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Title: Results of 6Li-glass detector tests for chi-nu

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<abstract>

Results of ^{6}Li-glass detector tests for chi-nu

Hye Young Lee

I will present the current status of the 6Li-glass detector development done for chi-nu project. The calibration work with 252Cf source and in–beam test on 235U will be discussed for charactering the detector performance and understanding the detector efficiency.

Results of ^{6}Li-glass detector tests for chi-nu

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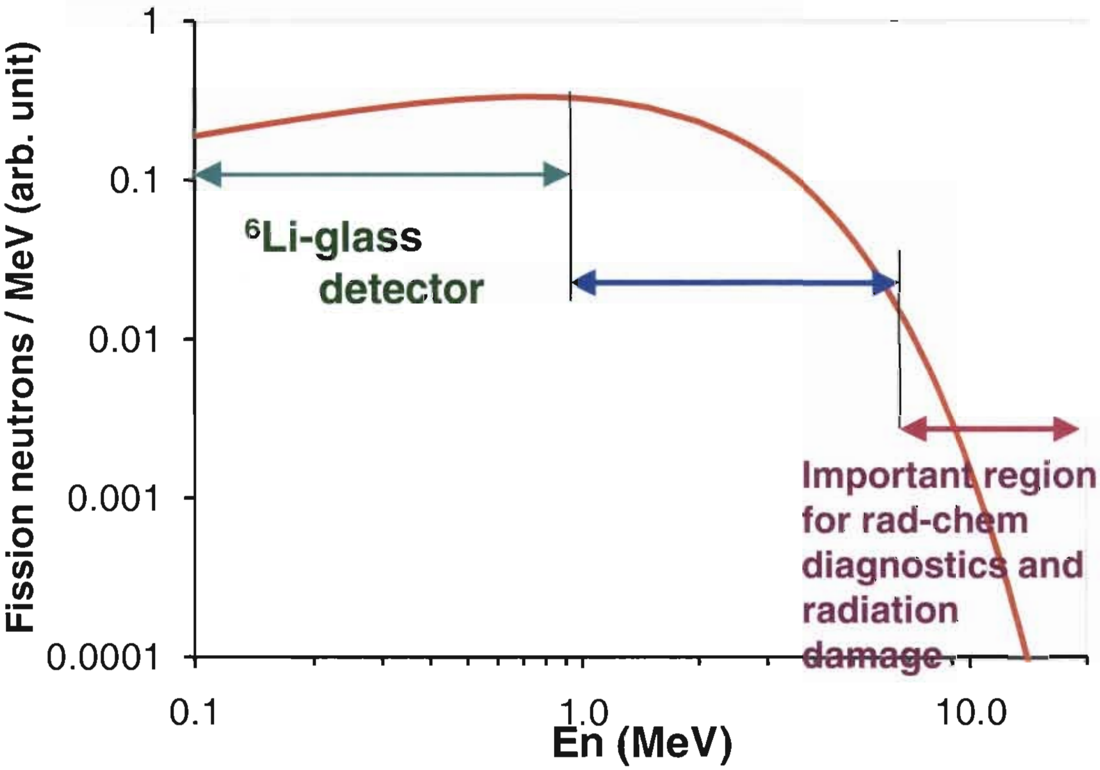
Li-glass detector tests

- **Calibration runs in Jan. 2011 using ^{252}Cf source**
  - Establish the analysis method for low energy measurements
  - Comparison with MCNPX Monte Carlo calculations
  - Determination of detection efficiency at $E < 1$ MeV
- **Preliminary results on the in-beam $^{235}U(n,f)$ measurements in Jun.-Sep. 2010**
  - Average neutron output energy
  - Nu-bar : neutron multiplicity

Fission neutron output spectrum (typical) : Watt distribution



Green arrow : about 35 % of fission-induced neutrons are produced at less than 1 MeV.

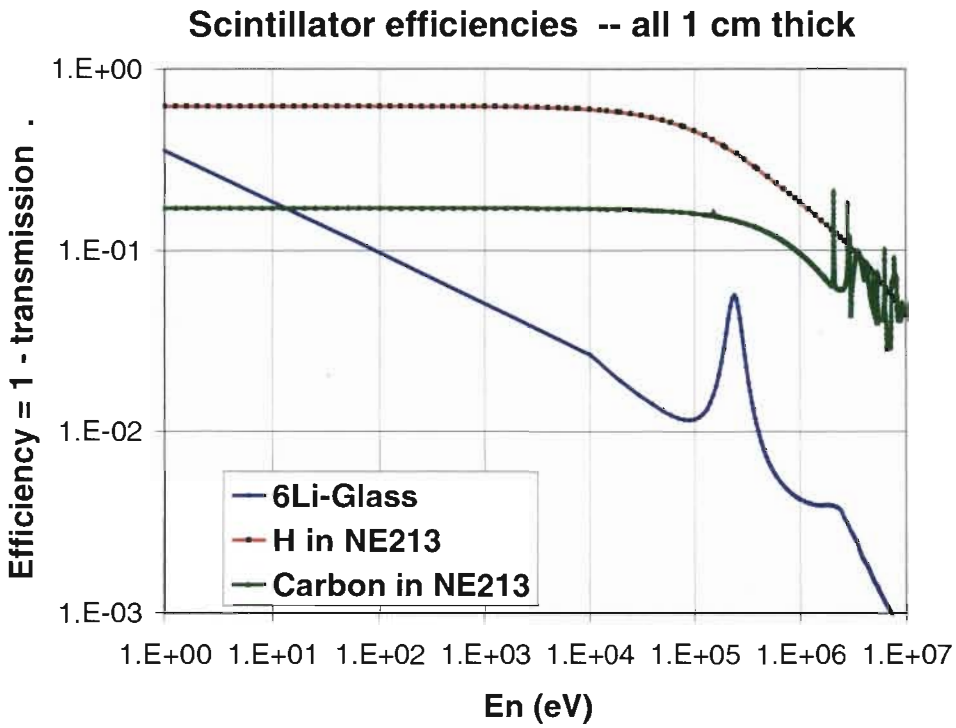
Blue arrow : number of neutrons in this region is determined by nu-bar and the shape of the entire spectrum.

