Very High Intensity Diffractometers on Continuous Neutron Sources

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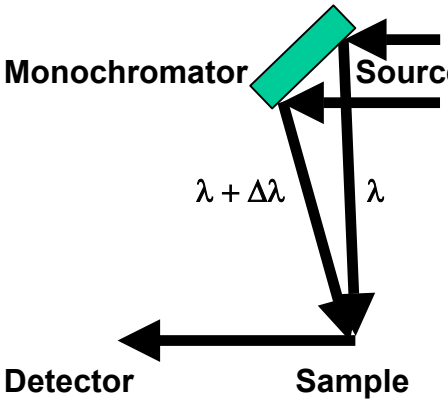
Continuous neutron sources like reactors can deliver a very high time averaged flux to the sample [1] using a relatively wide band of wavelengths, while still retaining high resolution. For example, the D20 diffractometer at ILL Grenoble, the world's highest flux neutron powder machine, can collect complete patterns in as little as 100 ms, and this has been important for the real time study of explosive SHS reactions [2]. The flux on the D20 sample, at more than $5x10^7$ $n.cm^{-2}.sec^{-1}$, is 25 times higher than at GEM on the world's current best pulsed source, yet the D20 detector is 15 times smaller than that of GEM. The ILL DRACULA [3] proposal would use a 6 times larger 2D PSD and would be unmatched for the speed of data collection from small samples, even for the future planned US-SNS diffractometers.

DRACULA would be the world's fastest diffractometer for small samples, such as those used for pressure experiments, for very high magnetic fields, for very absorbing materials, and in general for new compounds which are usually only available in small quantities. With it's 2D detector, DRACULA could be used for both powders and single crystals, and with a relatively small number of detector channels, for very fast real-time experiments.



	D20	GEM	DRACULA	SNS
Flux average sample	$5x10^7$	$\sim 2x10^6$	$\sim 10^8$	$\sim 2.5x10^7$
Detector solid angle	0.27sr	4.0sr	1.5sr*	3.0sr
Effic^y=Flux*Detector	1.7	1	18	9

*cf D19: R=760 mm, h=400 mm, 800 linear resistive wires 30°x160°

Fig. 2: Comparison of DRACULA with US-SNS pulsed source.

Fig. 1: Wavelength focusing gives high flux.

An even wider band of neutron wavelengths is used for quasi-Laue diffractometers such as VIVALDI [4] at ILL. Like TOF diffractometers, these machines use an almost white neutron beam, but on a reactor this white beam is continuous and the flux on the sample correspondingly higher. A new type of quasi-Laue machine, OrientExpress, using CCD neutron detectors of even greater efficiency, has recently been developed at ILL by B. Ouladdiaf.

References

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