JUNO OSIRIS Calibration Systems

Flash talk
Tobias Sterr for the JUNO OSIRIS group
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The OSIRIS Detector

• Due to the ambitious sensitivity goals of JUNO, a high purity level of the liquid scintillator (LS) is necessary
  ➢ The Online Scintillator Internal Radioactivity Investigation System (OSIRIS) was introduced to monitor the purity of this LS

• Main goal: monitoring of the U-Th chains via Bi-Po events ->
  • sensitivity of $10^{-16}$ g/g of U and Th for solar measurements
  • sensitivity of $10^{-15}$ g/g of U and Th for Inverse Beta Decay measurements in JUNO

• A contamination measurement of $^{14}$C and $^{210}$Po will be possible

• After its main purpose is fulfilled, OSIRIS offers a unique chance for low-budget high precision measurements of other topics like pp neutrinos, etc.
The OSIRIS Detector

- Light detection system of OSIRIS:
  - 76 newly developed iPMTs (PMTs with all readout and supply electronics included into base)
  - Two independent calibration systems: Automated calibration unit and Laser calibration system
Laser Calibration System

• For time and charge calibration: distributed fiber system, driven by pico-second Laser (pulse length ≈ 80ps)
• 24 diffusor capsules distributed in inner volume and muon Veto
• Laser system for time and charge calibration:
  ➢ Timing alignment ≈ 25ps (1σ)
  ➢ Charge calibration accuracy ≈ 7 x 10^{-3} p.e.
Automated Calibration Unit (ACU)

- ACU features three calibration sources:
  - High activity source (CS-137, Zn-65, Co-60) $\sum \approx 1\text{kBq}$
    - Used for vertex reconstruction
  - Low activity source (K-40), $\approx 0.2-1\text{Bq}$
    - Remains in the detector as continuing reference
  - Pulsed LED with diffusor ball encapsuled in acrylics
    - Redundant to Laser system
- Of axis calibration due to large variation of detector response along central axis
- Simulation to extrapolate remaining detector
- The ACU is a spare part from the Daya Bay collaboration, modified to the needs of OSIRIS
Expected Calibration Performance

• ACU source calibration:
  ➢ Relative source position accuracy: 0.5 cm
  ➢ Relative precision of energy scale: uncertainty of 0.2% - 0.5% @ 1MeV

• ACU LED calibration:
  ➢ Timing alignment <= 1ns
  ➢ Charge calibration accuracy ≈ 0.01 p.e.
Thank you.

Contact:

Tobias Sterr
Kepler Center for Astro and Particle Physics,
Eberhard Karls Universität Tübingen
Auf der Morgenstelle 14
72076 Tübingen, GERMANY

Phone: +49-7071-29-76276
Mail: Tobias-Richard.Sterr@uni-tuebingen.de