The JUNO experiment

The Jiangmen Underground Neutrino Observatory (JUNO) is a neutrino medium baseline experiment with an expected unprecedented energy resolution of 3% at 1 MeV, under construction in southern China [1,2].

Extensive neutrino physics and astrophysics program [1]
- Reactor νe: 60 IBD/day
- Supernovae burst: 5000 IBD + 2300 ES in 10 s (@ 10 kpc)
- DSNB: 2-4 IBD/year
- Solar νe: O(100)/year
- Atmospheric νe: O(100)/year
- Geo νe: ~400/yr

Main physics goals:
- Neutrino mass ordering determination @ 3 σ in 6 years
- Measurement of three oscillation parameters with sub-percent precision

Setup
- 20 kton liquid scintillator (LS)
- 13 boards (GCUs)
- 39 channels (37 active) with PMTs
- 1 back-end card (BEC) with 3 plastic scintillator bars to trigger cosmic muons

Characterization of JUNO Large-PMT electronics in a complete small scale test setup

3 PMTs are connected to 1 UWBox/GCU

Electronics specifications [3,4]:
- Waveform sampling: 1 GSPS
- WD/ Dynamic range: 1-3000 pe
- Acquisition rate up to 10 kHz
- High reliability: 0.5% failure rate over 6 years
- System synchronization: 8 ns clock alignment

44 GCUs are connected to 1 BEC through the synchronous link and to 1 switch through the asynchronous link.

PMTs are the key component in the processing of large-PMT signals: a thorough characterization is required.

Tests of the Large-PMT readout electronics at LNL

Data taking
- Laser
g-- cosmic muons
- calibration sources
- internal test pulser

Waveform properties
- baseline
- noise
- trigger stability

Measured cosmic muon rate = 2.65 Hz. During the test, we verified that all 13 GCUs stayed synchronized over the whole data taking period.

Trigger rate stability
- with cosmic muons (external trigger)
- 13 1-day-long runs over 14 days
- almost 350 consecutive hours of runtime

Slow control:
- check parameters:
  - temperatures
  - internal voltages
  - internal currents
- check connection with HVUs

On-going tests and large-scale integration test

Integration tests in Kunshan, China: mass testing of 344 GCUs at production site

See poster by R.Tricci, Mass testing of Large-PMT electronics at Kunshan for the JUNO experiment

References:
(*) Laboratori Nazionali di Legnaro, INFN, Italy