LABORATORIUM FÜR HOCHENERGIEPHYSIK
LHEP
UNIVERSITÄT BERN

MARIE CURIE ACTIONS

CERN

ARDENT
Advanced Radiation Dosimetry European Network Training

ESR_3

S.Puddu

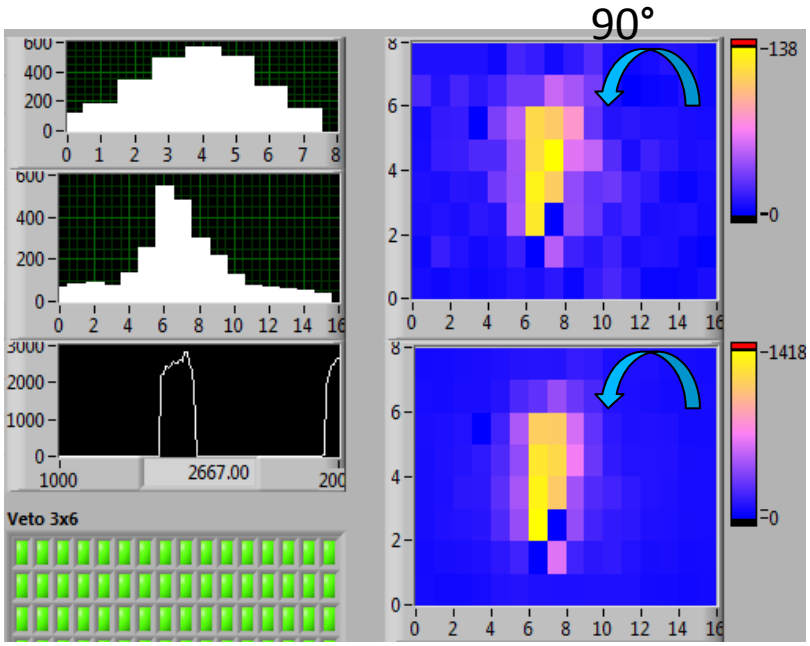
Supervisors: M. Silari, F. Murtas

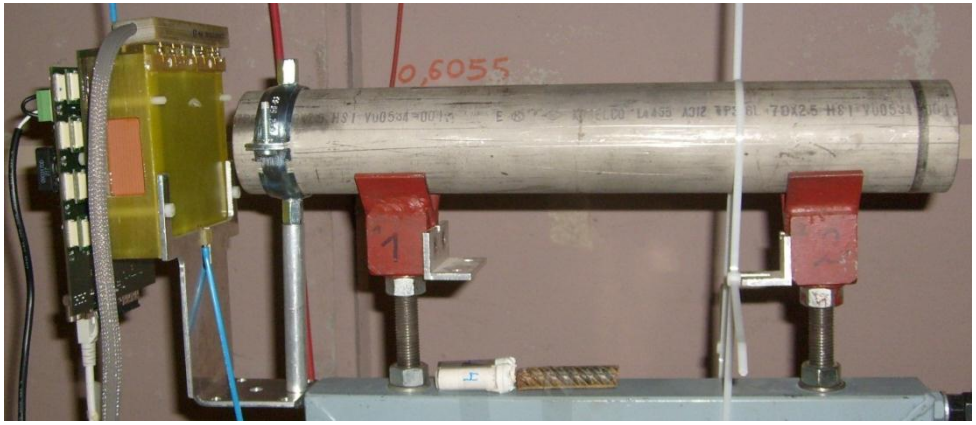
Nice to meet you

- Name: Silvia Puddu
- Born in Cagliari-Sardinia (Italy)
- Study: Università degli Sutdi di Cagliari
  - Bachelor thesis: Development of a portable system For the test on MWPC at ALICE esperiment
  - Master Thesis: Development of a diagnostic system for burning plasma (INFN-LNF/ENEA)
    - ✓ **Poster APS 2009** X-ray detector for burning plasmas – S. Puddu , F. Bombarda, G. Pizzicaroli, F. Murtas
    - ✓ **Nuclear Instruments and Methods, doi :10.16/j.nima.2009.06.101(2009)**
    - ✓ Design of a GEM-based detector for the measurement of fast neutrons. B. Esposito, F. Murtas, R.Villari, M. Angelone, D. Marocco, P. Pillon and **S. Puddu**

ESR 3

- Study of applications of triple GEM detector
  - Beam monitoring for CERF and CNAO
  - Beam monitoring for spallation source
  - Neutron dosimetry
  - Radioactive waste





