Campinas FY Measurements: Status and Plans

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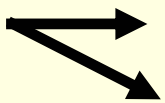
Talk Summary

- Prototype Chamber
  - Apparatus Description and Results
- New Chamber
  - Preliminary Design
- Beams
  - **Radiotherapy Machine**
  - **Sincrotron Light National Laboratory (LNLS)**



Chamber characteristics

- Cylindrical shape stainless-steel chamber
  - Black inner surface
- 25 cm maximum viewable electron path
  - Measurements @ 13 cm
- 2 (fluorescence) +1 (particle monitor) Hamamatsu R1398 PMTs
- Adjustable PMT distance from the axis
  - Measurements @ 8 cm
- Adjustable viewable track length
  - Shutter pipes
- Mylar windows (beam configuration)
- Al collimator (source configuration)

GEANT4 simulation (H. Nogima)

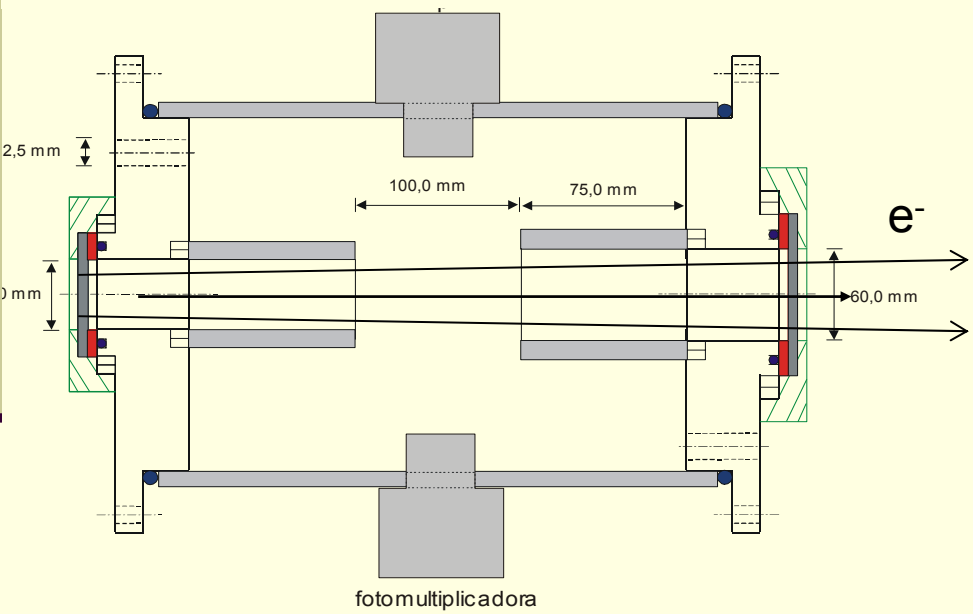
- Design & Project tool
- Background estimation
- ACCEPTANCE !

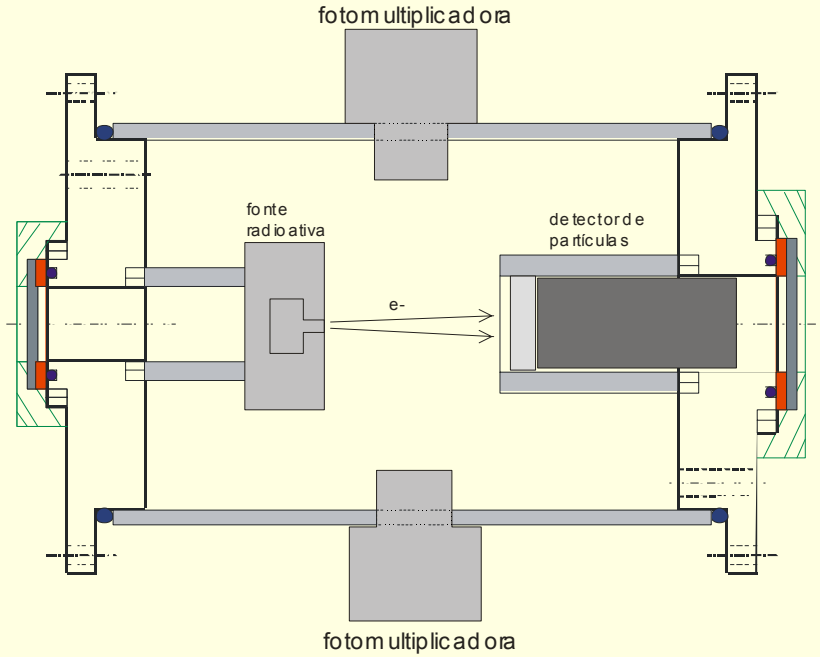
Includes:

- **Full geometry and materials**
- **Parameterized fluorescence yield:**
  (τ = 25ns) + spectral shape
- **Full surfaces optical interactions:**
  absorption, reflection, refraction
- **PMTs glass and the photocathode efficiency:**
  manufacturer specifications
- **Timing information can be tracked to simulate electronics coincidence.**

