Recent Work to Improve the Database for the Neutron Cross Section Standards Including Recent Work at NIST

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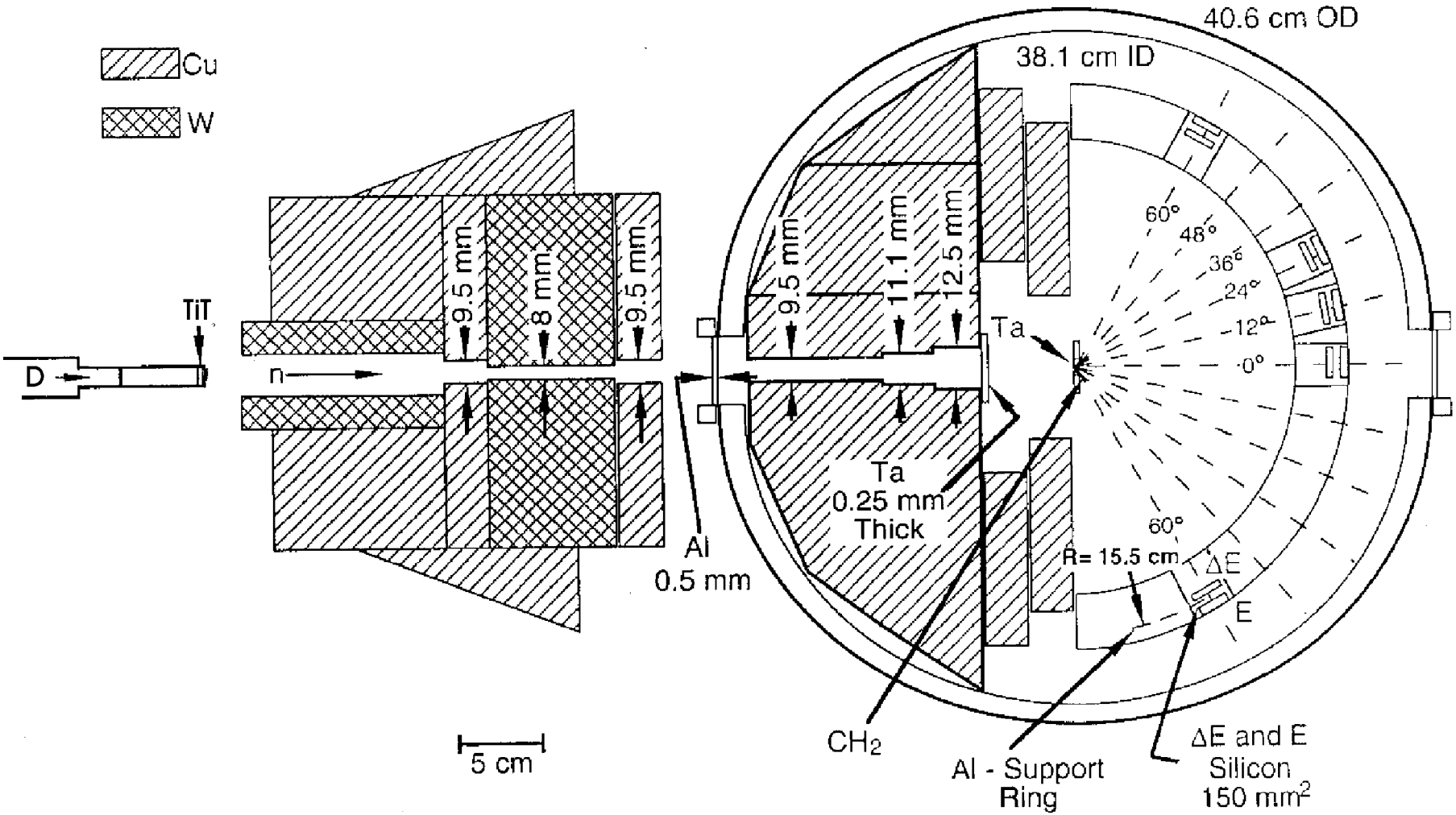
THE NEUTRON CROSS SECTION STANDARDS

