Beam monitoring at NFS

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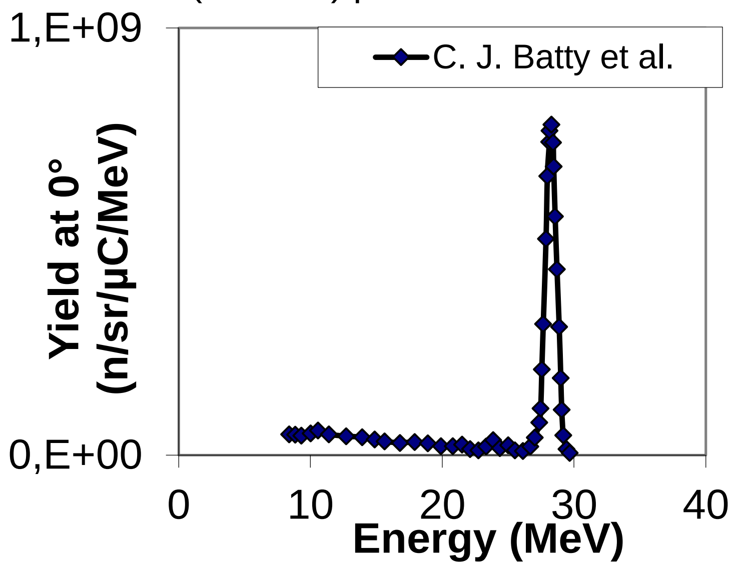
Ganil