Chamber Configurations

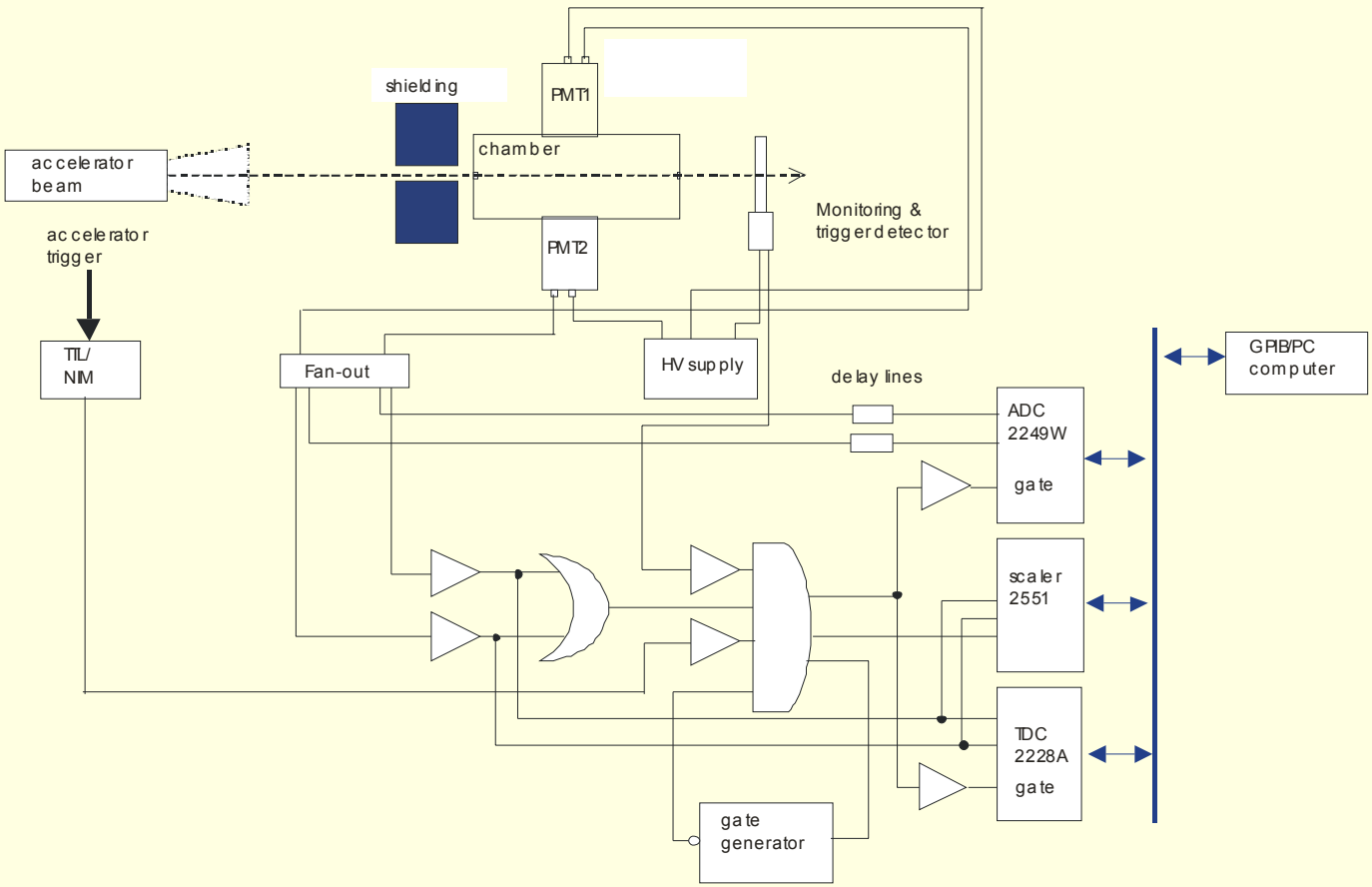
- **Particle Beam**



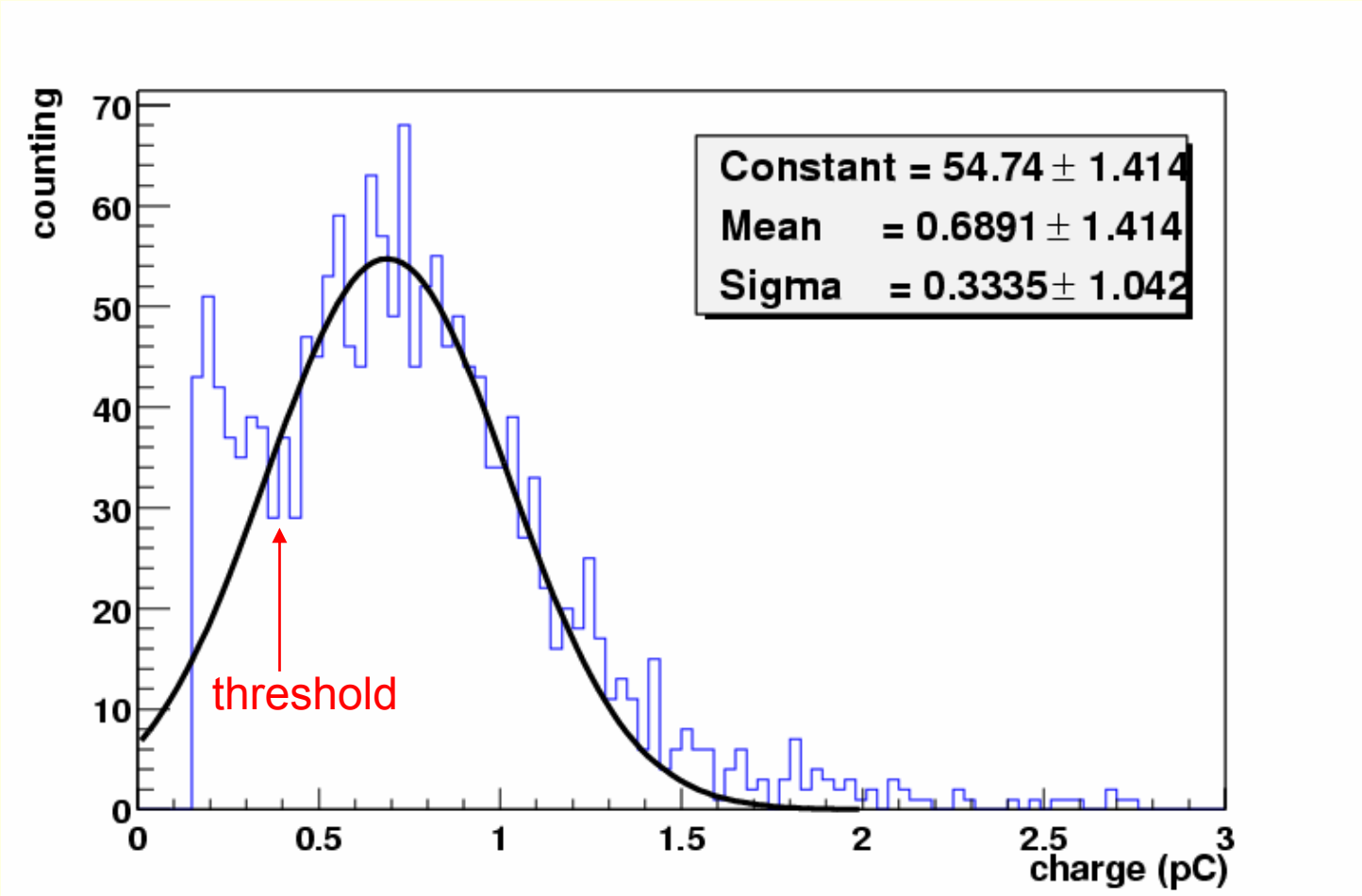


- **Radioactive Source**

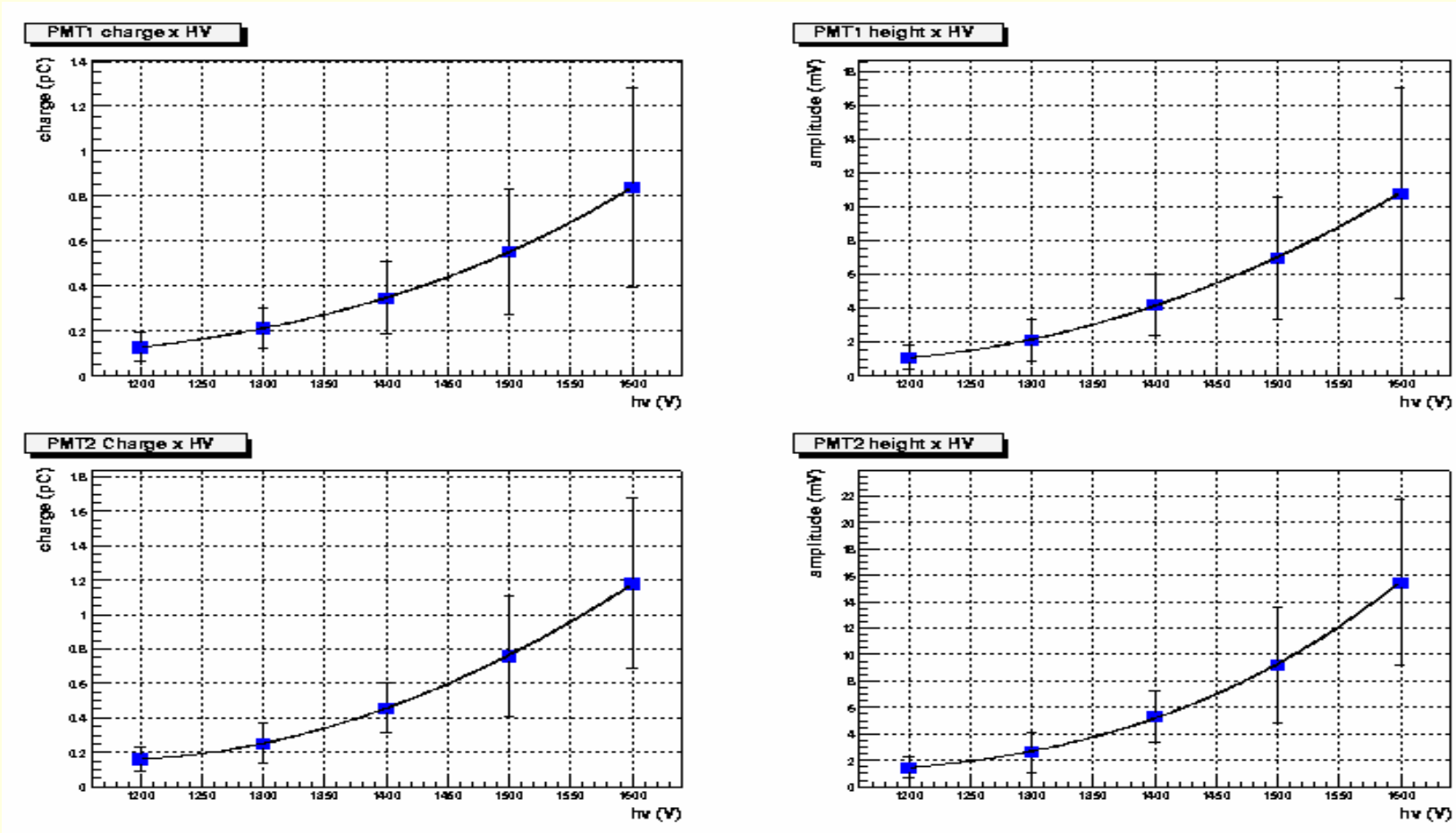
DAQ diagram


shielding
PMT1
chamber
accelerator beam
Monitoring & trigger detector
accelerator trigger
PMT2
TTL/ NIM
Fan-out
HV supply
delay lines
GPIB/PC computer
ADC 2249W
gate
scaler 2551
TDC 2228A
gate
gate generator