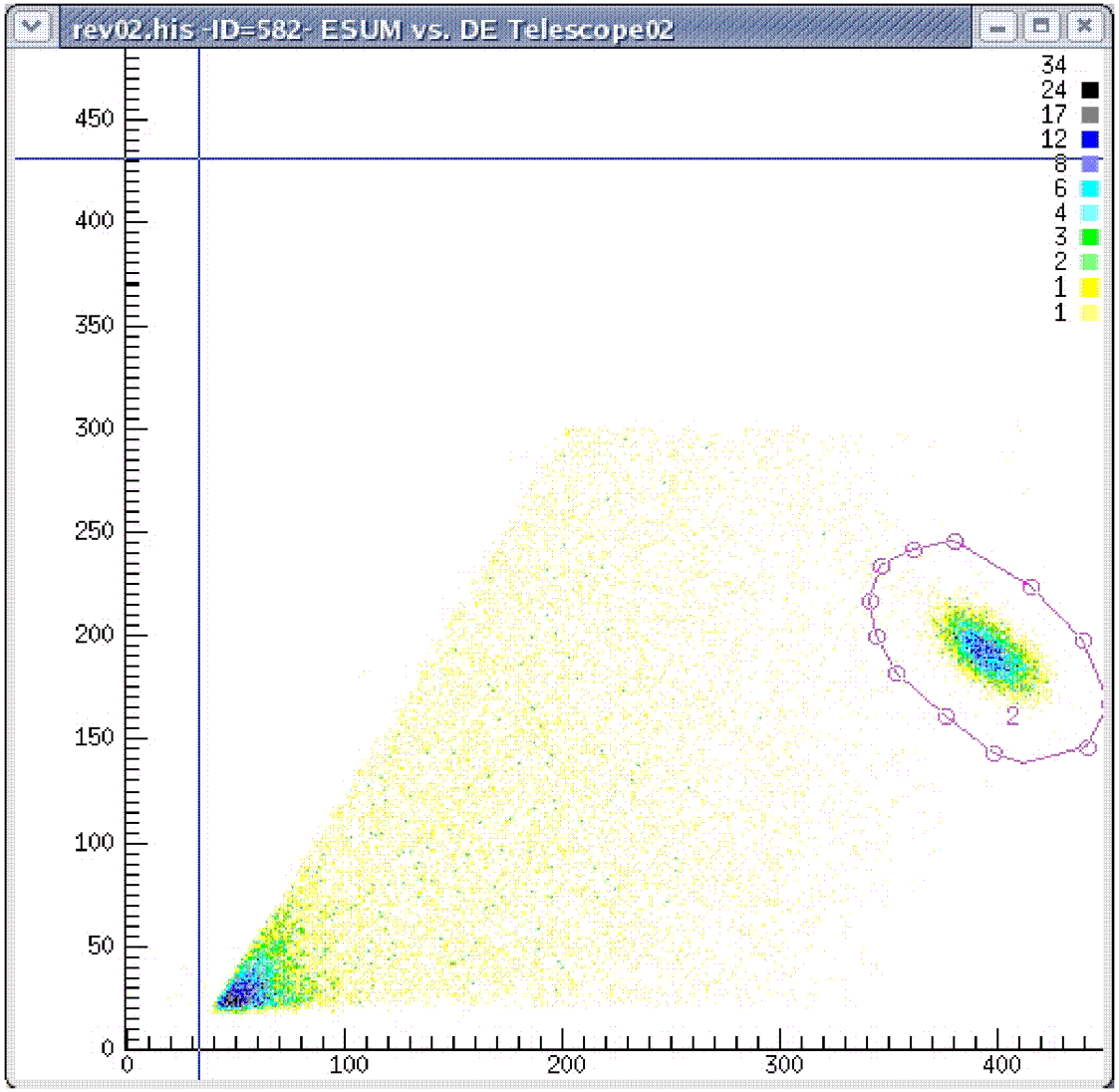
Reaction	Energy Range
H(n,n)	1 keV to 200 MeV
^{3}He(n,p)	thermal to 50 keV
^{6}Li(n,t)	thermal to 1 MeV
^{10}B(n,α)	thermal to 1 MeV
^{10}B(n,$\alpha_1\gamma$)	thermal to 1 MeV
C(n,n)	thermal to 1.8 MeV
^{197}Au(n,γ)	thermal, 0.2 to 2.5 MeV
^{235}U(n,f)	thermal, 0.15 to 200 MeV
^{238}U(n,f)	2 to 200 MeV