Purple arrow : above 6 MeV, hydrogen and helium generated from (n,p) and (n,α) can do radiation damage on structural materials.

* This plot is made from the neutron emission from spontaneous fission of ^{252}Cf.

Up to now the unmeasured data below 1 MeV are obtained by fitting to Watt distribution.

^{6}Li-glass detectors for measuring low-energy neutrons (< 1 MeV)



NE213 shows the similar characteristics as Liquid Sinctillators used in Chi-Nu. Although the efficiencies (red and green lines) are still high at En < 1 MeV, it is impossible to discriminate neutrons from gamma rays.

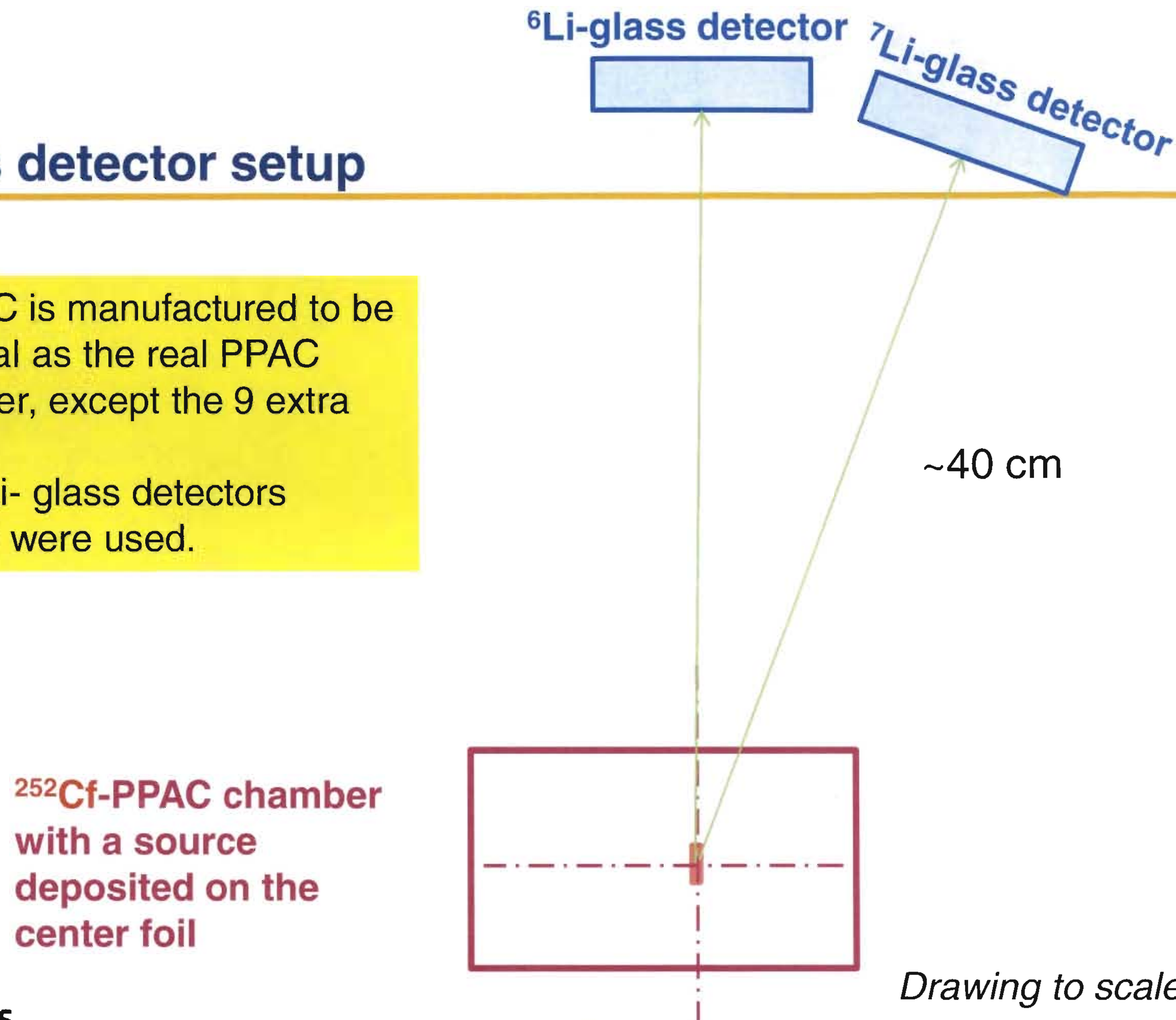
^{6}Li-glass detector has a usable efficiency below 1 MeV and can differentiate neutrons from gamma rays in this region.
The pulse height is generated from the $^{6}Li(n,\alpha)^{3}H$ reaction, where the α and triton products have a kinetic energy of about 4.8 MeV.

