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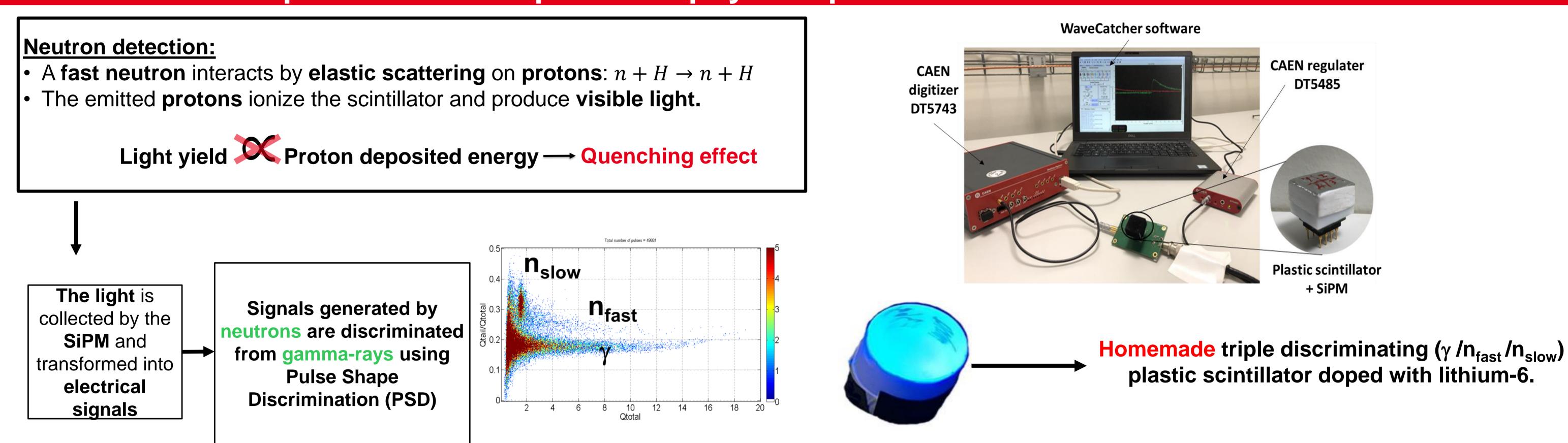
Measurement of the response function of a home made plastic scintillator using monoenergetic neutron and proton beams.

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Application, motivation and objective

- Plastic scintillators are currently used as the main components of various neutron spectrometers, allowing to determine neutron energy spectra.
 - To determine the neutron energy spectra, a finite calibration is required to determine the relation between incident neutron energy and the measured light yield.
 - In this work, two calibration methods were conducted, using both neutron and proton mono-energetic beams, to measure the light output of a homemade triple discriminating plastic scintillator.

Experimental set-up and the physical phenomena behind the detector



Experimental results and comparison between the two calibration method

Measurement of the light output of the homemade scintillator by using a mono-energetic neutron beam of IRSN AMANDE facility

Comparison of the two light output functions obtained with

both mono-energetic beams

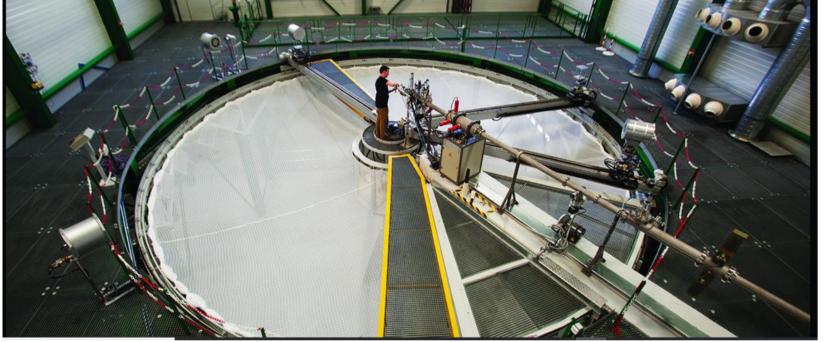
Measured light response of recoil protons