PMT Hamamatsu R1398
SPE spectrum



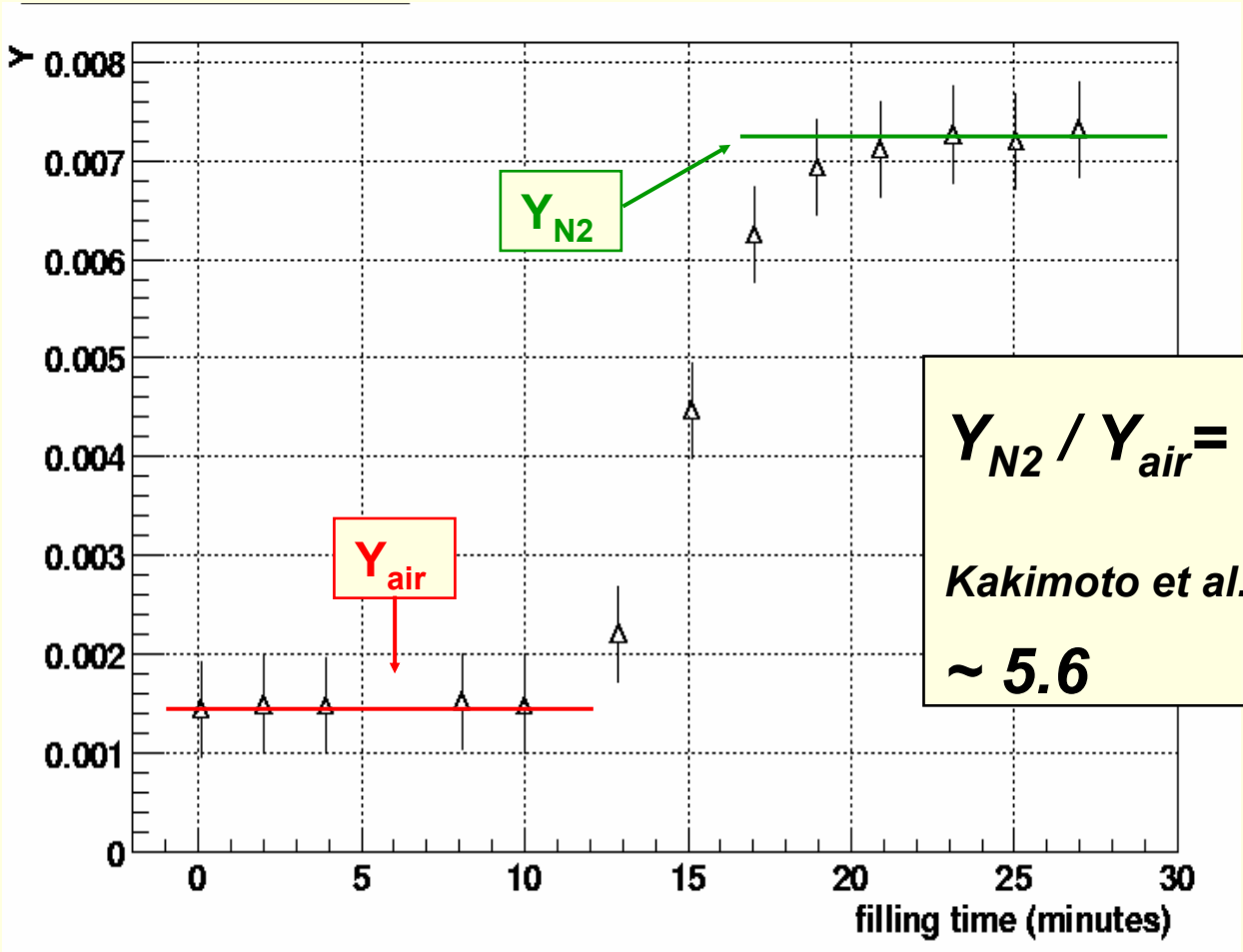
PMTs Gain vs. HV (from SPE spectra)



