



The $^7\text{Be}(\text{n}, \text{p})$ cross section and the Cosmological Lithium Problem: the measurement in EAR2@n_TOF

Lucia Anna Damone, Nicola Colonna, Massimo Barbagallo, Mario Mastromarco, Sergio Lo Meo

email: lucia.damone@ba.infn.it

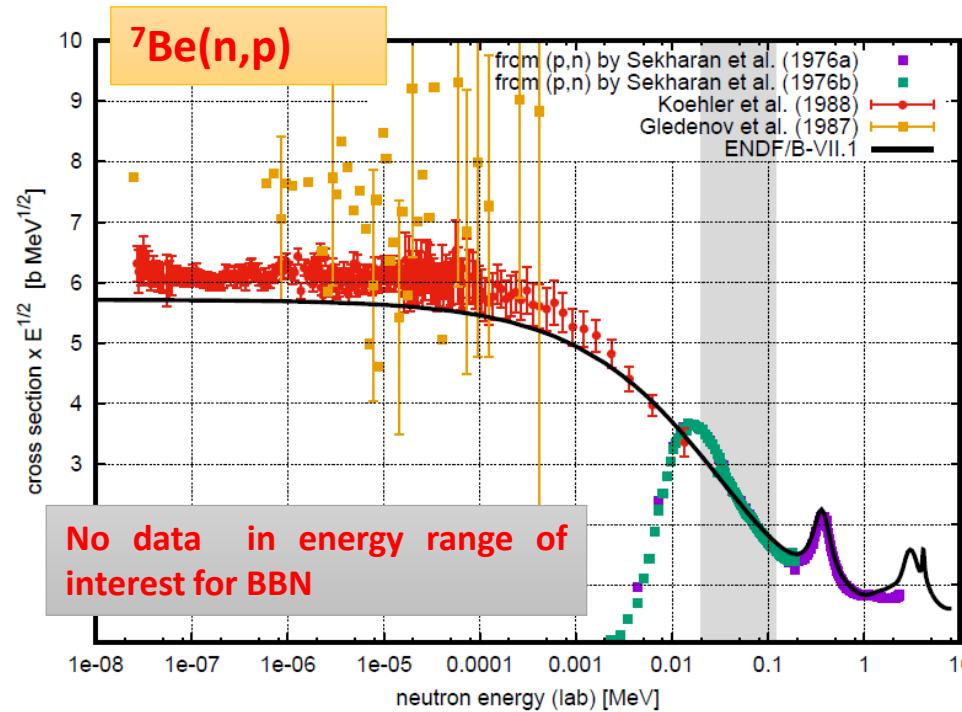
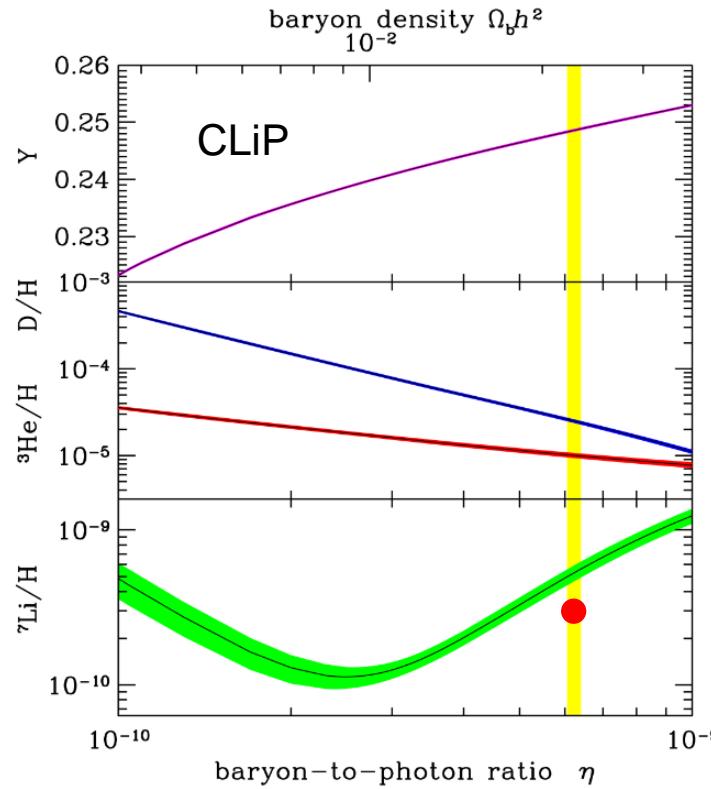
Meeting n_TOF Italia, LNL 20 Ottobre 2016

- ❖ Physics case: The Cosmological Lithium problem
- ❖ experimental set-up for the ${}^7\text{Be}(\text{n}, \text{p})$ measurement
- ❖ Geant4 Simulations
- ❖ Preliminary results of the ${}^7\text{Be}(\text{n}, \text{p})$ measurement
- ❖ Conclusions

A serious discrepancy between the predicted abundance of ^7Li and value inferred by measurements (Spite et al.)

Approximately 95% of primordial ^7Li is produced from the electron capture decay of ^7Be ($T_{1/2}=53.2\text{ d}$).

^7Be is destroyed via (n,p) and (p,x) , (d,x) , $(^3\text{He},x)$, ... reactions. Small contribution of the (n,α) reaction.