NFS Neutron Beams

- Quasi-mono-energetic

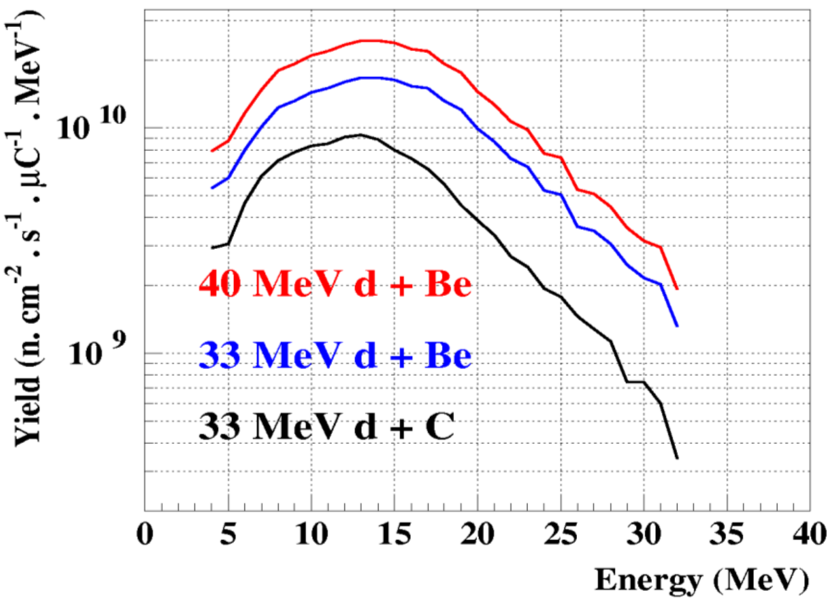
(33 MeV) p + ^{7}Li Thin converter



•Peak width
•Neutron flux
•Importance of tail

- White beam

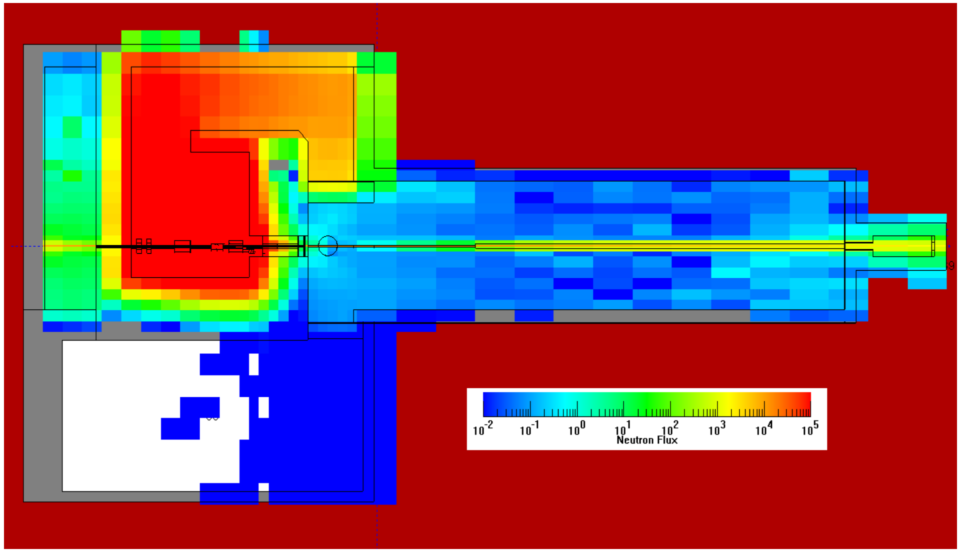
(40 MeV) d + Thick converter



•Energy distribution
•Neutron flux

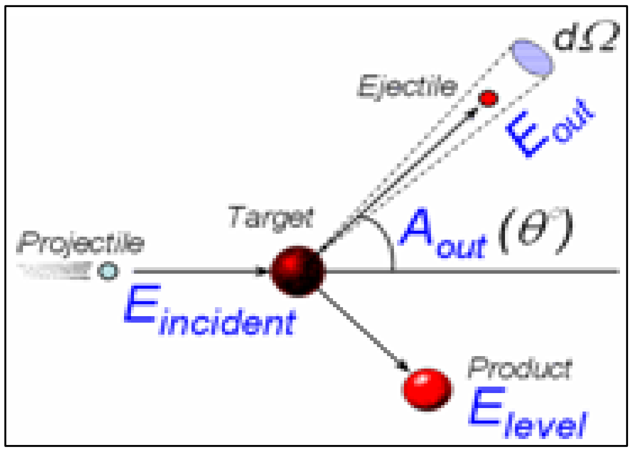
Quantities to measure

- Beam Characterisation
  - Neutron flux
  - Neutron energy distribution
  - Spatial extension
- Background conditions
  - Neutron outside de beam
  - Gamma rays



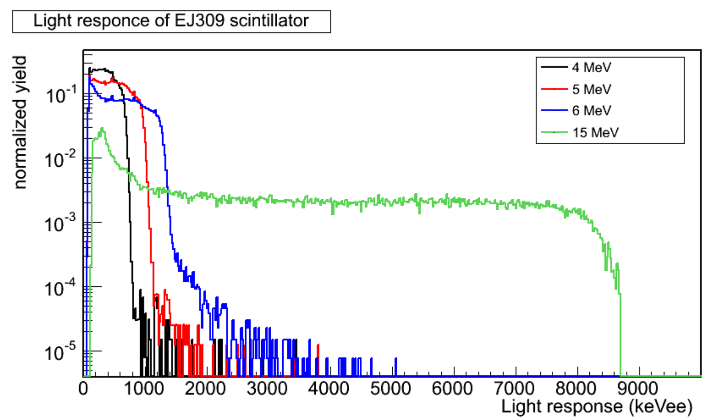
Detection of neutrons (in the MeV range)

Neutron elastic scattering on Hydrogen



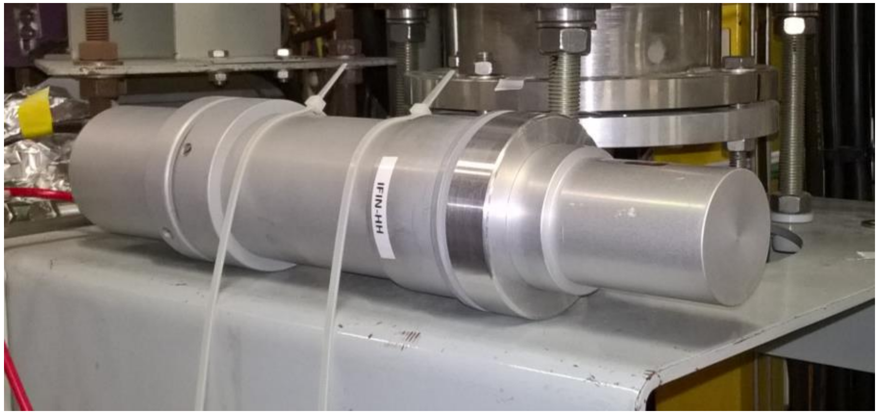
$$E_p = E_n \cos^2(\theta_n)$$

- Scintillator
  - Reactions on hydrogen in the scintillator
  - High efficiency (0.8 -0.1)
  - Detection of all scattering angles (continuous recoil energy distribution)



