NYUAD contribution in XENONnT

and

local LXe R&D

The XENON International Collaboration

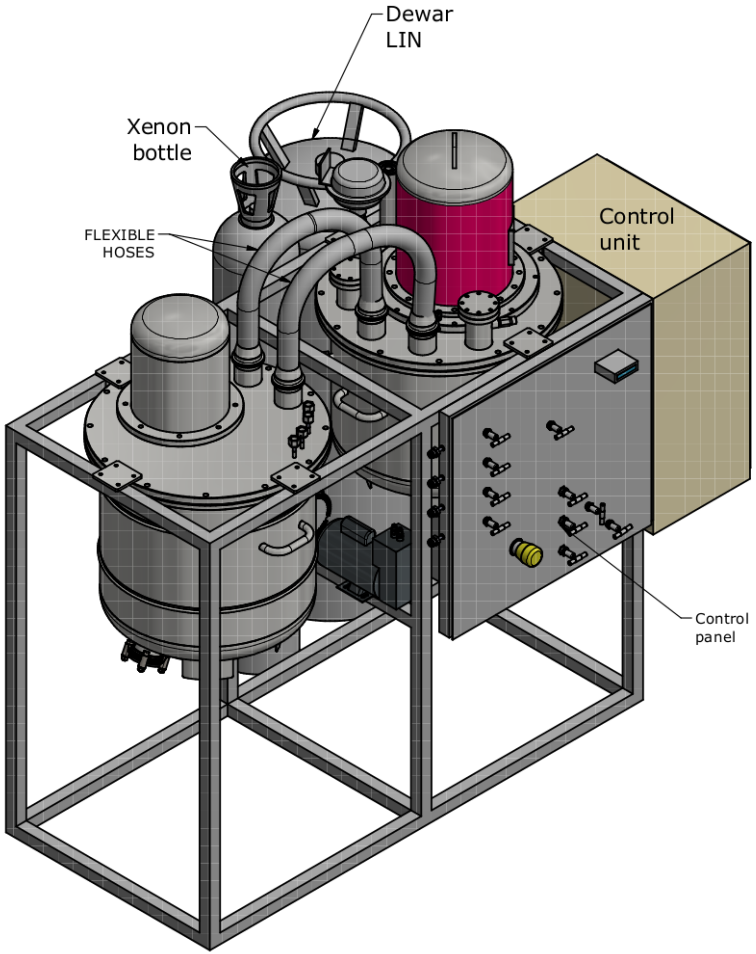
28 Institutions from 12 countries; 170 scientists.

NYUAD contribution to XENON

- **Analisys:**
  1. Development of software tools for the commissioning of the Muon Veto
  2. Contributed to characterizing a deuterium-deuterium plasma fusion neutron generator
  3. Development of a tool (XOM) for extracting and monitoring vital parameters from the TPC data
- **Hardware infrastructures:**
  1. Provided the purification system for the water of the Muon Veto
  2. Designed and installed the resistor chains of the XENON1T TPC
  3. Machining of PTFE components of the XENONnT TPC
  4. Provided a computing server for data transferring
  5. Provided an interactive screen for outreach purposes
- **Xe Inventory**:

  ~ 110 kg of the xenon inventory are owned by NYUAD
- **Commission of responsibilities**:
  1. Run coordination of XENON1T + XENONnT (3+3 months)
  2. Technical coordination of XENON1T (1 year)