H(n,n)H Recent Work

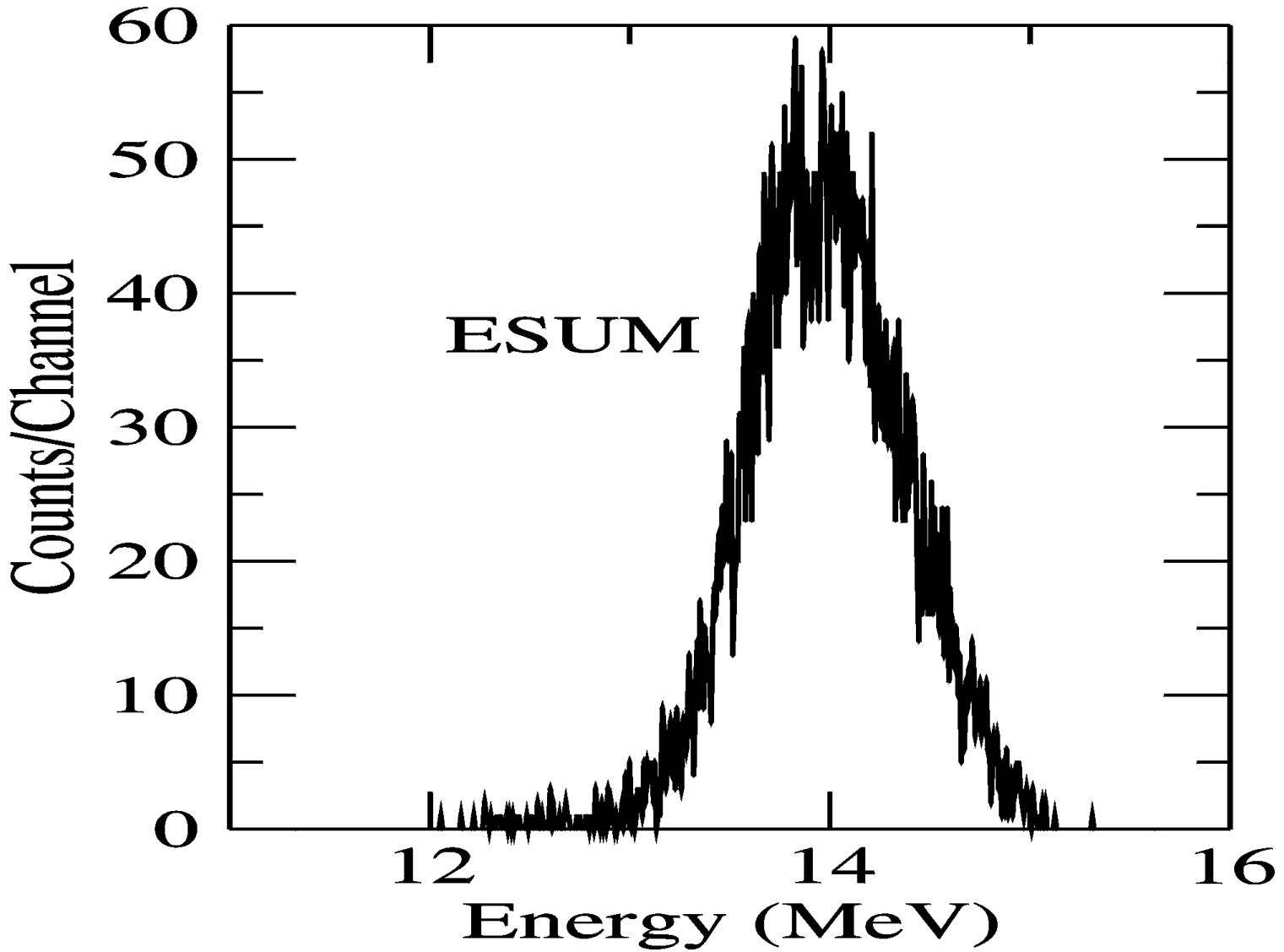
- NIST Coherent Scattering Length data published.
  - b_{np}=-3.7384 ± 0.0020 fm
- Ohio University-NIST-LANL 15 MeV angular distribution experiment.
  - Data taking has begun.



