**NAUSICAA Project**

**Request of ILL funding for PhD**

The NAUSICAA (**N**eutron **AU**gmented **S**αβ **I**n **C**ross sections **A**lternative **A**ssessment) project is a collaborative research study including the ILL, the IRSN, the CEA, the TUM, the ESS, the University of Florence and the Ecole Polytechnique de Montréal. This project aims to dramatically increase the accuracy of the international neutron cross section libraries for reactor physics by introducing direct measurements. The most direct consequence of this project will be the tremendous improvement heavy water reactors and cold sources modelling. This project is organized under the auspices of the OECD/NEA, which will bring us a strong support, and in collaboration with the IAEA.

One caveat of the neutron cross section libraries is indeed the evaluation process of thermal neutron cross sections in liquids, especially in hydrogenated liquids in which inaccurate approximations are employed. This problem could be solved by the direct use of measured structure factors S(Q,ω), where Q is the neutron momentum transfer and ω is the neutron energy transfer. Until now all evaluations related to thermal neutron were based upon experiments performed with a momentum transfer Q=0, like IR or Raman. The extension on the whole Q domain is carried out by approximate laws which become clearly wrong in the case of liquids like water. This means that measurements of a real S(Q,ω) enable to get rid of the extension laws approximations and thus to significantly enhance the accuracy of the cross sections.

The first step of the study is now completed. A paper has been submitted for heavy water and a detailed report has been published in the framework of the CRISP project. We have demonstrated the feasibility and the reliability of this method. Two additional steps are foreseen in the next future and will be carried out in parallel. One is the acquisition and refinement of accurate data on light and heavy water in several conditions of temperature and pressure, from ambient to supercritical conditions. The other is the study of cryogenic liquids like liquid hydrogen and deuterium, which is will require several years to carry out the measurements in the best conditions.

NAUSICAA partners proposed to pool resources, like PhD students or permanent staff, or share PhD costs. They all are very interested by this project which may bring, between others, breakthrough in cold sources modelling. Details of the commitments are detailed in the NAUSICAA workshop minutes.

Our project is to rely upon two ILL PhDs, one for each step. The first one will be centred on water, based upon both measurements and Molecular Dynamics calculations and its benchmark with real models using MCNP like codes. The second one will be focused only on cryogenic liquids because of the difficulty of experiments and the lack of adapted quantum modelling tools. The PhD on water could be partially funded by the Ecole Polytechnique de Montréal, provided that the student spends some time in Canada. The University of Florence proposes to teach the PhD student how to perform measurements on cryogenic fluids.

Because the NAUSICAA project will bring very high level of visibility to the ILL for a negligible cost, I’m requesting a strong support from you when discussing about PhD funding (and internships) this year.