R&D: the Cryogenic test facility

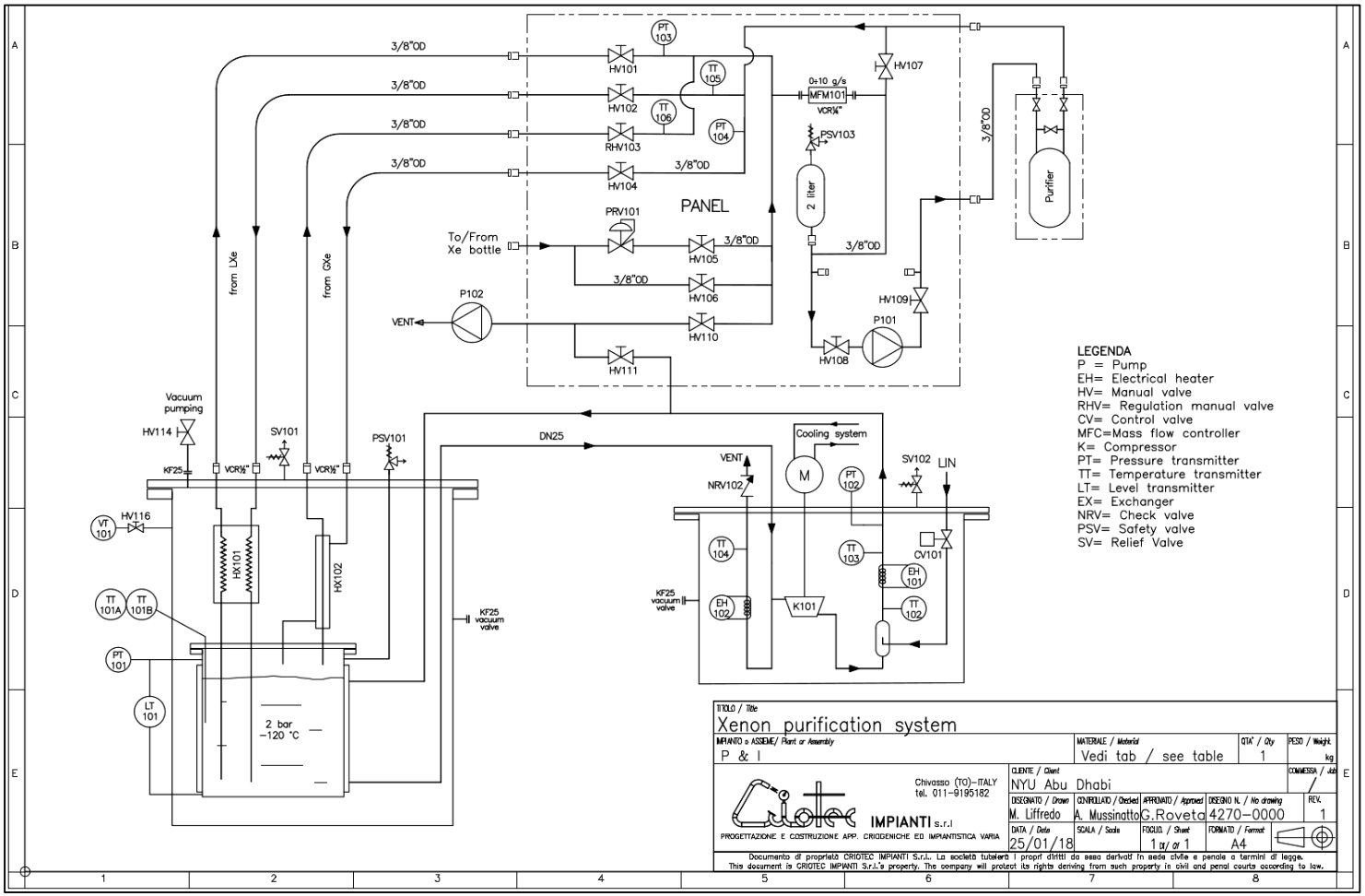


- Two independent loops:

  - N2 gas-liquid mixture

  - Xe/Ar

- 2 heaters (1.0 kW, 2.5 kW)
- SS bellow circulation pump
- Hot SAES getter
- Instrumentation: x8 pt100, 4 pressure sensors, 1 MFM, 2 differential pressure sensors.
- Circulation capability: top and bottom extraction
- Real-time monitoring and control system
- Chamber volume: ~20 L