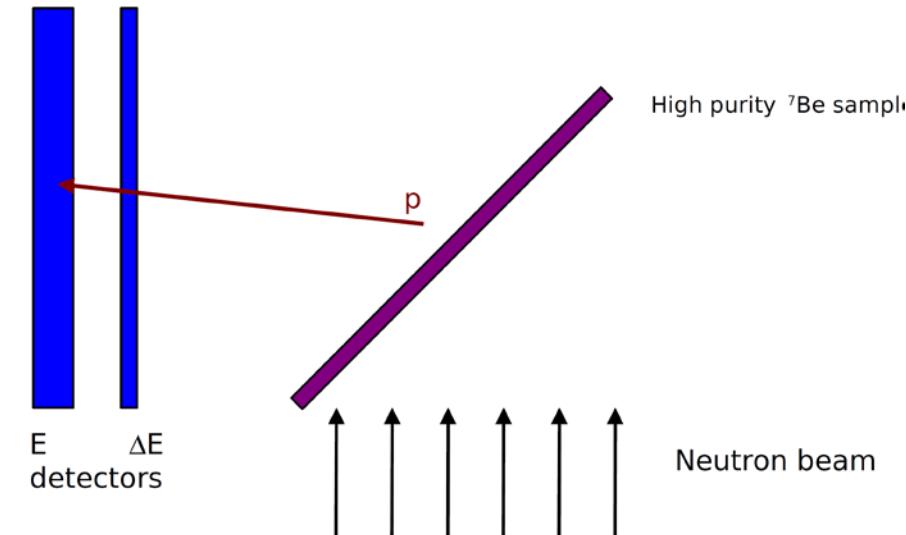


Silicon telescope **outside of the beam.**

Detection of protons of 1.4 MeV and 1 MeV

High purity sample needed: PSI + ISOLDE

1 GBq activity sample required

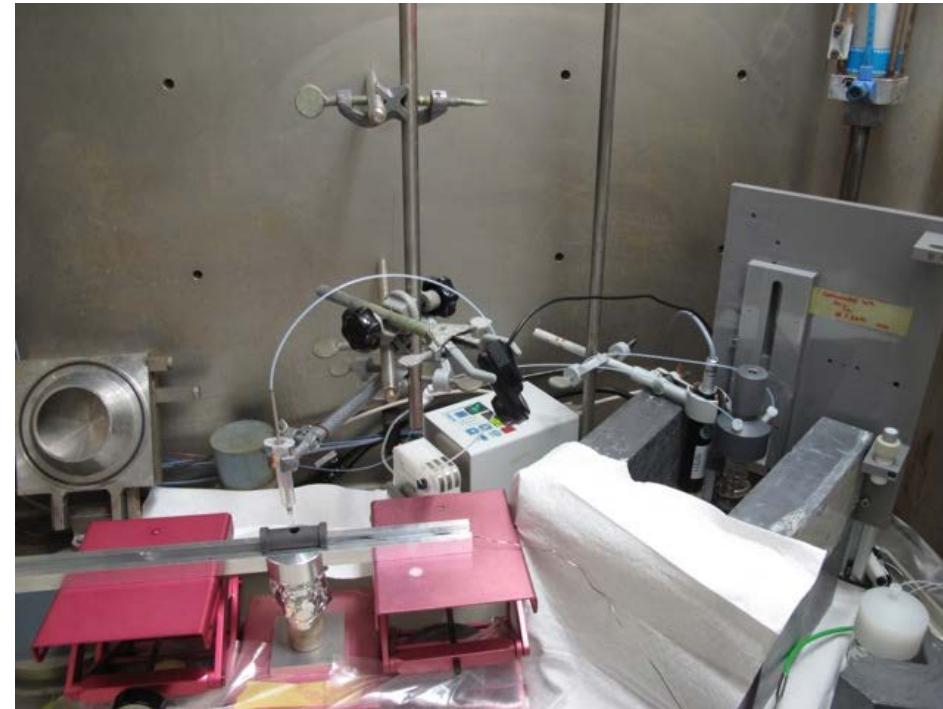


20 MBq (16/04/2016), due to
issues of the ISOLDE beam line

1.1 GBq (14/05/2016)

Sample preparation (PSI)

200 GBq have been extracted from water cooling of SINQ spallation source at PSI and later inserted in the form of ${}^7\text{Be}(\text{NO}_3)_2$ colloid in the ISOLDE Ion Source ("Isolde oven").



CNMO M11 type A container used for the shipment from PSI to CERN.

Additional 2.5 cm Pb shielding needed.

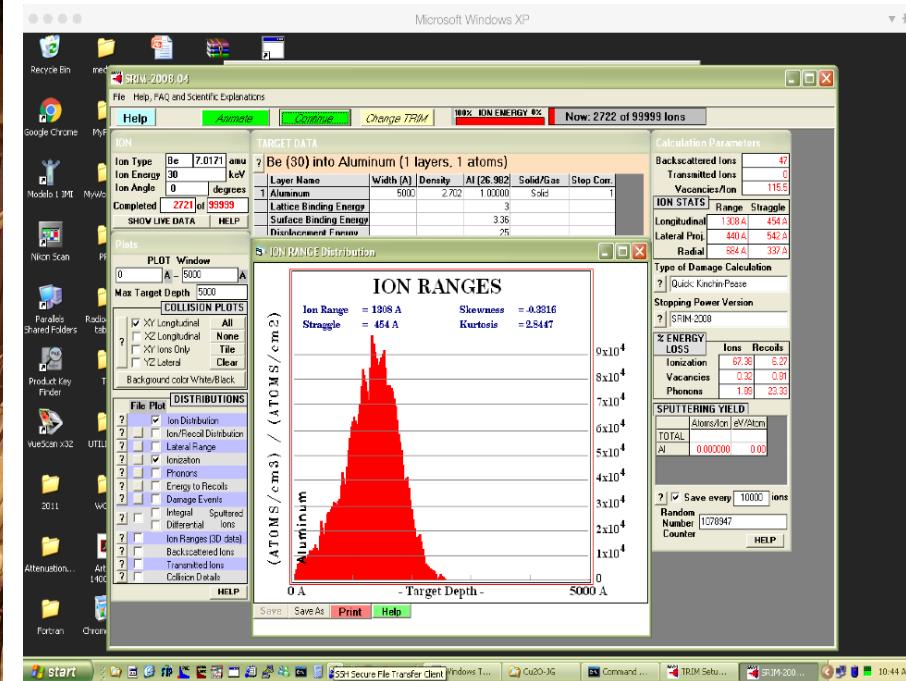
Mass separation at the GLM beamline.

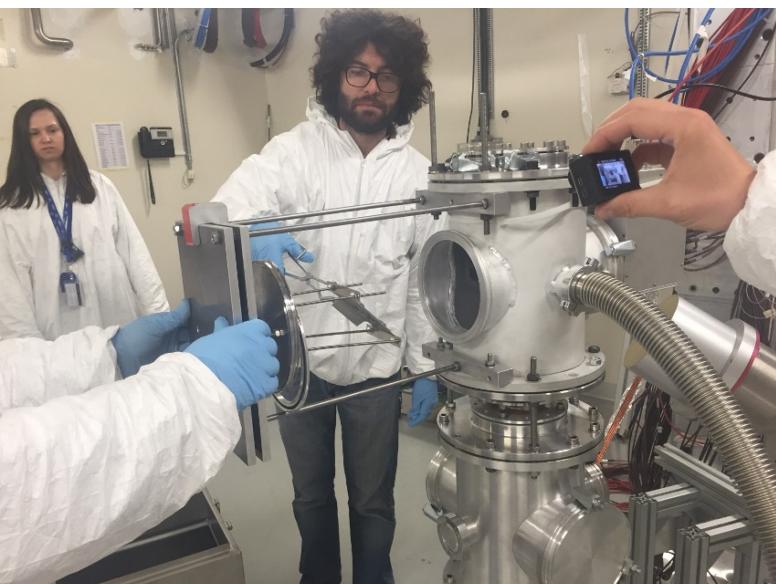
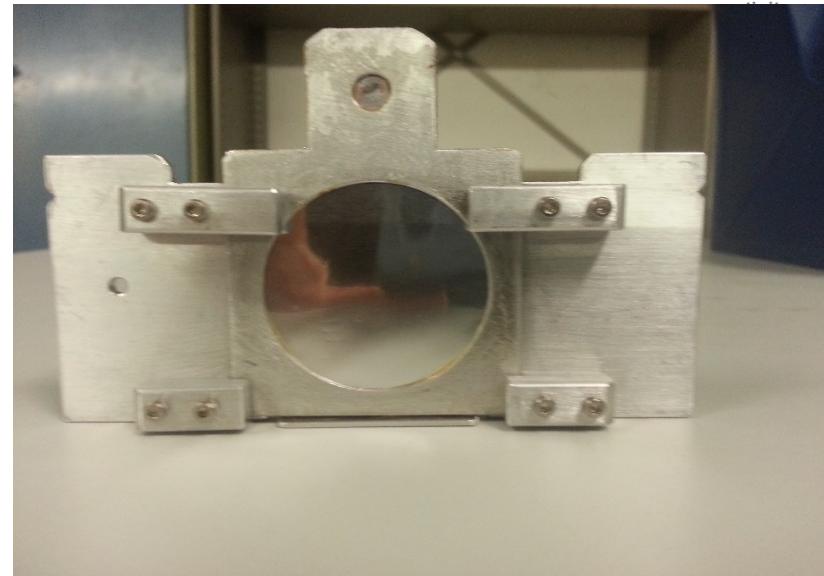
Current injection to heat up the oven, lasers (RILIS) to ionize the ^{7}Be (and ^{7}Li).