Experimental setup for the Ohio U.-NIST-LANL measurement of the n-p scattering angular distribution at 15 MeV.



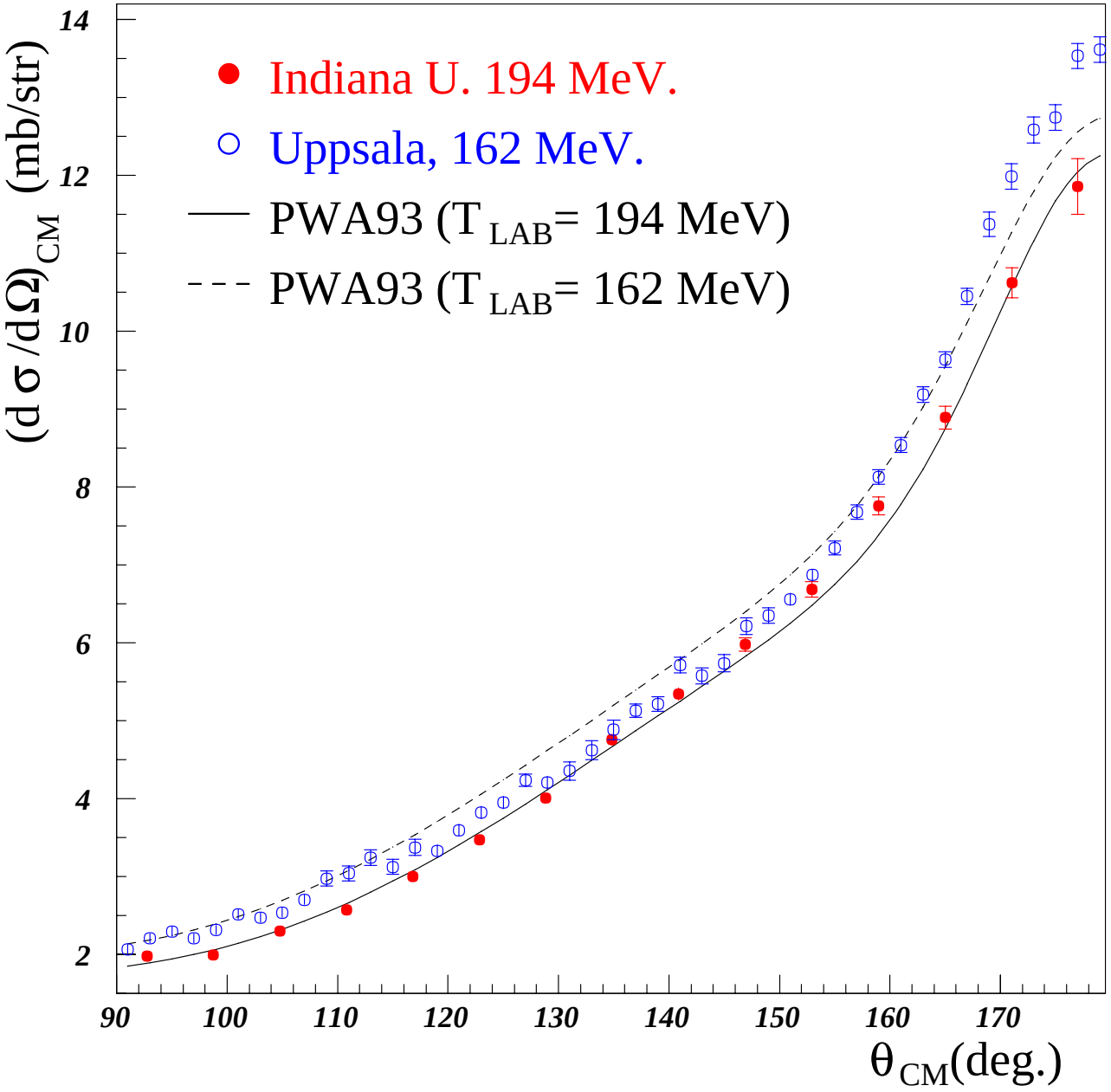
Two dimensional plot (sum of the pulse heights in the E +DE detectors vs the pulse height in the DE detector) for a telescope at 12 degrees from the neutron beam direction. The colors indicate the number of events. The region “2” shows the two dimensional gate used to select the region of interest.