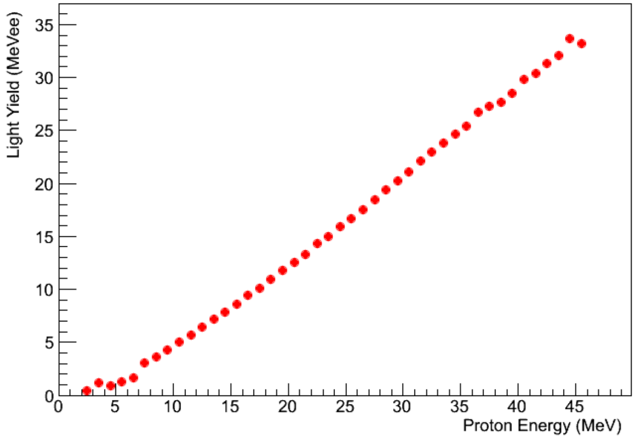
- Proton recoil telescope
  - Reaction on thin plastic foil
  - Low efficiency (~10^{-6})
  - Finite angle allows measuring proton and neutron energy

EJ309 scintillator



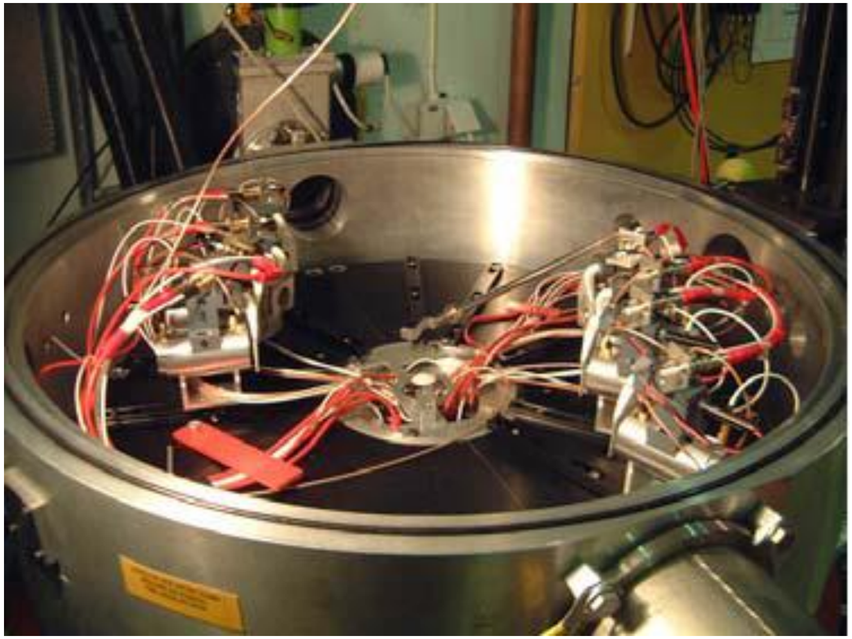
- Neutron energy by ToF
  - ToF limited at NFS without the bunch selector
- Measure of the beam size