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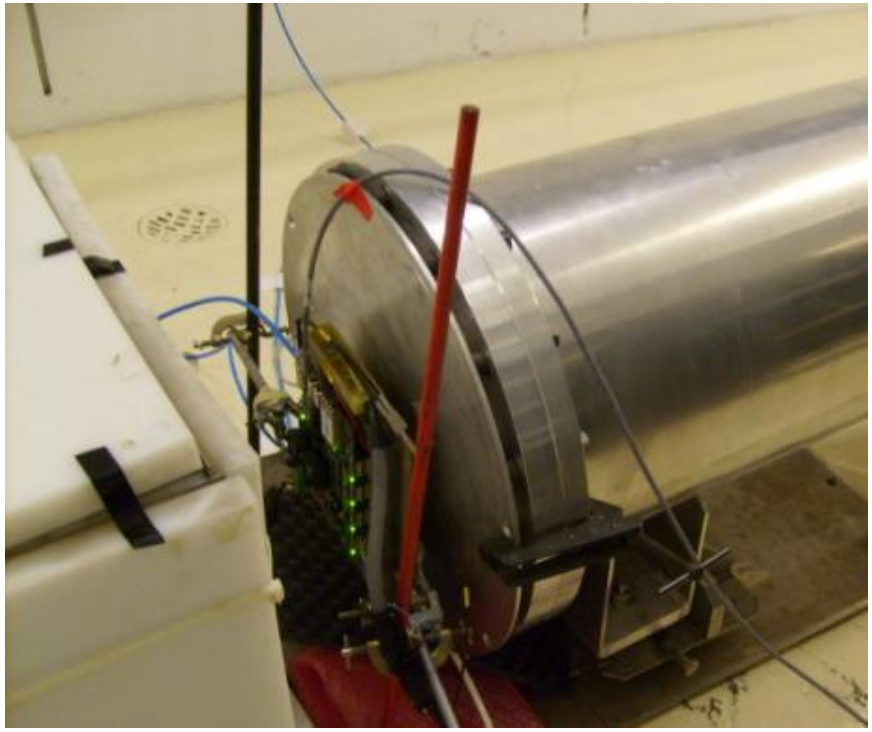
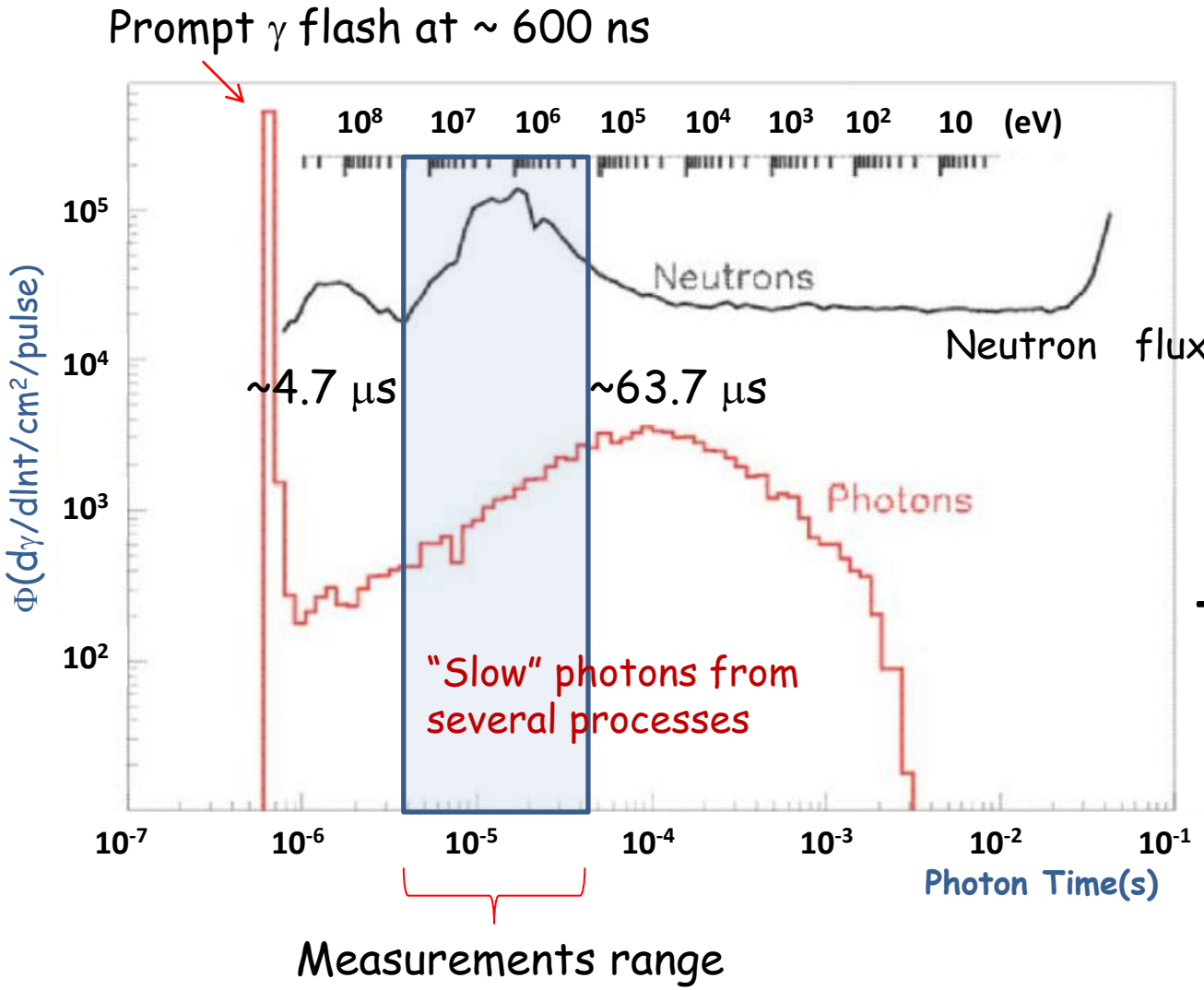


