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Journal: Physical Sciences Forum (ISSN 2673-9984)
Manuscript ID: psf-2088638
Type: Proceeding Paper

Title: DEVELOPMENT OF A CLOCK GENERATION AND TIME DISTRIBUTION SYSTEM FOR HYPER-KAMIOKANDE

Authors: Lucile Mellet * , Mathieu Guigue , Boris Popov , Stefano Russo , Vincent Voisin

Abstract: The construction of the next-generation water Cherenkov detector Hyper-Kamiokande (HK) has started. It will have an about ten times larger fiducial volume compared to the existing Super-Kamiokande detector and increased detection performances. The data taking is planned from 2027. Time stability is crucial, as detecting physics events relies on reconstructing Cherenkov rings based on the coincidence between the photomultipliers. The above requires a distributed clock jitter at each endpoint smaller than 100 ps. In addition, since this detector will be mainly used to detect neutrinos produced by the J-PARC accelerator in Tokai, each event needs to be timed-tagged with a precision better than 100 ns with respect to UTC in order to be associated with a proton spill from J-PARC, or events observed in other detectors for multi-messenger astronomy. The HK collaboration is in an R&D phase and several groups are working in parallel for the electronics system. This proceeding will present the studies performed at LPNHE (Paris) related to a novel design for the time synchronization system. We will discuss the clock generation, including the connection scheme between the GNSS receiver (Septentrio) and the atomic clock (free-running Rubidium), the precise calibration of atomic clock and algorithms to account for errors on satellites orbits, the redundancy of the system ; and a two-stage distribution system that sends the clock and various timing-sensitive information to each front-end electronics module, using a custom protocol.

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Comments and Suggestions for Authors: Described the challenge of clock generation and time distribution system and corresponding proposed solution clearly. Expected to see the runs under full real conditions.

Submission Date: 25 November 2022
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