^{7}Be ions, accelerated up to 30 keV and separated by means of a magnetic dipole, have been implanted on an Aluminum backing 20 μm thick placed in high vacuum collection chamber.



Average depth of implantation: 150 nm

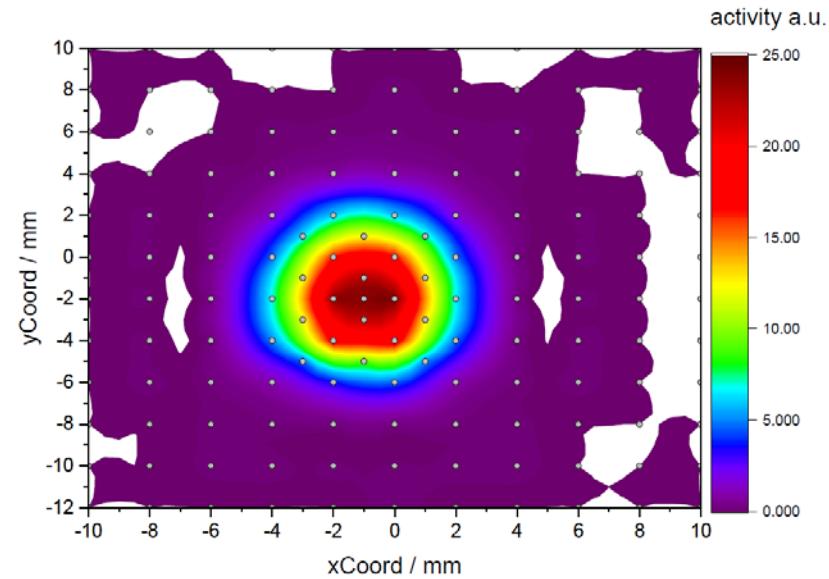
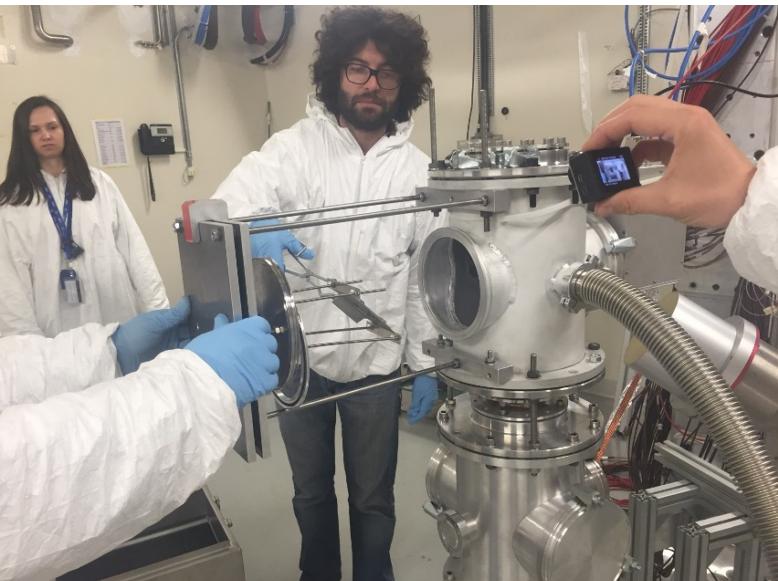




April-June 2016

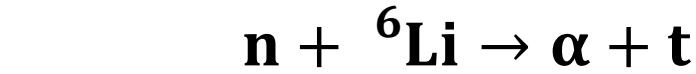
- Alignment (Gafchromic)
- LiF reference measurement
- (2x) ^{7}Be implanted samples
- Al Dummy

Sample preparation and measurement

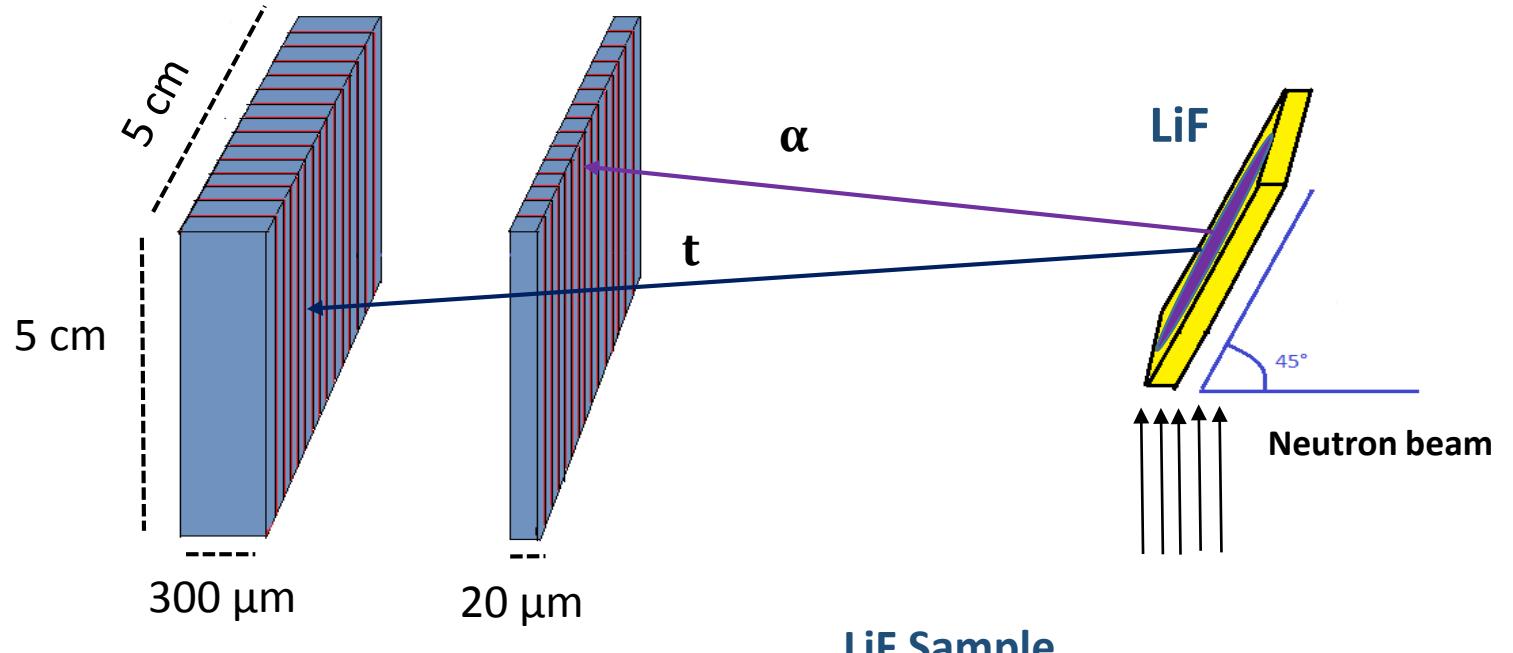


April-June 2016

- Alignment (Gafchromic)
- LiF reference measurement
- (2x) ^{7}Be implanted samples
- Al Dummy