Results @ n_TOF: ieee 2012



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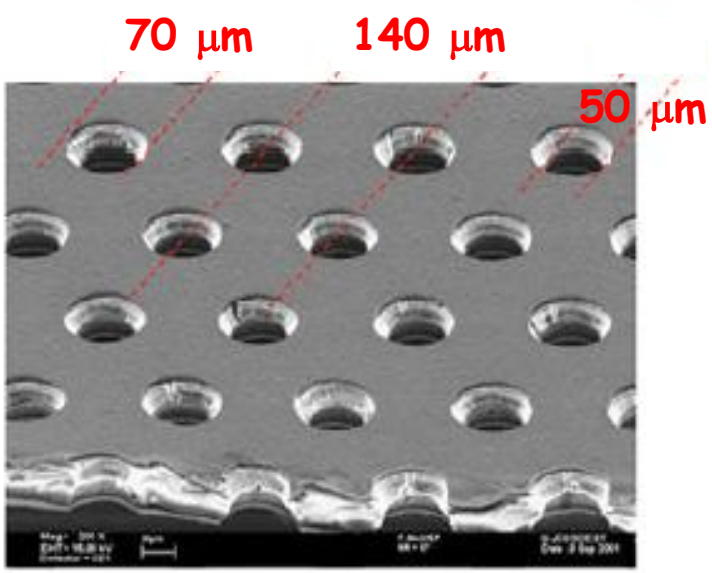
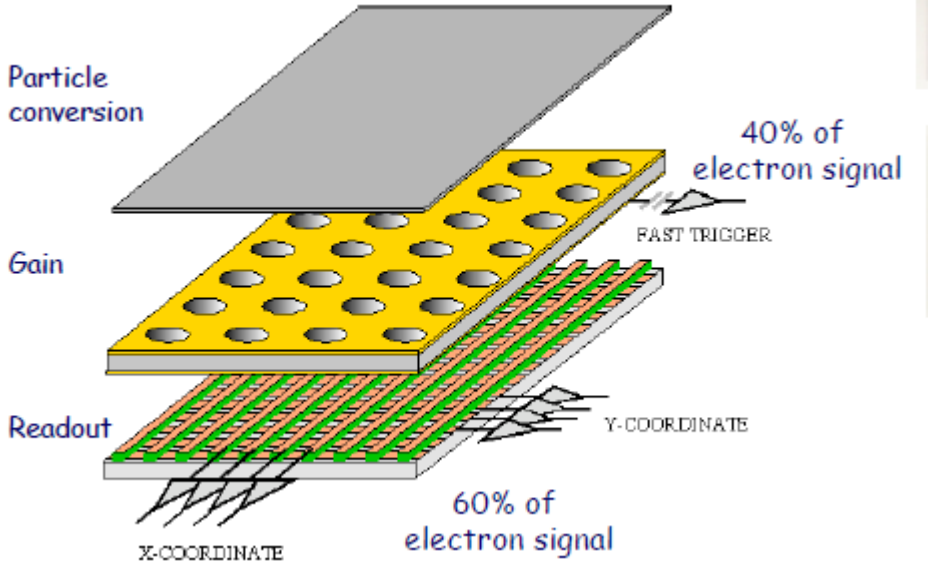
γ from neutrons radiative capture in the beam dump

E. Chiaveri et al, CERN n_TOF facility performance report, CERN-SL-2002-053 ECT (2002)

C. Guerrero Sanchez, The neutron beam and the associated physics program of the CERN n_Tof facility, ATS seminar

Results @ n_TOF: ieee 2012





- Particle conversion, charge amplification and signal induction zones are physically separated
- Time resolution depends on geometry and gas: **9.7 ns** for Ar-CO2 (70-30)
- Spatial resolution depends on geometry (up to **200 μm**), however is limited by readout
- Dynamic range: **from 1 to 10^8 particles/cm^2 s**
- Effective gain is given by the formula: $G_{eff} \propto \sum V_{G_i}$

F. Sauli NIM A386 531

M. Alfonsi et al., The triple-Gem detector for the M1R1 muon station at LHCb, N14-182, 2005 IEEE-NSS

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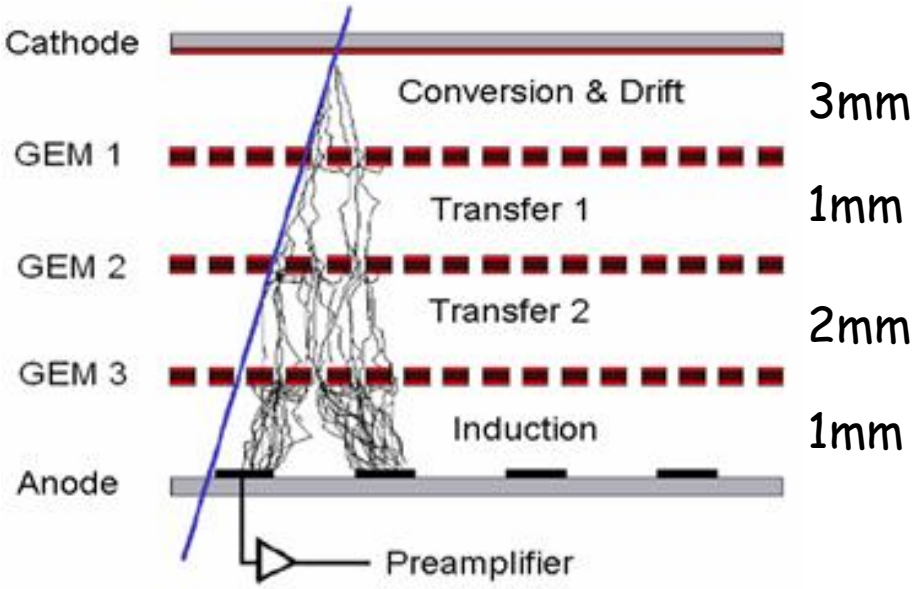