Relative Efficiency
Gas Filling: Dry Air → N_2

$Y_i = N_E / N_P$

- N_E : coincidence excesses
- N_P : particle detector counting
- i : gas type

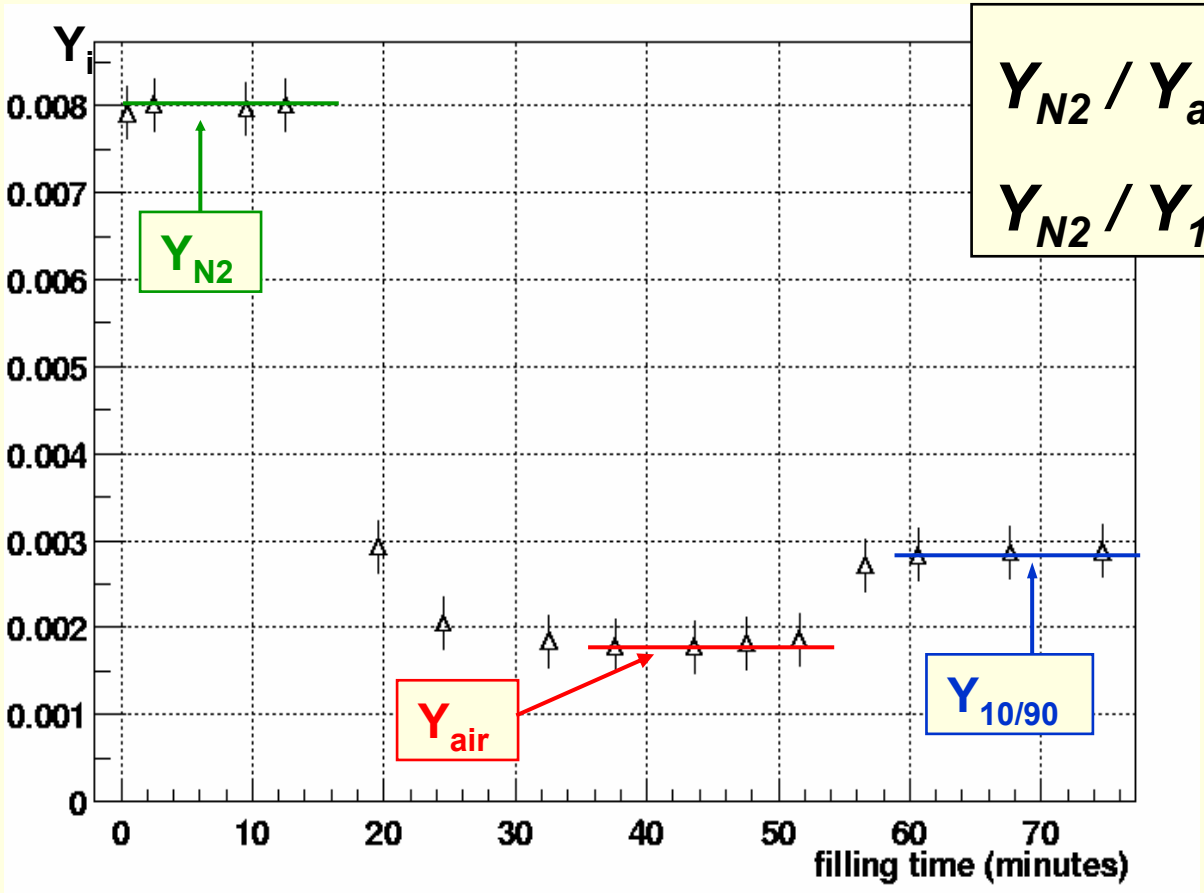


$Y_{N2} / Y_{air} = 5.1 \pm 0.3$

Kakimoto et al. , NIM 372A, 527 (1996)

~ 5.6

Relative Efficiency
Gas Filling: $N_2 \rightarrow$ Dry Air $\rightarrow$ 10/90



$Y_{N2} / Y_{air} = 4.8 \pm 0.2$

$Y_{N2} / Y_{10/90} = 2.9 \pm 0.2$

Fluorescence Yield

- Global acceptance (from simulation):

