

# **Recent Improvements to the Database for the Evaluation of the Neutron Cross Section Standards Including Recent Work at NIST**

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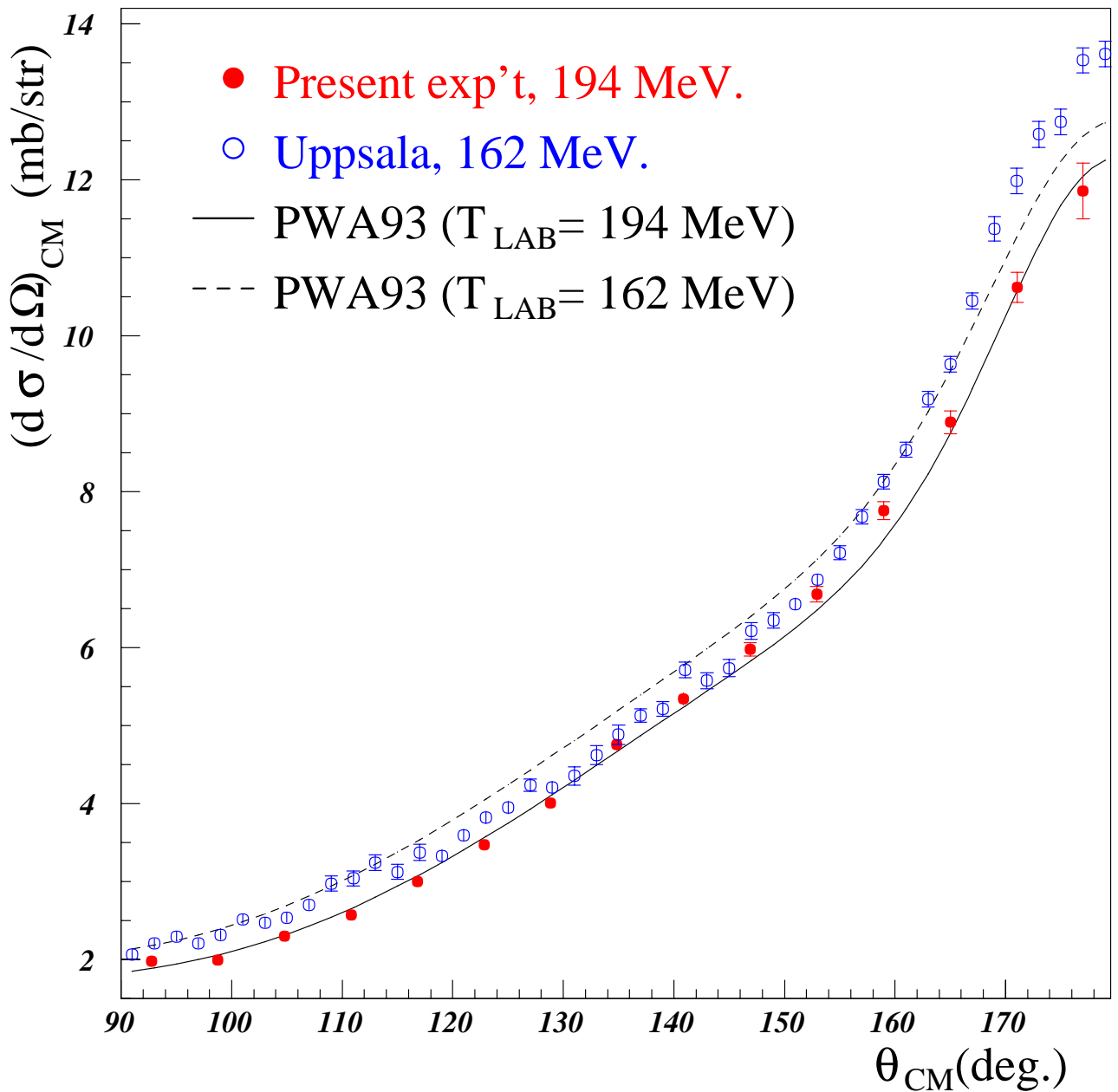
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Brookhaven National Laboratory  
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## STANDARDS TO BE EVALUATED

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

# H(n,n)H Recent Work

- NIST Coherent Scattering Length data
  - $b_{np} = -3.7384 \pm 0.0020$  fm
- Ohio University-NIST-LANL  
15 MeV angular distribution experiment
- Uppsala angular distribution data
- Indiana University angular distribution data
- PSI angular distribution data