^{252}Cf source measurement

Li-glass detector setup

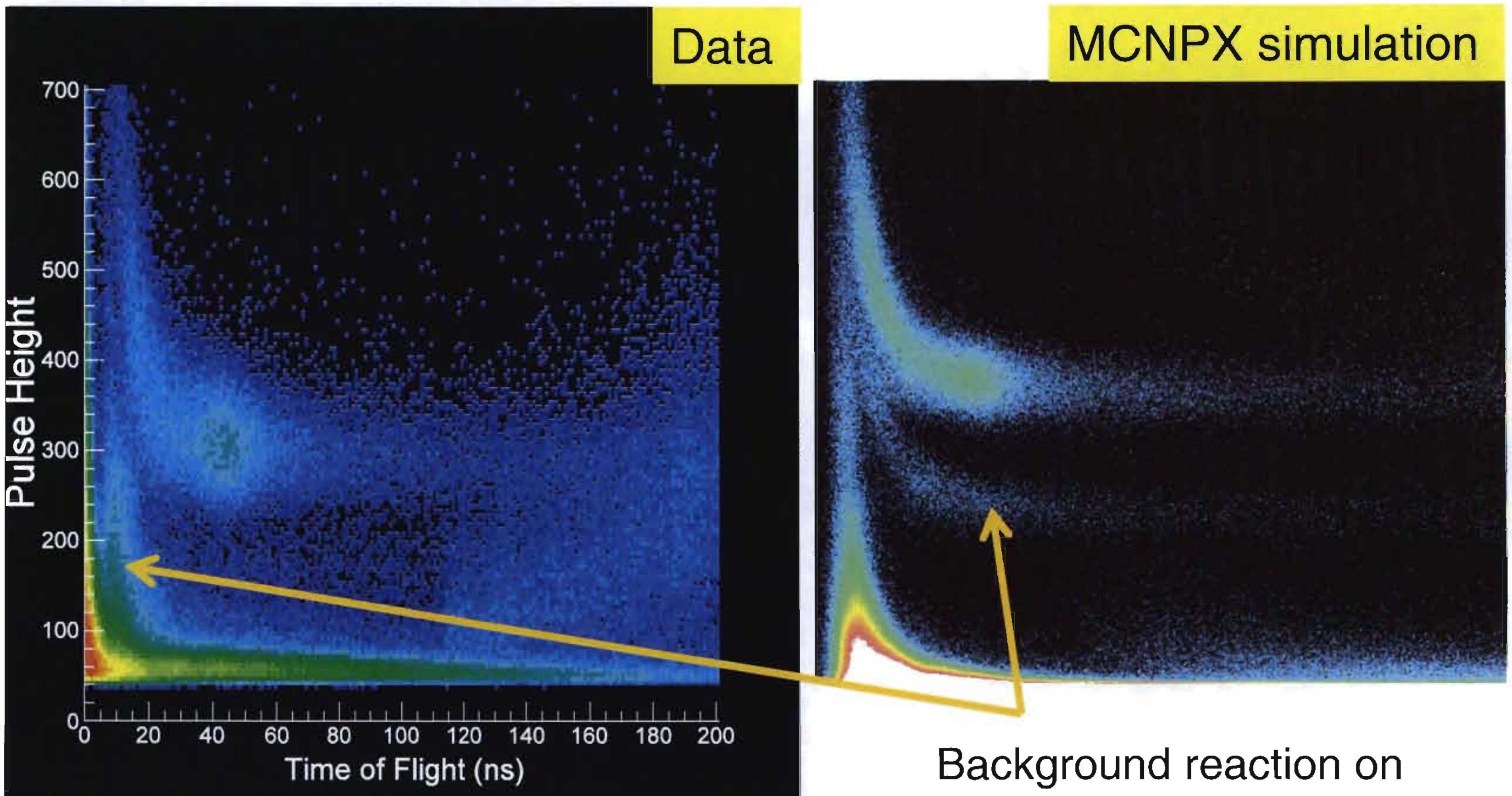
^{252}Cf-PPAC is manufactured to be identical as the real PPAC chamber, except the 9 extra foils.

^{6}Li- and ^{7}Li- glass detectors (4"X1") were used.



Drawing to scale

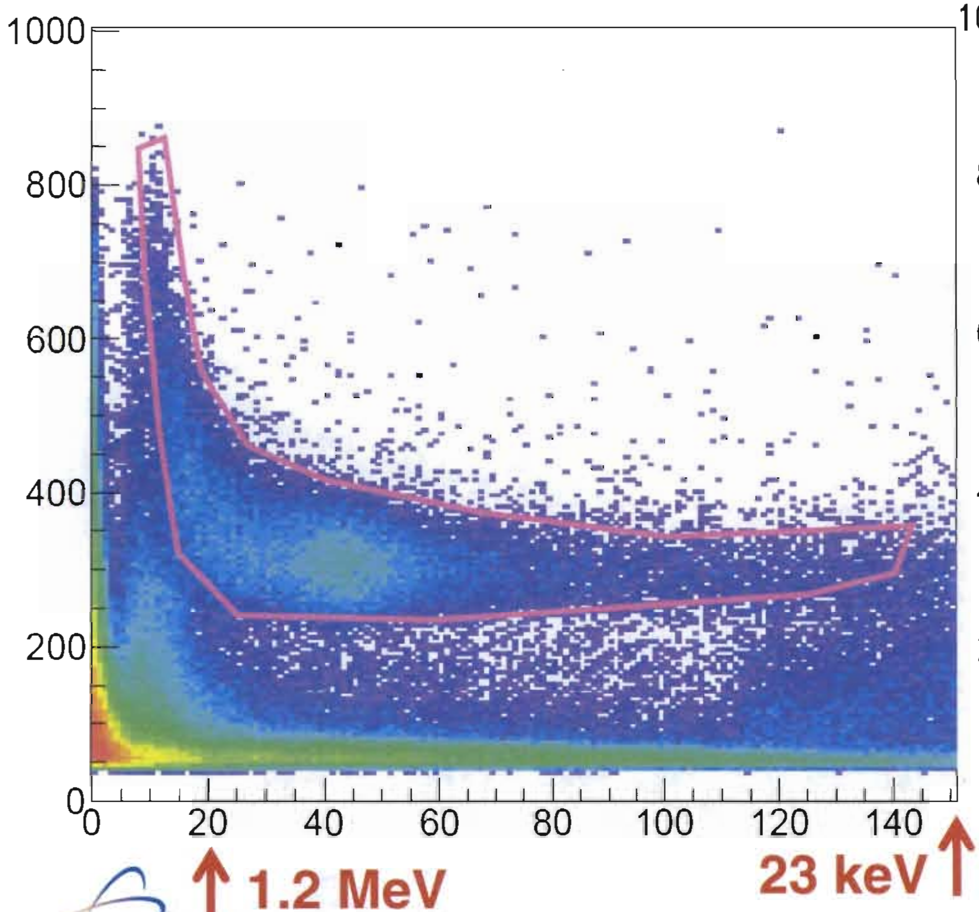
Pulse height (y-axis) vs. Time of Flight in ns (x-axis) : data and simulation



