonia [Ninet et al, Phys. Rev. Lett. **108**, 165702 (2012)] and topologically frustrated ionization in ammonia monohydrate [Liu et al, Nature Com. **8**, 1065 (2017)]. The present internship will focus on the liquid phase of theses mixtures, and will aim to determine the sound velocity and equation of state at high P-T. This will be done using Brillouin spectroscopy, a light scattering experiment which gives a direct measurement of the sound velocity u_s. By measuring u_s as a function of P and T, the fluid equation of state $P(V, T)$ can be obtained by integration of thermodynamic equations. Raman spectroscopy will also be used to probe the evolution of molecular and ionic species in the samples. This research is supported by the ANR through the SUPER-ICES grant.

Techniques involved: high pressure techniques (diamond anvil cells), in-situ Brillouin and Raman spectroscopies

Paid internship: Yes
Can this internship be continued for a PhD? Yes
If yes, type of PhD funding envisaged is: Ecole doctorale