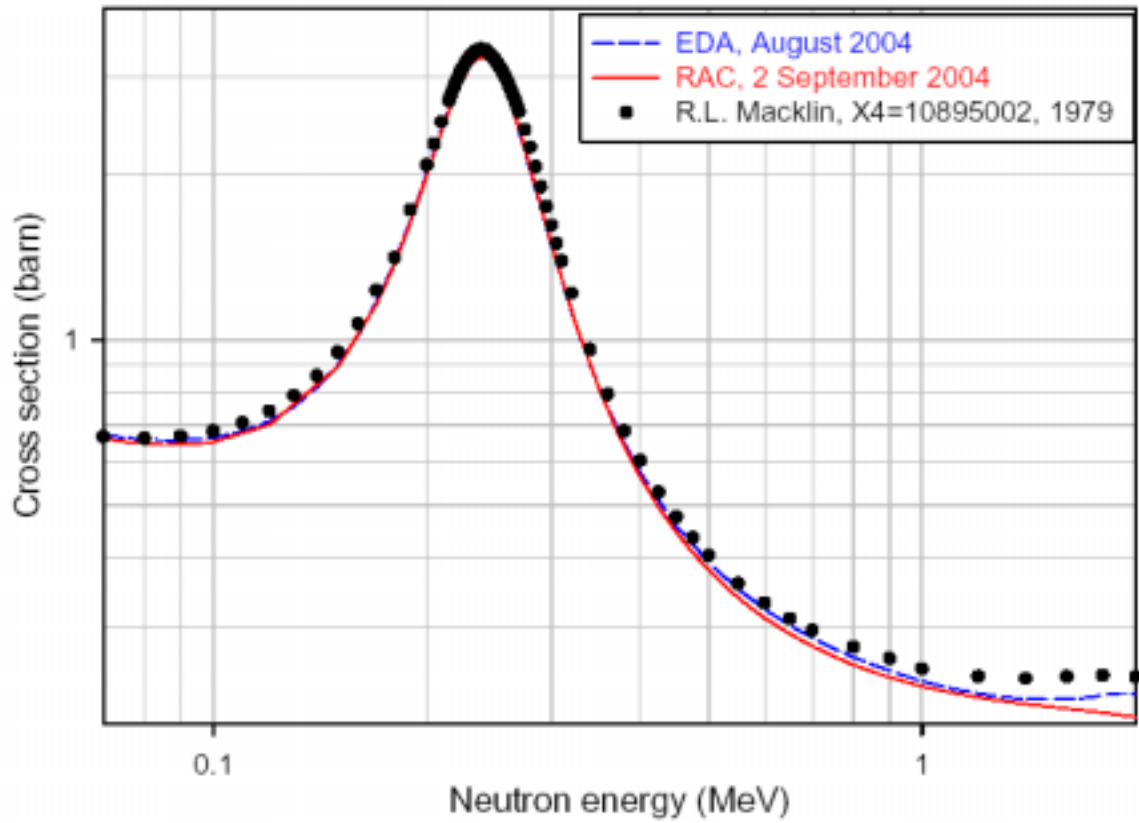
Measurements of the hydrogen scattering cross section by the Indiana (labeled Present exp't) and Uppsala groups compared with PWA calculations.

## **$^3\text{He}(n,p)$ Recent data**

- NIST-Indiana University-LANL  
total cross section data
- NIST Coherent Scattering Length data
  - $b = 5.872 \pm 0.0072$  fm

## ${}^6\text{Li}(n,t)$ Recent data

- NIST thermal measurement
  - Agrees excellently with CRP results
    - 937.86 GMA database
    - 938.02 EDA
    - 938.38 RAC
    - 940.98 ENDF/B-VI
- Macklin used in R-matrix work
- Zhang data withdrawn, "Particle Leaking" ++

