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Sub-Nanosecond Time Resolution in Time-of-Flight Style Measurements with White Rabbit Time Synchronization

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As radiation detector arrays in nuclear physics applications become larger and physically more separated, the time synchronization and trigger distribution between many channels of detector readout electronics becomes more challenging. Among applications requiring the highest precision are time-of-flight measurements which try to determine the time difference in two or more related particle interactions in two or more separate detectors to sub-nanosecond precision, ideally in the tens of picoseconds. Clocks and triggers are traditionally distributed through dedicated cabling, but newer methods such as the IEEE 1588 Precision Time Protocol and its high accuracy profile (White Rabbit) allow clock synchronization through the exchange of timing messages over Ethernet.

We report here the use of White Rabbit, implemented in the Pixie Net XL detector readout electronics, to synchronize multiple modules that read out separate detectors. The timing performance is characterized both coincident gamma rays from Na22 and a split pulser signal. Time resolutions are about 300 ps full width half maximum for Na22 and about 90 ps for the pulser, compared to ~15 ps for 2 channels on the same module using the pulser.

Minioral

No

IEEE Member

Yes

Are you a student?

No

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