Status of the Neutrinos Angra Experiment

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on behalf of Neutrinos Angra Collaboration
Motivation and Design

Objectives:

- Build a small surface detector for Nuclear safeguard with water Cherenkov technique
- Development (detector, electronics…) entirely in Brazil;

The Neutrinos Angra Detector is an assembly of four systems:

- A top active veto with 25 cm height filled with pure water and equipped with 4 PMTs each;
- A Non-Active volume around the detector with 25 cm height filled with pure water, to reduce the flux of low energy particles background;
- An Active Inner Veto around the detector with 25 cm height filled with pure water and equipped with 4 PMTs;
- The Neutrino Target, filled with GdCl3 doped water (0.2%) and equipped with 32 PMTs.
The Angra Collaboration

6 Brazilian Institutes:
- CBPF (Rio de Janeiro - RJ)
- UEFS (Feira de Santana - BA)
- UEL (Londrina - PR)
- UFBA (Salvador - BA)
- UFJF (Juiz de Fora - MG)
- Unicamp (Campinas - SP)

13 Researchers
15 Students
The Experimental Site
The Experimental Site
The Detector Assembly

PMTs (R5912) 8"

Calibration LEDs
The Detector Assembly

September 2017

Iuri Pepe (UFBA)
Dion Ribeiro (UFBA)
Jose Alejandro (UFBA)
Leandro Teixeira (UFBA)

Germano Guedes (UEFS)
The DAQ: Electronics

- 40 PMTs (Hamamatsu R5912)
- 40 HV channels (CAEN SY4527)
- 5 Front-End boards (Custom)
- 5 Digitization Boards (NDAQ, custom)
- 1 SBC (VME Single Board Computer)
- 1 Trigger Boards L1 (FPGA)
- Online system
The DAQ Assembly

January 2018

Digitizer Modules (NDAQ)
8 channels/module × 5 modules
125 MHz, 10 bits (VME)

Front-End (FEE)
8 channels/module × 5 modules
(NIM)

High Voltage System (CAEN)
Model SY4527
The DAQ: online

August 2018

- First complete DAQ (v1);
- Trigger Bug was found: rate is ~150 Hz now;
- FEE Remote controlled;
- NAS Installed;
- Third Commissioning Campaign;
Storage and Computing

August 2018

CBPF Cluster (PCs) - Gigabit Ethernet - Hard Disk - Hard Disk

Tunnel

Dataflow control

Online Monitor

Jupyter HUB

Gigabit Ethernet

Internet

Unicamp Cluster (PCs) - Gigabit Ethernet - RAID Controller - Hard Disk

Trigger Rate

Veto Rate

Neutrinos Angra Dashboard

Status of the Neutrinos Angra Experiment - AAP18 - 10/10/2018
The Commissioning

The Commissioning

Trigger Rate by date

First Campaign

Second Campaign

Third Campaign

Last week
The Commissioning

Time Between Events Histogram - Stopping Muon Candidates

Best fit:
$\tau = (2100 \pm 80) \text{ ns}$
Data Analysis

- Data Analysis meetings are ongoing to develop the software tools
- Main analysis is being developed in python on a collaborative way: testing on a Jupyter notebook and running the final code on a Server or Cluster
- Using python allow us to use a lot of libraries: pyRoot, numpy, SciPy, pandas, scikit-learn, tensorflow
- Data is being stored on Parquet format for efficient disk storage and fast data access
- Currently implementing methods for charge reconstruction on saturated pulses to improve the understanding of cosmogenic backgrounds
Next steps

Steps for the fourth (and last) Commissioning Campaign:

- Generate a clock distributed for all the electronics;
- Acquire individual PMT trigger rate from the trigger system;
- Develop a Online Run Control for Shifters;
- Test the LED calibration system;
- Generate and distribute the clock for the TDCs;
- Include the TDC data into the datastream;

Develop the tools for the data analysis and start the first data analysis campaign after next reactor off period (February 2019).
Final Remarks

- The detector is installed and taking Commissioning Data since March 2018;
- We will do 4 commissioning campaigns to improve the DAQ;
- We are now on the third one;
- Physics Data Taking will start on January 2019;
- So far the detector and electronics are stable;
- Next reactor off period will happen in February 2019;
- First Neutrino results are expected for April 2019.
Thank you!