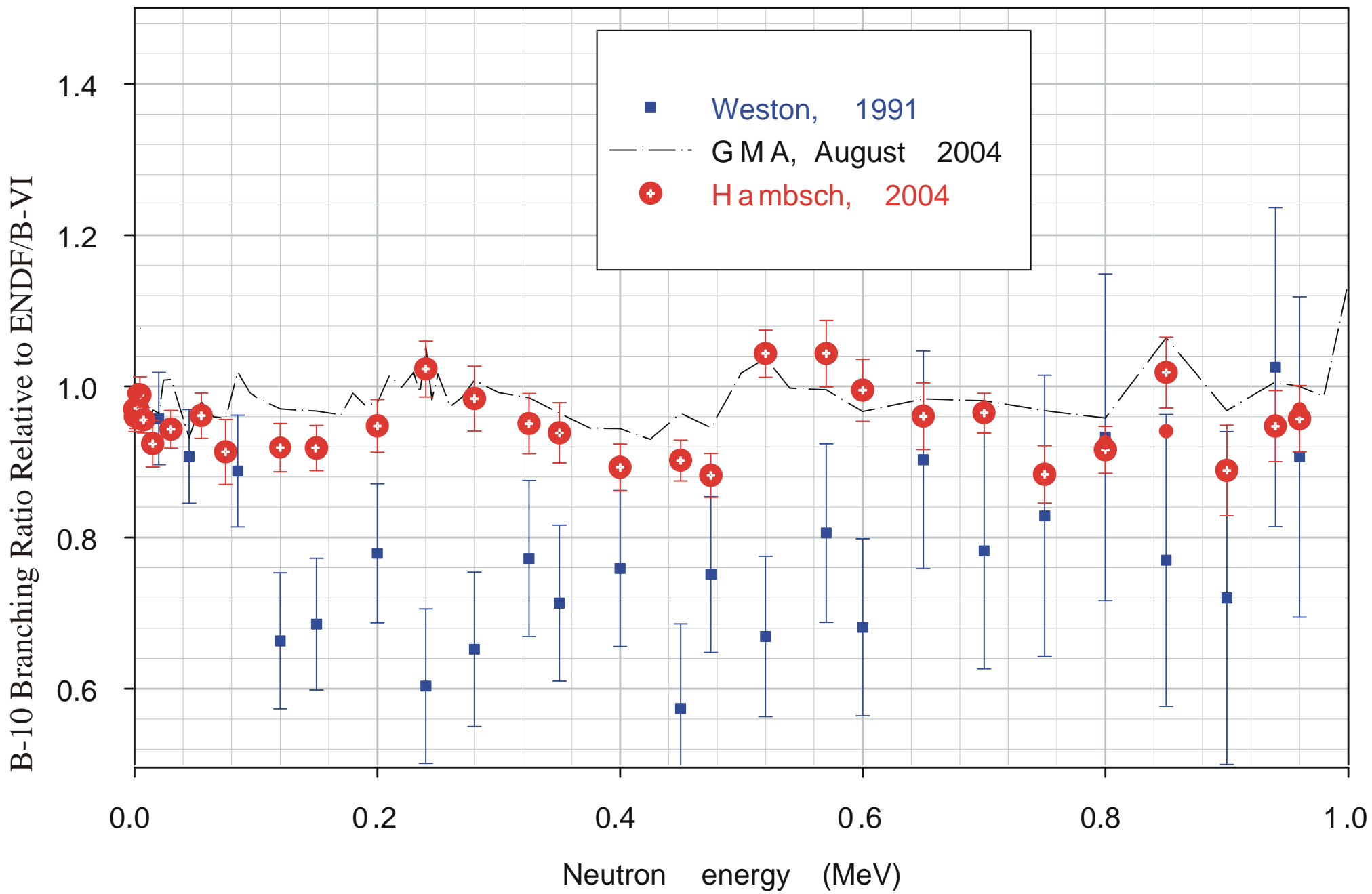


The  ${}^6\text{Li}(n,t)$  cross section of Macklin compared to recent CRP evaluations.

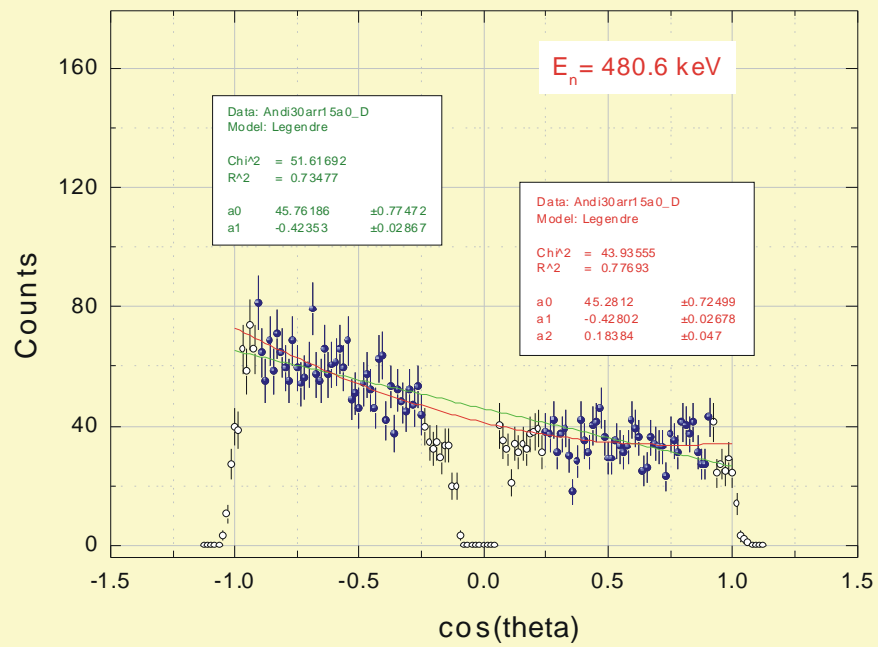
## $^{10}\text{B}(n,\alpha)^7\text{Li}$ Recent data

- IRMM Habsch Branching ratio
- IRMM Habsch angular distributions
- NIST Wasson total cross section
- IRMM Georginis cross sections
- Zhang data withdrawn, "Particle Leaking" ++

