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# Inconsistent data and uncertainties – SG44/46

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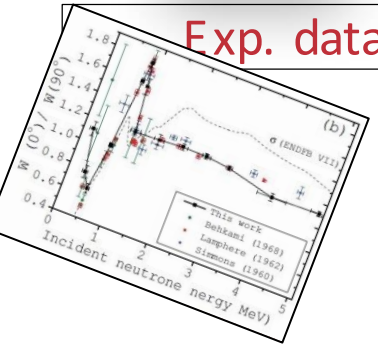
# Evaluated nuclear data

Exp. data




Imperfect/ inconsistent/ unconfirmed

Eval. technique

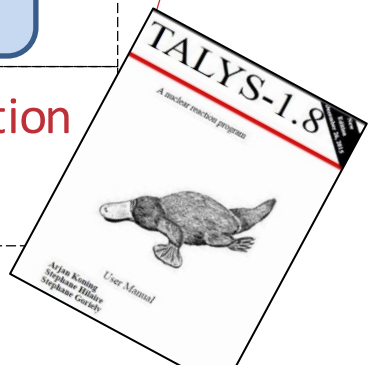
Eval. ND

- GLS
- UMC-G
- GLS-P
- UMC-B
- BMC
- By eye

Physics model

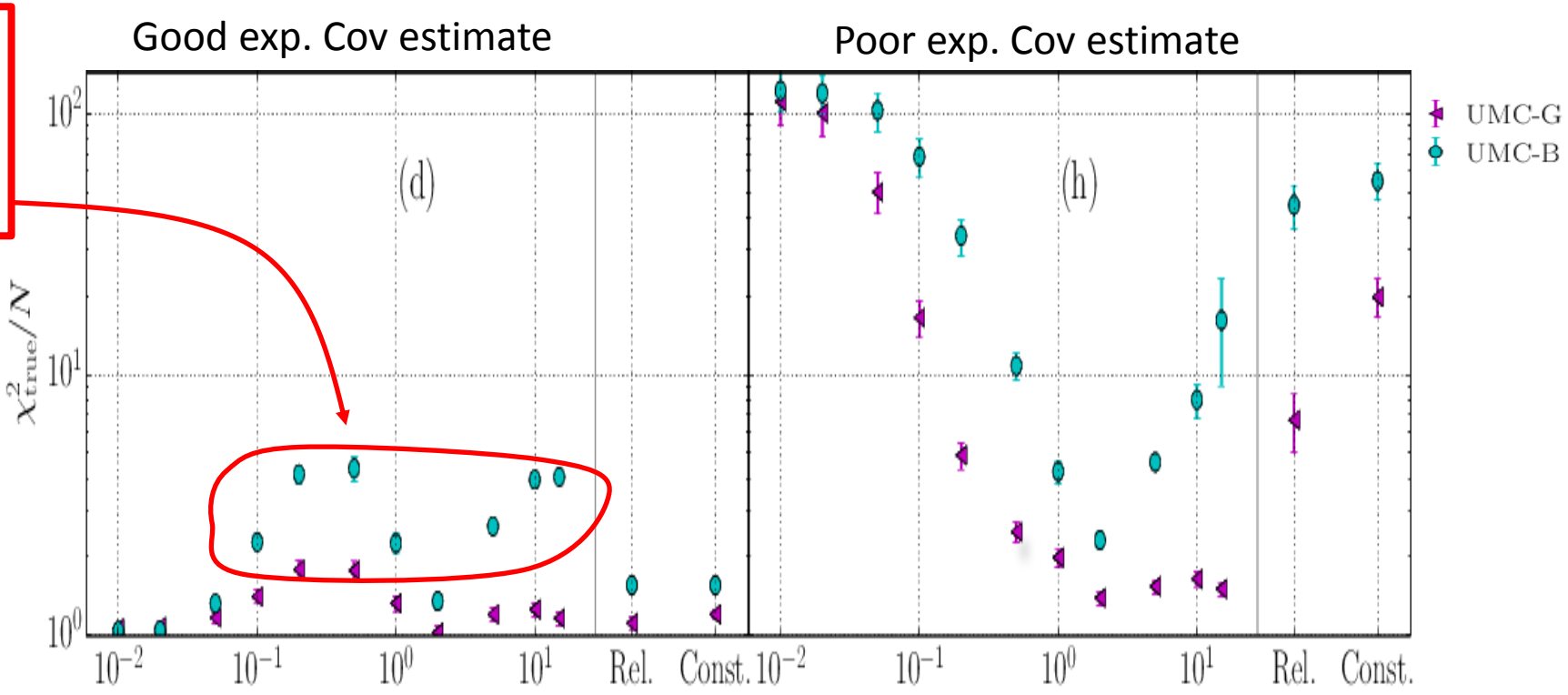
Contains model defects

Prior distribution



# Estimation of exp. covariance paramount

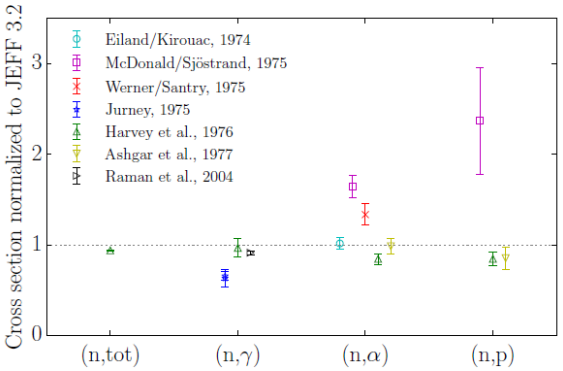
Can be treated with GP.



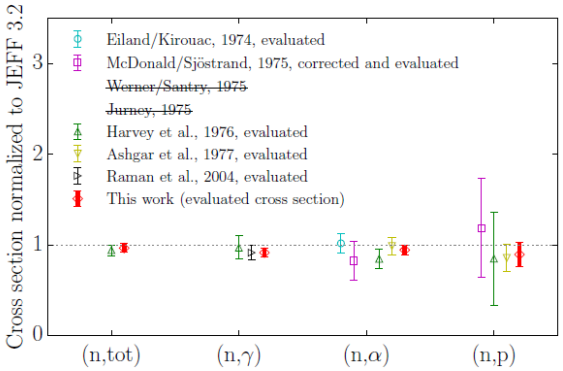

