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#11-34 Multitube detectors as an alternative to Uranium fission chambers for neutron beam monitoring

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Neutron beam monitors are key instrumental components in neutron scattering science; they are used to measure the instantaneous neutron flux upstream the sample in order to normalize the experimental data. The measurement consists in converting a small fraction of the neutron beam into individual pulses or into a current signal. Among the different monitoring systems used, Uranium fission chambers operated in pulse mode are considered as the state of the art, thanks to their robustness, high stability and low sensitivity to gamma. Their sensitivity to thermal neutrons is proportional to the density of U235 atoms in the thin convertor film deposited inside the chamber. This parameter being fixed by fabrication, it must be specified according to the range of counting rate the monitor must deal with; this range is defined on one hand by the limit of statistical fluctuation imposed by the experiments performed on the instrument, and on the other hand by the limit of counting rate before monitor saturation becomes an issue. The optimal sensitivity of a beam monitor is the one corresponding to this second limit. When purchasing a fission chamber, the requested sensitivity is generally specified in a conservative way, at a value lower than the optimal sensitivity. This is done to take into account 2 types of uncertainty: first a factor of 2 discrepancy between the sensitivity specified and the sensitivity measured is not rare. Second, the precise value of the maximum flux deliverable on an instrument is often lacking, in particular for new instruments. This reduction of the monitor sensitivity results in a degraded normalization procedure at low flux, due to poorer statistics. To this respect, a beam monitor with adjustable sensitivity would be of considerable interest. The MultiTube beam monitor presented in this paper allows changing the neutron sensitivity parameter easily. Its principle consists of proportional counters machined side by side by spark erosion in a block of Aluminum. The gas mixture contains a small fraction of a neutron sensitive component, generally 3He or N2, and a valve allows changing the gas mixture. Even though the wall of the tubes is 0.5 mm thick, this beam monitor can be operated in a vacuum environment without deformation of its mechanical structure. Furthermore, the MultiTube does not emit fast neutrons like in U235 fission chambers.
For all those aspects, the gas-filled MultiTube monitor is an attractive alternative as it allows adjusting the detection efficiency with a very good accuracy –around the percent level –and covering a broad range of efficiencies, at least comparable to Uranium fission chambers. Experimental results show that it provides a more uniform response, and a better transparency to neutrons, close to 97.5 %, thanks to the 0.5-mm thick aluminum windows and to the absence of organic materials. Its intrinsic geometry guarantees a fast charge collection and the possibility to operate the detector at low pressure enhances further its high counting rate capability. So far, the monitor was tested up to 800 kHz with reasonable count losses (< 10 %). Number of other options, available thanks to the "Multitube"geometry, will be presented, such as absolute flux determination of monochromatic beams, beam profile in 1D, and beam mapping in 2D.

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