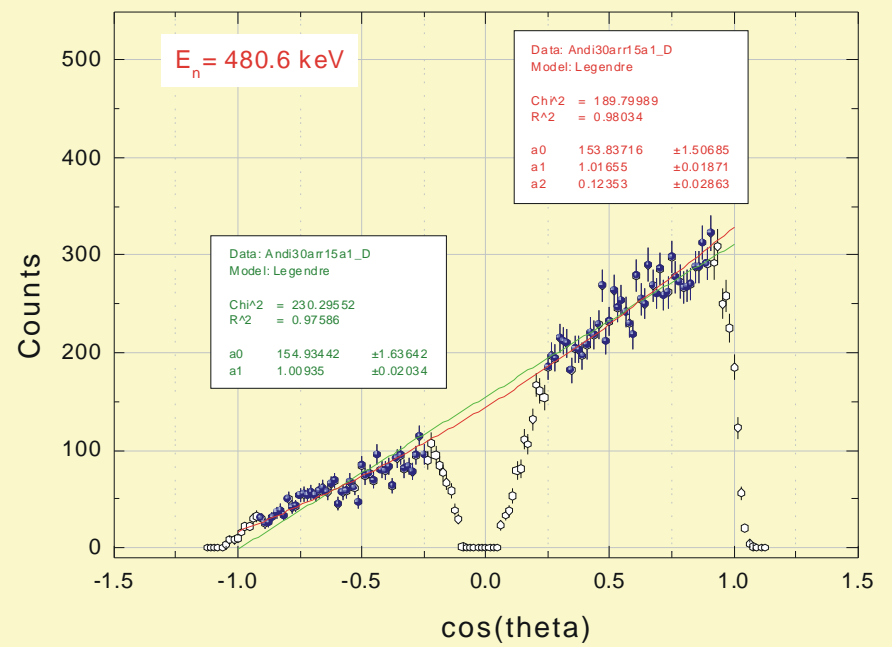




# $^{10}\text{B}(n,a)$ angular distribution

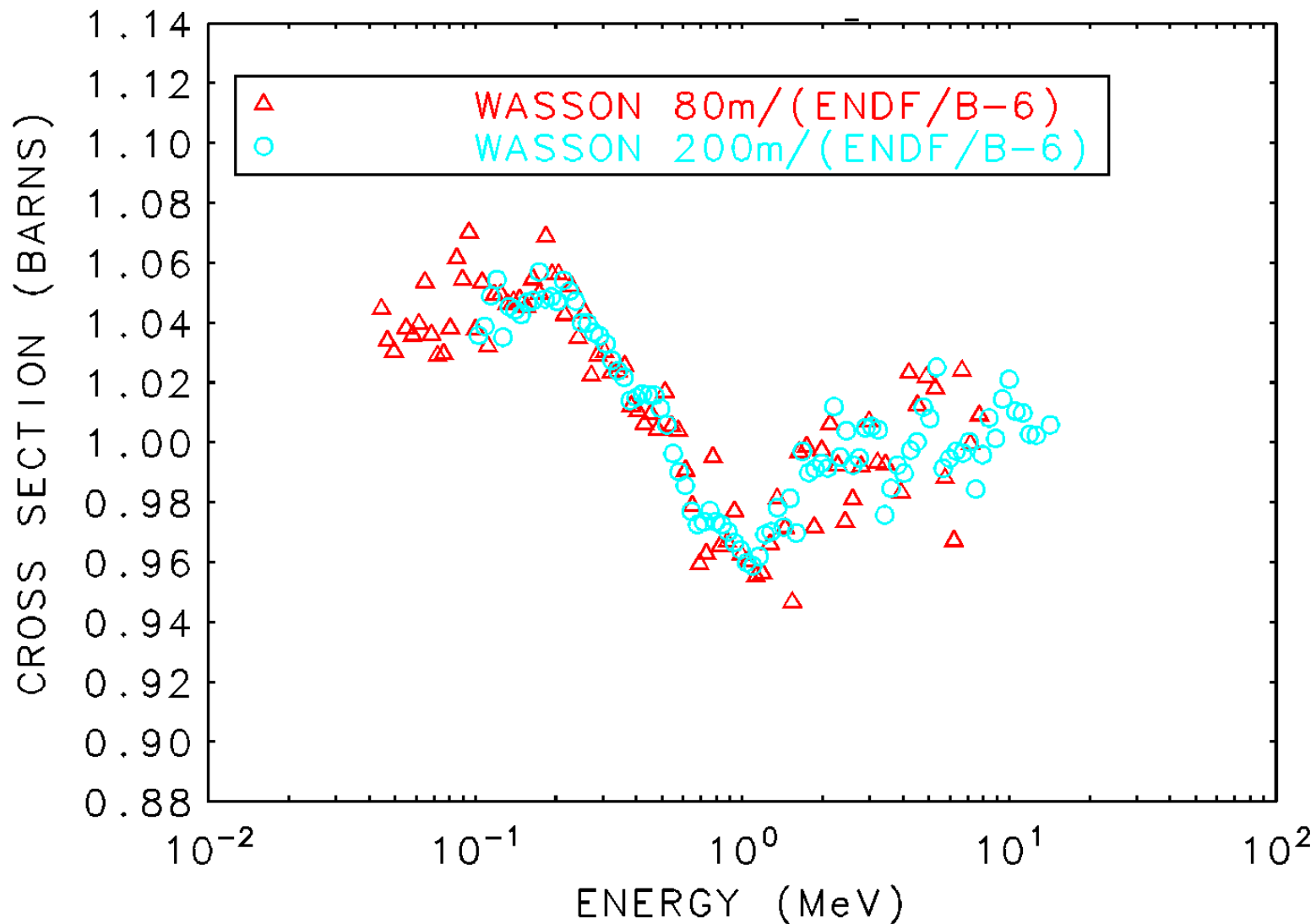


(n,a0)

