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Event Logic and Data Reduction in Continuous Beam Muon Spin Spectroscopy

Typical time spectra measured in muon spin spectroscopy (μSR) are histograms of the detected positron times from one or multiple positron detectors as a function of time after implantation of the muon. In experiments at continuous muon beams, an online event logic is applied to the incoming streams of single detector hits [1,2]. Its two main purposes are (i) data reduction by multiple orders of magnitude and (ii) identification and rejection of invalid events. The latter are primarily due to multiple muons being present simultaneously (pre- and post pileup), detector noise (missing coincidence events), and muons missing the target. Associated with this are a significant number of detector type, detector geometry and readout-electronics dependent configuration parameters. We have refactored the corresponding code into a standalone event logic library which is sufficiently configurable to be used in all current PSI μSR spectrometers. Feeding this library with artificial, simulated or experimentally measured event streams allows us to elucidate the origin of measurement systematics and to optimize the configuration parameters offline. Here we present simulated and initial experimental results from the Flame spectrometer with normal and MORE-kicker operation.

[1] T. Prokscha et al., Physica B 404, 1007 (2009)
[2] A. Amato, et al., Rev. Sci. Instrum. 88, 093301 (2017)

Email

jonas.krieger@psi.ch

Funding Agency

Supervisors Name

Supervisors Email

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Primary authors: KRIEGER, Jonas A. (Paul Scherrer Institute); HICKEN, Thomas (Paul Scherrer Institute); JANKA,

Gianluca (PSI); Dr SALMAN, Zaher (Paul Scherrer Institute); SUTER, Andreas; LUETKENS, Hubertus (Paul Scherrer Institute); PROKSCHA, Thomas (Paul Scherrer Institute)

Presenter: KRIEGER, Jonas A. (Paul Scherrer Institute)

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