Results from a synthetic data study of a PFNS like evaluation. From: P. Helgesson et al. "Assessment of Novel Techniques for Nuclear Data Evaluation"; Conference: 16th International Symposium of Reactor Dosimetry (ISRD16); (2017)

# Do we know how the evaluators treat experimental data?

- Mostly no. Sometimes information available in the file or in associate publication. Information often incomplete. No standardized format (within WPEC) on how to report on the use of experimental data and associate co-variance in connection to the evaluations.

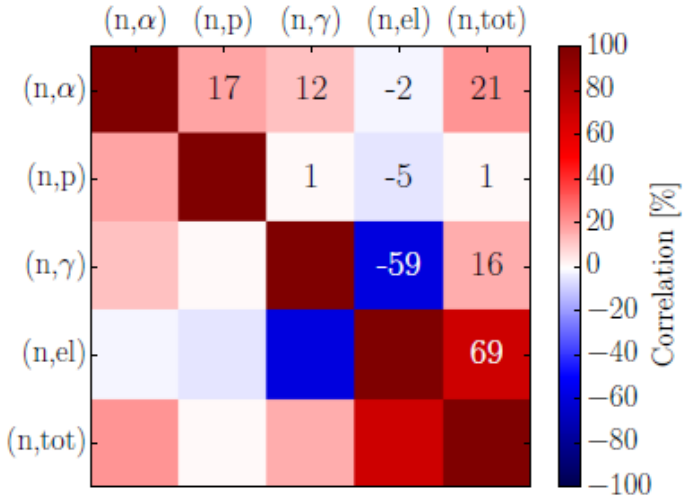



(a) As reported.