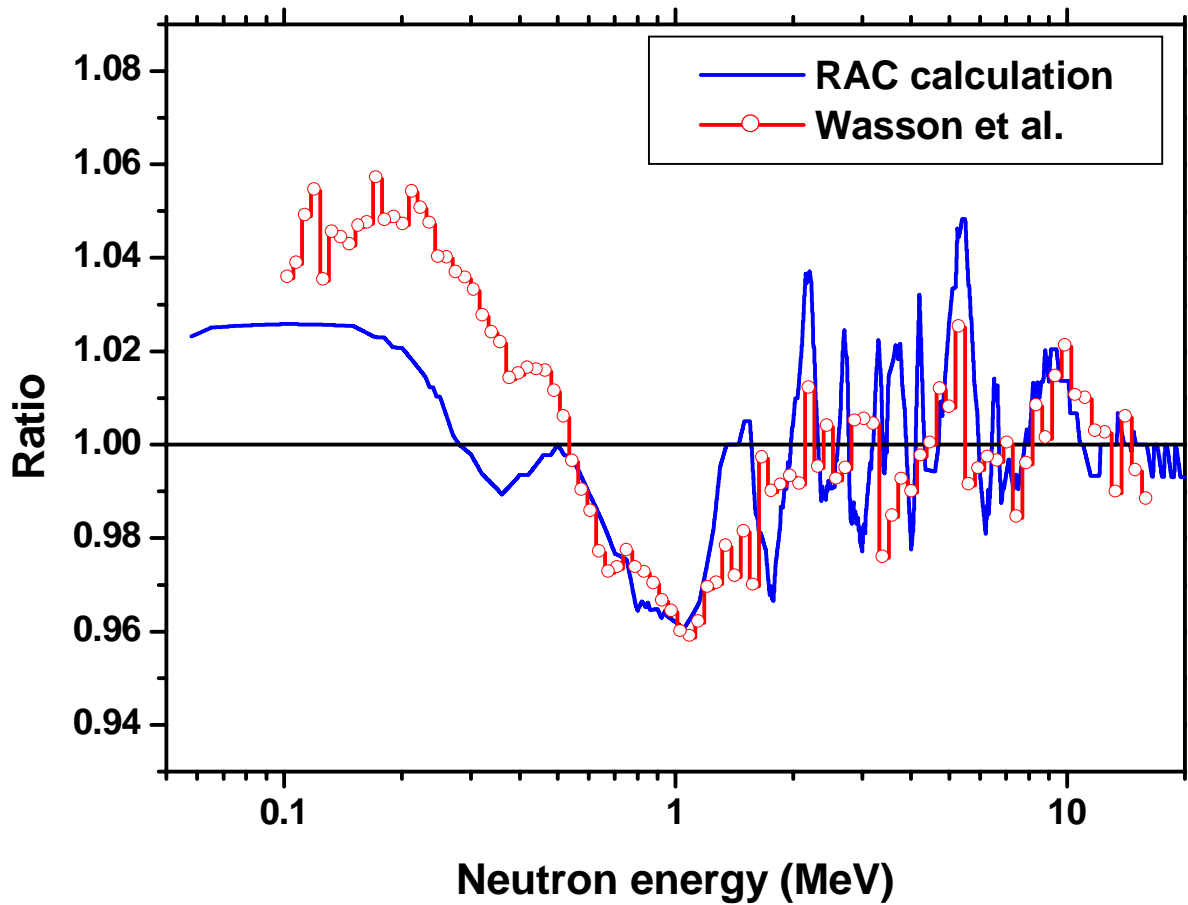


(n,a1)