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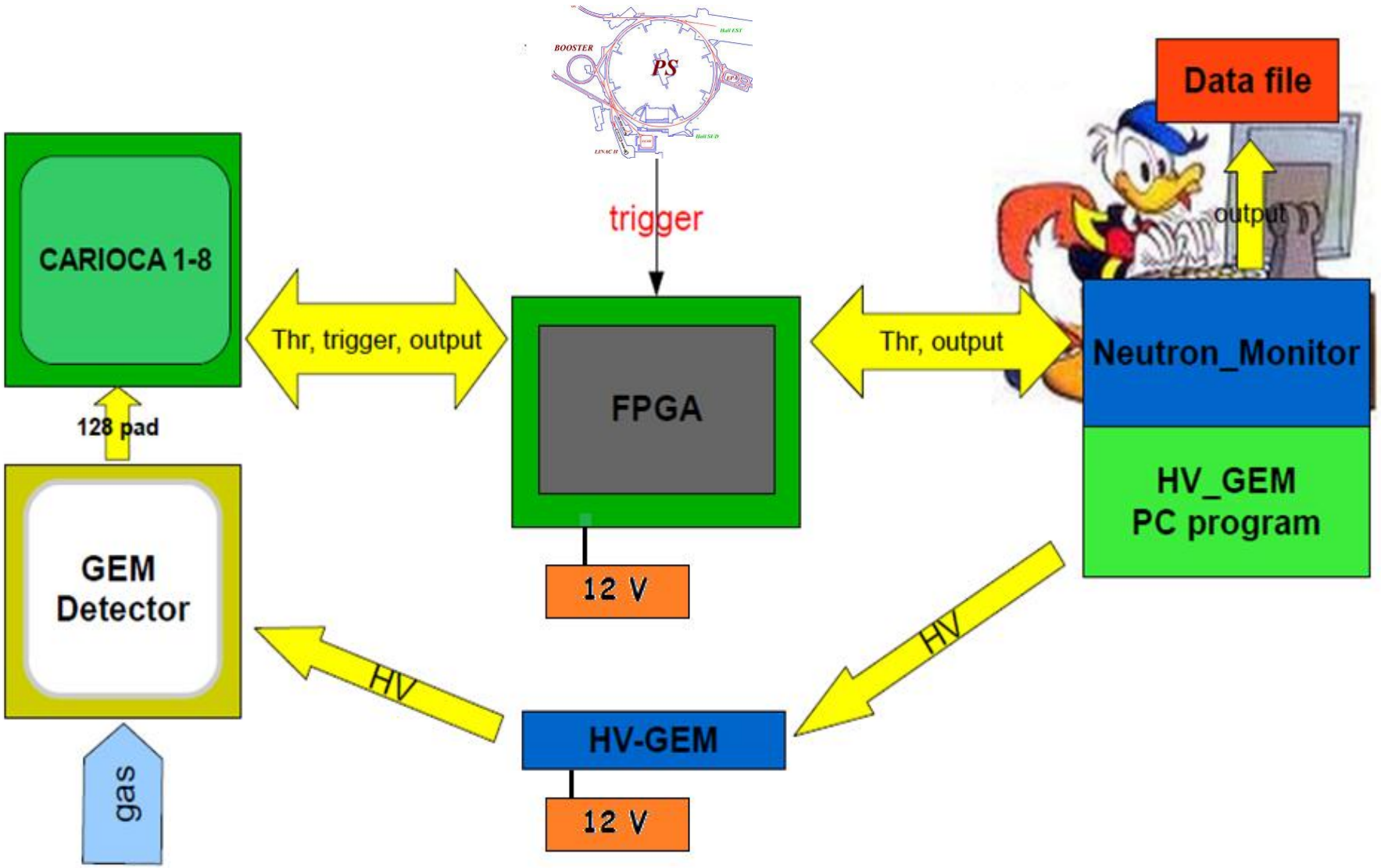
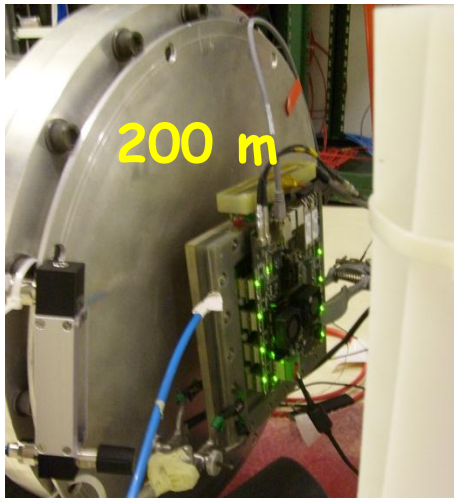
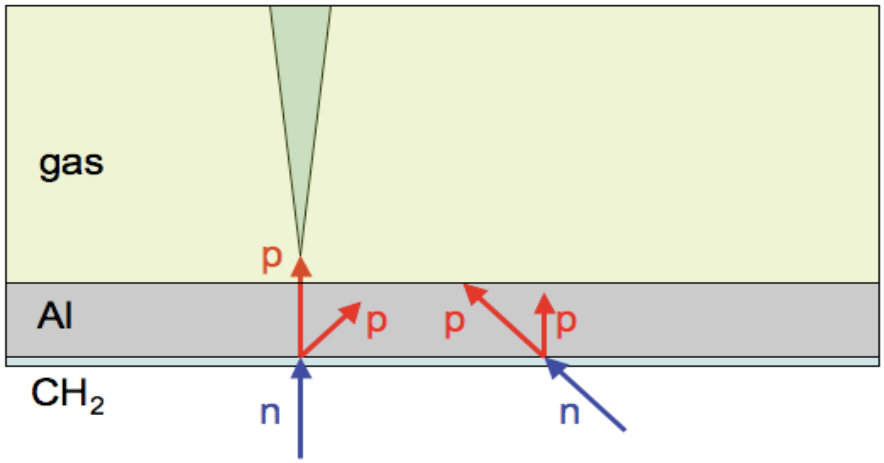


