# Background Caused by High-Energy Neutrons on the Chopper-Type Neutron Spectrometer 4SEASONS

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Suppressing unexpected and unwanted neutrons (background) is critical for realizing high performance in inelastic neutron scattering instruments, which need to detect very weak inelastic scatterings of neutrons. So is the time-of-flight neutron chopper spectrometer 4SEASONS installed at MLF in J-PARC [1]. One of the most serious causes of the background is high-energy neutrons. To suppress high-energy neutrons which are produced when protons hit the neutron target at a time of $T_0$ and are observed soon after $T_0$, we have installed a so-called $T_0$ chopper. Although this chopper successfully suppresses this kind of high-energy neutrons [2], we recently found another kind of the background probably caused by high-energy neutrons. The latter is observed even in a time region much larger than $T_0$. Its intensity is almost constant, but oscillates weakly as a function of time with a period corresponding to the rotation of the monochromating chopper (Fermi chopper). These characteristics are quite similar to those observed at the spallation neutron facility ISIS in Rutherford Appleton Laboratory, UK, when ISIS utilized uranium as the neutron target material. There, the origin of the background was proved to be high-energy neutrons continuously emitted from the neutron source by nuclear fission (delayed neutrons) [3]. Therefore, we speculate the origin of the background observed on 4SEASONS is of the same origin, though MLF does not explicitly utilize a fissioning material for its target. This suggests that an inelastic scattering instrument should be designed paying attention to the effect of the delayed neutrons even in recent facilities whose neutron targets are not fissioning materials. In the presentation, we show the features of the delayed-neutron background in detail including its intensity compared to the inelastic scattering signal, and discuss how to minimize its effect in the observed data.

References

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