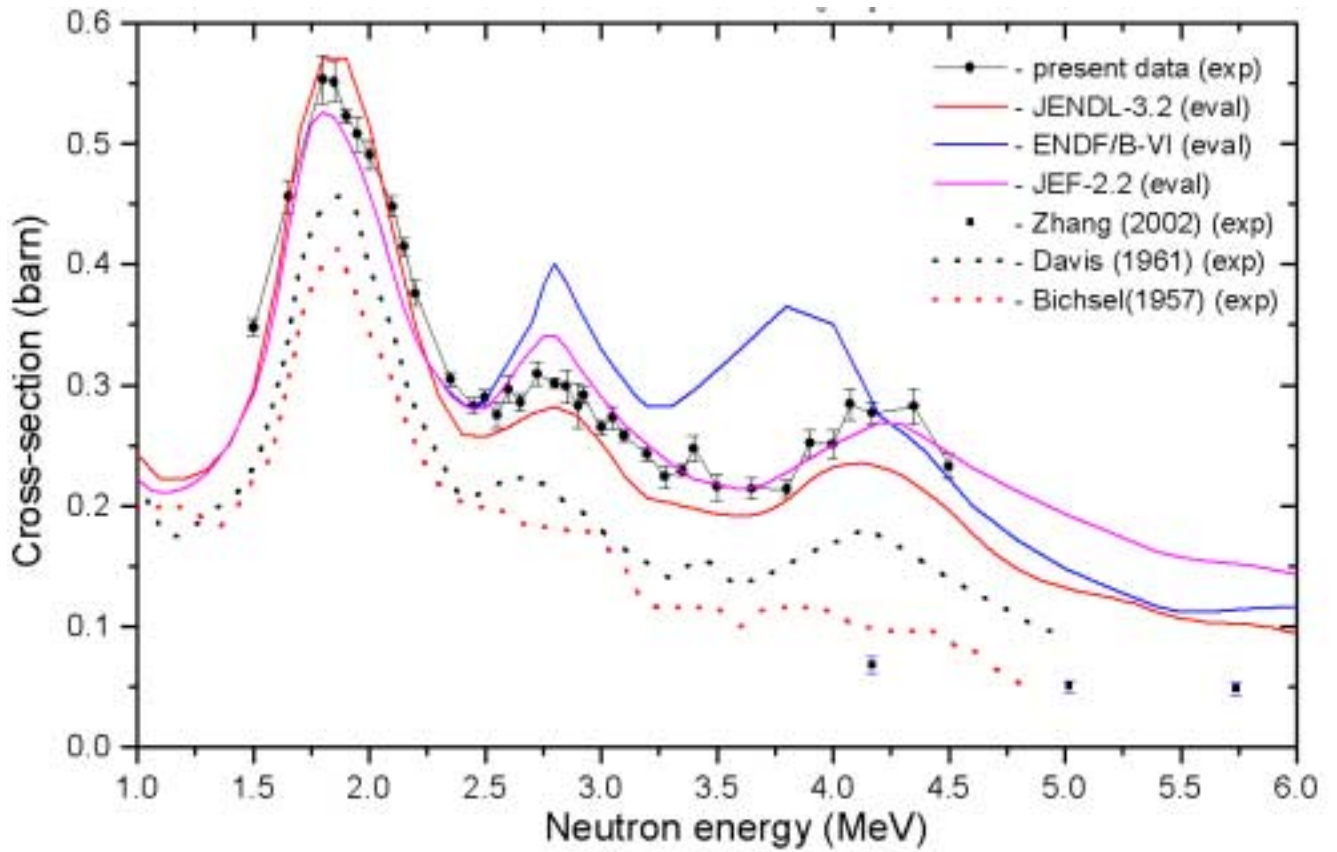
# $^{10}\text{B}$ total cross section



Comparison of  $^{10}\text{B}$  total cross section measurements of Wasson et al. at two different flight paths



$^{10}\text{B}$  total cross section measurements of Wasson et al. and a calculation with the RAC code shown as ratios to the ENDF/B-VI evaluation



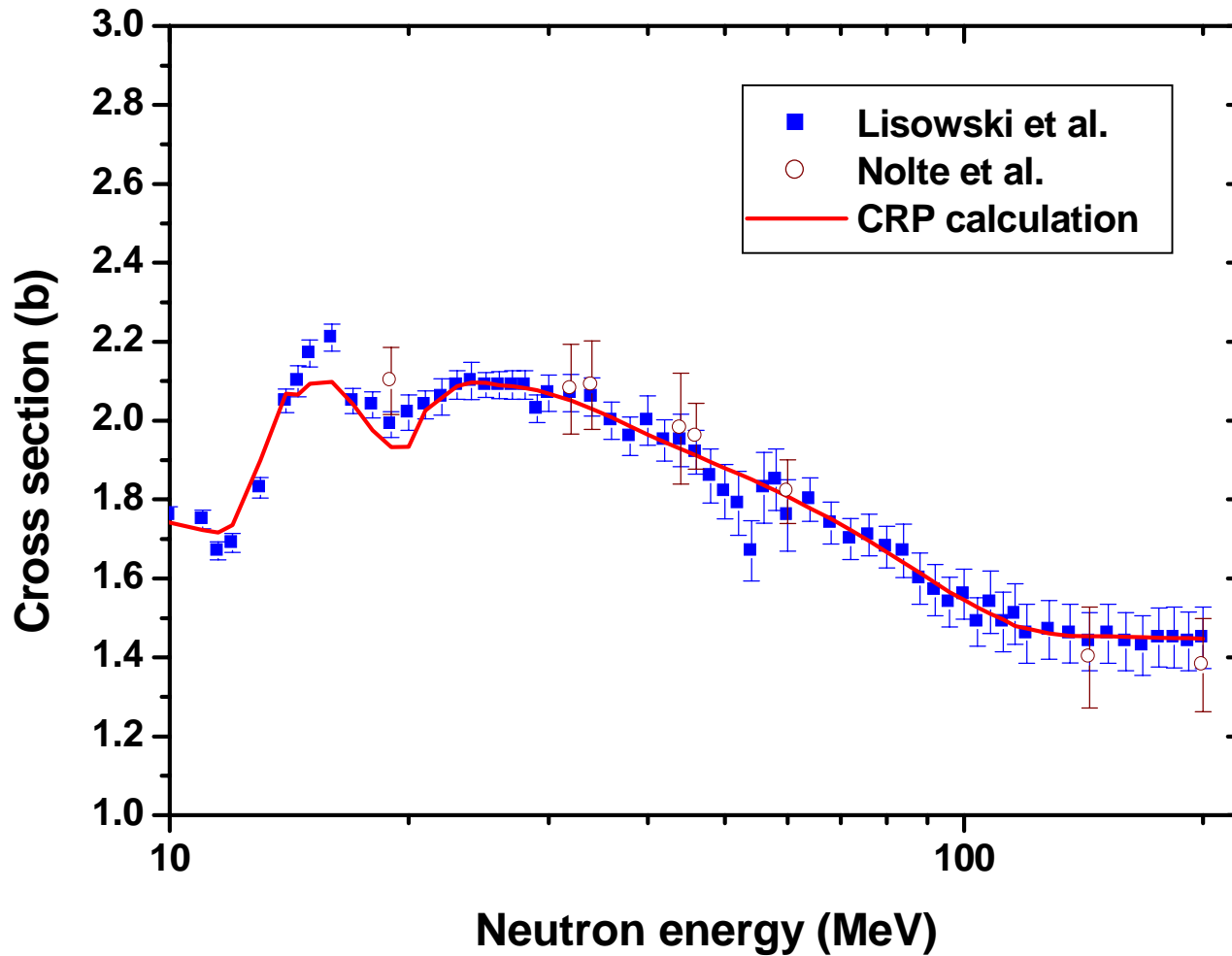
The  $^{10}\text{B}(n,\alpha)$  cross section in the neutron energy region above 1 MeV. The present measurements are the data of Giorganis and Khriatchkov.

