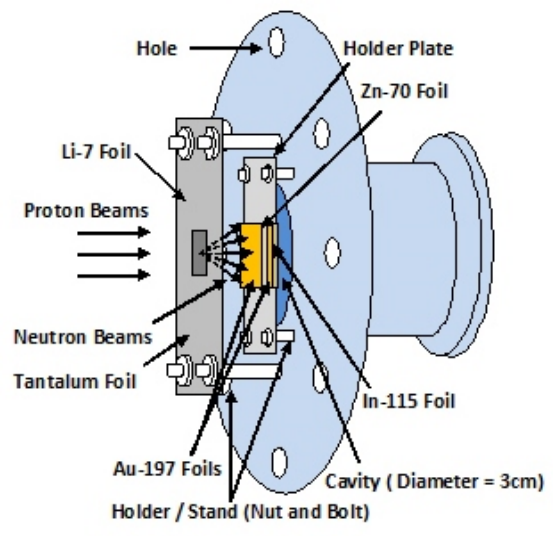
A tool for calculation of the $^{7}Li(p,n)^{7}Be$ neutron spectra below the three-body break up reaction threshold



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INTRODUCTION

- $^{7}Li(p,n)^{7}Be$ reaction -neutron source.
- Subtraction of (p,n_1) - neutron-induced reaction cross section.

We developed a new deterministic code

EPEN-Energy of Proton Energy of Neutron

- **Formalism:** Similar to that of Lee and Zhou except that-
  - Kinematic equations in terms of ^{7}Li mass
  - Differences in selection criteria of "±" in the double valued region

$$\frac{dY(E_n)}{dE_n} = \int d\Omega \frac{d^2Y(\theta, E_n)}{dE_n d\Omega} w_1(\theta) w_2\left(E_p(\theta, E_n)\right)$$

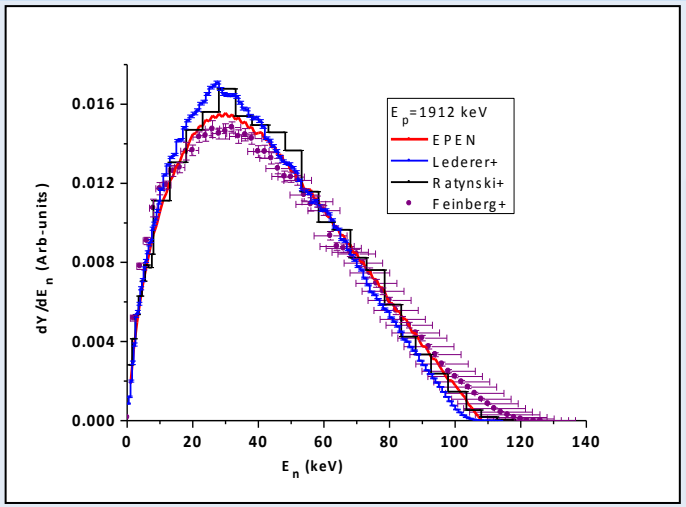
Differential Cross-sections

- **E_p > 1.95 :** Evaluated data - Liskien et. al.
- **E_p near threshold :** Functional form – Macklin & Gibbons
- **1.92 MeV< E_p <1.95 MeV :** Cubic Spline fits

Weighting functions

- Solid angle covered by sample (w_1)
- Proton energy spread (w_2)

RESULTS AND DISCUSSION



Validation

EPEN reproduces experimental spectra well

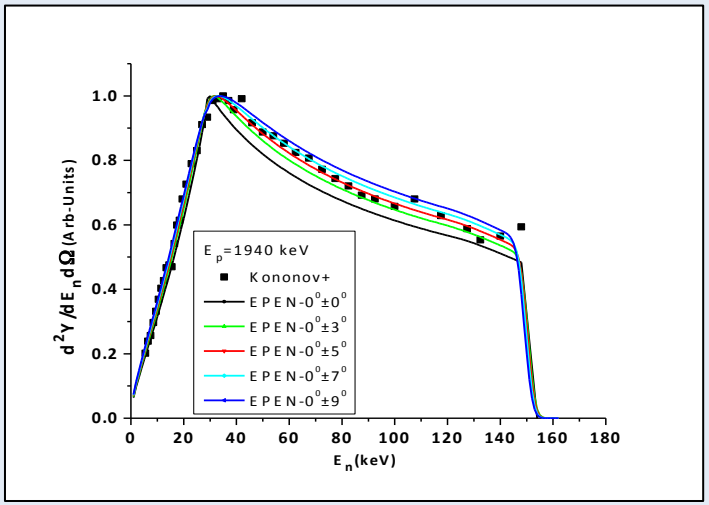
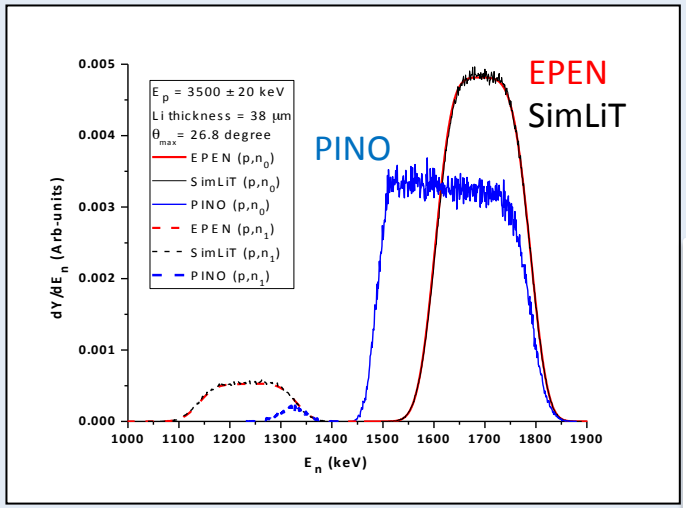


