Title：The status of Back-end card (BEC) for JUNO experiment

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Abstract (max:100):

The Jiangmen Underground Neutrino Observatory (JUNO) aims to determine the neutrino mass hierarchy by detecting antineutrinos from nuclear reactors using a large liquid scintillator volume. The detector uses around 20,000 20-inch photomultiplier tubes powered and read out by two electronics readout systems: underwater and above water. The back-end card (BEC) is a crucial component of the latter and links 7,000 underwater electronics boxes to the trigger system. 180 BECs have been installed and tested at the JUNO site, including self-tests and combined tests. This presentation reports on the current status of the BEC and on the various test results.

Summary(max.500):

The Jiangmen Underground Neutrino Observatory (JUNO) is currently under construction in a 700 m deep underground laboratory in Guangdong province, China. Its main goal is to determine the mass hierarchy of neutrinos using electron antineutrinos from two nuclear power plants (8 reactor cores). With a target mass of 20 kt of liquid scintillator, JUNO will also be able to detect neutrinos from various other sources such as the Earth, the Sun, the atmosphere, and supernovae.

To achieve these physics goals, JUNO employs a system of 17612 20-inch PMTs and 25600 3-inch PMTs to detect light produced when particles deposit energy in the liquid scintillator. The PMT electronics can be divided into two parts: the front-end electronics system performing analog signal processing under water (UW), and the back-end electronics system which consists of the DAQ and the trigger sitting outside water.

A scheme of the Large-PMT readout electronics is presented in Figure 1. The back-end card (BEC) is a crucial component of JUNO's back-end electronics system and plays an important role in the trigger and clock system. It functions as a concentrator to collect and compensate incoming trigger request signals. A Trigger/Timing Interface Mezzanine (TTIM) handles all the trigger request signals, and the hit signals from the various BECs are sent to Reorganize & Multiplex Unit (RMU) cards. The sum of the signals is then forwarded to the Central Trigger Unit (CTU), which makes the trigger decision based on the trigger logic and sends it to the Global Control Unit (GCU) via the RMU and the BEC.

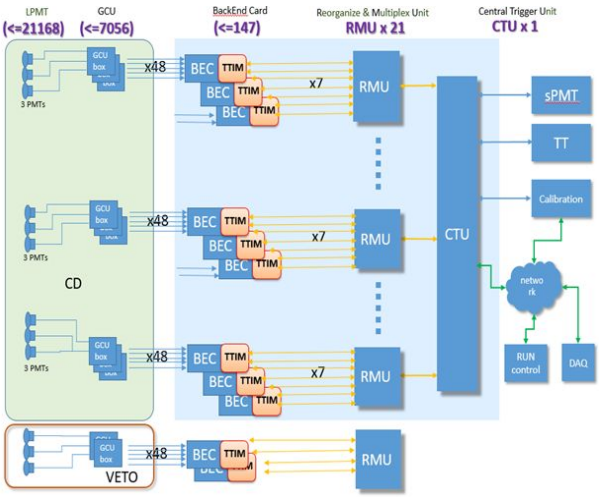

Figure1: Schematic view of the trigger system of JUNO. The BEC functions as a collector and compensator of trigger signals. The other device in the figure is, GCU: Global Control Unit which is located in underwater, TTIM: Trigger/Timing Interface Mezzanine, RMU: Reorganizing and Multiplexing Unit, CTU: Central Trigger Unit, WR: the White Rabbit system, DAQ: the Data Acquisition system.

160 BECs are needed for the JUNO main detector, and 2 BEC for the sub-system: The Online Scintillator Internal Radioactivity Investigation System (OSIRIS) and the Taishan Antineutrino Observatory (JUNO-TAO). All BECs have been tested and installed at the JUNO site. This presentation reports on the BEC current status and the various test results including both direct and indirect tests. A transmission error mass test was completed in Kunshan after production, and an underground test was done after installation. All BECs passed the tests. Figure 2 shows the test setup in Kunshan and JUNO underground. A long-term monitoring of all BECs was conducted to check their work status, with each run taking 48 hours and lasting a period of 1 month. After the partial installation of PMTs and UW boxes, a joint test with LPMT/sPMT + electronics + trigger + DAQ + DCS was performed using a BEC-level trigger, which provided a good result for the trigger system and data acquisition system.

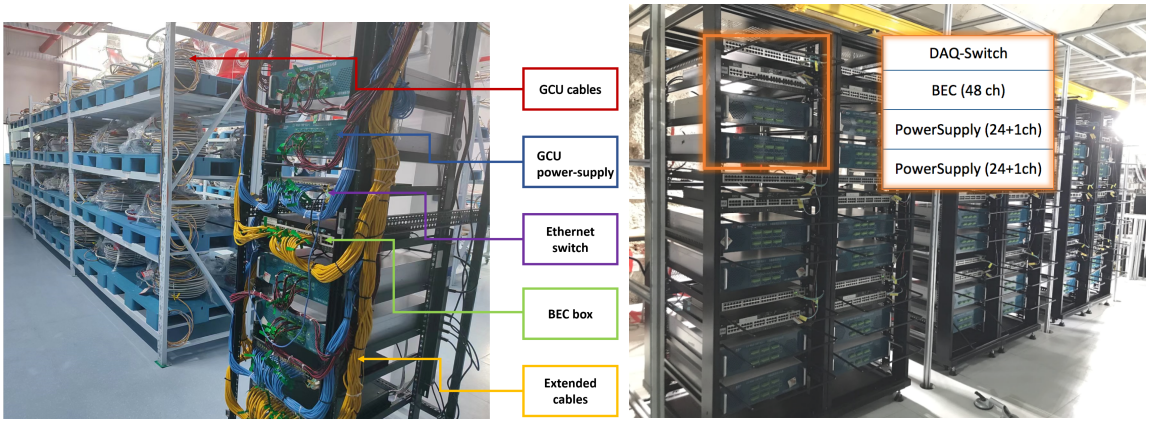

Figure 2: The test setup of BEC in Kunshan and JUNO underground.