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JUNO Calibration: hardware and strategy

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The Jiangmen Underground Neutrino Observatory (JUNO) is an experiment aiming to detect rare events, such as antineutrinos originating from nuclear reactors and from the interior of the Earth, as well as neutrinos from galactic and extragalactic sources. JUNO's active target is made of 20 kton of organic liquid scintillator, monitored by more than 40,000 photosensors.

JUNO will act as a huge homogenous calorimeter, designed to measure MeV-scale energy depositions with a resolution better than $3\%/\sqrt{E}$, and with a sub-percent bias. As a consequence, JUNO's most challenging task will be to ensure that such a demanding calorimetric performance is met consistently over a volume larger than $2 \cdot 10^4 m^3$, and for a time period longer than 10 years.

In my contribution, I will introduce the innovative instrumentation that has been developed and that is being built to calibrate the JUNO detector. I will describe how we plan to ensure a linear detector response when using a scintillation medium known to be non-linear at low energy. More importantly, I will explain how we will make JUNO's main photosensors, and their readout electronics, respond linearly over a dynamic range spanning three orders of magnitude, i.e. from single photoelectron (PE) up to more than 1000 PE. While this challenge has been met before on benchtop setups, JUNO's novelty will be the capability to precisely assess the performance of the light-detection system during the actual data taking, by employing simultaneously two different sets of PMTs of different size, which will experience very different illumination levels. I will finally show how JUNO's calorimetric performance is so demanding that it might be affected even by the shape and polishing of the cm-sized envelopes enclosing the radioactive sources.

Collaboration

JUNO

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