



Neutron detector efficiency measurement

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NE213 - BC501 Neutron Detectors



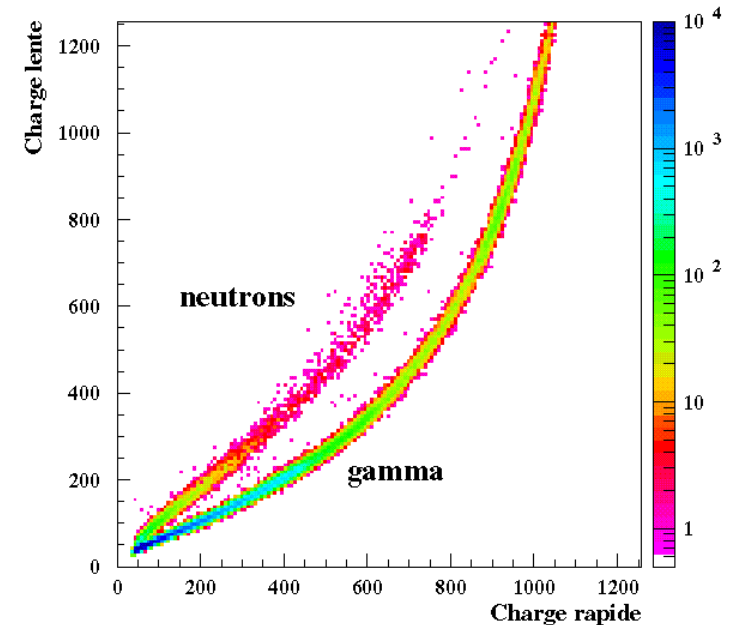
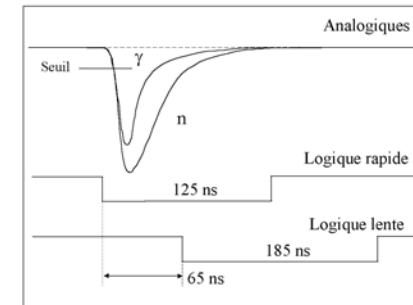
Often used in **neutron spectroscopy** and **fluence measurement**
for fast neutrons ($E > 2$ MeV)

Detector composition :

Liquid scintillator cell
coupled to
a Photo tube

Characteristics :

Efficiency ($\epsilon \geq 10\%$ depending on the size)
n/ γ discrimination by pulse shape analysis
Fast scintillator \rightarrow TOF technique