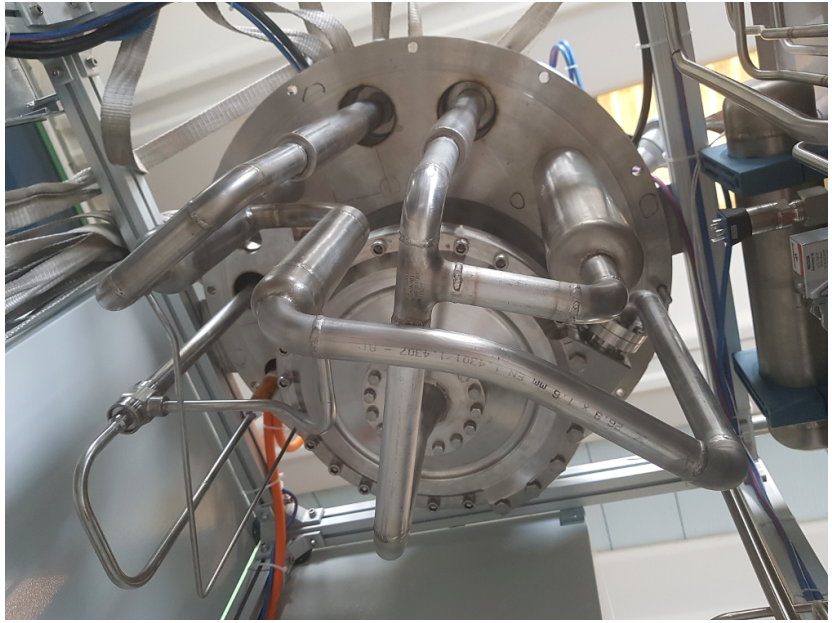
Cooling by **cold GN loop:**

- Phase separator
- LN injection
- Heather
- Copper coil
- Compressor
- Mixer
- 2nd heater
- Venting valve

Hardware details

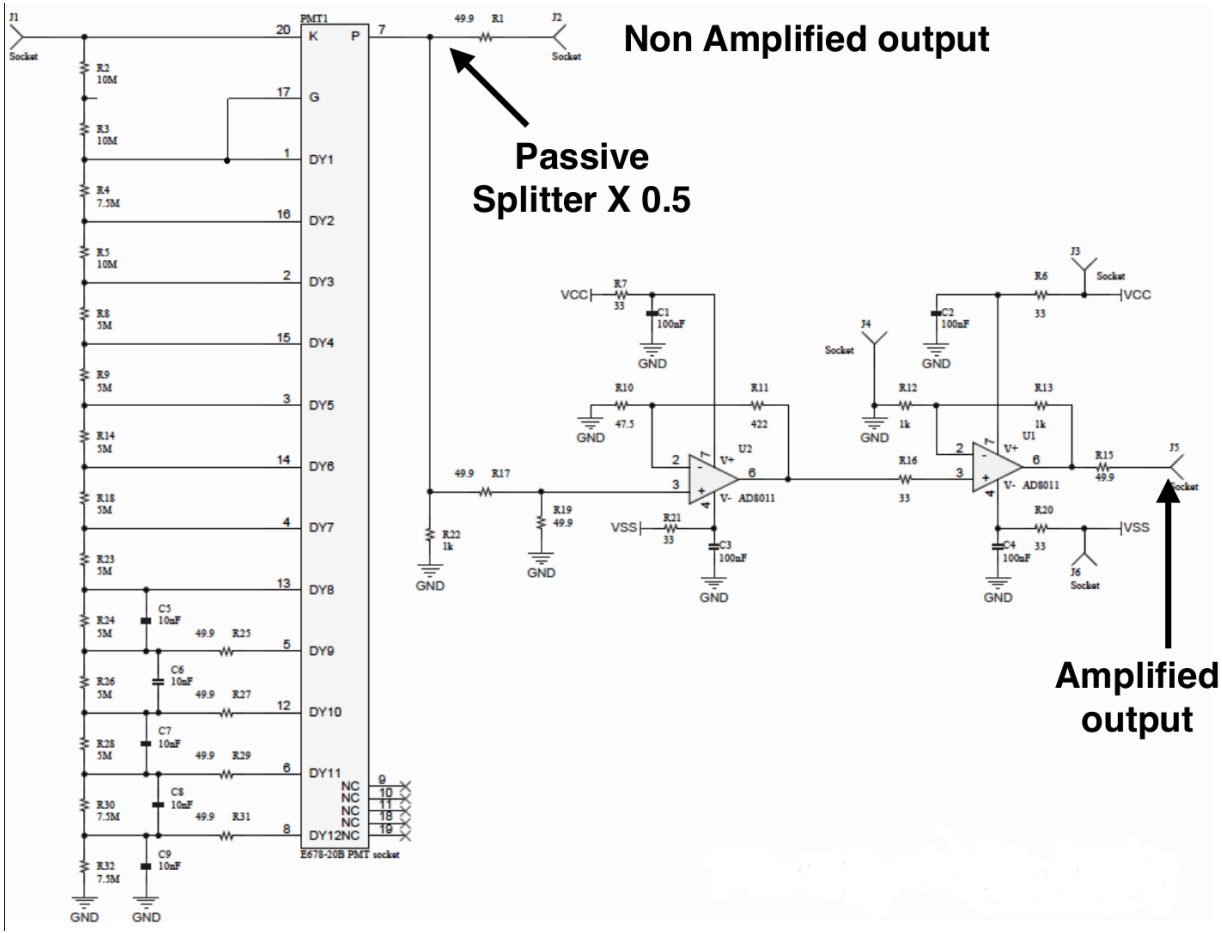
Inner vessel

Cooling circuit



Amplifier for cryogenic applications

Schematic



Specs

- Based on commercial operational amplifiers: AD8011
- Gain: 10
- Bandwidth: 85 MHz
- In/Out impedance: 50 Ω
- Low noise
- Supply voltage: ±5 V

Why do we need an amplifier?