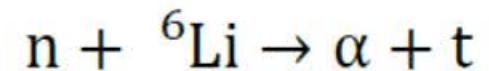
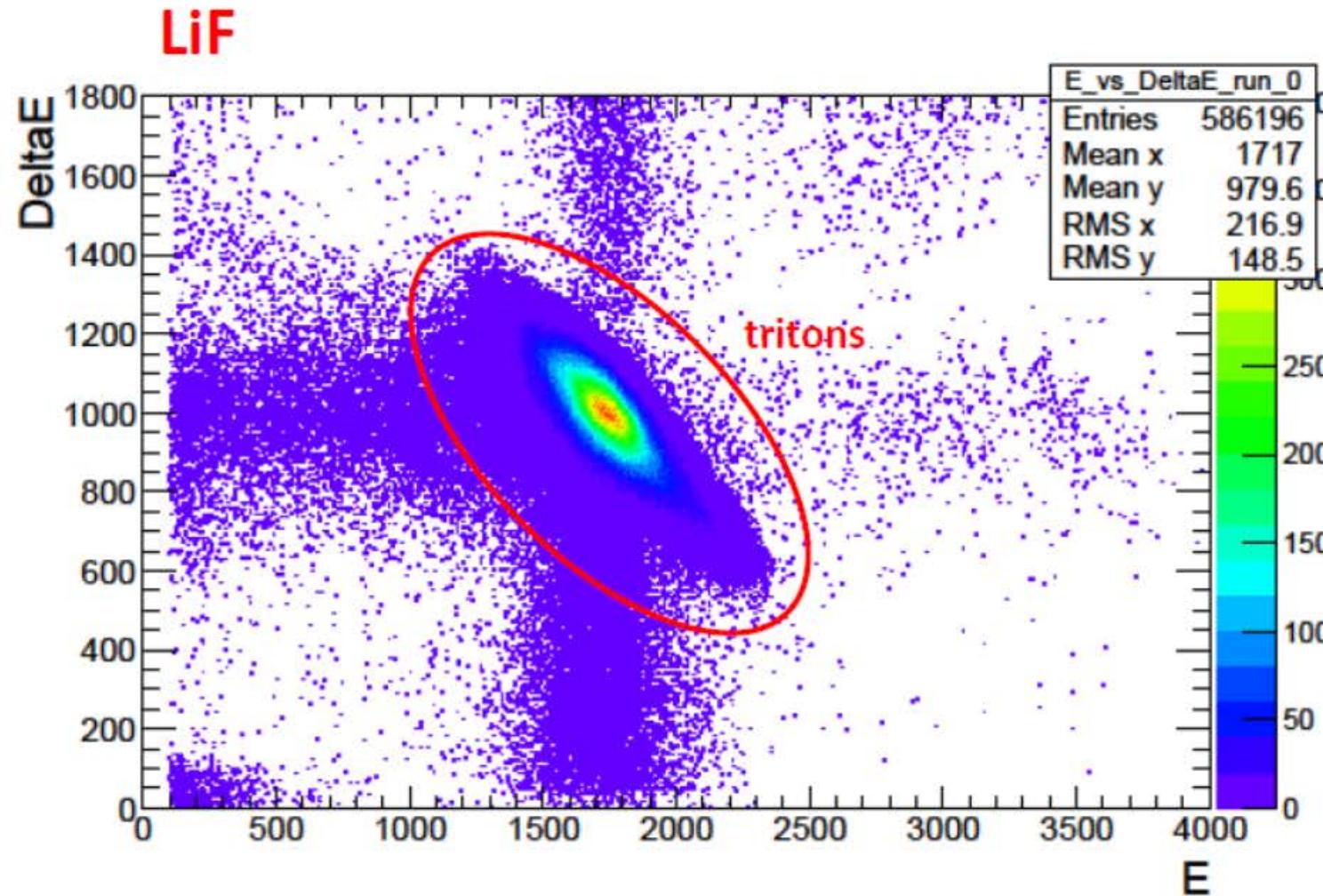