## $^{238}\text{U}(n,\gamma)$ Recent data

- Thermal evaluated value of Poenitz replaced with Trkov evaluation
  - $2.685 \pm 0.011$  barns

## $^{235}\text{U}(n,f)$ Recent data

- Use of Arif Coherent Scattering data to improve K1 value ( $K1 = v\sigma_f - \sigma_a$ )
  - Caused an increase in K1 of 0.8 b
- Further improvement in K1 using Gwin v with reported (smaller) uncertainty
  - Caused an increase of 1.9 b so  $K1 = 721.6$  b
- Hardy K1 value =  $722.7 \pm 3.9$  b
- Nolte data are finalized

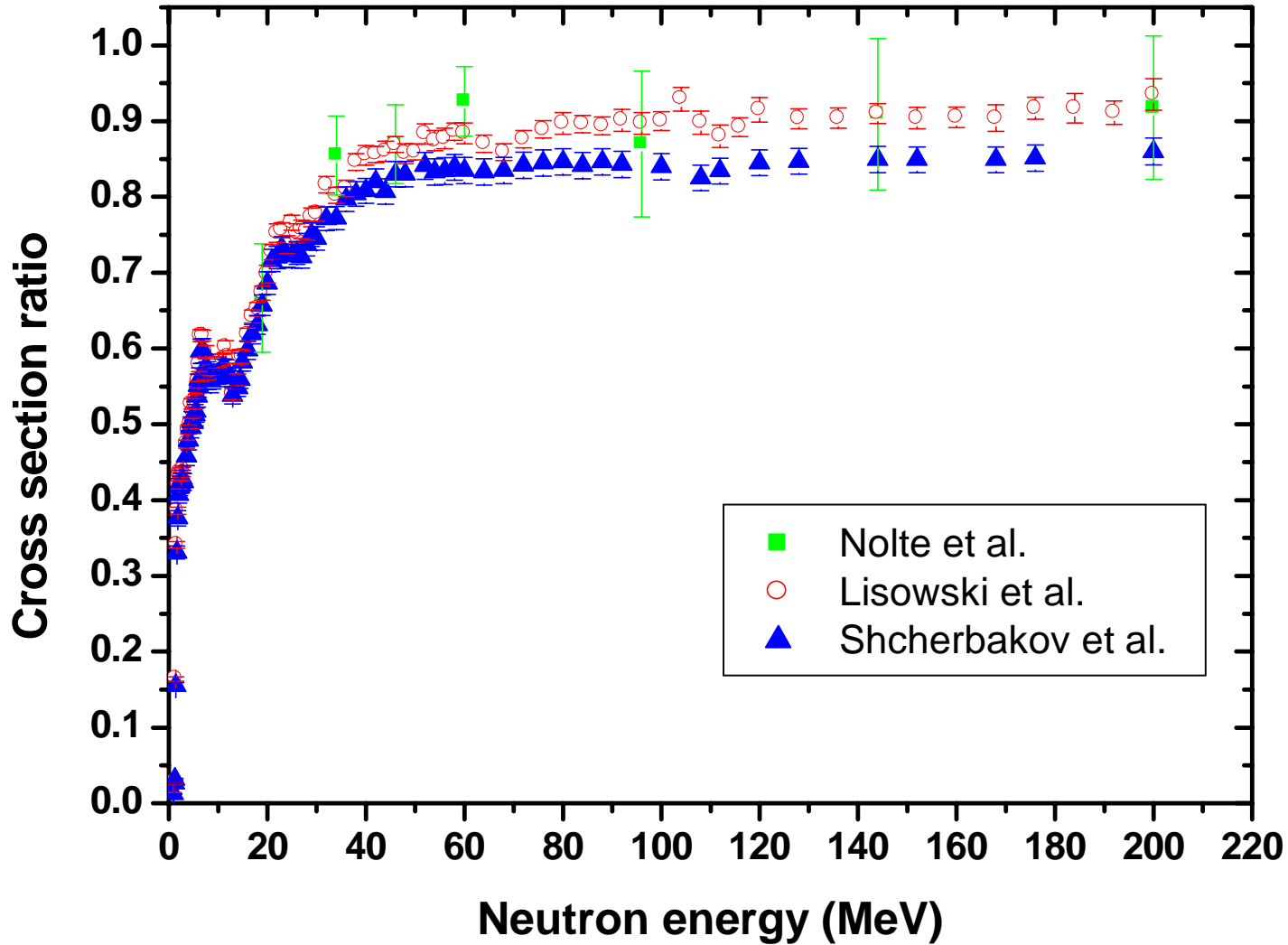


Measurements of the  $^{235}\text{U}(n,f)$  cross section above 10 MeV compared with the GMA calculation by the CRP.