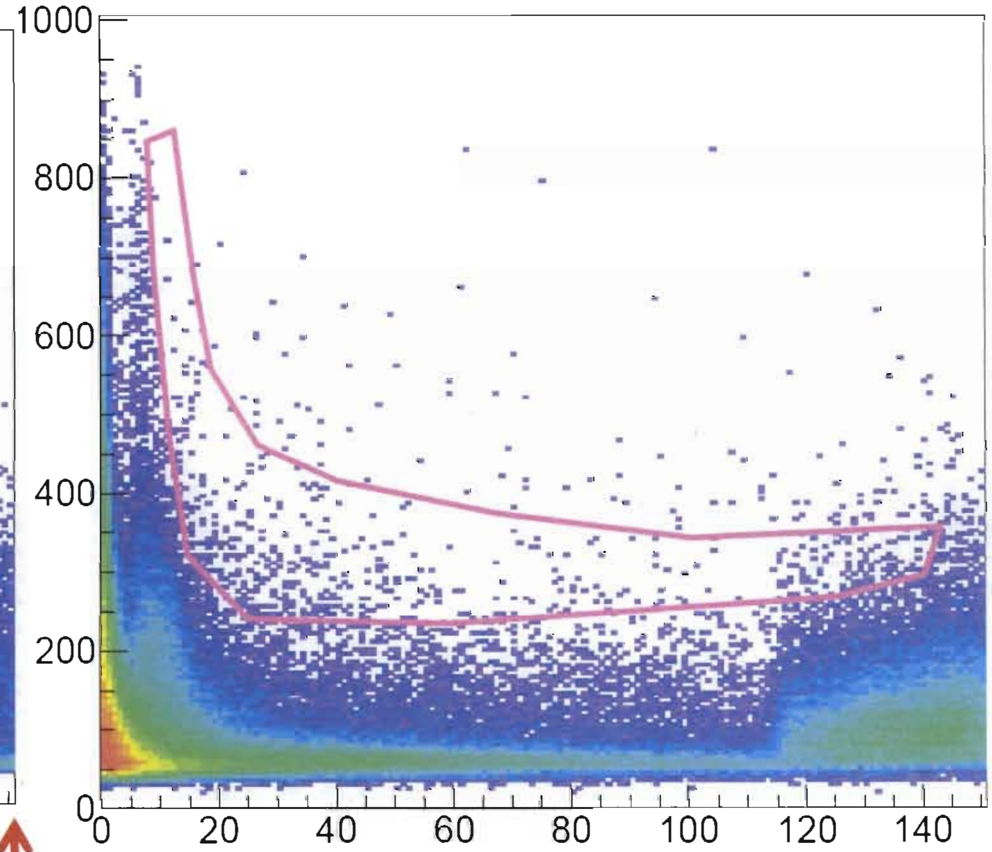
Background reaction on glass materials

Detector efficiency vs. neutron energy

6Li(1): pulse height vs. TOF

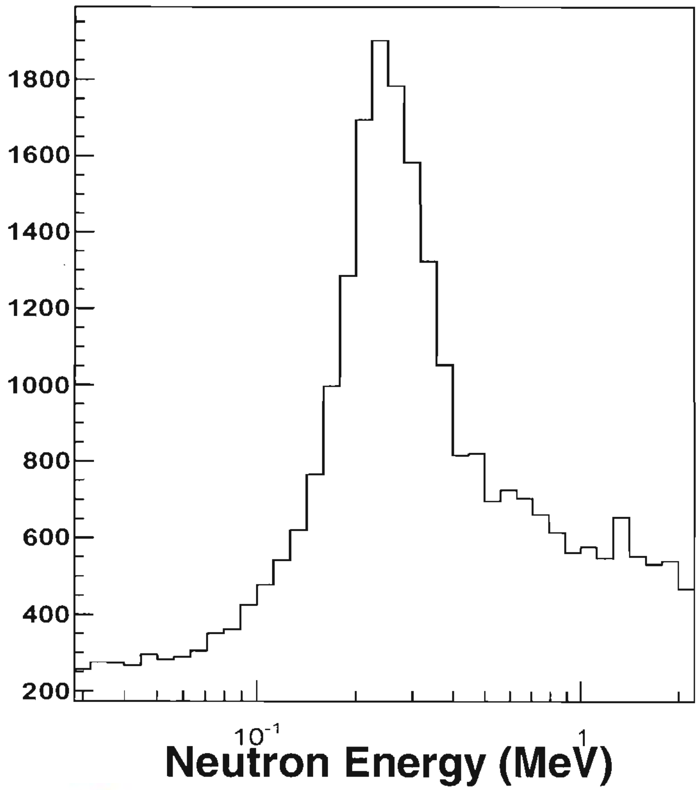


7Li: pulse height vs. TOF