How detect fast neutrons

- Neutron converter **60 μm PE + 40 μm Al**
- Gas mixture **Ar-CO_2 70%-30%**
- Measurements near to the beam dump
- Low γ sensitivity: **HV at 870V** → gain ~ 300

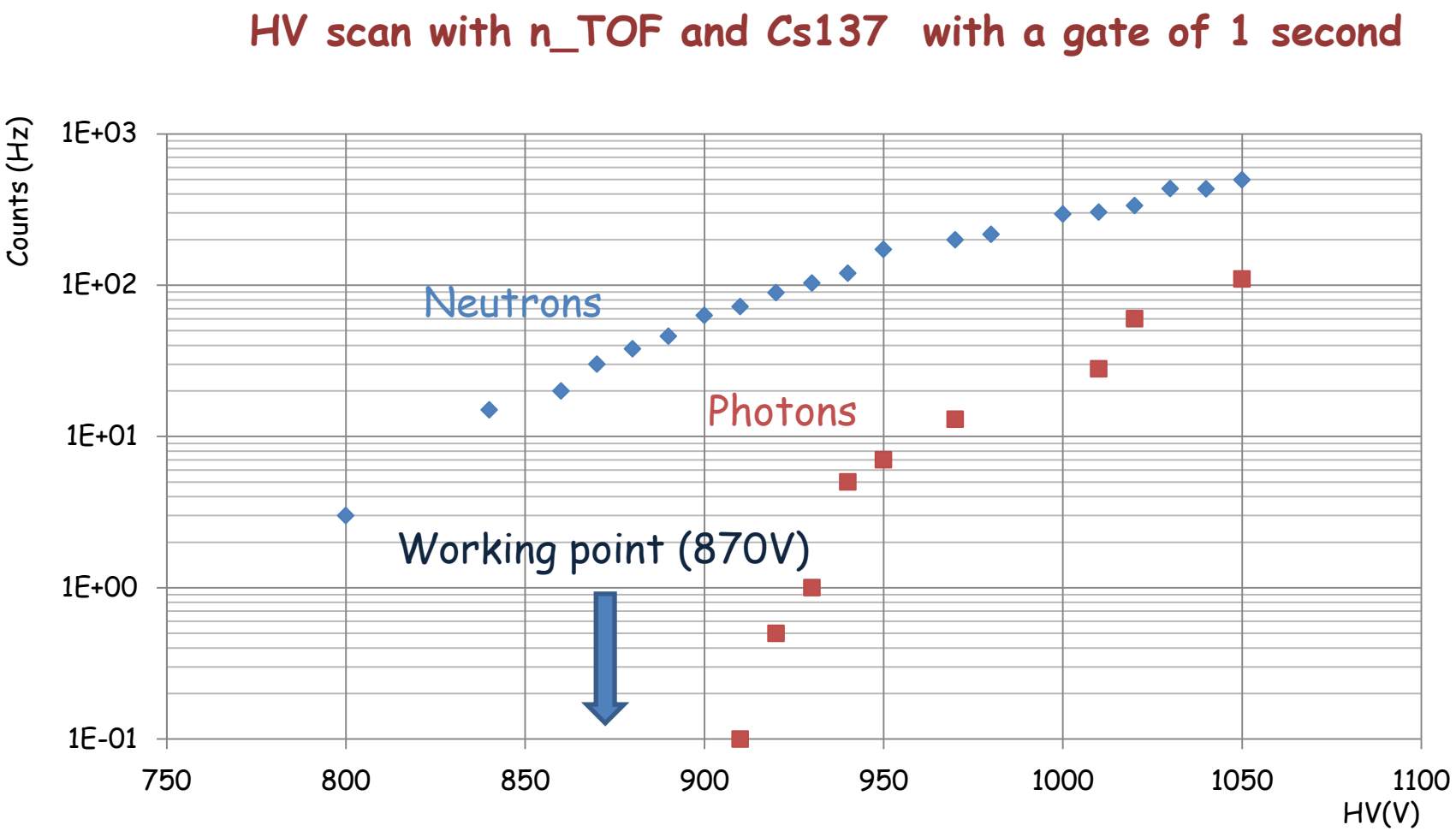




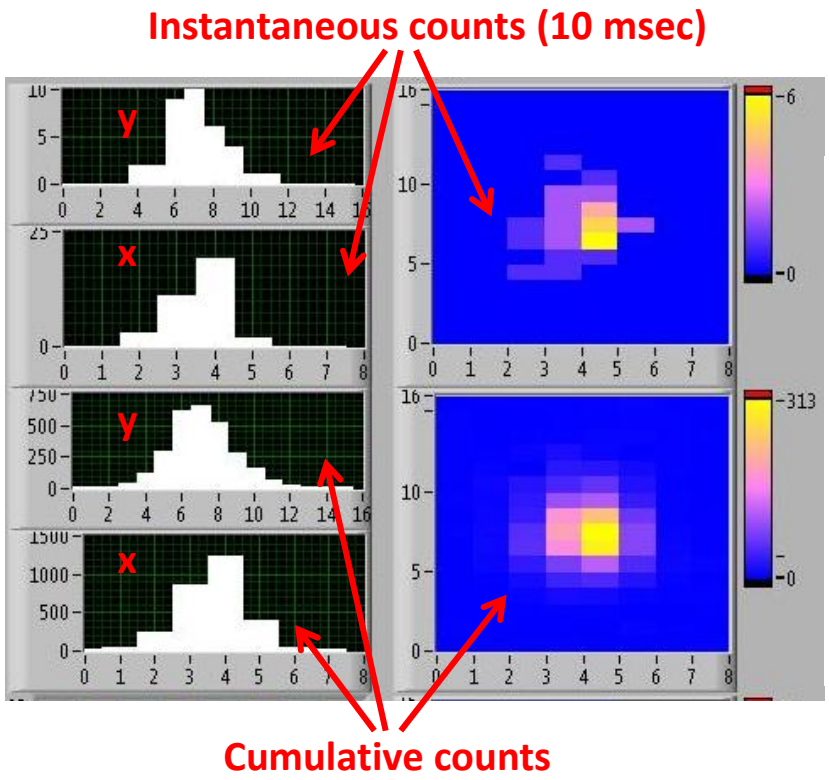
Neutrons interact with **CH_2**, and, due to elastic scattering processes, **protons** are emitted and enter in the gas volume generating a detectable signal.

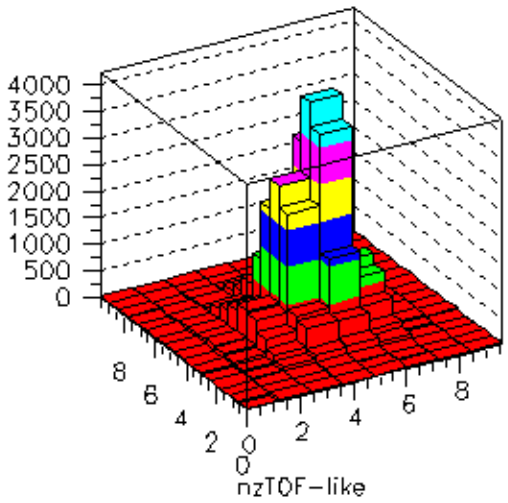
Aluminium thickness ensures **the directional capability**, stopping protons that are emitted at a too wide angle.

