New Methods for Spin-Echo Spectroscopy with Small Samples: Wide Angle NSE and Helium Spin-Echo

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Neutron spin-echo spectroscopy has seen large improvements in both resolution and signal in recent years. More importantly, even, the availability of NSE spectrometers to users around the world is rapidly improving as new instruments are being built at most facilities. These developments will allow for a significant increase in the size of the scientific user community. In my presentation I will discuss several recent and future advancements that could help users substantially in taking full advantage of the NSE technique.

In general, one of the problems most often encountered in the analysis of NSE data is the bad statistics of data if measurements are taken outside of the SANS regime. For larger scattering angles the small solid detection angle that is typically associated with NSE spectrometers kills a large part of the NSE advantages over TOF spectroscopy.

At ILL we are, hence, designing a wide angle NSE spectrometer to significantly increase the solid detection angle. I will give a description and status report of the WASP (Wide Angle SPin echo spectrometer) project which is going to replace the prototype NSE spectrometer IN11. The design of WASP profits from the experience gained with the novel spectrometer SPAN which has recently been commissioned at the Hahn-Meitner Institute in Berlin, Germany [1]. Careful field analysis revealed that within this design a near perfect $\cos^2$ field shape [2] can be created along the neutron trajectories, so that field correction can be minimized.

For surface scattering the low signal problem has been attacked by replacing neutrons by helium-3 atoms as probe particles. He atoms are strictly surface sensitive and large fluxes can be created using nozzle expansion sources. A newly built HeSE spectrometer in Cambridge, UK, has been used to measure molecule dynamics on single crystal surfaces in the ps to ns time range for the first time [3]. Recent measurements also show that by combining NSE and HeSE we can now look at slow dynamics in confinements from a completely new point of view.

Finally, I will touch the problem of the theoretical framework for the analysis of NSE data. Most often oversimplified pictures are used for describing both the instrumental response and the sample dynamics. It is crucial at this stage to keep revising the models and to develop more versatile and user friendly tools for the analysis of NSE measurements. This is important for attracting a wider user community in future and for establishing NSE as a truly mature technique.

[1] C. Pappas, R. Kischnik and F. Mezei, Physica B **297**, 14 (2001).
[2] C.M.E. Zeyen, P.C. Rem, R.A. Hartmann and L.J.N. Klundert, IEEE Trans. Magn. **24**, 1540 (1988).
[3] A.P. Jardine, S. Dworski, P. Fouquet, et al., Science **304**, 1790 (2004).