Cover $1.5 \times 1.5 \text{ cm}^2$



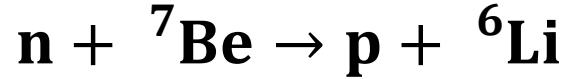
LiF Sample

xy	$5 \times 5 \text{ cm}^2$
z	$1.8 \mu\text{m}$

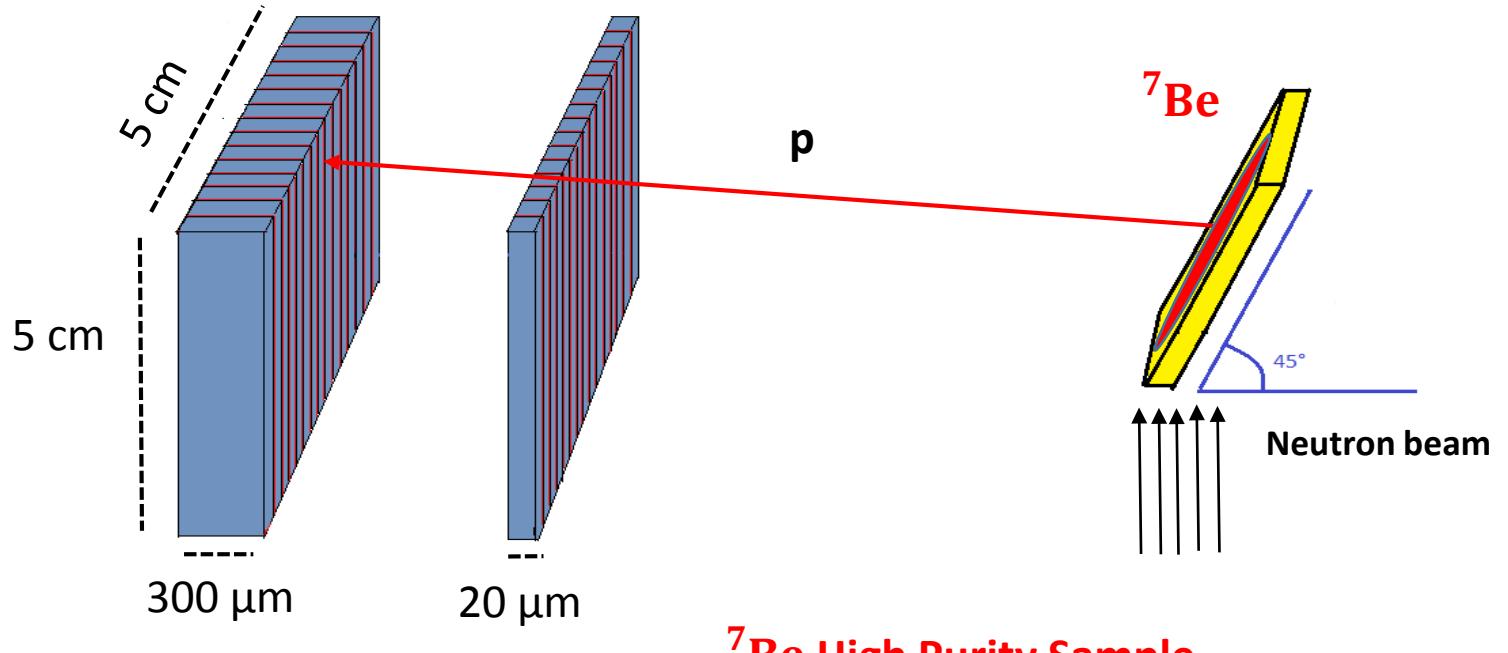


$$Q = 4.78 \text{ MeV}$$

Coincidence window = 100 ns

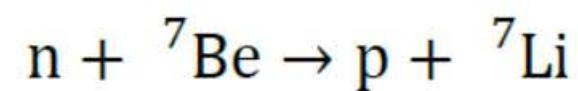
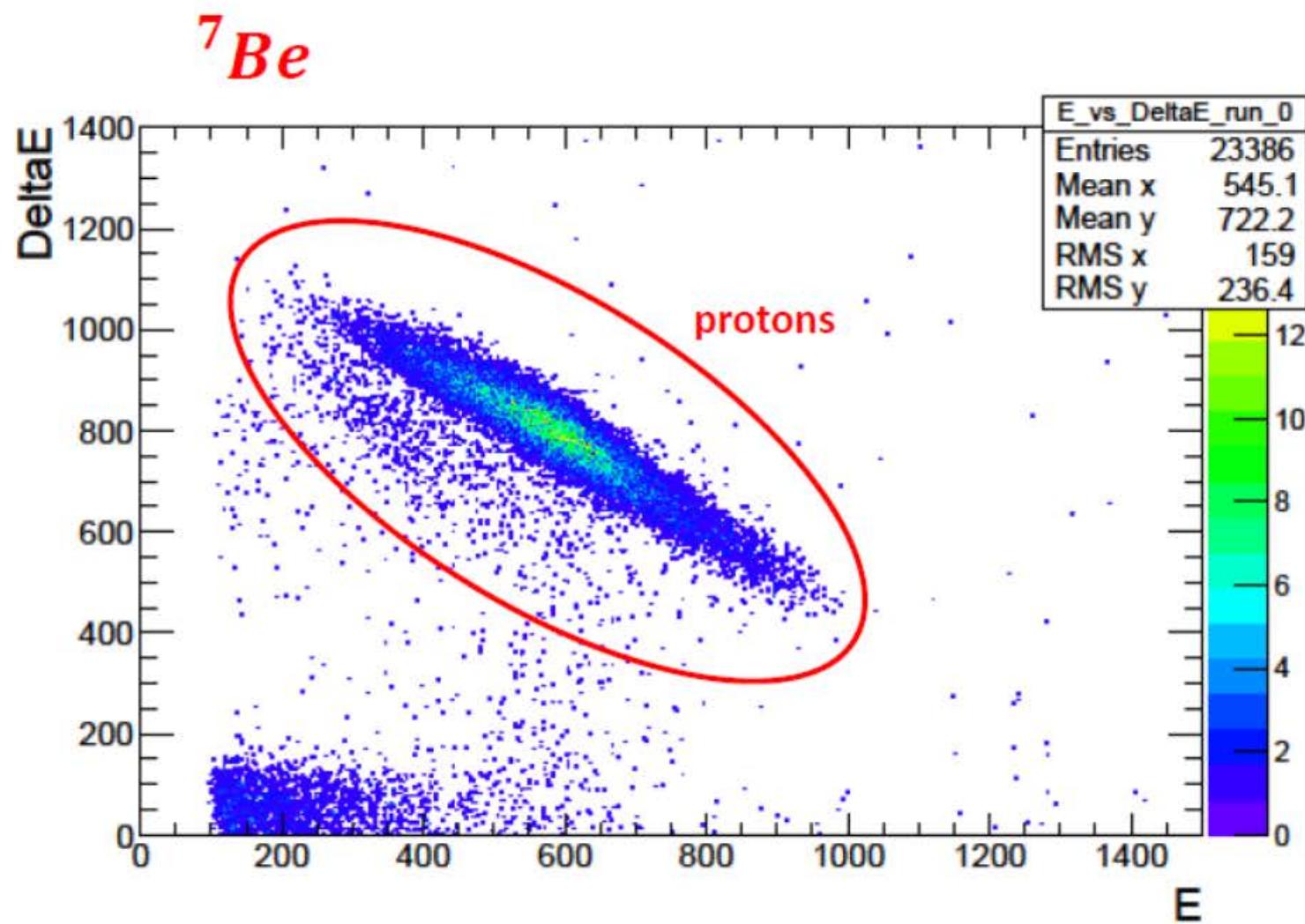