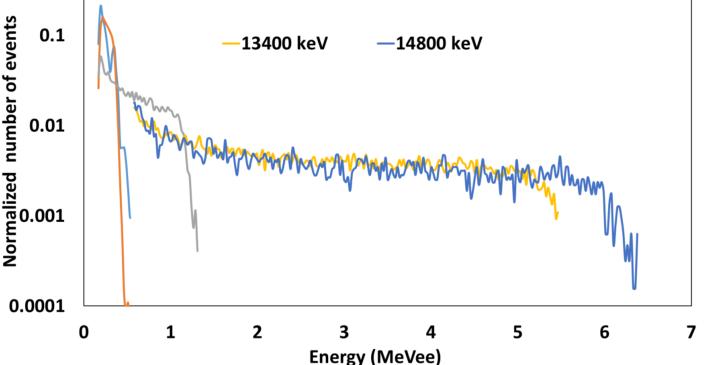
—1063 keV —2062 kev —4404 kev

Measurement of the light output of the homemade scintillator by using a mono-energetic proton beam of CYRCE platform

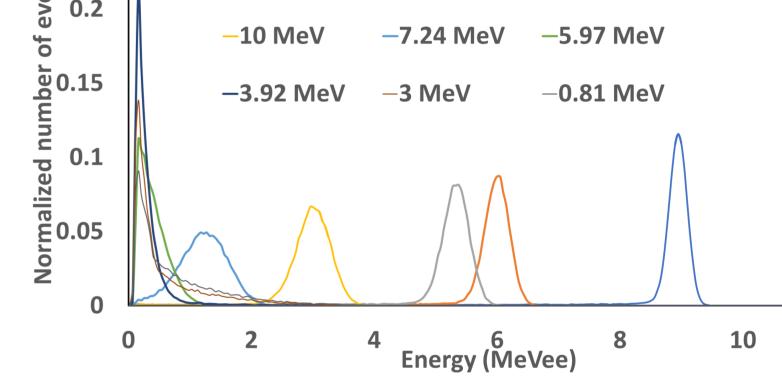


0.25 Measured light response of protons -19.97 MeV -14.33 MeV -13.7 MeV



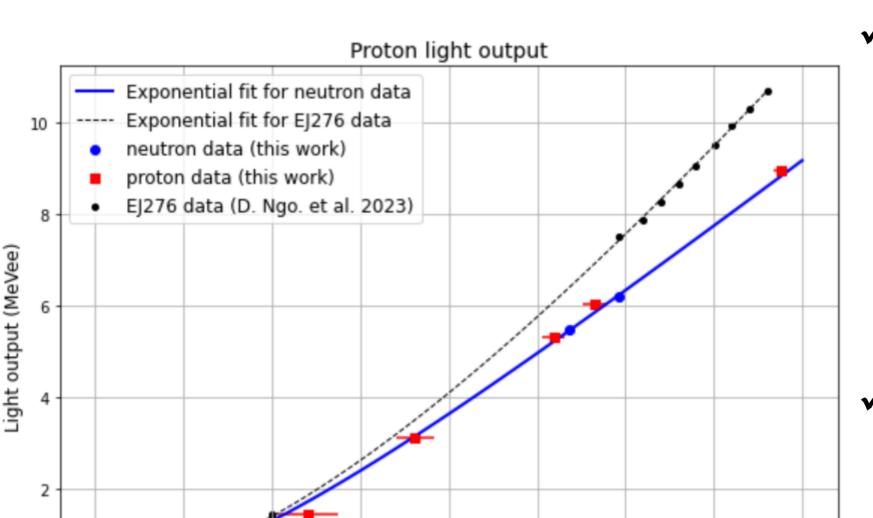




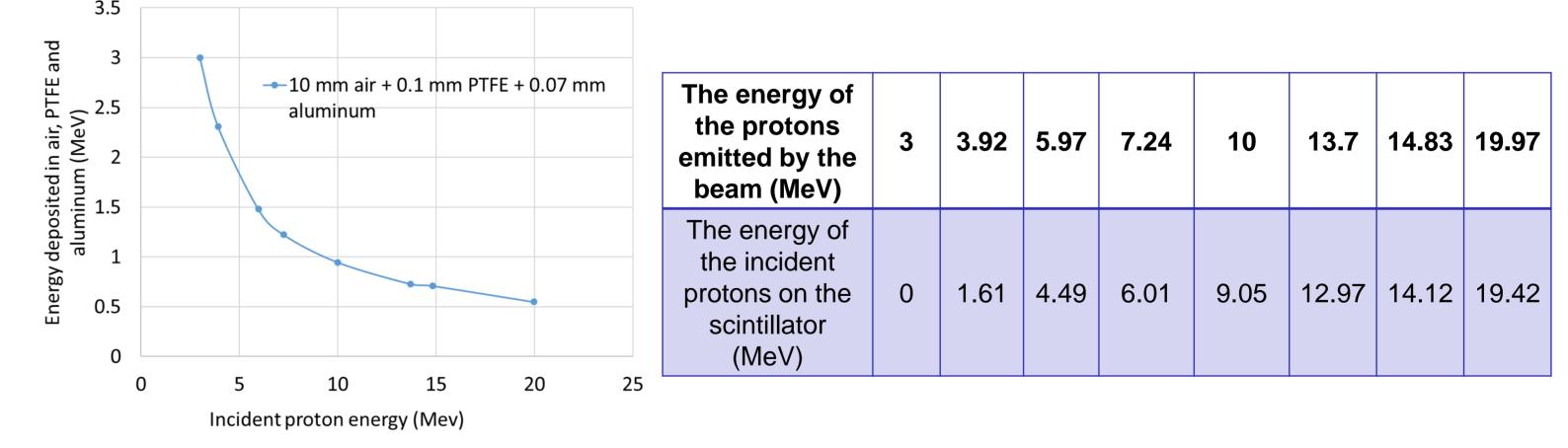


The **Teflon** and **Aluminum** layer surrounding the scintillator causes a **reduction** in the **energy of incident protons** as they pass through it, leading to a decrease in their energy when they reach the scintillator.

Study of the proton energy loss by using MCNP6 Monte Carlo code:

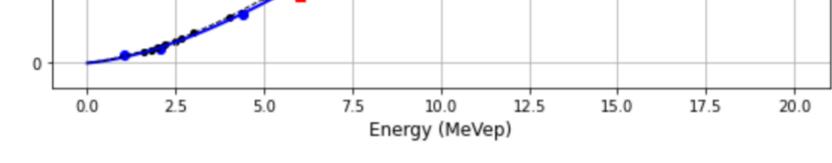


- ✓ The **light output data** obtained with the mono-energetic **neutron beam** was fitted using the following empirical model: $L(E_p) = aE_p - b(1 - e^{-cE_p})$ a= 0.580, b = 2.48, and c = 0.204
- ✓ The fitting exponential curve used for the light output data obtained with the mono-



Key benefits of using a proton beam compared to a neutron beam

The Gaussian shape of the light response makes the determination of calibration points easier.



energetic **neutron** beam **fits well** with the **light output** data obtained with the monoenergetic **proton** beam.

- Absence of unwanted events such as gamma radiation.
- The availability of calibration data for proton energies between 5 and 13 MeV, for which neutron generator physics does not allow their production.
 It is possible to carry out an automatic beam collimation.

Conclusions and perspective

- ✓ We determine the **light output** function for the **plastic scintillator neutron spectrometer.**
- For the first time, a mono-energetic proton beam was used for carrying out a plastic scintillator energy calibration. This method is a complementary approach compared to a calibration step based on a mono-energetic neutron beam.
- ✓ To calibrate the scintillator using a proton beam, it is necessary to have precise control over the thicknesses of the material layers that the protons pass through before interacting with the scintillator.
- > In future work, we will use the mono-energetic proton beam to calibrate the 12×12 pixelated plastic scintillator.