## $^{238}\text{U}(\text{n},\text{f})$ Recent data

- Nolte data are finalized
- Discrepancies at high energies persist

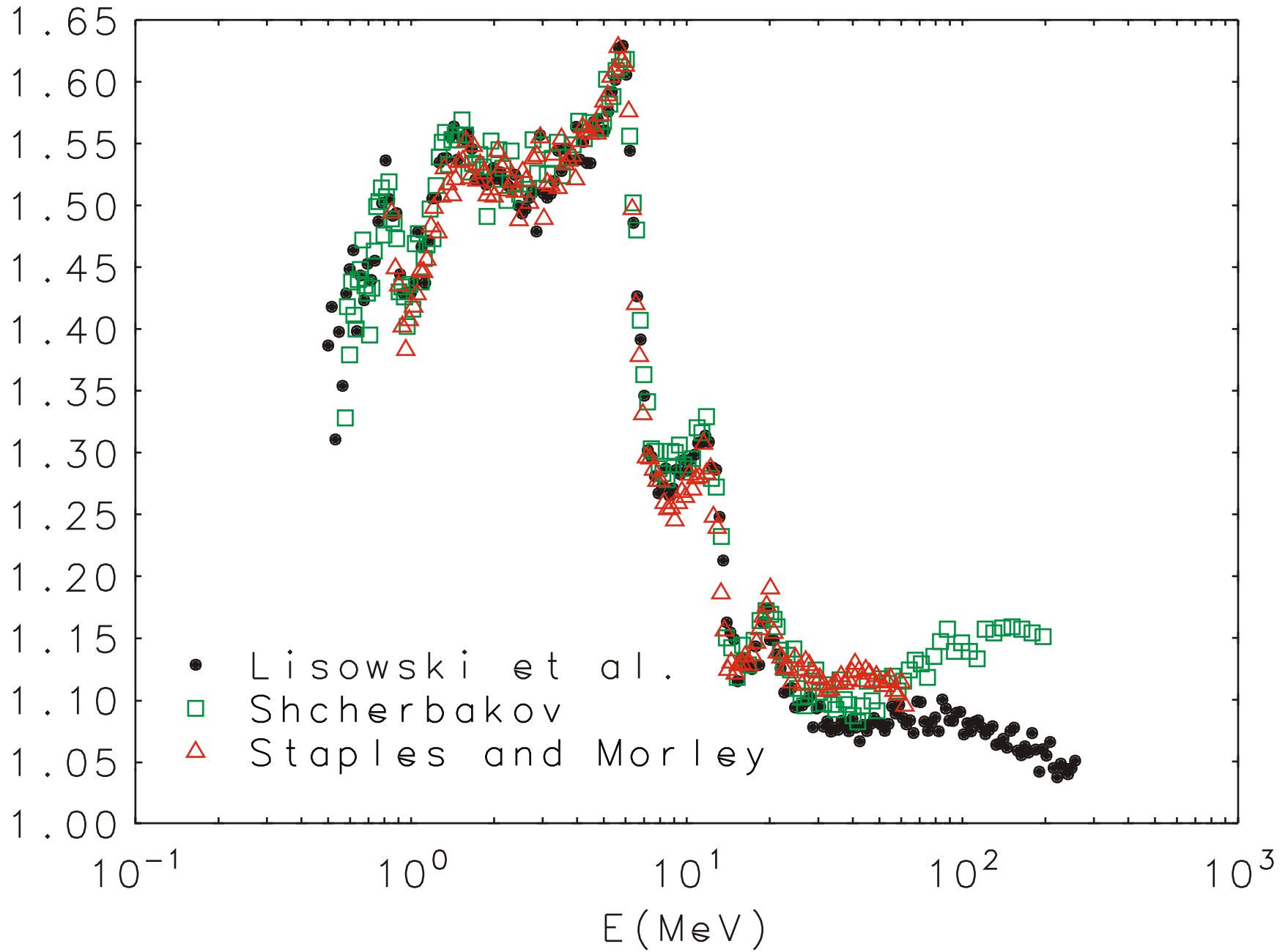


Measurements of the  $^{238}\text{U}(n,f)$  cross section at high neutron energies

## **$^{239}\text{Pu}(n,f)$ Recent data**

- Discrepancies at high energies persist
- LANL is considering a precise measurement in the MeV region

Ratio of the  $^{239}\text{Pu}(n,f)$  to  $^{235}\text{U}(n,f)$  Cross Sections



# Conclusions and Recommendations

The work on the database is necessarily essentially finished. The immediate focus is on producing the standards for the new ENDF/B-VII library..

Important discrepancies still exist in the standards database. Particular concern is noted for  $^{235}\text{U}(n,f)$ ,  $^{238}\text{U}(n,f)$  and  $^{239}\text{Pu}(n,f)$  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.