Cover $1.5 \times 1.5 \text{ cm}^2$

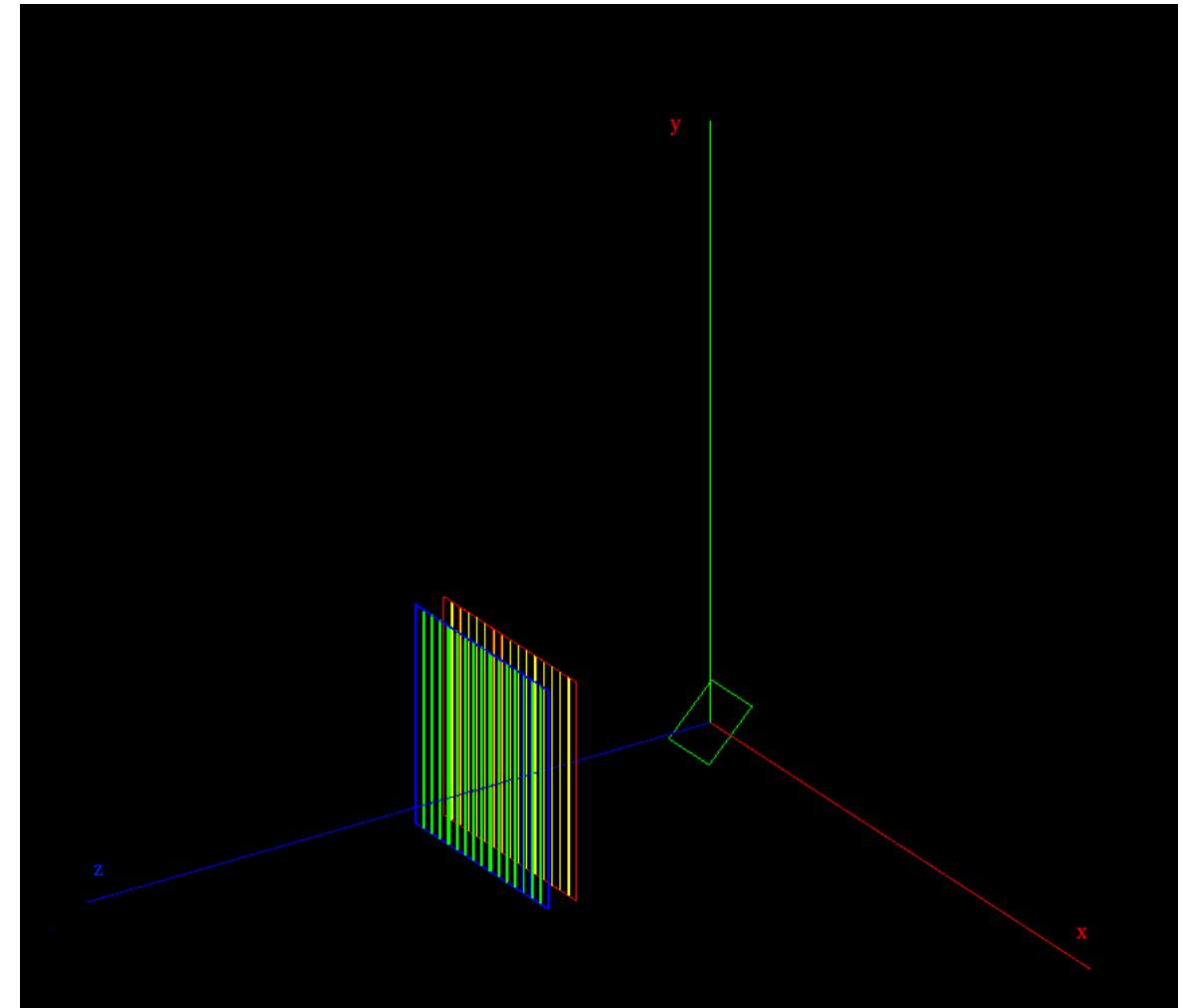
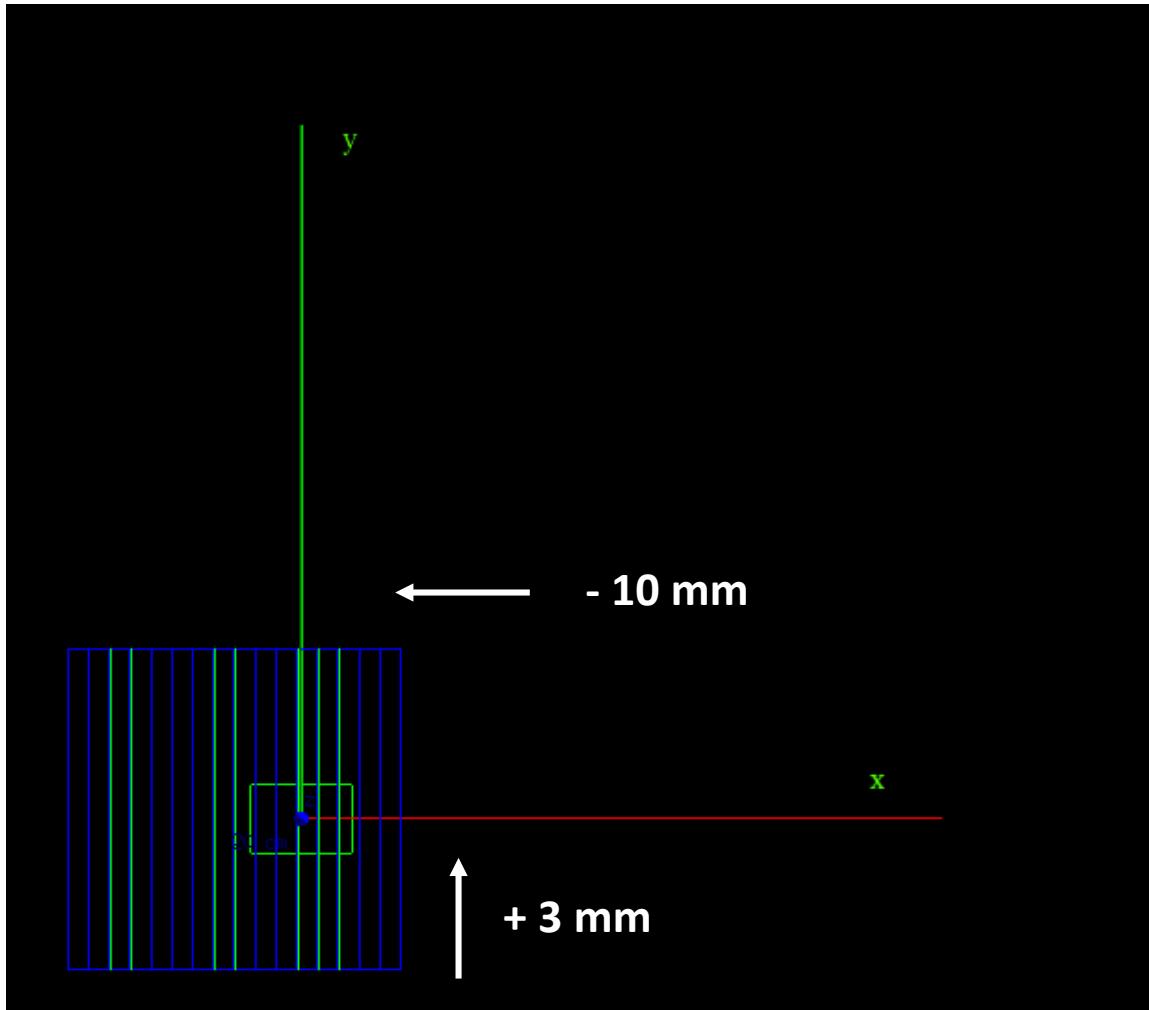