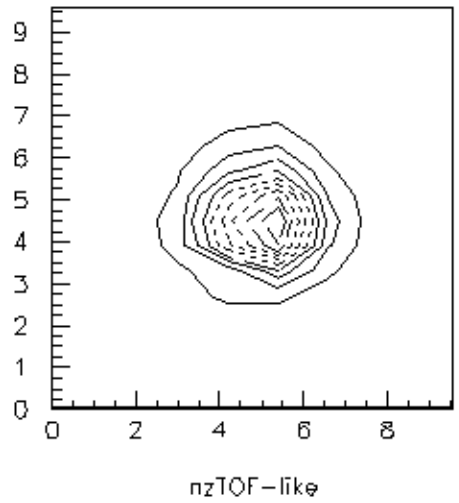
Low Sensitivity to Photons



Results @ n_TOF: ieee 2012





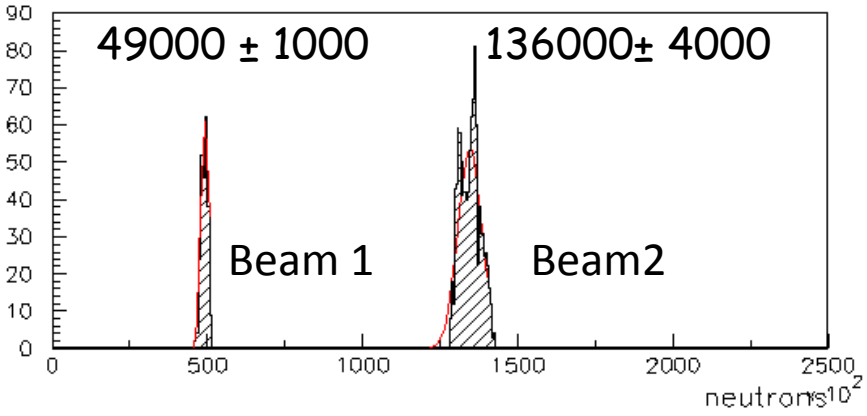


Constant: 3640 ± 40
Mean1: 5.9 ± 1.8 cm
Mean2: 5.5 ± 1.8 cm

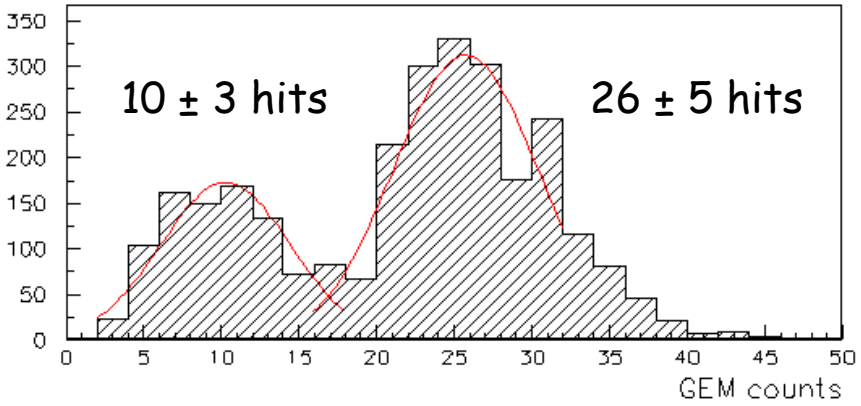
- Delay 2000 ns, HV 870 V, gate 10 ms
- Two different intensity beams arrive to the facility