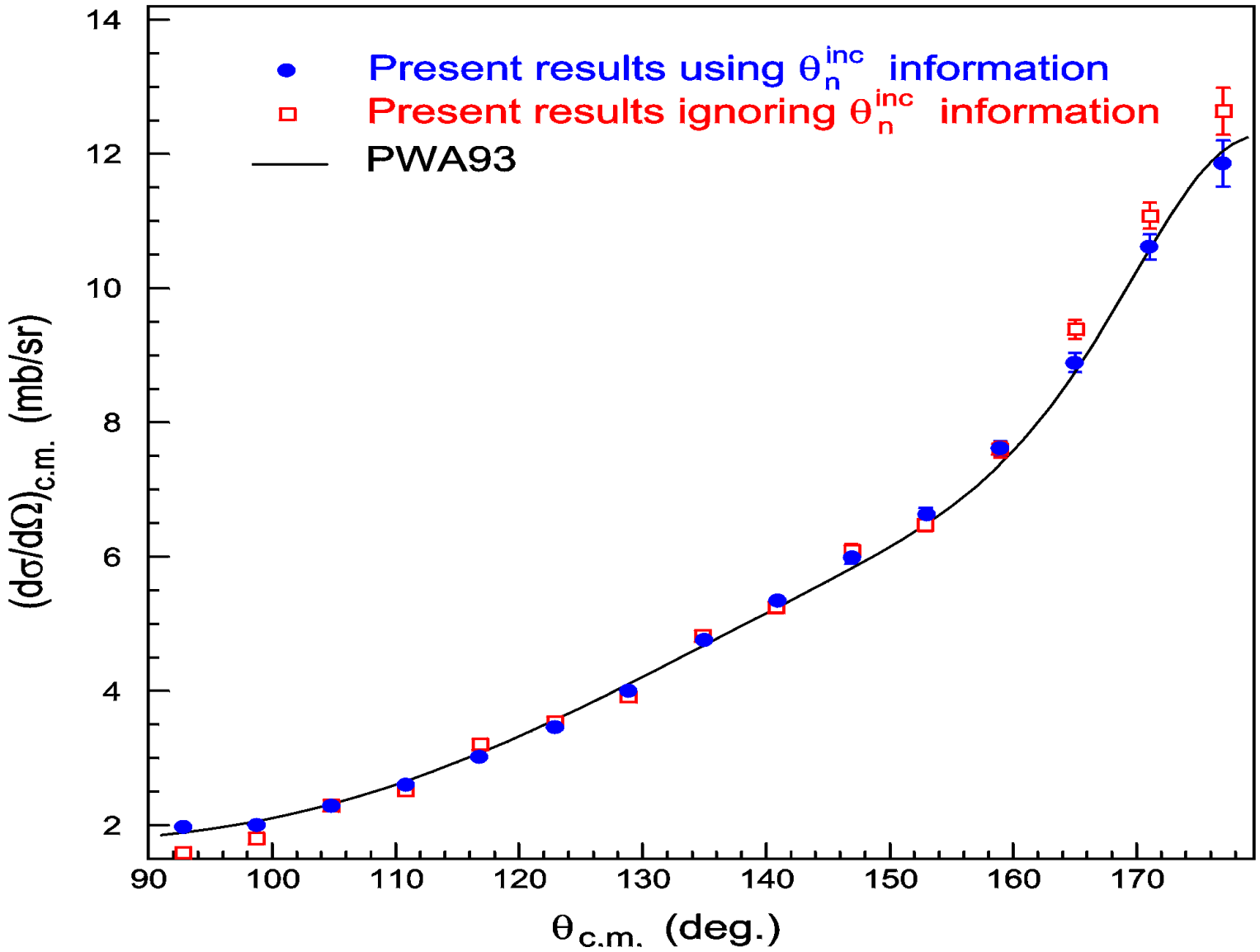
The pulse height distribution for the sum of the pulse heights in the E +DE detectors for telescope 2 (12 degrees) for the region of interest, region “2”.