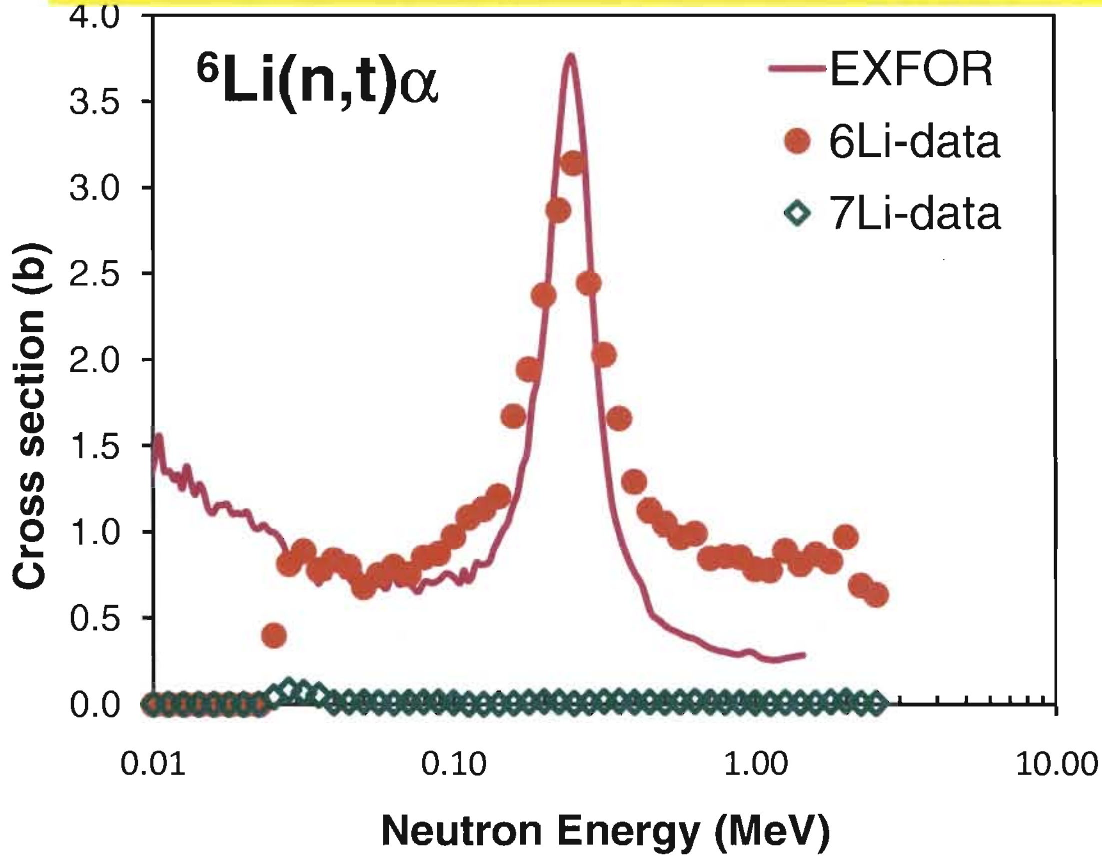


Neutron Output Yield from ^{252}Cf

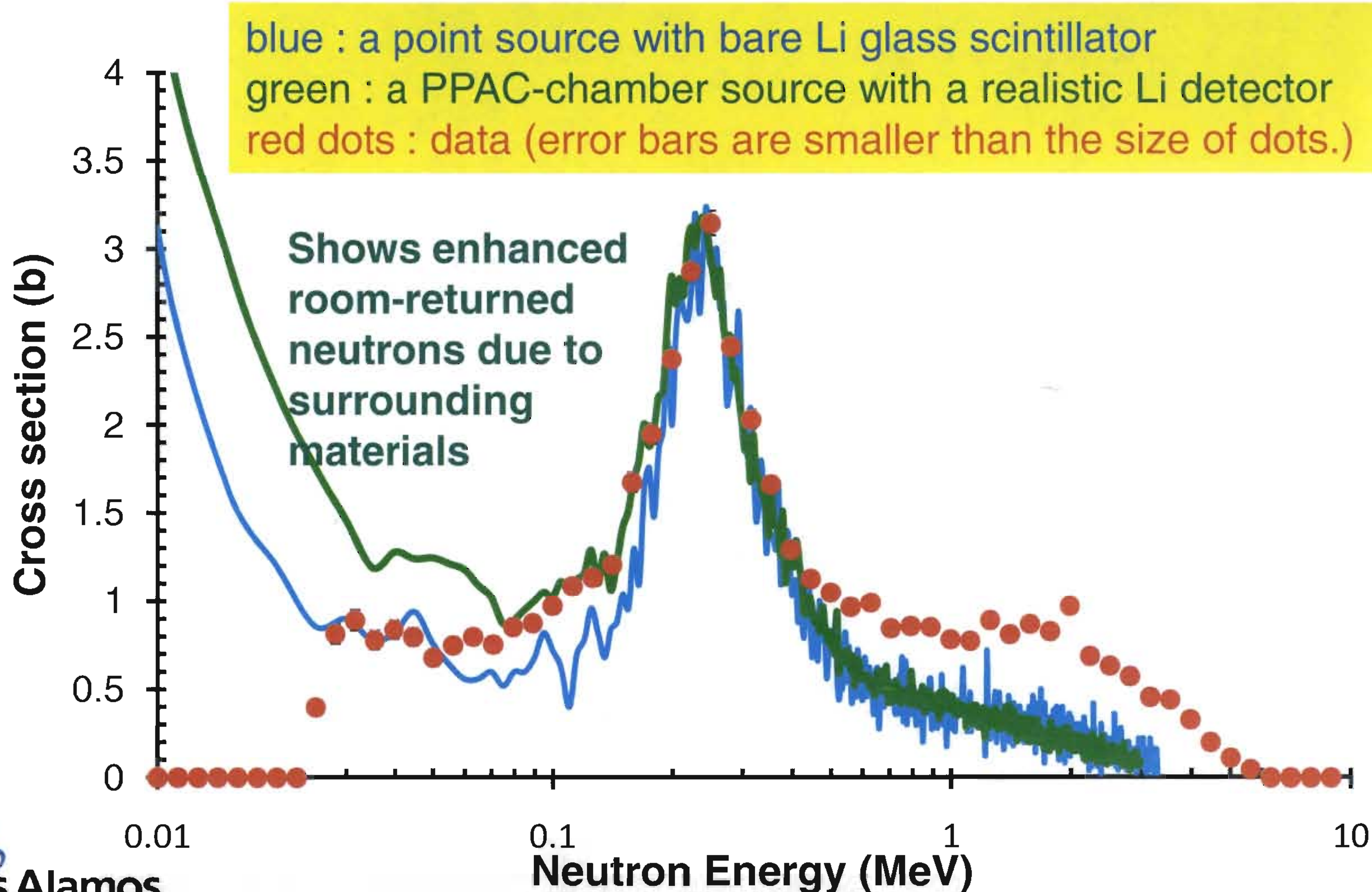
Raw yield



Data are normalized to Watt distribution
-> the detector response function (red dots)



