

Design and Upgrade of the JUNO DAQ Readout System

Tuesday, 12 May 2026 14:50 (15 minutes)

The Jiangmen Underground Neutrino Observatory (JUNO) aims to determine the neutrino mass ordering and precisely measure neutrino oscillation parameters. Its Data Acquisition (DAQ) system is required to read out, assemble, process online, and store over 40 GB/s of physical data from the front-end electronics. As the first stage of the dataflow software, the readout module's primary tasks include network readout of raw data, data checking, packetization, and first-level assembly.

To simultaneously accommodate triggered and triggerless data assembly, the readout module adopts a pre-processing scheme based on data timestamps, which segments different data types into fixed-duration time fragments. This allows data from the same time fragment to be assembled into full-channel time fragment data for online processing. However, in real-world environments, the fixed-duration time fragment strategy may result in some time fragments containing an excessive number of events, leading to processing timeouts or even memory overflow. To address this issue, a time fragment management (TFM) module capable of global dynamic time fragmentation decisions has been added. Furthermore, a new two-stage processing architecture based on an event bus has been designed and implemented for the readout module. In the new design, the front-end processing stage extracts timing information and sends it to the time fragment management module for centralized dynamic length determination, while the back-end processing stage performs fragmentation and first-level assembly based on the decisions received. Additionally, to handle anomalous channels and further improve software high availability, a channel management module has also been introduced, providing consistent internal and external interfaces for adding and deleting channels, thereby enabling dynamic removal and recovery of faulty channels.

The readout module under the new architecture has been released and deployed for physics data taking at the JUNO site. Compared to the previous version, its dynamic time fragmentation strategy brings significantly higher stability to the system.

Primary author: CHEN, chao (TDLI)

Presenter: CHEN, chao (TDLI)

Session Classification: Session 1: Collider+DM+Neutrino