IN6-SHARP: towards a new cold neutron spectrometer at ILL. Illustration of the potentialities of QENS to probe the dynamics of Ionic liquids in bulk and under 1D nanometric confinement.

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Following the agreement to strengthen the Franco-Swedish cooperation in the field of neutron scattering, the Laboratoire Léon Brillouin (LLB) is involved in the construction of an inelastic neutron time-of-flight (INToF) spectrometer. After the announcement of the Orphée reactor shutdown in 2019, the project originally planned at Saclay has been transferred to the Laue Langevin Institute (ILL, Grenoble). This renaissance takes the form of a A CRG A contract concluded on September 29 2017 between the DRF of the CEA, the INP of the CNRS, and the ILL. This new SHARP (Spectromètre Hybride Alpes Région Parisienne) project consists in a complete rebuilding of the IN6 secondary spectrometer: sample environment, time-of-flight chamber and detection. This talk will start by an update on the project.

We will then illustrate the potentialities of Quasi-Elastic Neutron Scattering (QENS) in the study of Ionic liquids (ILs). ILs are pure solutions of charged organic molecules with no solvent. These molecular electrolytes show a property original for a pure liquid: they self-organize in nanometric fluctuating aggregates [1]. When probed at the macroscopic scale, ILs behave as highly dissociated (*i.e.* strong) electrolytes [2] while, at the molecular scale, they show clear characteristics of weak ionic solutions [3]. In this talk, we report a multi-scale analysis that sheds new light on these apparently at odd behaviors [4,5]. We then address the conductivity of electrolytes directly relevant to the field of electrochemical storage systems: ILs charged with lithium salts. We show that these electrolytes confined in composite polymer CNT (Carbon NanoTube) membranes show a drastic and unprecedented increase in ionic conductivity: we report conductivity gains by a factor up to 50 compared to the bulk analogues. Such CNT membranes are a possible route to boost the transport properties and hence the specific power of lithium batteries [6,7].

On a more neutron technical ground, this talk will illustrate on the practical case of the multiscale dynamics of a bulk IL, the RRM (Repetition Rate Multiplication) method [8] on INToF spectrometers. With this setting, successive wavelength bands are selected within each of the incident neutron pulses, resulting in an extended mapping of the (Q,ω) space. As this will be a routine mode on INToF instruments at the European Spallation Source (ESS), a take-home message will be that, to take full advantage of the ESS potentialities, it is time to get hands-on practice in this new method.

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