- Light response of EJ309 determine up to 40 MeV in experiment at GANIL

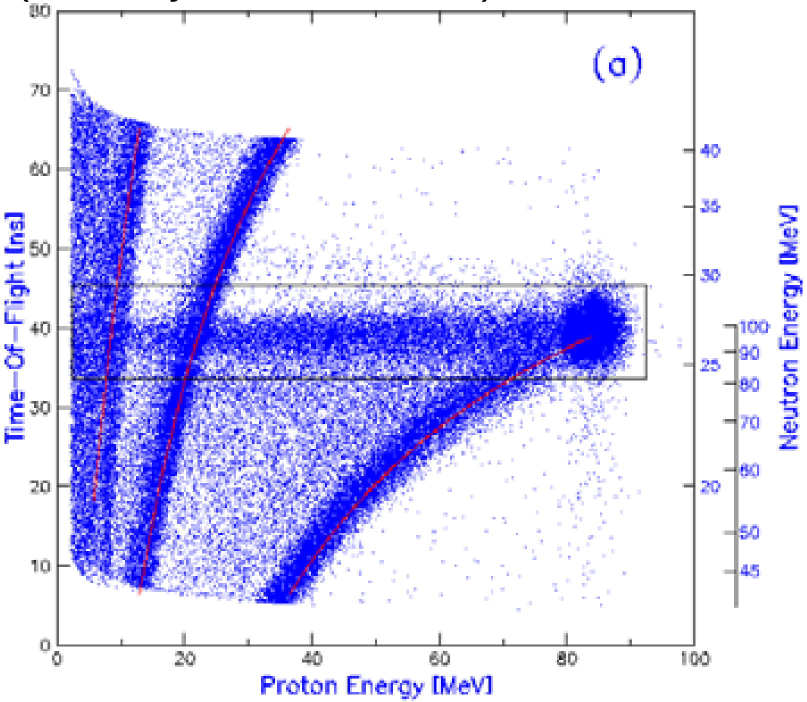


- Efficiency measured relative to a detector calibrated in PTB (on-going work)

Medley



Measure at The Svedberg Laboratory (courtesy or A. Prokofiev)



•Telescopes for detection of LCP
•Measure of n,p elastic diffusion

•Neutron energy by time of flight (even for ToF longer than bunch width)
•Selection of n,p reaction with the kinematic

Proton recoil telescope

- Proton recoil in n,p elastic scattering.
- Neutron energy by proton energy
- Dimension optimized for energy resolution (5%), threshold (2 MeV) and detection efficiency (1.0×10^{-6})
- Same principle as MEDLEY but more portable
- Under development (test in November at Bruyères-le-Châtel)
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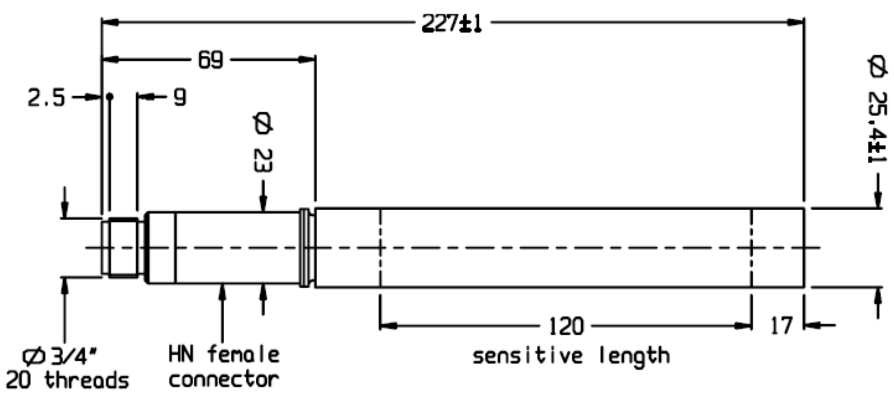
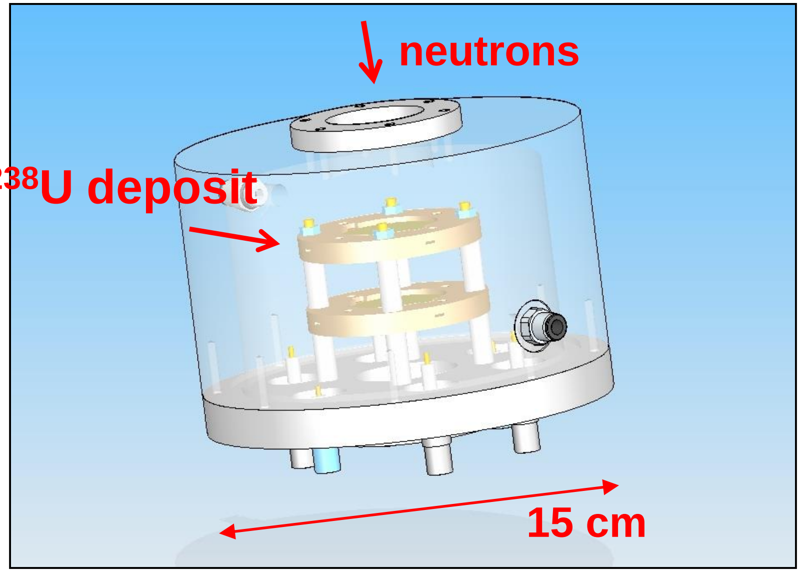
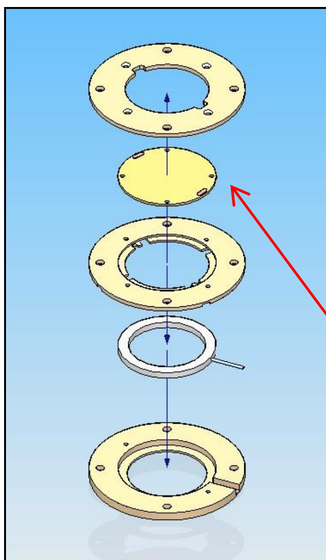
Fission chamber (^{238}U)