H(n,n)H Recent Work (cont.)

- Indiana University angular distribution data.
  - Estimates of ignoring the neutron incidence angle onto the scattering target have been made by Vigdor and Sarsour.
    - This may explain the results obtained by the Uppsala and PSI groups.



Measurements of the hydrogen scattering cross section by the Indiana and Uppsala groups compared with PWA calculations.



Calculations by Vigdor and Sarsour of the effect of ignoring the neutron incidence angle onto the scattering target for the Indiana n-p scattering experiment. Comparison is made with the Nijmegen PWA93 partial-wave analysis.

^{3}He(n,p) Recent Work

- NIST Coherent Scattering Length data has been published.
  - b=5.872 ± 0.0072 fm
- An NIST experiment is beginning on measurements of the spin-dependent portion of the n-^{3}He coherent scattering length.

^{6}Li(n,t) Recent Work

•Improvements continue on an NIST measurement of the ^{6}Li(n,t) cross section standard at ~ 4 meV neutron energy. The emphasis is on improved fluence determinations using methods based on:

- •calorimetry, by measuring the heat produced by the ^{6}Li(n,t) reaction in a thick Li target.
- •The well known nu-bar of ^{252}Cf and counting fissions events in a ^{252}Cf fission chamber. A Mn bath is used as a means of comparing the ~4 meV neutron fluence with the ^{252}Cf neutron fluence.
- •α-γ coincidences using the ^{10}B(n,$\alpha_1\gamma$) reaction.

