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Workshop summary: "S(Q) measurements by chopper machine"

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Total diffractometers are used to measure S(Q) (S(Q): static structure factor, Q: momentum transfer) of liquids and glassy materials. However, measured S(Q) are integration of S(Q, E) along non-constant Q path and weighted by I(λ) (see references). Therefore it is almost impossible to obtain "real" S(Q) although many correction methods have been developed. Especially, in liquid samples, which contain light atoms like hydrogen, inelastic effect is not negligible and very careful data reduction is required. In a next generation pulsed neutron source, S(Q) of liquids with very high accuracy will be very important and a quick data reduction will be also required. One of the idea which can satisfy these requirements is to measure S(Q,E) and integrate it to obtain accurate S(Q). Taking into account the required Q-resolution and the high Q-maximum, direct geometry instrument (chopper machine) may be the best choice. As far as now, this kind of spectrometer designed so as to balance energy resolution against intensity and Q-resolution is not got enough for S(Q) measurements because a large beam divergence caused by a large sample size. For S(Q) measurements, 1% energy resolution is not required but 1% resolution at $Q = 1 \text{ \AA}^{-1}$ is required at least. This means its intensity can be increased by large solid angle coverage with short distance of sample to detector (L2) and sample size should be balanced against detector element size. The energy resolution may be 3 - 5 %, which is the most popular resolution on MARI at ISIS. It may be possible to choose 1.5 m for L2 to achieve such energy resolution with viewing sharp

pulse-shape moderator. Also, such compactness leads to increase total number of chopper machine and allows vertical arrangements of detectors without digging the ground.

The other aspect of a compact and lower energy resolution chopper machine is a high throughput $S(Q,E)$ machine. It is also worth to consider needs of 10% energy resolution experiments. One of an example of such kind of experiment was presented by Ken Andersen is his study of ^4He liquids on MARI. In this study, first and second moment of $S(Q,E)$ are important but much more intensity is essential. A larger sample size and other devices like super-mirror guide will gain intensity. It may be very nice to have 100 times intensity of MARI.

Conclusion

$S(Q)$ measurements by chopper machine may be important in a next generation neutron source. It will be very compact chopper machine and useful not only for $S(Q)$ measurements but also for other measurements of dynamics itself. This kind of $S(Q)$ measurement is not conventional as total diffractometers.

Therefore, more feasible design work of this machine should start.

References

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