Motivations

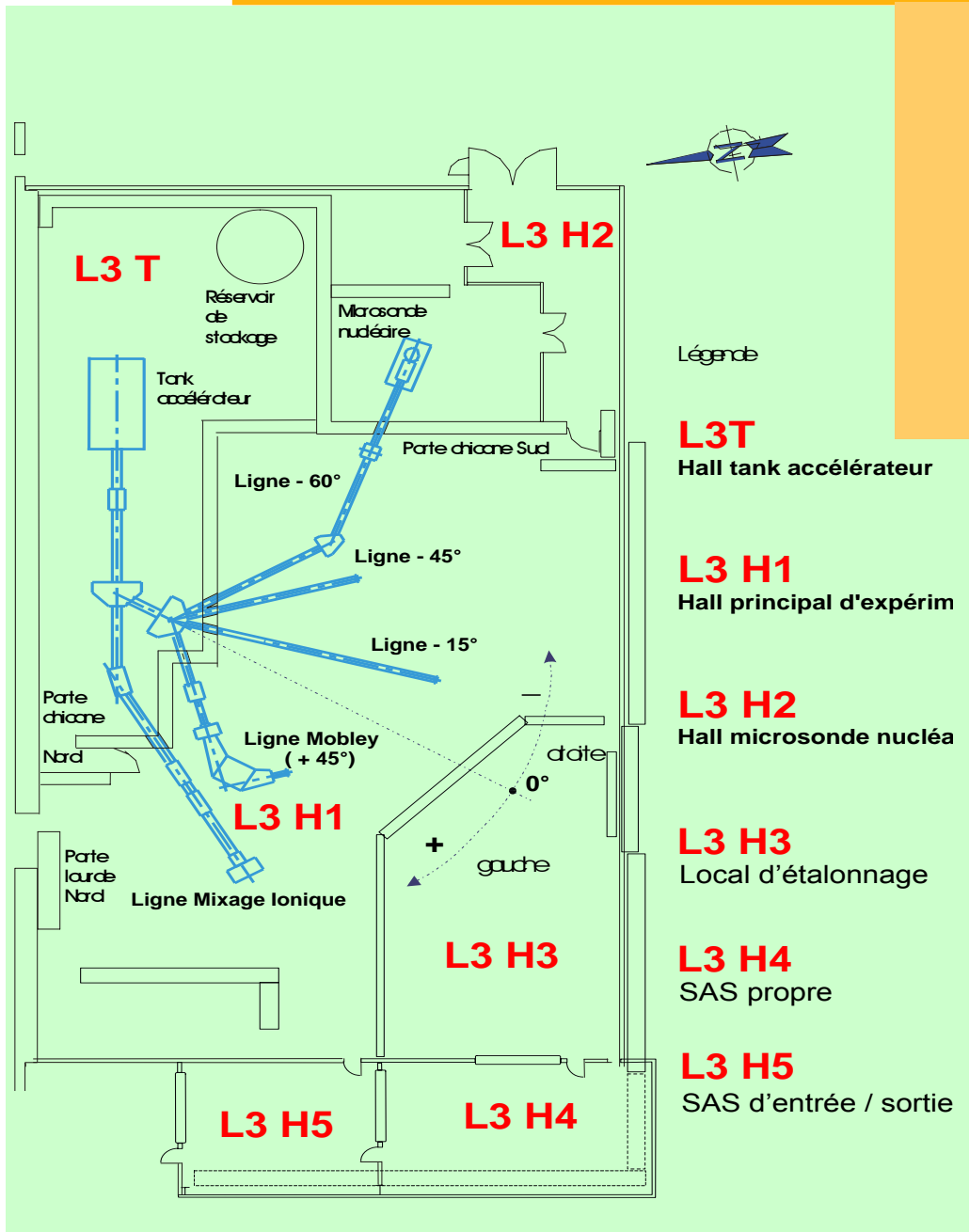


- Neutron beam monitoring of Bruyères-le-Châtel neutron facilities :
 - VdG 4 MV **neutron beam** (100 keV-20 MeV)
 - VdG Tandem 7 MV, **normalization** of recent experiments

- Neutron spectroscopy :
 - (n,xn) reactions
 - Fission neutrons spectra..

- EFNUDAT support for efficiency measurement at PTB :
 - PTB is reference laboratory** for neutron measurement
 - PTB is in charge of the **Quality insurance for neutron beam monitoring (JRA2)**

The Van de Graaff 4 MV accelerator



- Include in EFNUDAT
- Neutron production by :
 - ${}^7\text{Li}(p,n){}^7\text{Be}$
 - ${}^3\text{H}(p,n){}^3\text{He}$
 - ${}^2\text{H}(d,n){}^3\text{He}$
 - ${}^3\text{H}(d,n){}^4\text{He}$

