MONDO

MOnitor for Neutron Dose for hadrOntherapy

a neutron *tracking* detector

Frontier Detectors for Frontier Physics
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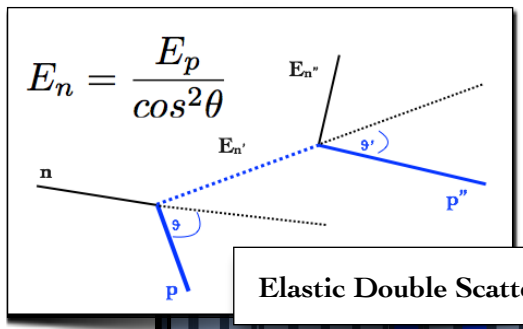


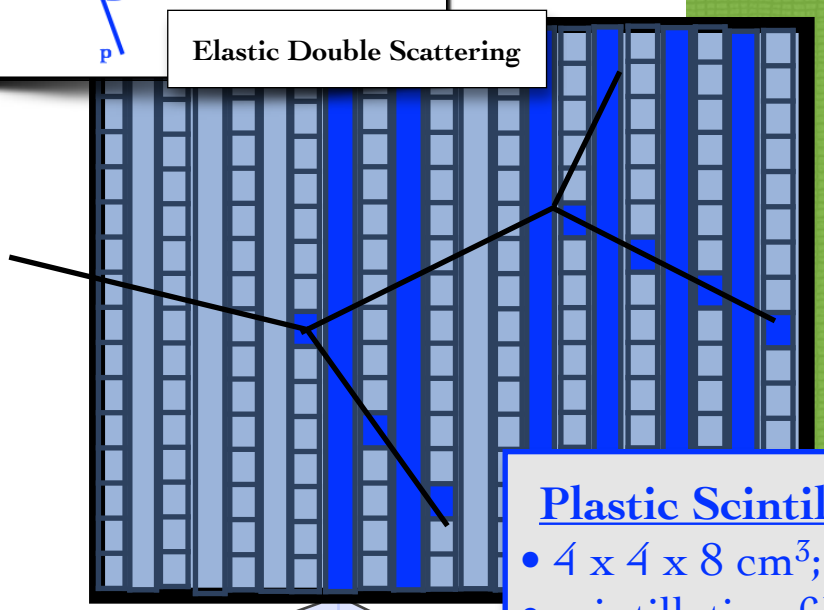
Elastic Double Scattering

In a particle therapy treatment the beam interactions with patient produce many secondary particles. Monitoring methods using photons and charged particles have already been proposed, but no attempt has been made yet to use the abundant neutron component. The large penetrating power of neutrons produces nearly energy threshold free escape, providing a secondary particle sample that is higher in number with respect to photons and charged particles. Therefore, neutrons allow for a backtracking of the emission point that is not affected by multiple scattering.

Moreover The neutron induced complications are the main concerns in Particle Therapy administration and planning, in particular in pediatric treatments [1].

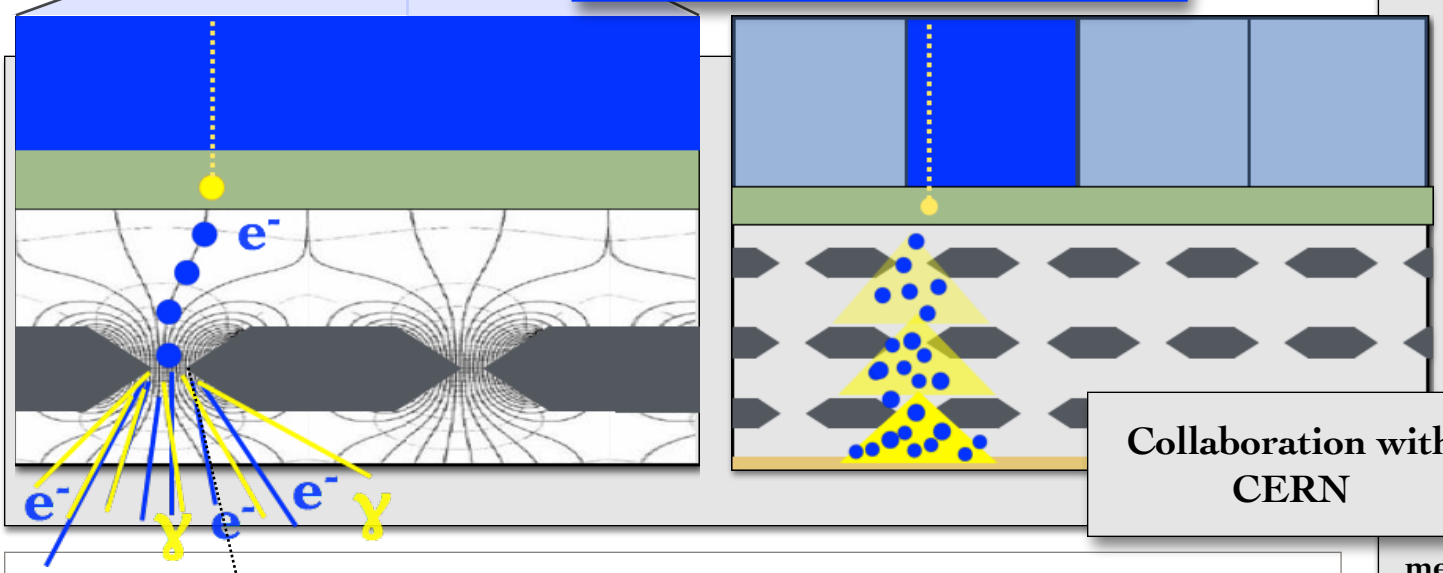
We want to measure and track the ultra-fast neutrons produced in Particle Therapy treatments developing a **tracking device** tailored for hadrontherapy dose monitoring applications!