Fig. 1: Comparison of EPEN $^7Li(p,n_0)^7Be$ neutron energy spectrum at E_p=1912 ± 0 keV with experimental results .

Fig. 2: Comparison of EPEN $^7Li(p,n_0)^7Be$ double differential neutron energy spectrum at E_p=1940 keV with experimental result.



Comparison of EPEN with Monte Carlo codes

- EPEN always agree with SimLiT perfectly
- PINO – narrow (p,n_1) spectrum centred near the upper boundary of the (p,n_1) energy spectra of EPEN & SimLit

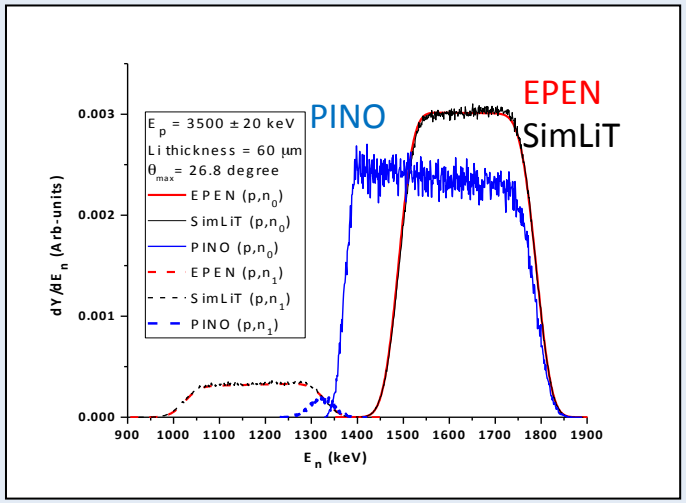


Fig. 3: Lithium target thickness 38 µm at E_p = 3500±20 keV

Fig. 4: Lithium target thickness 60 µm at E_p = 3500±20 keV

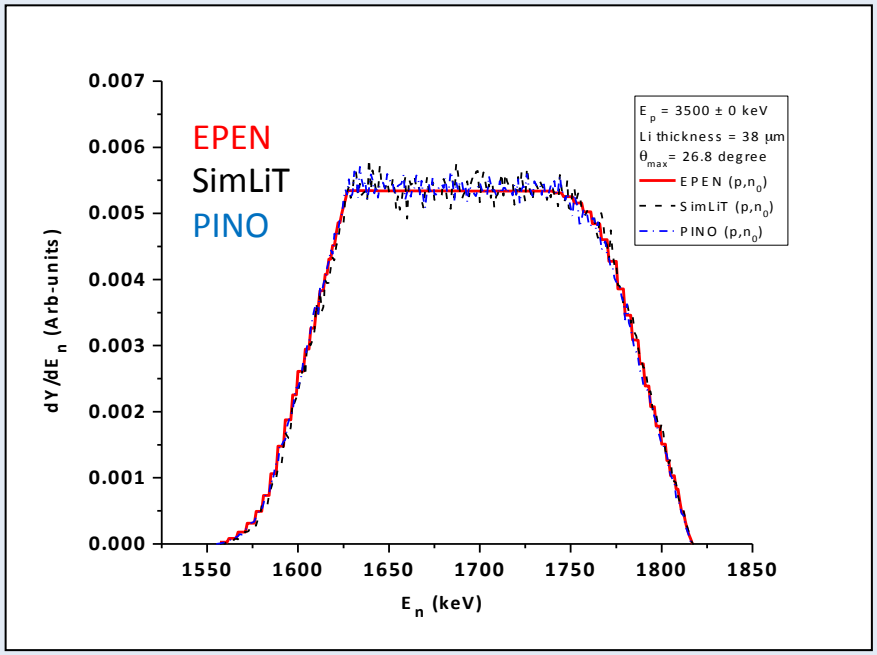


Fig. 5: Comparison between EPEN, SimLiT and PINO neutron energy spectra for lithium target thickness 38 µm at E_p = 3500±0keV.

(p,n_0) neutron spectra of EPEN, SimLiT and PINO - excellent agreement if the proton beam energy spread is negligible.

EPEN output can be used as an input to the Monte Carlo particle transport codes to describe more complicated neutron source systems as done by Friedman *et al.* for SimLiT+GEANT.

☺ Dank je ☺