(b) Evaluated, corrected, renormalized and compared to the evaluated thermal cross sections resulting from Sec. II (including physical constraints).

Re-evaluation of experimental data for $Ni^{59}$ (JEFF3.3[1] )




[1]P.Helgesson et al., *Uncertainty driven nuclear data evaluation including thermal (n,alpha): applied to Ni-59*, Nuclear Data Sheets 145 (2017) 1–24

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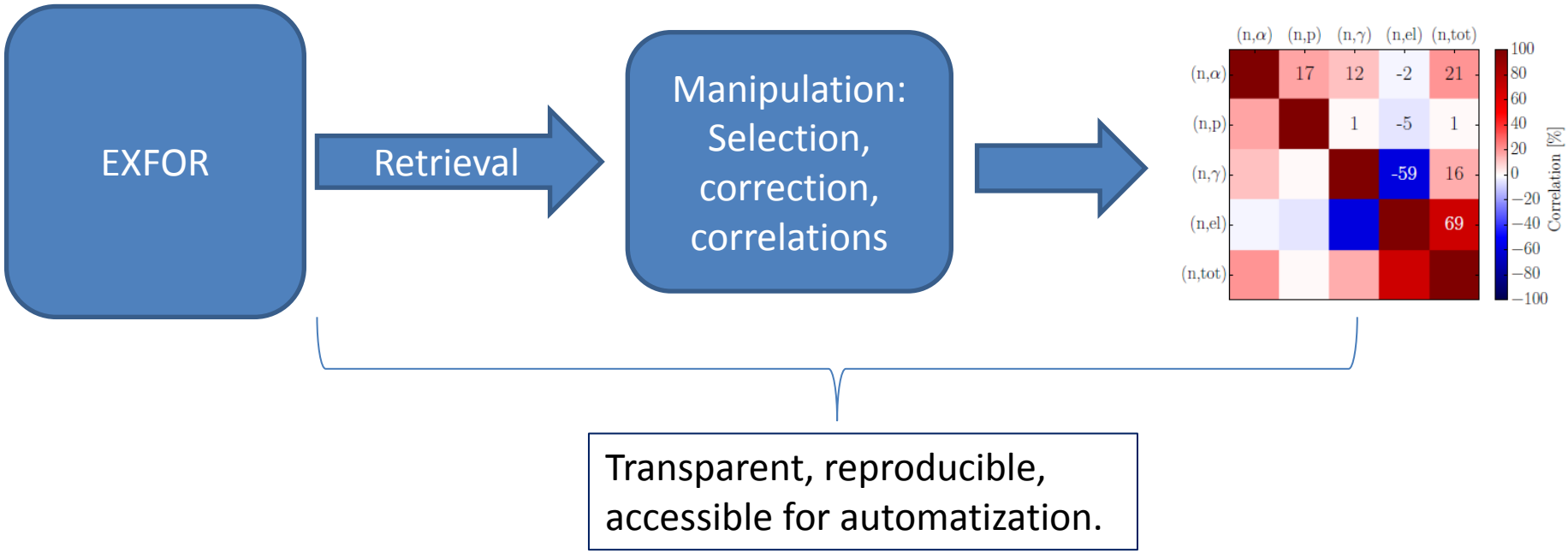
# Recommendation

- To understand the evaluated co-variances and why it sometimes differ between libraries we need a standardized way/format to report how we treat experimental data in connection to the libraries.
  - Unified application interface to databases