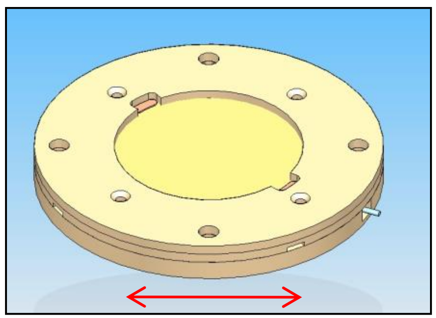


- Standard equipment for nuclear reactors
- Neutron flux from 10 n/s/cm^2 (pulse mode) to 10^{11} n/s/cm^2 (current mode)
- Not sensitive to thermal neutrons (^{238}U fission threshold = 1.5 MeV)

Flumo: MicroMegas neutron flux monitor

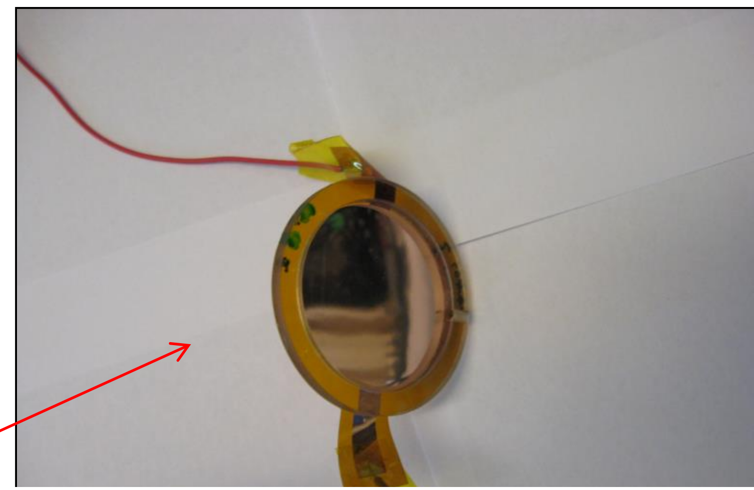






3.5 cm beam interception

MicroBulk



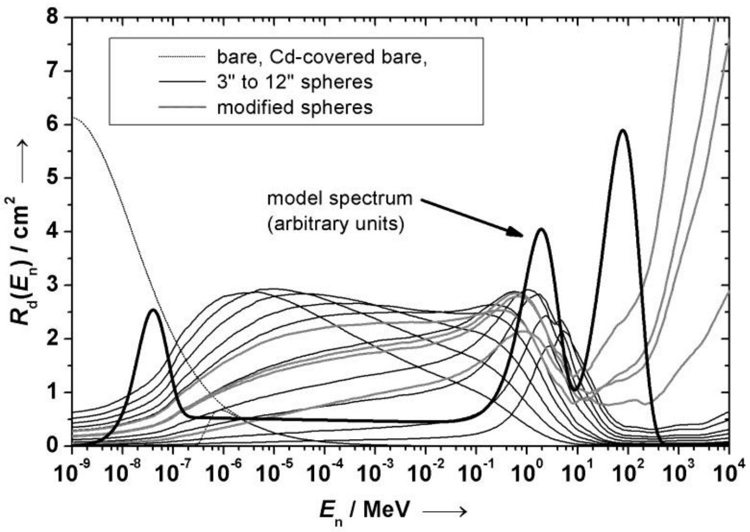
Thin detector to put in the beam at the exit of the collimator

Conclusion

- **Beam intensity**
  - MicroMega (at exit of collimator), Fission chamber, EJ309 scintillator
- **Spatial distribution**
  - EJ309 scintillator
- **Background conditions**
  - Fission chamber, EJ309 scintillator
- **Energy distribution**
  - Medley, Proton recoil telescope, Bonner sphere and EJ309 scintillator

Thank you for your attention

Bonner sphere



- Detectors from IRSN
- Measurement of energy distribution
- Method sensitive from thermal energy neutrons up to 200 MeV
- Determination of the thermal neutron component in the beam