Hamamatsu R11410

For more specs please see: Manufacturer website

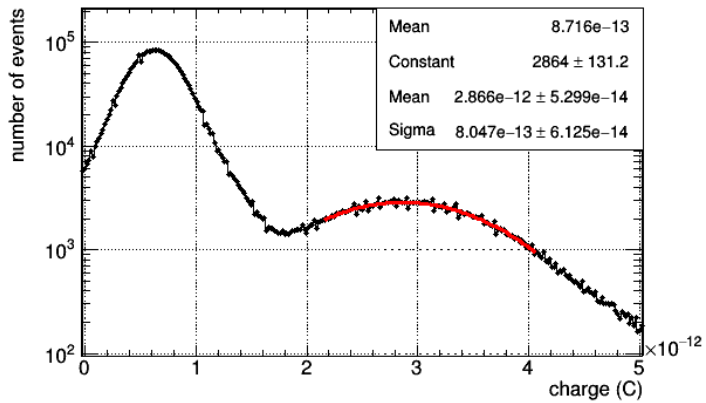
Some PMTs have been observed to emit light, causing an increase of accidental coincidences in face-to-face PMTs setup.

This effect can be suppressed (or at least mitigated) by reducing the supply voltage, hence an amplifier is desirable to match the output signal range to readout electronics.

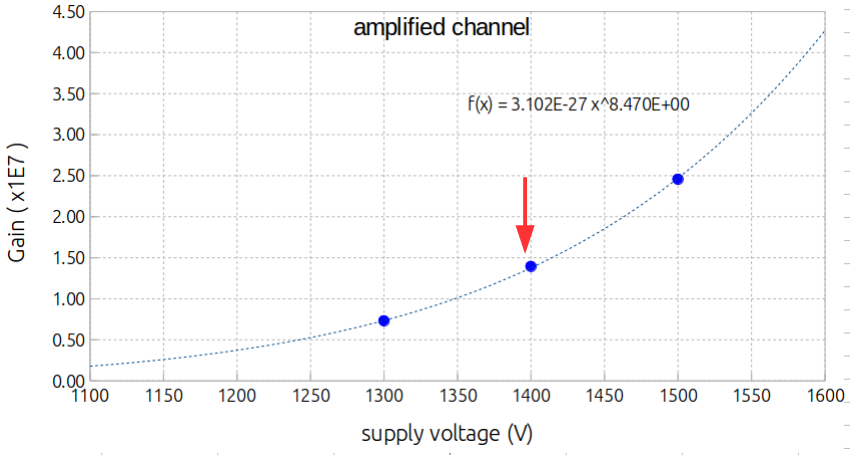
PMT calibration at room temperature

Single photoelectron spectrum

(supply voltage: 1400 V)