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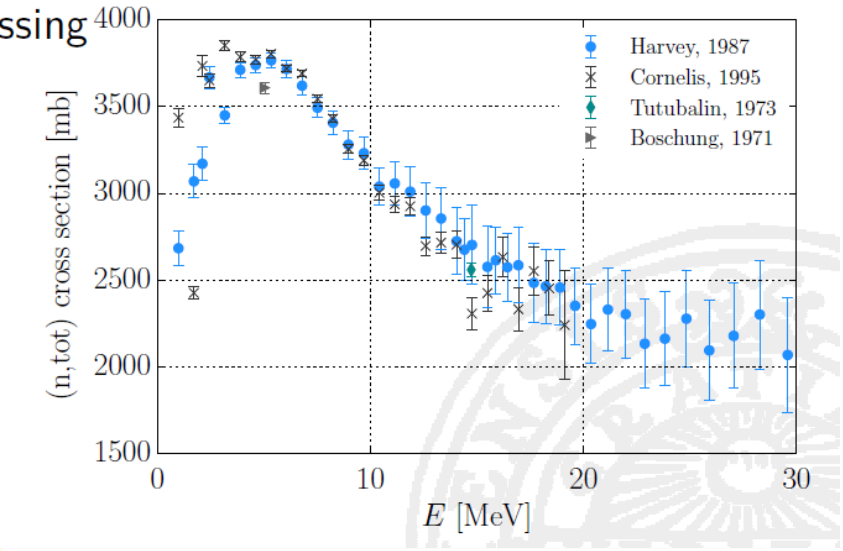
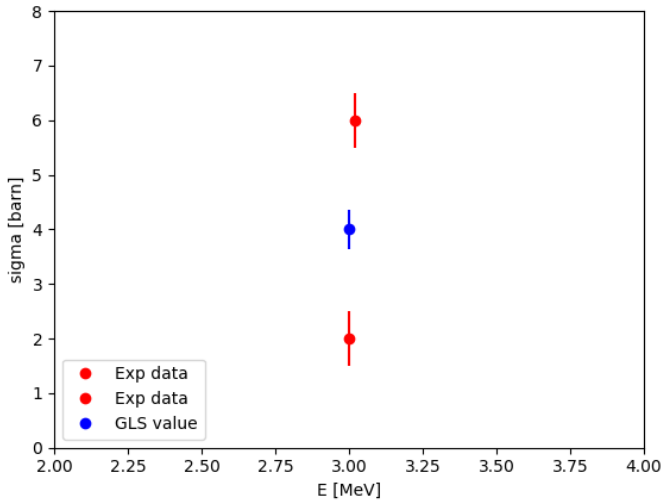
# If the data is inconsistent?




- Expert judgment
  - Time consuming
  - Reproducible?
  - Maybe not enough. Still inconsistent.
- Choose based on integral data.
  - Compensating errors.
- Based on the model.
  - Circular argument.
- GLS-fit.



# Using marginal likelihood optimization (MLO)

- Treat unrecognized systematic uncertainties in a systematic way.
- Ad an extra uncertainty component to the experiments.

$$\sigma_{tot}^2 = \sigma_{reported}^2 + \sigma_{extra}^2$$

- $\sigma_{extra}$ found by maxzimizing[1] L:

$$L = \frac{1}{\sqrt{2\pi n \left| SA_0S^T + \mathrm{cov}_{rep} + \mathrm{cov}_{extra} \right|}} e^{-\frac{\chi^2}{2}} e^{-\beta \sum \sigma_{extra}}$$

$A_0 = \text{prior covariance}$

$n = number \text{ of experiments}$

Agreement between GLS-value and original experiments

To favor small extra uncertainties. I.e., we believe what the experimentalists report.

[1]G. Schnabel, Fitting and Analysis Technique for Inconsistent Nuclear Data, Proc. of MC2017, 2017

