

Development of a pipelined data acquisition system for μ SR experiments at J-PARC

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“MUon Science Establishment” (MUSE) at J-PARC starts the delivery of the pulsed μ beam to experiments at the autumn of 2008. The maximum magnitude of the beam is estimated about three orders higher than that of KEK-Muon Science Laboratory (KEK-MSL). This high magnitude brings us an unprecedented amount of μ decay events in a bunch. On the other hand, the existing detector, electronics and data acquisition system will not be tolerable any more because of the high single rate.

The detector used in KEK-MSL consists of 64 scintillators and the signals are read by the CAMAC TDC (LeCroy 3377). The TDC observed about 5 hits per bunch. This TDC can hold up to 16 hits per trigger and it is quite insufficient for experiments in MUSE. In the ordinary way, the solution is the replacement of the detector that has more finger segmentation. But the three orders higher segmentation is unrealistic and hard to read by the CAMAC system. Therefore we will replace three components: the detector that is segmented into a few thousand pieces, TDCs that can hold a thousand hits per trigger and the pipelined readout system.

To supersede the CAMAC system, we chose COmmon Pipelined Platform for Electronics Readout (COPPER) as the platform for the new TDC. This platform is designed in KEK for the high energy physics experiments and currently used more than ten thousands channels from the drift chamber of the Belle experiment. The pipeline based architecture allows the asynchronous readout and the readout software is free from operations associated to the trigger timing. All modules in COPPER system equips the network for the data transmission. This feature makes the data acquisition system free from the crate unit operation and various middle wares for the data acquisition system are applicable. This scalability is sufficient for the experiments in MUSE. The core part of the new TDC is implemented in a Field Programmable Gate Array (FPGA) and the first version is ready to use. One TDC module can handles 64 input channels.

We tested this new TDC module with the readout system at the RIKEN-RAL Muon Facility in the winter of 2007/2008. We will report the result of the performance of this new readout system.