Data compared to MCNP calculation for realistic setup

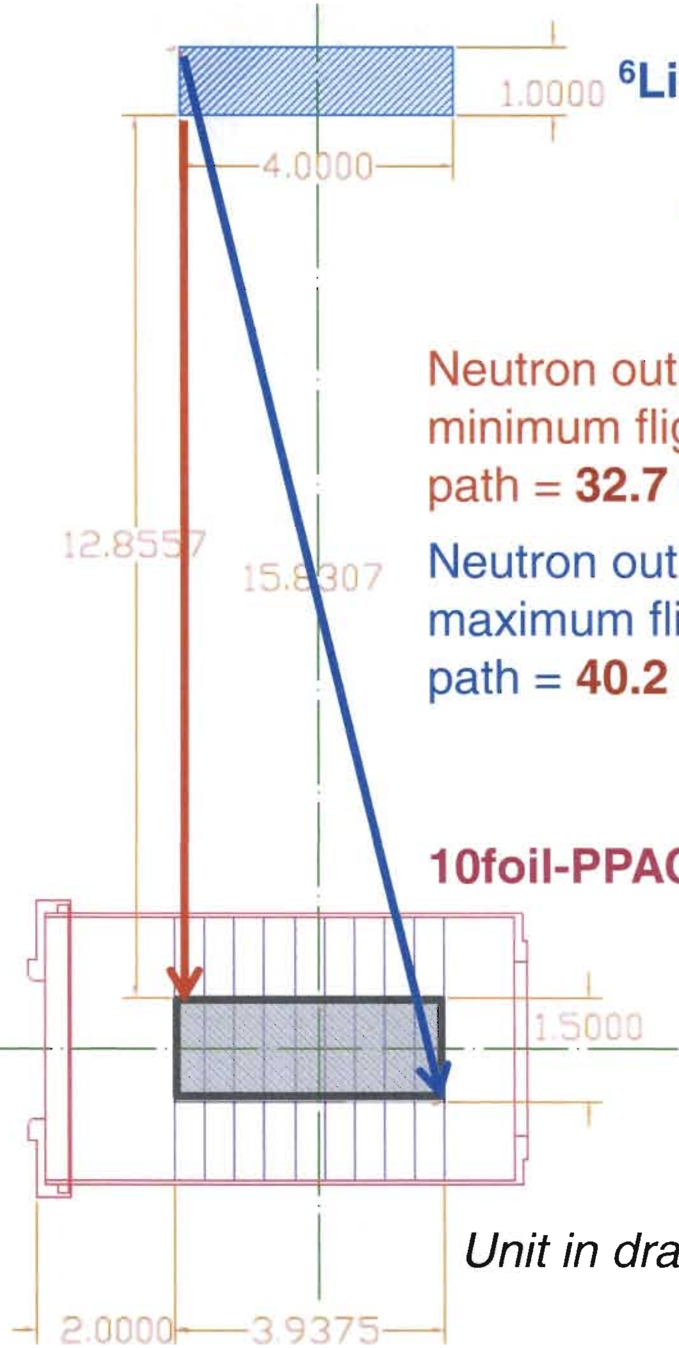


$^{235}U(n,f)$ measurement

Li-glass detector setup

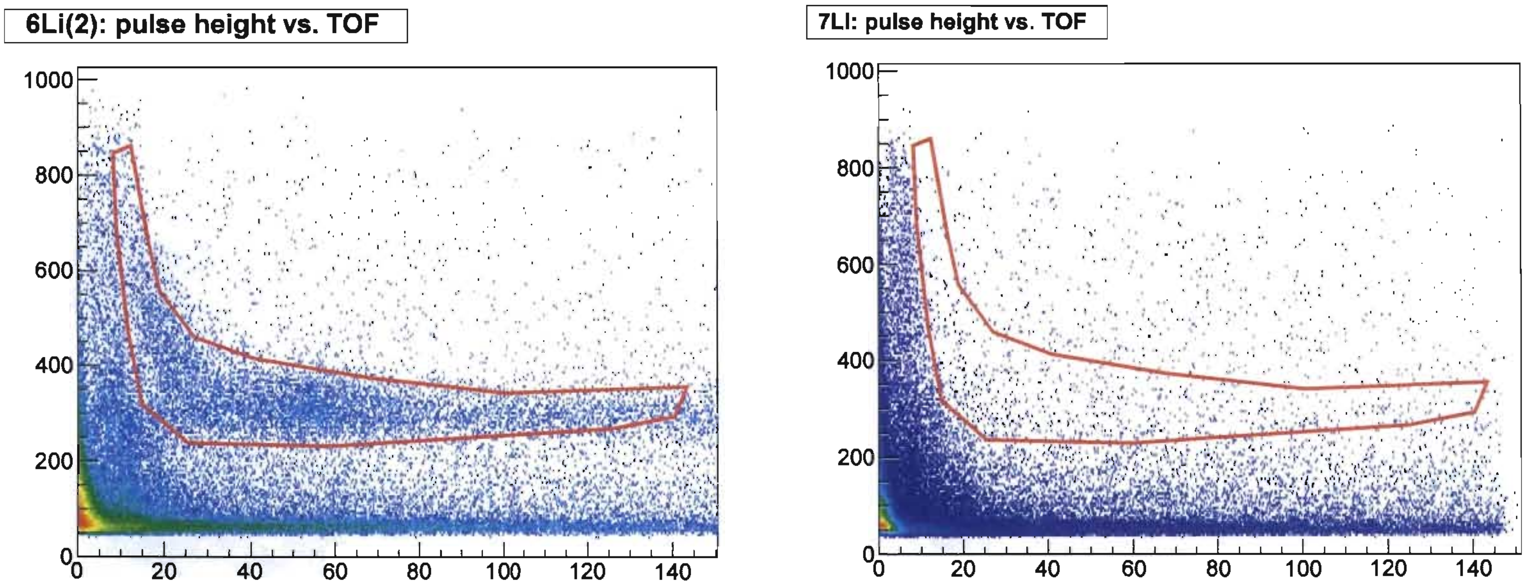
Contribution to the broadening :
1. Extended foil elongation
   -> can be corrected from the data, so FWHM is improved to be 215 keV (~20 %)
2. Extended beam spot
3. Large solid angle for ^{6}Li glass