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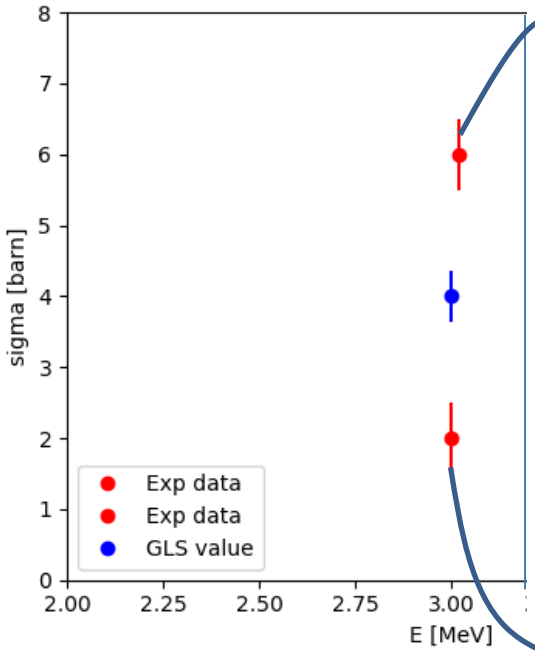
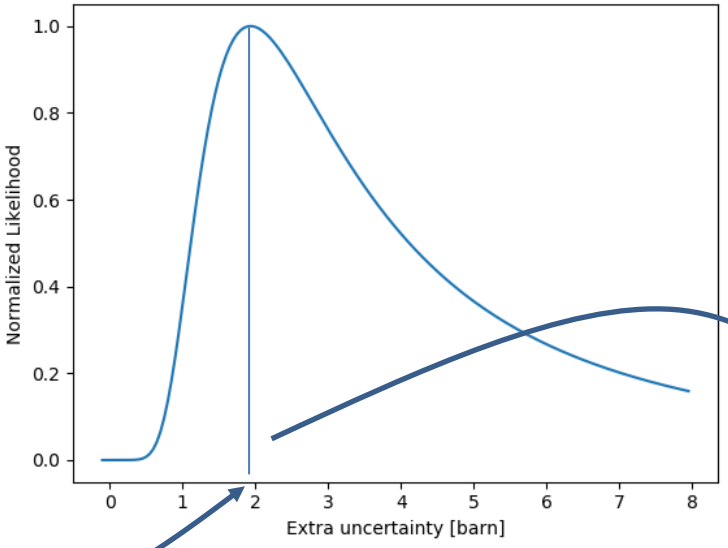
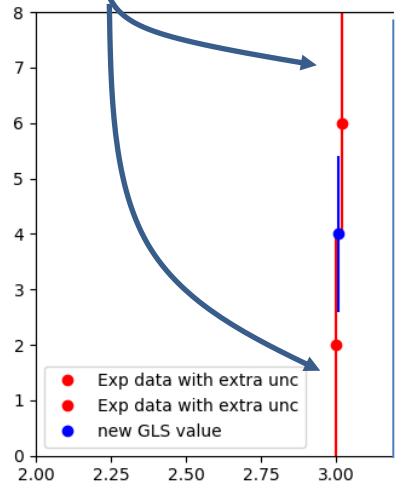
# Toy example and L- function




$$L = \frac{1}{\sqrt{2\pi n \left| SA_0S^T + \mathrm{cov}_{rep} + \mathrm{cov}_{extra} \right|}} e^{-\frac{\chi^2}{2}} e^{-\beta \sum \sigma_{extra}}$$