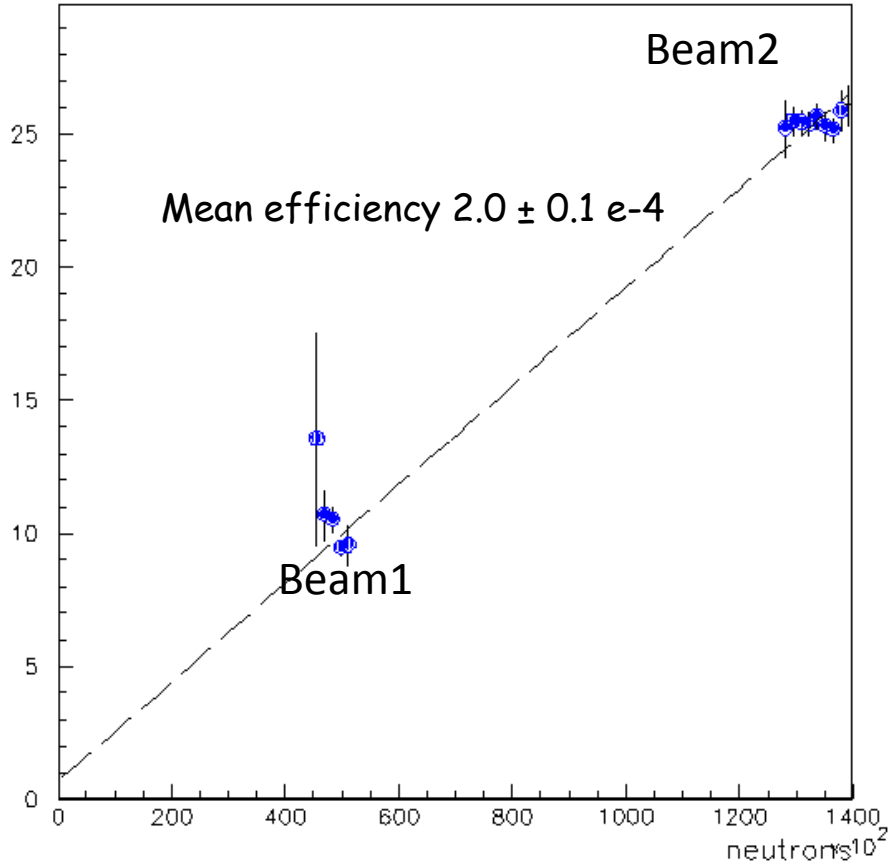
Results @ n_TOF: ieee 2012

From proton beam monitor



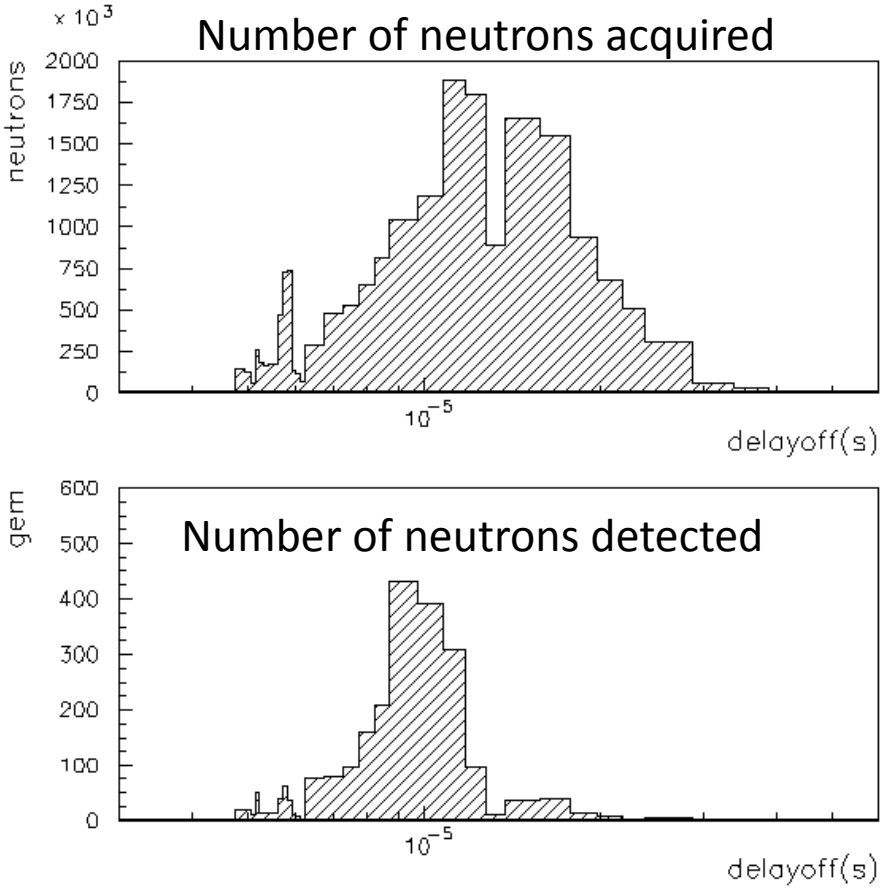
From gem neutron monitor

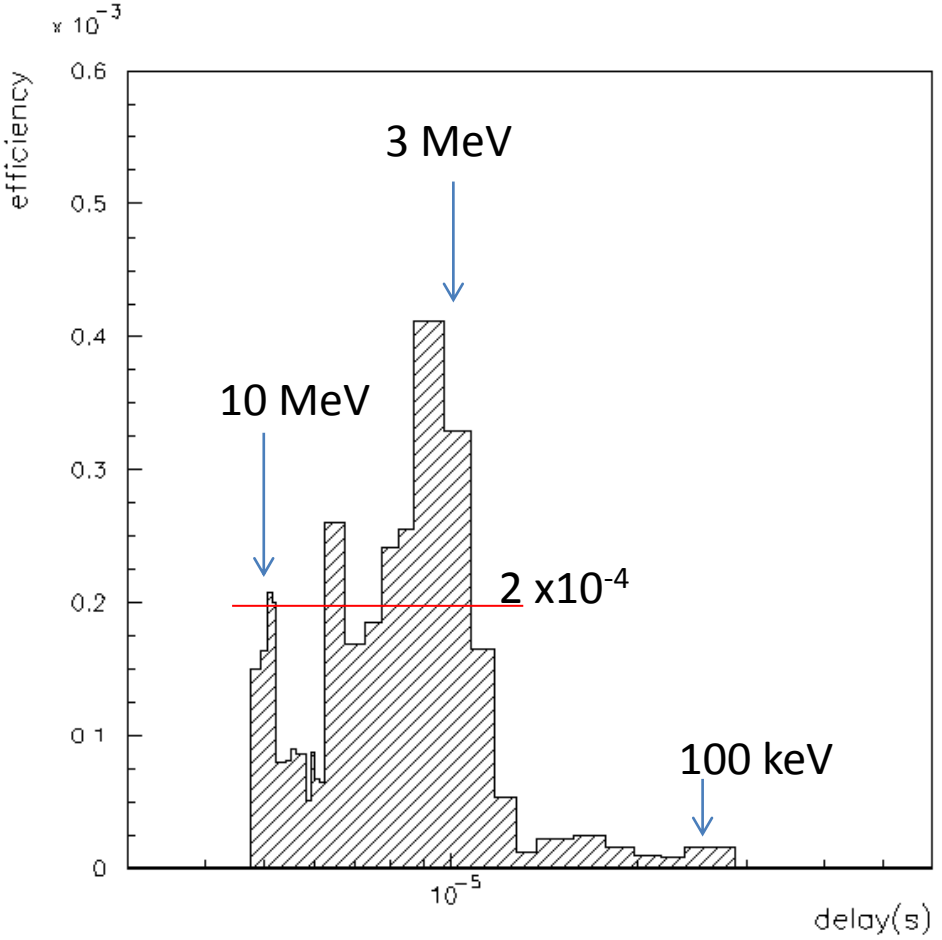




Results @ n_TOF: ieee 2012

The FPGA can detect neutrons vs a delay in time allowing to make a time (i.e. Neutron energy) scan that allows the efficiency vs energy to be measured (uncertainty ~0.1 ÷1%, ~20% at 10 MeV) .





TANKS