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New Features in ADTimePix3 Controls for Neutron Detection

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The TimePix3 detector, developed by the Medipix collaboration, has emerged as a powerful tool for neutron detection applications at Department of Energy (DOE) National User Facilities, including the Spallation Neutron Source (SNS) and High Flux Isotope Reactor (HFIR). This presentation introduces new features and improvements in the EPICS area detector driver (ADTimePix3), specifically designed for neutron detection experiments.

Recent developments focus on optimizing the driver for weak neutron signals through several key innovations. A dual raw .tpx3 channel system has been implemented, with one channel dedicated to real-time neutron processing that maintains compatibility with existing neutron detector infrastructure. The preview channel now offers enhanced functionality, including summation and averaging capabilities for low count rate experiments, while ongoing development includes direct computation of Time-of-Flight (ToF) histograms and advanced hardware triggering acquisition modes.

To address data rate challenges, we have developed an Advanced Mask Generation and Control system. This innovative feature provides an areaDetector image mask system supporting arbitrary shapes through circular and rectangular elements for both single-chip and quad-chip detector configurations. The system includes Binary Pixel Configuration vector generation with automatic file generation and upload from EPICS waveforms, enabling flexible and efficient data collection.

Radiation effects mitigation has emerged as a critical need in neutron experiments, as high-energy radiation can cause various detector artifacts such as temporarily activated “hot” pixels, non-counting double columns, and elevated count rates in specific chips. We have developed correction and mitigation tools to address these radiation-induced effects, which are particularly important in high-radiation neutron experiments.

This work represents a significant step forward in the integration of advanced detector technologies into the EPICS control system framework. Future work will focus on further refinement of calibration and equalization methods to optimize detector performance in DOE’s Scientific User Facilities.
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