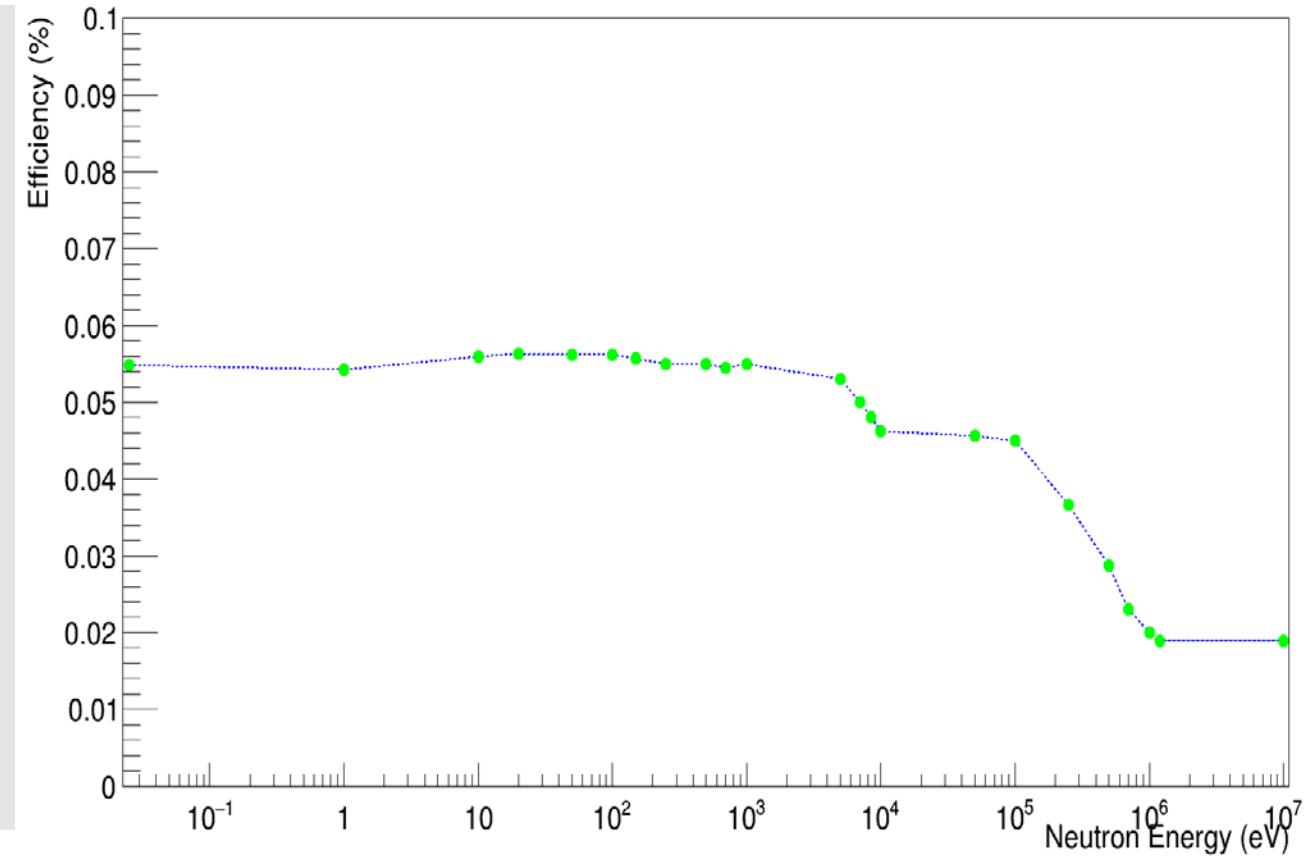
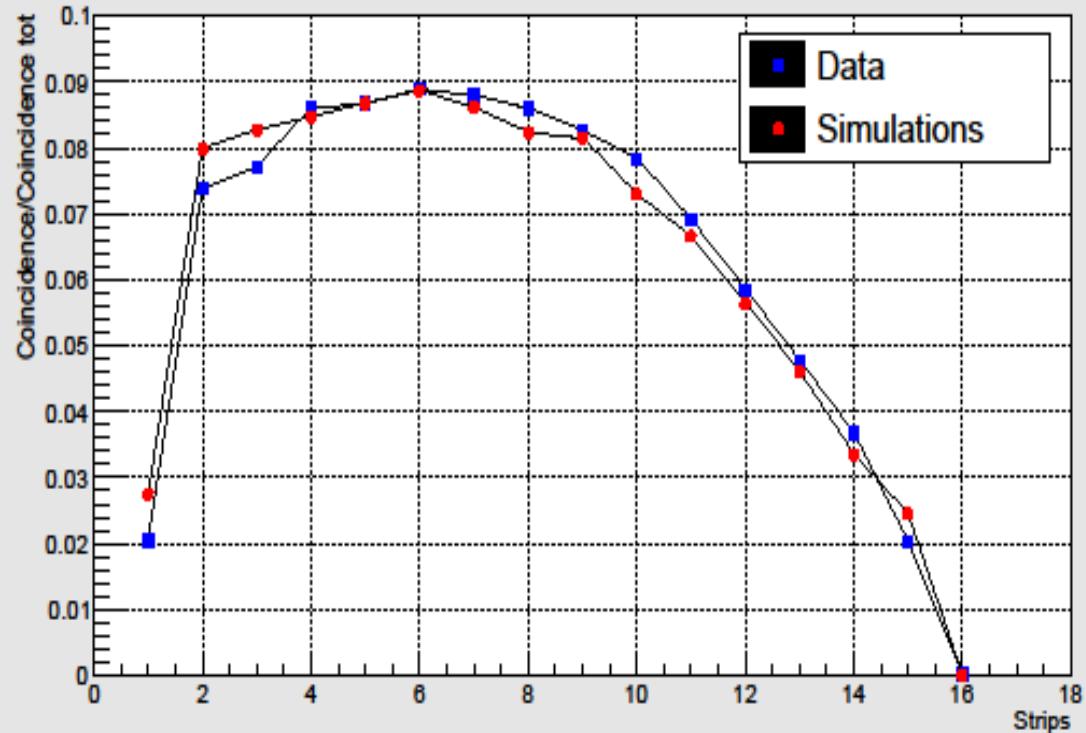
${}^7\text{Be}$ High Purity Sample