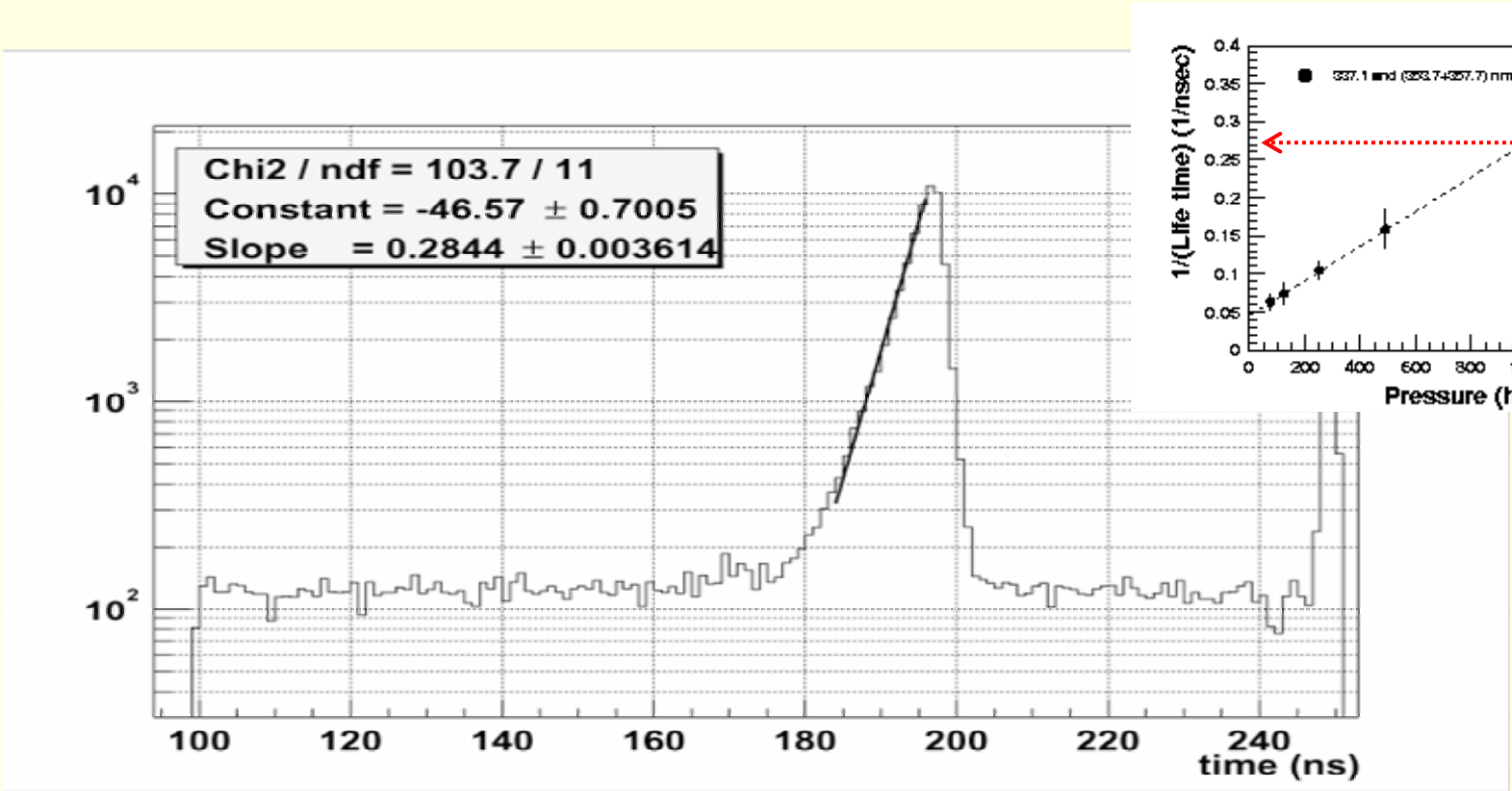
$$A_{\Omega} = 0.003176$$

Includes geometry and PMTs overall eficciencies

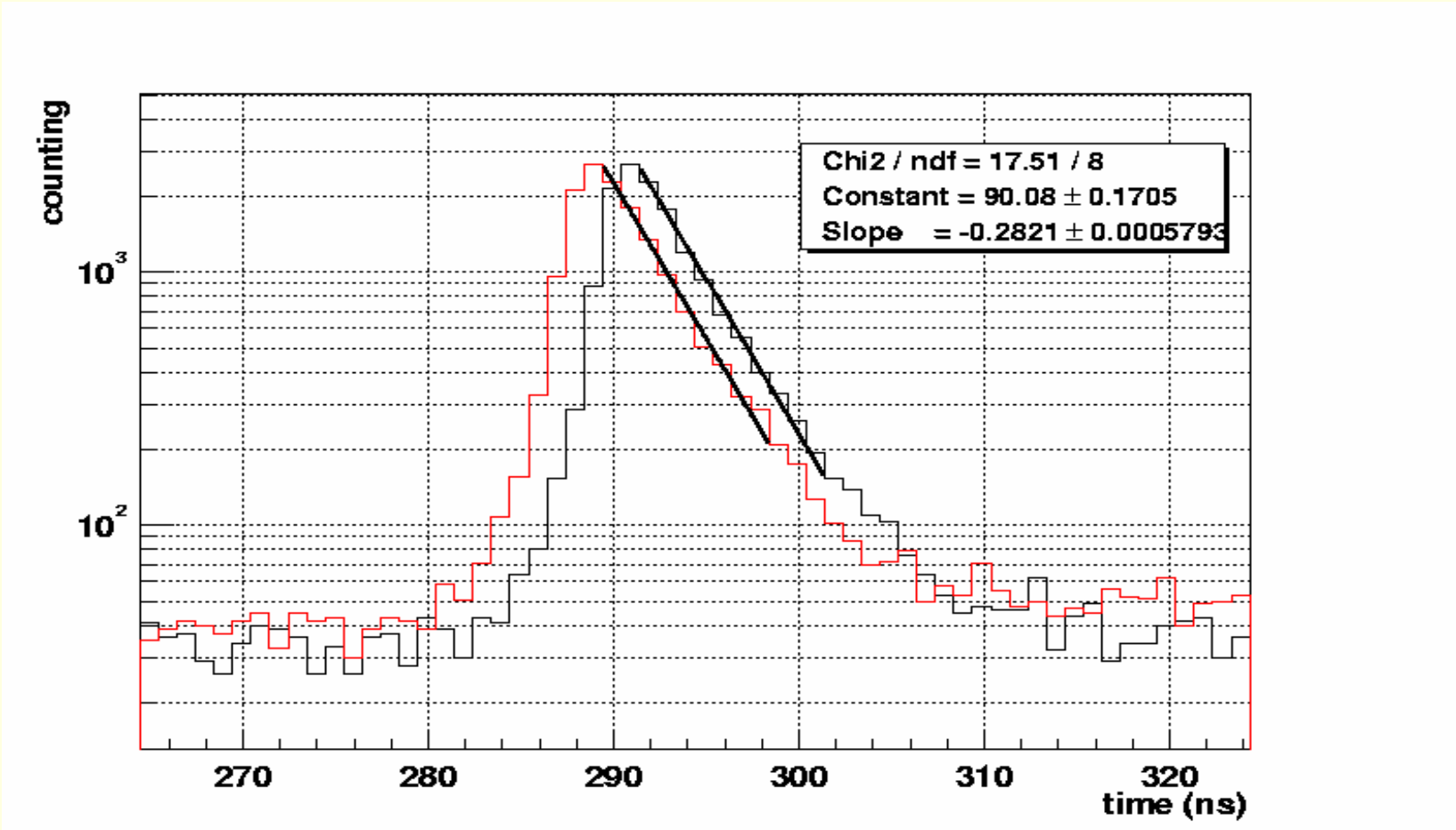
$$Y_{\text{all } \lambda} = 3.9 \pm 0.2$$

Decay Time Constant (in N_2)