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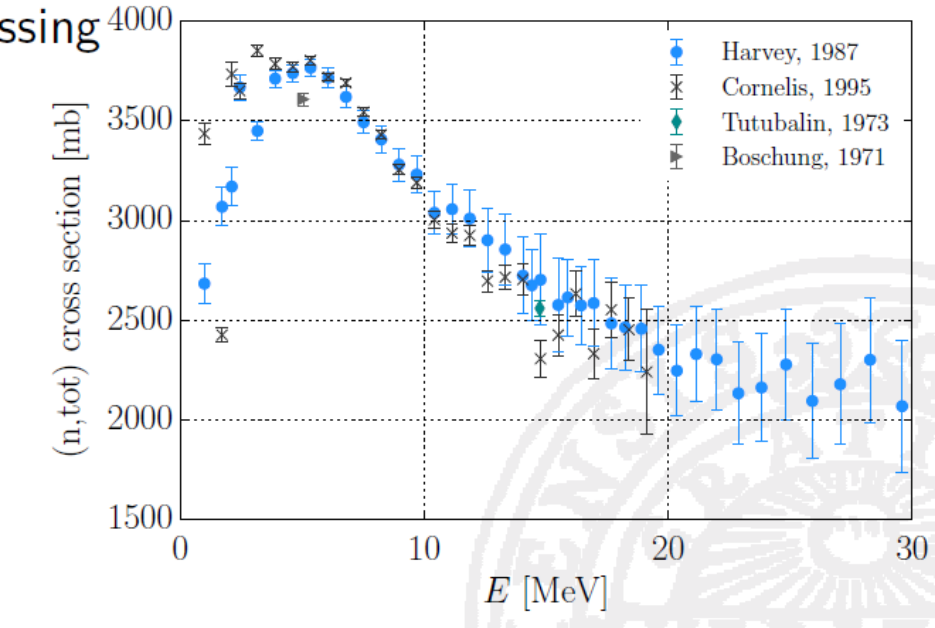
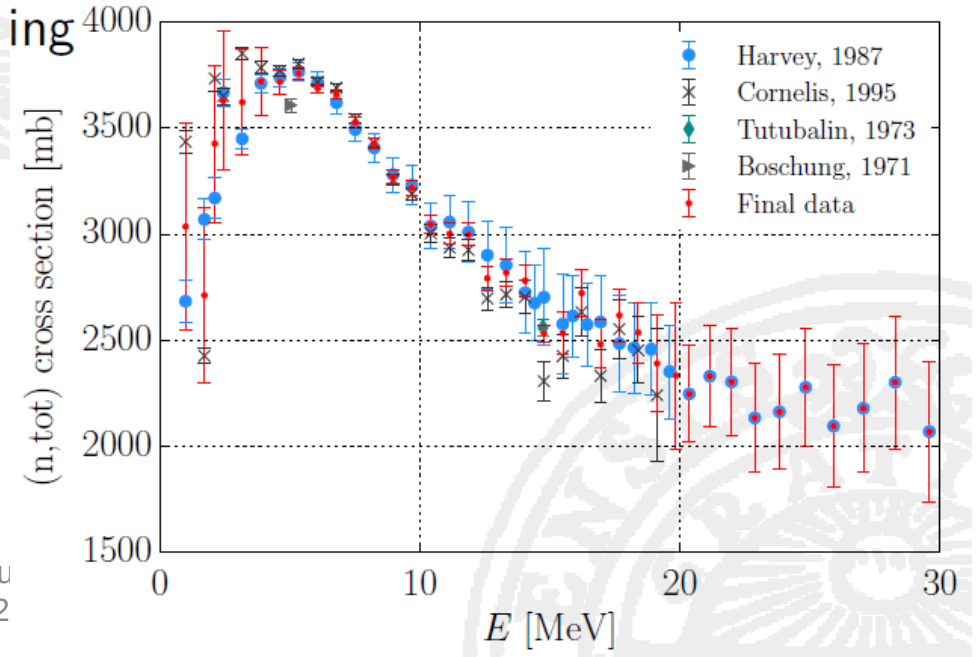
# Fe56 results-old



