DUNE FD Calibrations

Contribution to Interface Workshop

Caveat:
Calibration system design still in flux.

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Planned systems

- Laser
  - high intensity, to ionize Argon along tracks
  - measure E field map
- Radioactive source
  - single 9 MeV gamma from Cf/Ni source
  - deployed outside FC
- Pulsed neutron source
  - bring neutrons from DD gen. down to 57 keV
  - neutron capture events in 1/2 of the detector

Interfaces with:

1. Detector Safety
2. Life/Personnel Safety
3. DAQ
4. Databases

Personnel Safety

- Laser
  - Eye safety during operation of class 4 laser
    - Interlock on laser box closure
    - Trained personnel with PPE for one-time alignment
- Pulsed neutron source (radiation danger)
  - Proper design of shielding
  - External neutron flux monitoring, possible interlock
  - Possibility of remote operation
- Radioactive source (radiation danger)
  - Glovebox for handling
  - Shielded storage box + safe storage area

Detector Safety (1/2)

- Safety of Calibration equipment
  - During installation
    - Other equipment (DSS, HV, APA) hitting laser periscopes, if already installed inside cryostat
  - During installation and operations
    - Calibrations will populate a large part of the cryostat roof. Moving equipment/personnel bumping calibration equipment, misaligning laser.
- During operations
  - Humidity ingress → ice blocking laser mechanism.
  - Large currents → lateral movement of deployed source

Detector Safety (2/2)

- Safety of other DUNE components
  - Photon detection system
    - Laser beam hitting PD at higher rates than normal → Software to block beam while mirrors stopped or pointing at PD
  - Cryostat insulation
    - Activation of materials by neutron exposure → check materials now, limit pulse intensity

Electrical

- Pulsed neutron source (x2)
  - Starfire n-Gen300 DD generator
  - Op. voltage: 150 kV; Power: 400 W
  - Water cooling closed loop (no ext. water req.)
  - Power and cooling through 3.18 m umbilical
- High power UV laser (x20)
  - Surelite Continuum Nd-YAG 60mJ/pulse, 10Hz
  - 200 - 240 VAC, single ϕ, 10 A, 50/60 Hz
  - Also closed loop water cooling
  - Also fed from nearby power source
- Additional hardware (lower power)
  - Step motors to drive laser mirror movement, radioactive source
  - Laser monitor, neutron monitor

DAQ

- Calibration systems must provide DAQ:
  - "Fast signals"
    - Trigger signal for laser or pulsed neutrons
    - Pulse intensity monitoring for neutrons
  - Slow signals
    - System is powered on/ personnel is on roof
    - Which of the lasers (in which FT) is on?
    - Intensity attenuator settings
    - Encoder settings indicating mirror position
    - Which laser positioning diode fired?
    - Which neutron gen is on?
    - DD gen rate/width settings?
    - Radioactive source position encoder information

Databases

- Description of installed systems
  - Position of laser mirrors, parameters relating encoder readings to angles in detector
  - Position of laser positioning diodes/fibers
  - Results from calibration of system, relating attenuator settings to pulse intensity
  - Full geometry of neutron source moderator
  - Description of DD neutron energy/angle spectrum
  - Rope position offsets for source movement
  - Full geometry of radioactive source
- Operational parameters
  - All the signals described in previous page