[1] M.Durante W.D. Newhauser doi:10.1038/nrc3069



Plastic Scintillator
- 4 x 4 x 8 cm^3;
- scintillating fibres 250 µm;
- x-y layer orientation;

Image Intensifier: Triple GEM detector

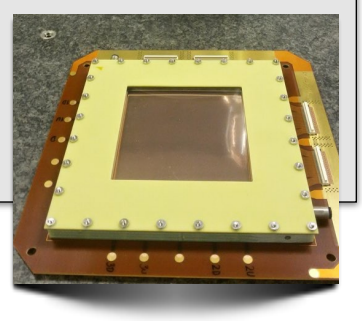


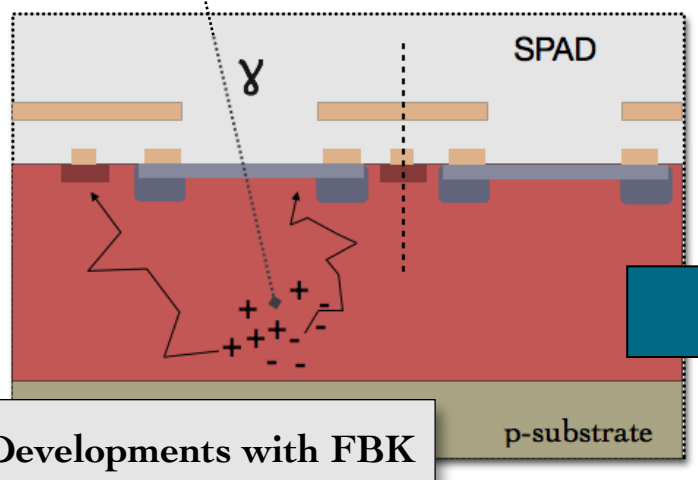
Gas Electron Multiplier
- 45 µm hole
- 70 µm hole distance
- triple GEM

We use GEM as photon intensifier instead of look for electron multiplication

Collaboration with CERN

For GEM light measurements => See also D.Pinci POSTER





- ☑ integrated TDC (resolution ~65 ps)
- ☑ self triggered sensor
- ☑ pixel 600 µm

Signals ReadOut: CMOS Single Photon Avalanche Diode (SPAD) array sensor

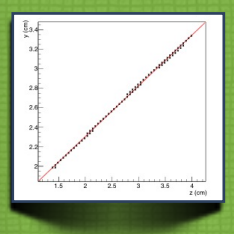
Developments with FBK
http://www.spadnet.eu/

- Simulation
  - Efficiency and Reconstruction
- Detector
  - Tracker
  - Readout
- Measurements
  - Calibration
  - Test Beam p,n
  - **Neutrons from Therapeutical ion and proton beam**

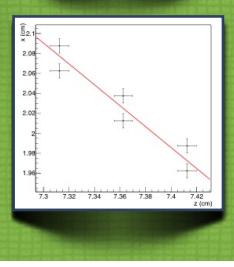
Simulation in FLUKA

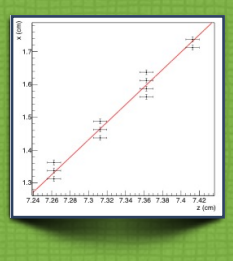
When both protons are contained the neutron energy can be computed by measuring the proton range.

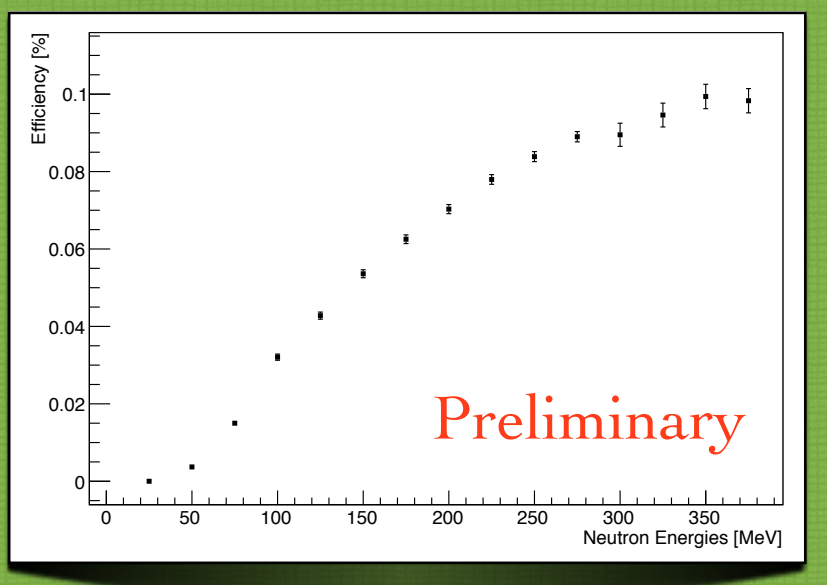
- ☑ 320 layers (x-y oriented)
- ☑ 160 fibres per layer



Example of reconstructed proton tracks







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