Incoming Beam : 4 cm in diameter



Unit in drawing : inch

235U(n,f) : offline analysis steps

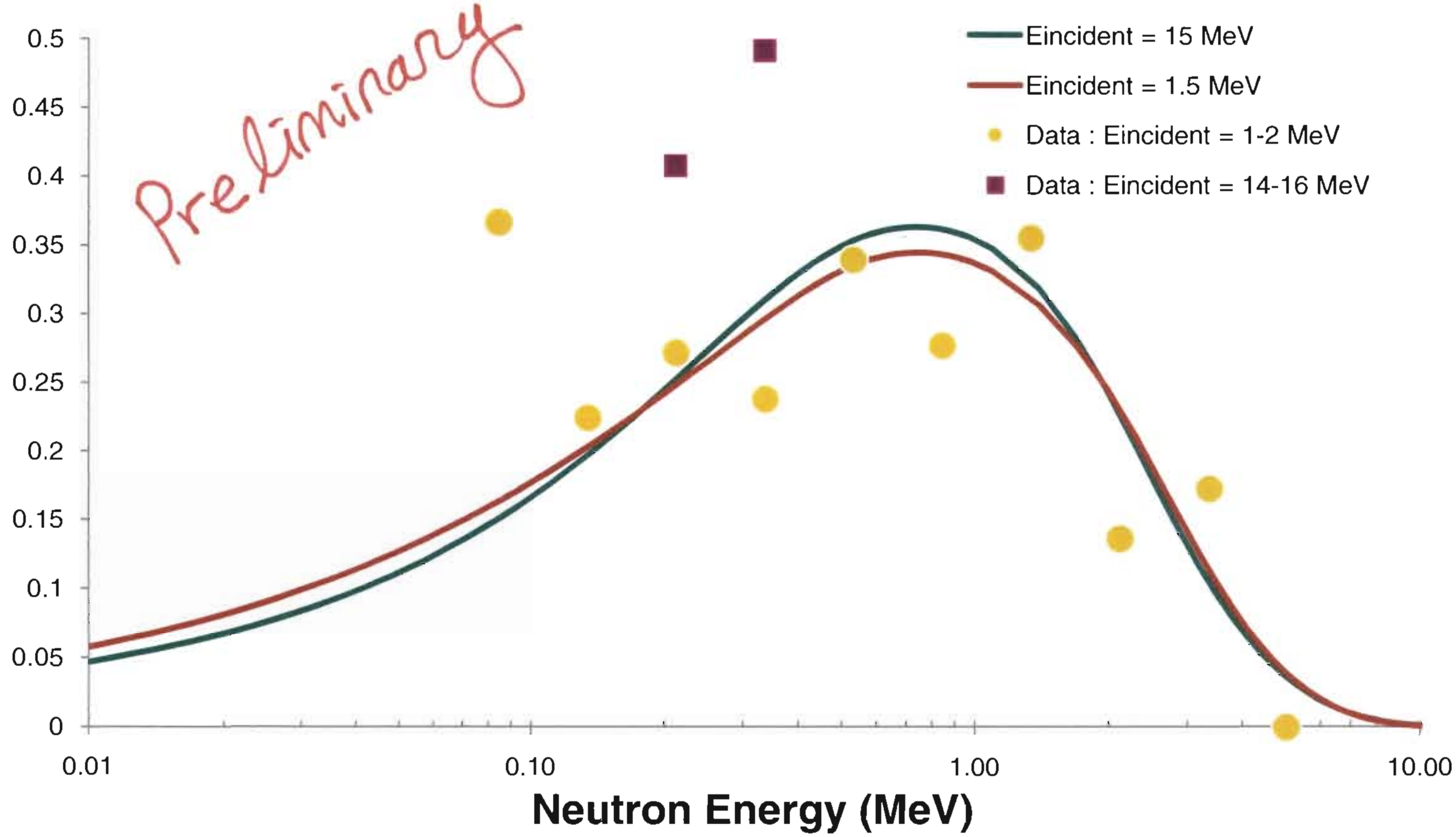


[1] Yield is obtained by applying the same graphical locus as the ^{252}Cf analysis.

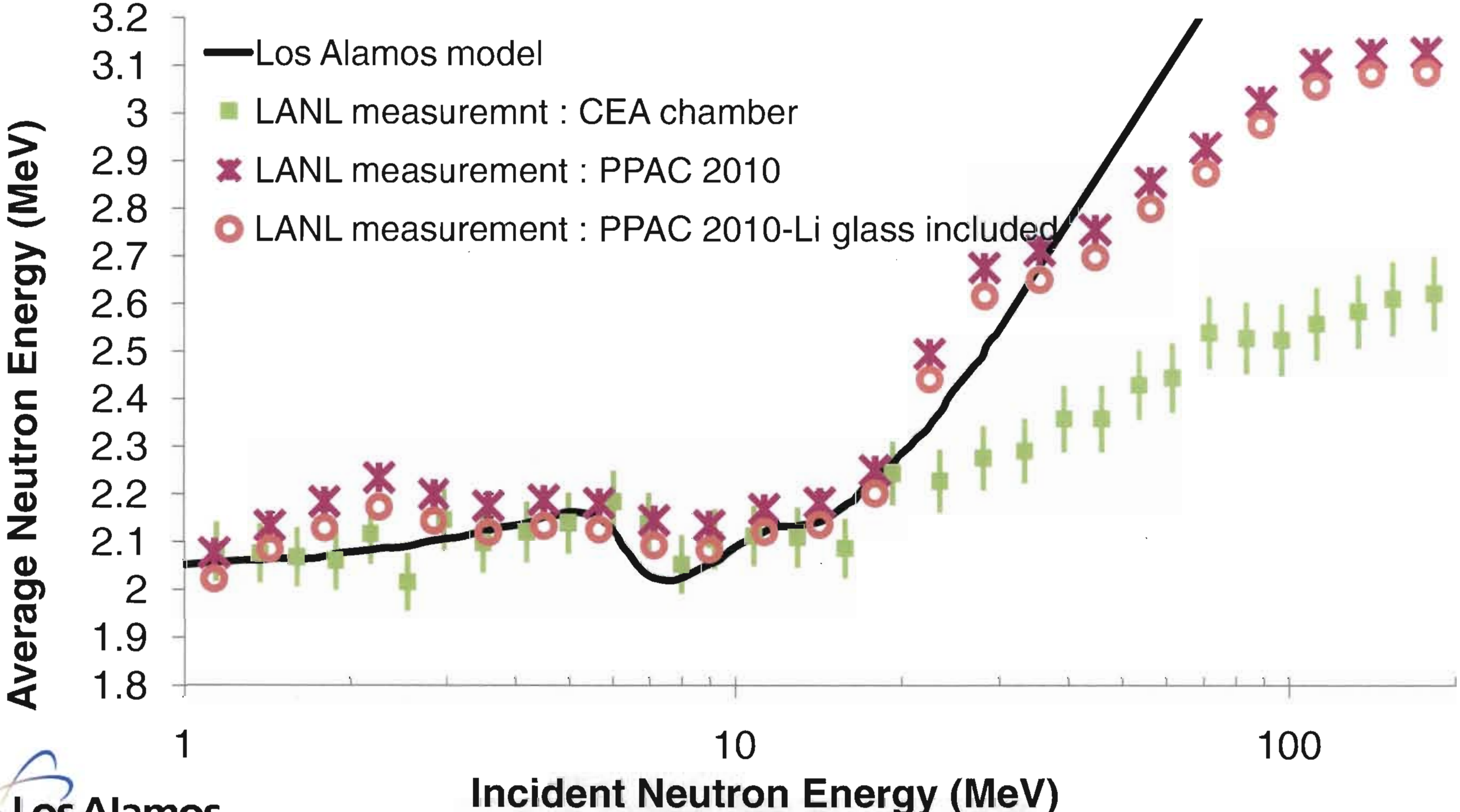
[2] Subtract the yield of ^{7}Li-glass data from that of ^{6}Li-galss data.

[3] Normalize it to the detector response function, taken from the ^{252}Cf measurement.

Neutron output distributions compared with the LA model



Preliminary Average neutron output energy



Preliminary Average neutron multiplicity (nu-bar)