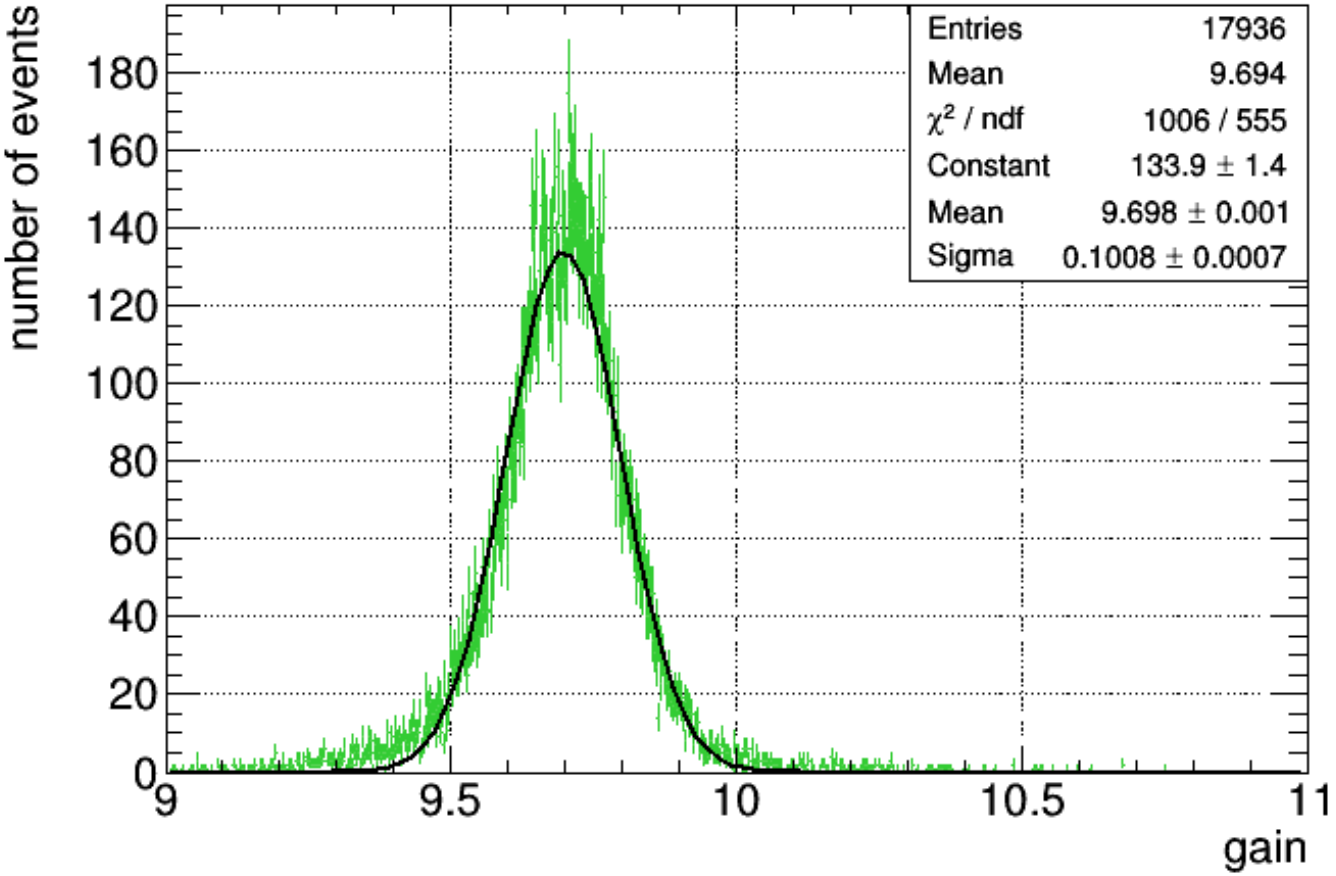
Gain curve



Non amplified channel:

Supply voltage	Gain
1400 (nominal voltage)	1.4E+6
1100	1.9E+5

Gain in LXe temperature



- Temperature of the amplifier: -94 C
- Gain is calculated as the ratio: amplified over non-amplified amplitude
- Supply voltages:

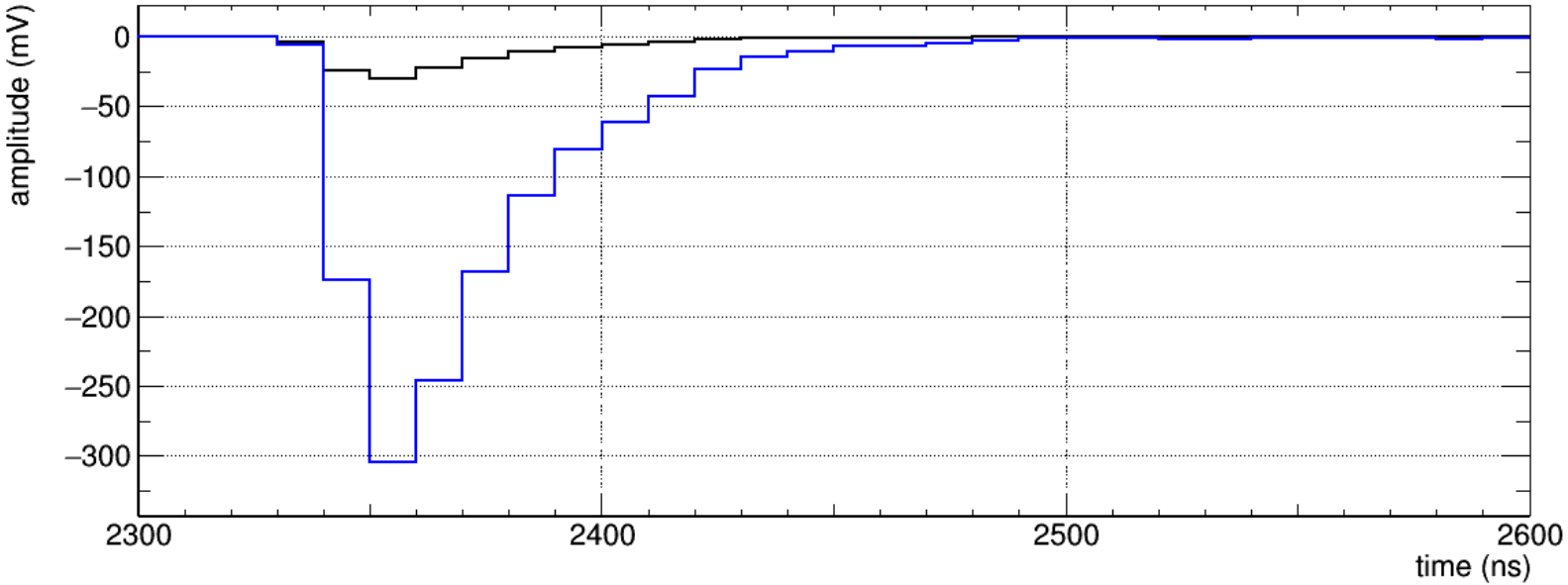
  V_1=+2.5V

  V_2=-7.5V
- Current absorption:

  I_1=1.765 mA

  I_2=-2.422 mA

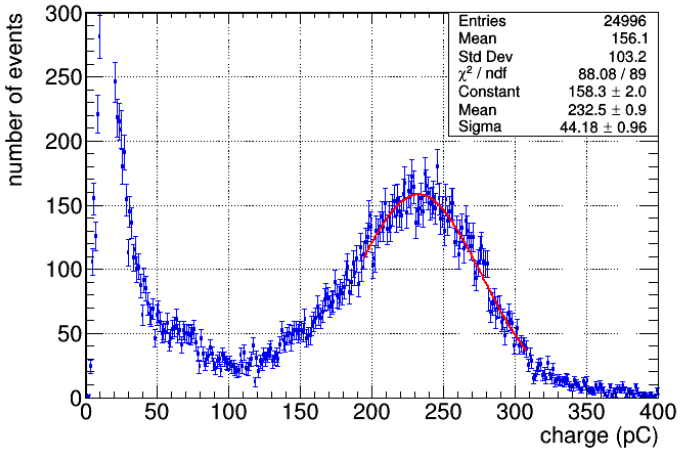
Typical ^{57}Co event in LXe



- PMT Supply voltage: 1100 V
- Sampling period: 10 ns
- Vertical resolution: 0.137 mV

Charge spectra from ^{57}Co

Supply voltage = 1100 V



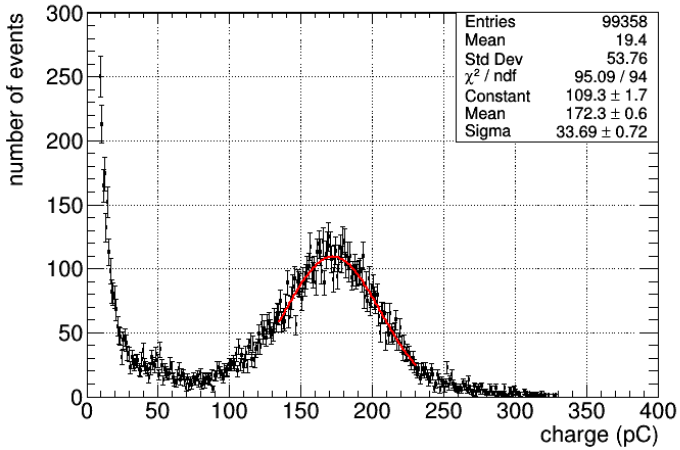
Amplified

μ = 232.5 pC

σ / μ = 19.0±2%

VS

Supply voltage = 1400 V



Non Amplified

μ = 172.3 pC

σ / μ = 19.5±2%

Concluding remarks

- The amplifier has been immersed in liquid xenon showing performance and stability compatible with the design specs.

- The amplifier allows us to operate the pmt at a gain of 1.9E5, obtaining:
  - the same energy resolution (at 123 keV)
  - 35% more signal

  with respect to the nominal voltage.