5 beam lines
2 experimental rooms

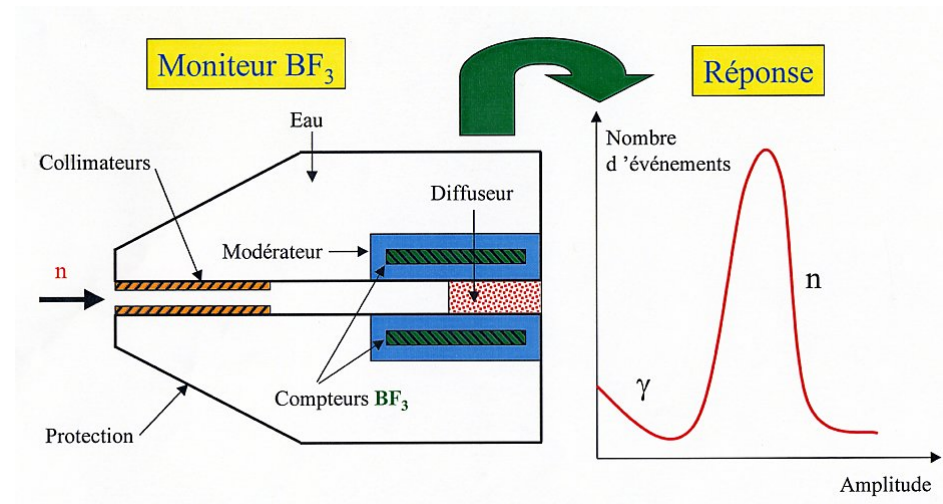


Neutron flux monitoring



- BF3 Proportional counter

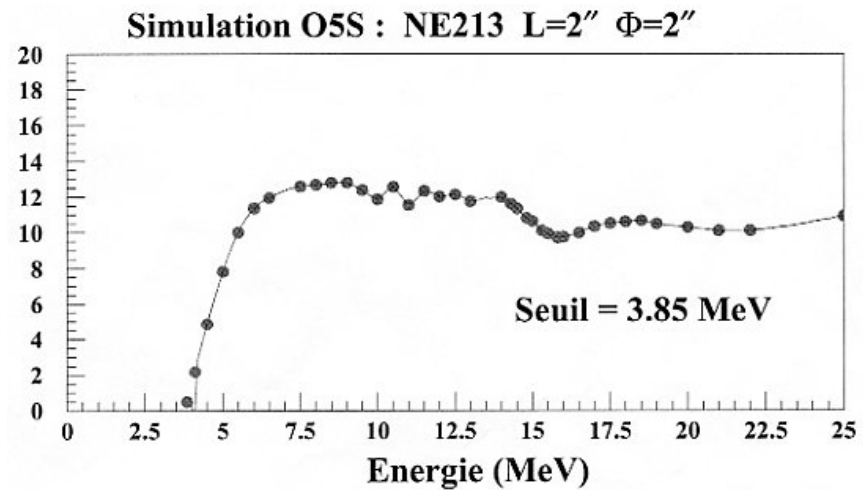
100 keV E <math>< 6</math> MeV



- BC501 detector

$E > 14$ MeV

Efficiency **needed to be measured**



Methodology



- In the 2-14 MeV range : **Standard procedure of PTB**

Monokinetic peaks (8, 10, 12 and 14 MeV)

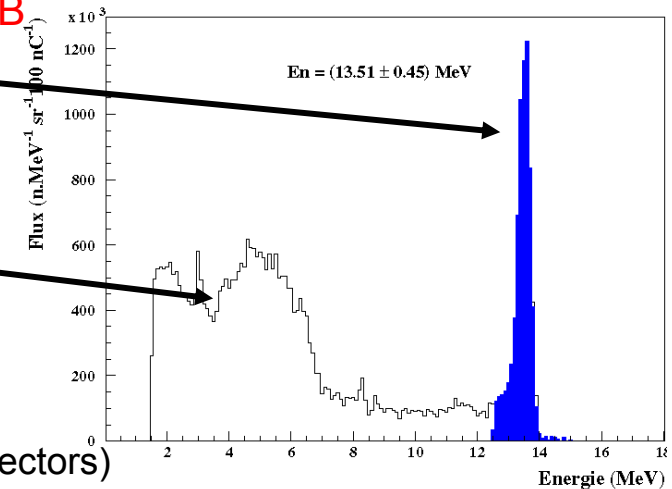
→ detector response normalization

Break-up components (2-7 MeV)

→ pulse height response

Fluence determined by NE213 reference detector

Four deuteron energies (1 day per energy for the 3 detectors)



- High energy range (E>15MeV) :

Monokinetic peaks (19 and 22 MeV) → Detector response normalization

Fluence determined recoil proton telescope

Two deuteron energies (2 days)

- The Pulse Height response calculated with the NRESP code and measurement comparison give the normalization factor

Experiment status and expected results



- Full characterization of 3 detectors between 2 and 22 MeV
 - 2 “small” ones of $\Phi=5.08$ cm and $L=5.08$ cm
 - 1 « large one » of $\Phi=12$ cm and $L=5.08$ cm
- **Accurate neutron fluence measurement** on the 4 MV:
 - Calibrated BC501 detectors for $E_n > 14$ MeV
 - Recalibration of the BF3 proportional counter between 3 and 6 MeV
- Validation of recent experiments realized on the Tandem VDG:
 - Pre-equilibrium studies
 - D(n,2n)p cross section measurements
- EFNUDAT funding
 - beam time (≈ 100 h)
 - working days fees
- status : Experiment previously planned from 11th to 19th of Feb will be split in 2 parts
 - from 11th to 15th of February
 - in the next months