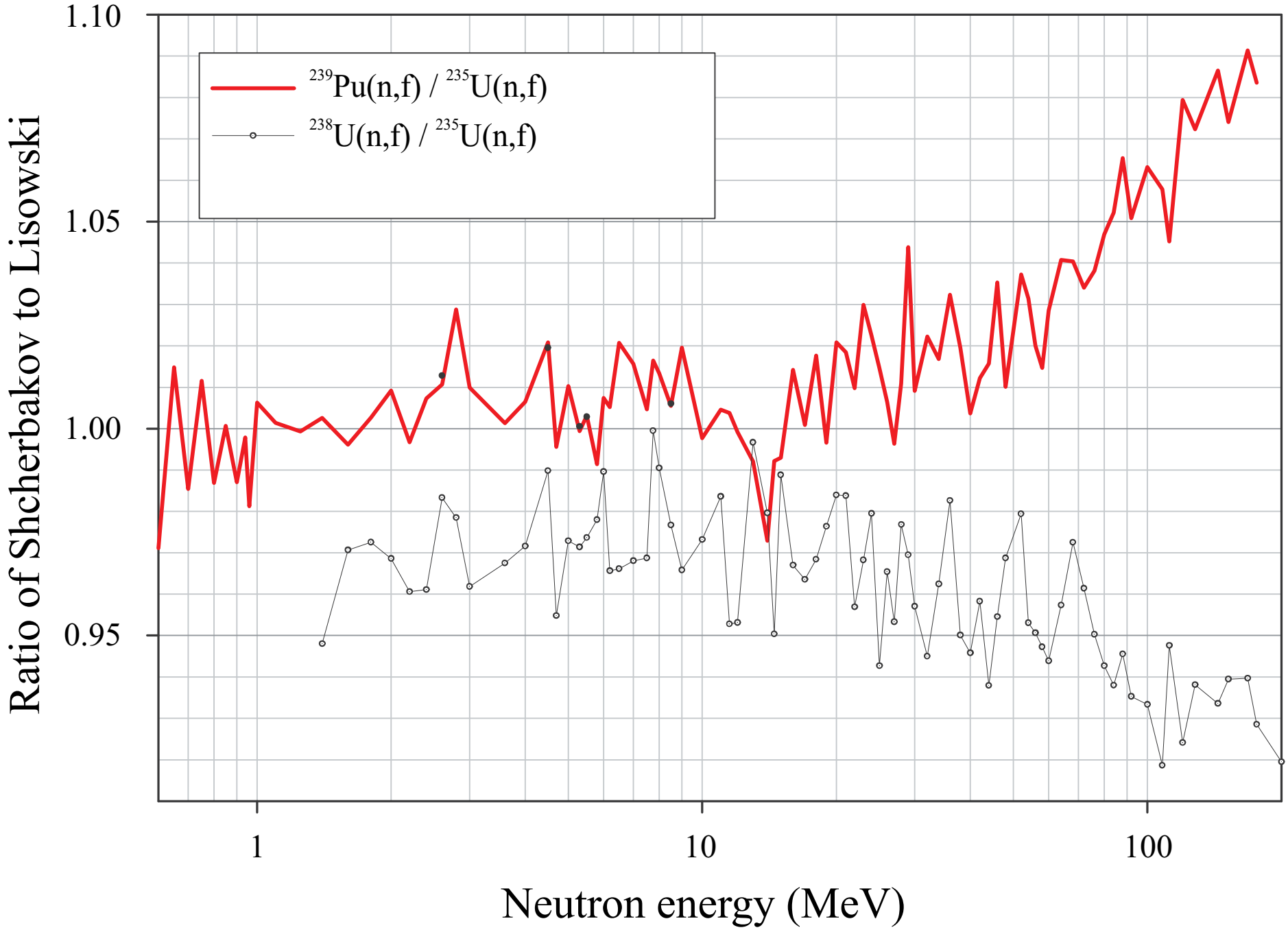
•Zhang et al. have re-measured the ^{6}Li(n,t) cross section in the MeV energy region since "particle leaking" effects were present in their original data. The data are now being analyzed.

$^{10}B(n,\alpha)^{7}Li$ Recent Work

- Hambsch et al. are making measurements of the $^{10}B(n,\alpha)$ branching ratio at the 60 m station of GELINA. These data will allow them to extend their energy range to ~3 MeV. Their previous measurements with a 30 m flight path extended to 1 MeV.
- Hambsch et al. are are planning measurements this year of the $^{10}B(n,\alpha)$ and $^{10}B(n,\alpha_1\gamma)$ cross sections relative to the $^{235}U(n,f)$ cross section up to 3 MeV.
- Giorginis and Khriachkov have planned $^{10}B(n,\alpha)$ angular distribution and branching ratio measurements at energies below 1.5 MeV but the work can not begin until a new low pressure chamber is built.
- Zhang et al. have re-measured the $^{10}B(n,\alpha)$ cross section in the MeV energy region since "particle leaking" effects were present in their original data. The data are now being analyzed.

Recent Fission Cross Section Work

- Data have been obtained by the nTOF collaboration of the ratio of the ^{238}U(n,f) to ^{235}U(n,f) cross sections. The data have not been finalized yet. Careful review of these data for systematic effects is necessary since they come from a new facility.
- New measurements with very high accuracy are planned at LANL of the ratio of the ^{239}Pu(n,f) to ^{235}U(n,f) cross sections in the MeV energy region.


1.10
1.05
1.00
0.95
Ratio of Shcherbakov to Lisowski
239Pu(n,f) / 235U(n,f)
238U(n,f) / 235U(n,f)
1
10
100
Neutron energy (MeV)

Conclusions and Recommendations

Important discrepancies still exist in the standards database. Particular concern is noted for ^{235}U(n,f), ^{238}U(n,f) and ^{239}Pu(n,f) cross section data and their ratios at energies above about 20 MeV. New measurements are required that are understood very well. Such work should be done through an international collaboration, such as a WPEC Subgroup.