M.Nagano et al., ICRC 2001



Consistence between Fluorescence PMTs

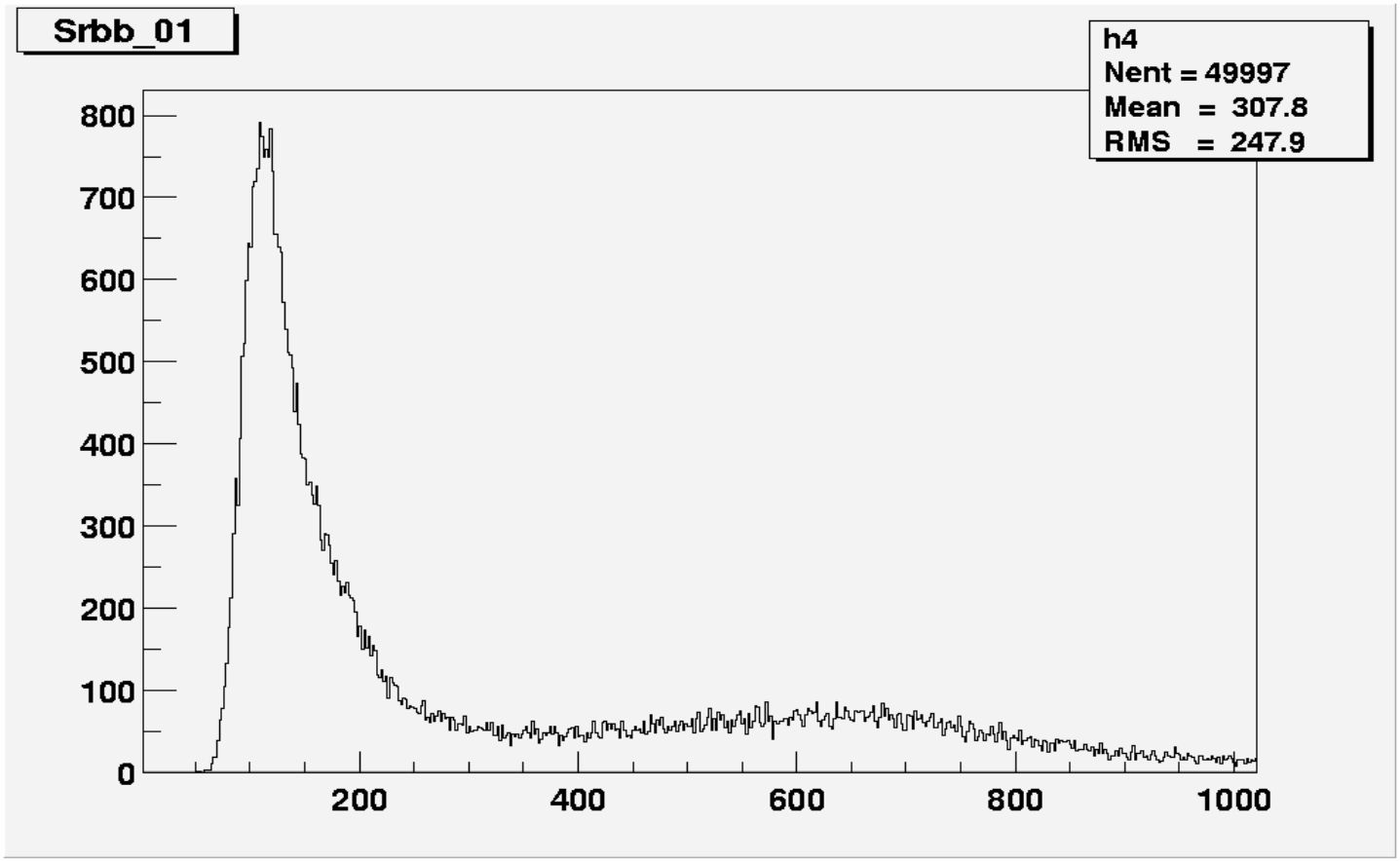


Dry Air and 10/90 Decay Times

- $\tau_{air} \sim \tau_{90/10} \sim$ 1.5 ns

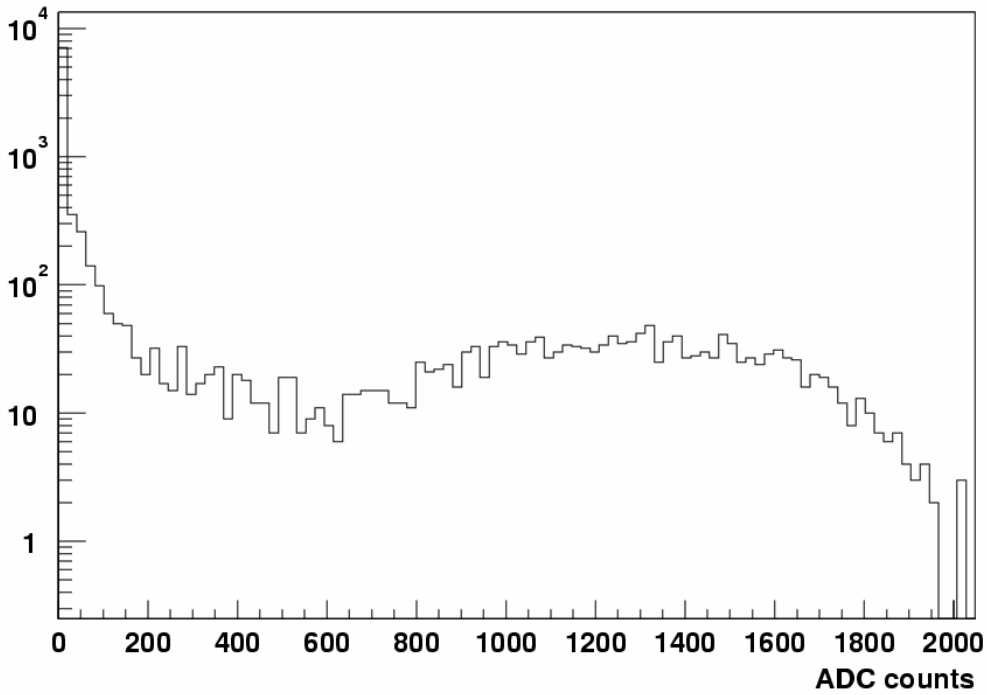
** Out of our time resolution ! **

^{90}Sr spectrum in test-box



But, inside the chamber…

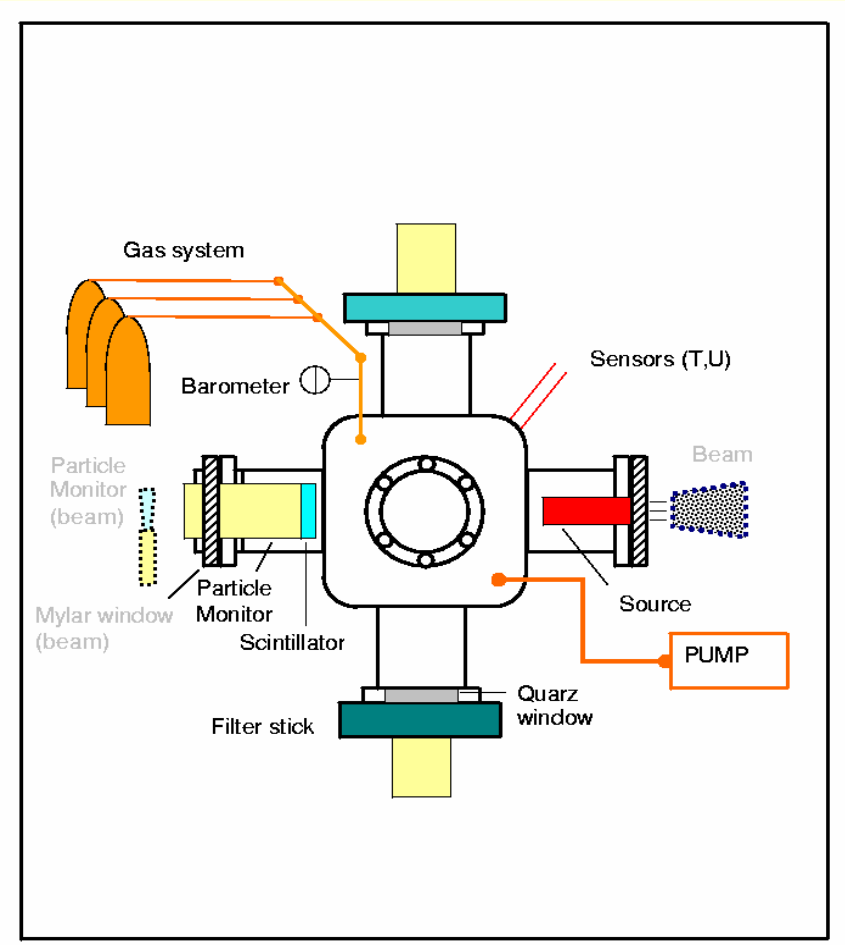
^{90}Sr spectrum in the chamber



Prototype Chamber Overview

- **Consistent Results (^{90}Sr source)**
  - ✓ **τ in N_2 @1k hPa**
  - ✓ **Relative Efficiency - Y_i/Y_j : N_2 , 0.1 O_2 + 0.9 N_2 , Dry Air**
  - ✓ **Integrated Yield**
- **To do**
  - → **Energy calibration (on the way…)**
  - → **Go ahead with ^{137}Cs measurements**
  - → **Improve the Background Control**

New Chamber



Available new parts (already in lab):

- 6-way Cross (from LNLS)
- Pump
- PMTs
- Gas system
- Mylar windows

To develop and/or implement and/or buy..

- Quartz windows