Activity	1.1 GBq
Radius	2.5 mm



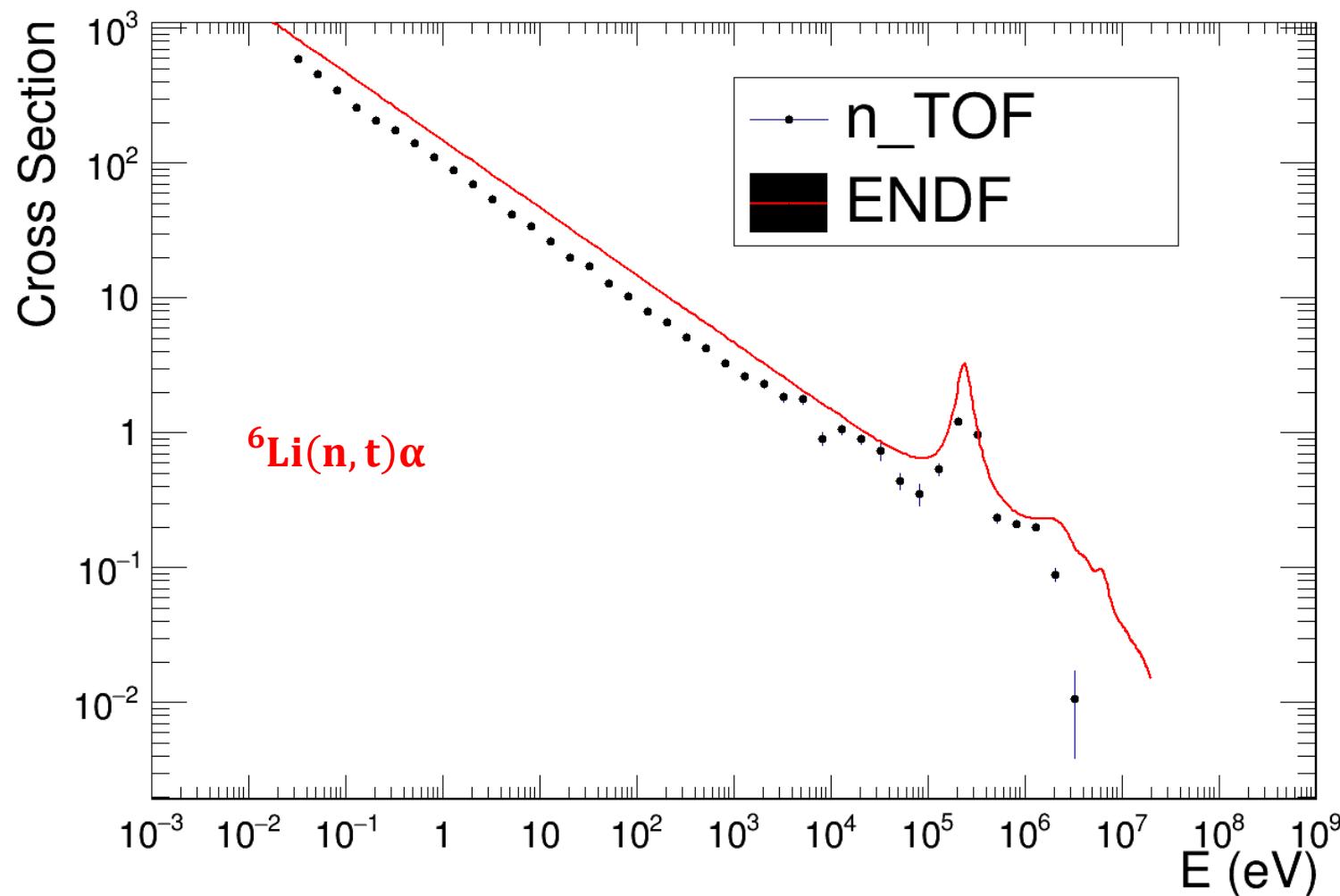
$$Q = 1.644 \text{ MeV} (\sim 95\%)$$





Very good agreement!

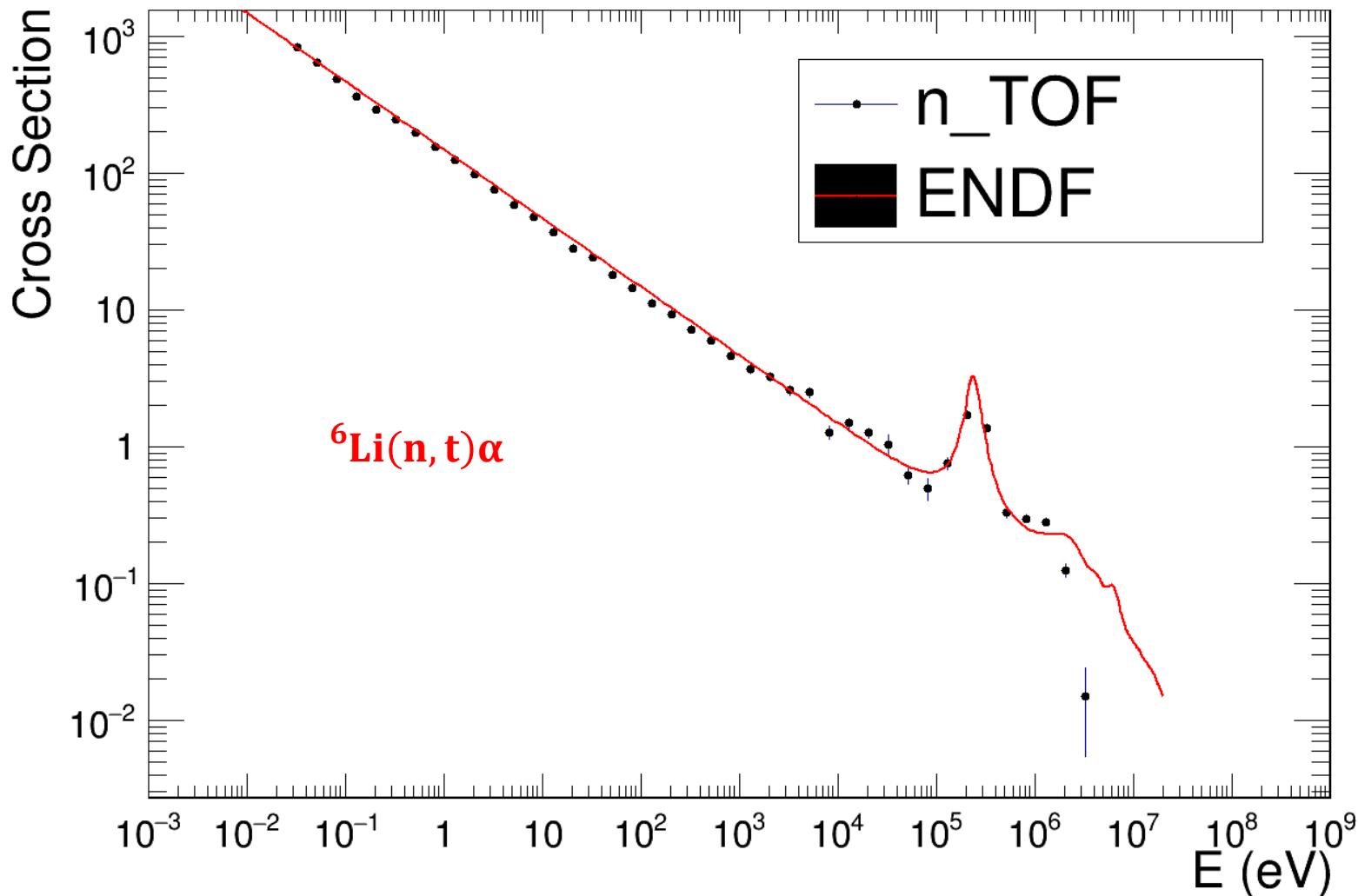
Factor 1.41 lower





Preliminary results

normalizing the cross section of ${}^6\text{Li}$ at thermal energy...



Conclusions

- ❖ We'll try to find a better agreement between ENDF ${}^6\text{Li}(\text{n}, \text{t})\alpha$ cross section and our data in order to correctly evaluate the ${}^7\text{Be}(\text{n}, \text{p}){}^6\text{Li}$ cross section.

THANK YOU FOR YOUR
KIND ATTENTION