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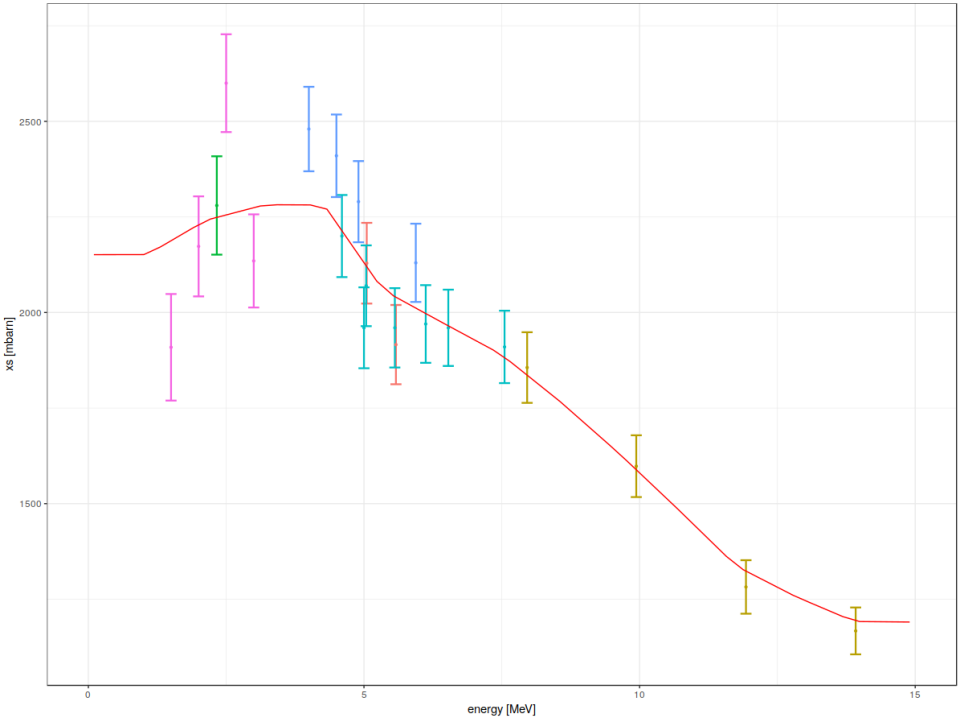
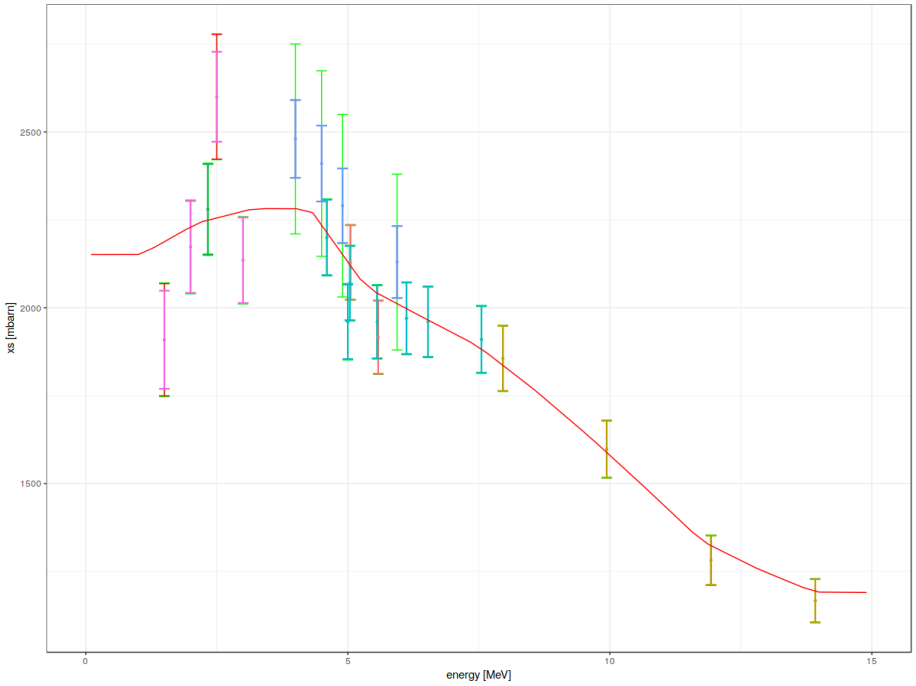
# Fe56 results (preliminary)




Fe56(n,el)

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# Conclusions

- The treatment of $cov_{exp}$. is paramount for the resulting $cov_{eval}$.
- Wanted: A standardized way to report how experimental data is treated.
- A MLO technique to handle inconsistent data is presented.
  - Statistical well-founded
  - Transparent
  - Complements expert judgement

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# References


- P. Helgesson et al. "Assessment of Novel Techniques for Nuclear Data Evaluation"; Conference: 16th International Symposium of Reactor Dosimetry (ISRD16); (2017)
- P.Helgesson et al., *Uncertainty driven nuclear data evaluation including thermal (n,alpha): applied to Ni-59*, Nuclear Data Sheets 145 (2017) 1–24
- G. Schnabel, Fitting and Analysis Technique for Inconsistent Nuclear Data, Proc. of MC2017, 2017