- Filters and related system
- New detection systems (?)

Beams:
a) The medical accelerator

- Old Machine: Extremely High RF noise
- New machine: has been recently installed
  - Obs.: Not yet available for the radiotherapy group. Perfect time to perform preliminary tests

- Main Parameters
  - Available Energies: 5, 6, 8, 10 and 12 MeV
  - 1 ms repetition
  - 10^{12} e-/pulse

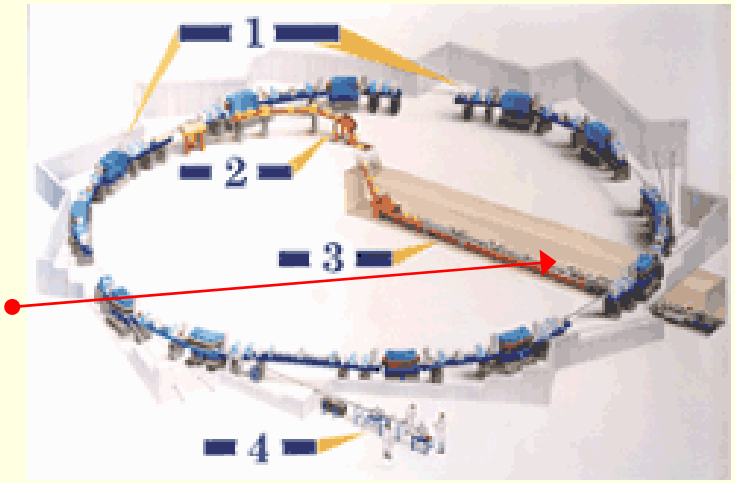
Beams:
b) LNLS (sincrotron light ring)

Laboratório Nacional de Luz Síncrotron
Operado pela ABTLuS para o Ministério da Ciência e Tecnologia / CNPq

LNLS Injector Main Parameters	
Operation Energy (nominal)	1.37 GeV
Injection Energy	500 MeV
Beam Current (max)	250 mA

Status

- LNLS does not have a beam extractor
- Tests might be done only during maintenance of the injection line
- LNLS Direction had an enthusiastic response ☺ for a project submission



Conclusions

- Go back home and work…