The Abdus Salam International Centre for Theoretical Physics

International Atomic Energy Agency

Introduction to the nuclear reaction data evaluation

Joint ICTP-IAEA Workshop on *Nuclear Reaction Data for nuclear power applications*, 22-26 Sept. 2014, Trieste

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NUCLEAR DATA NEEDS

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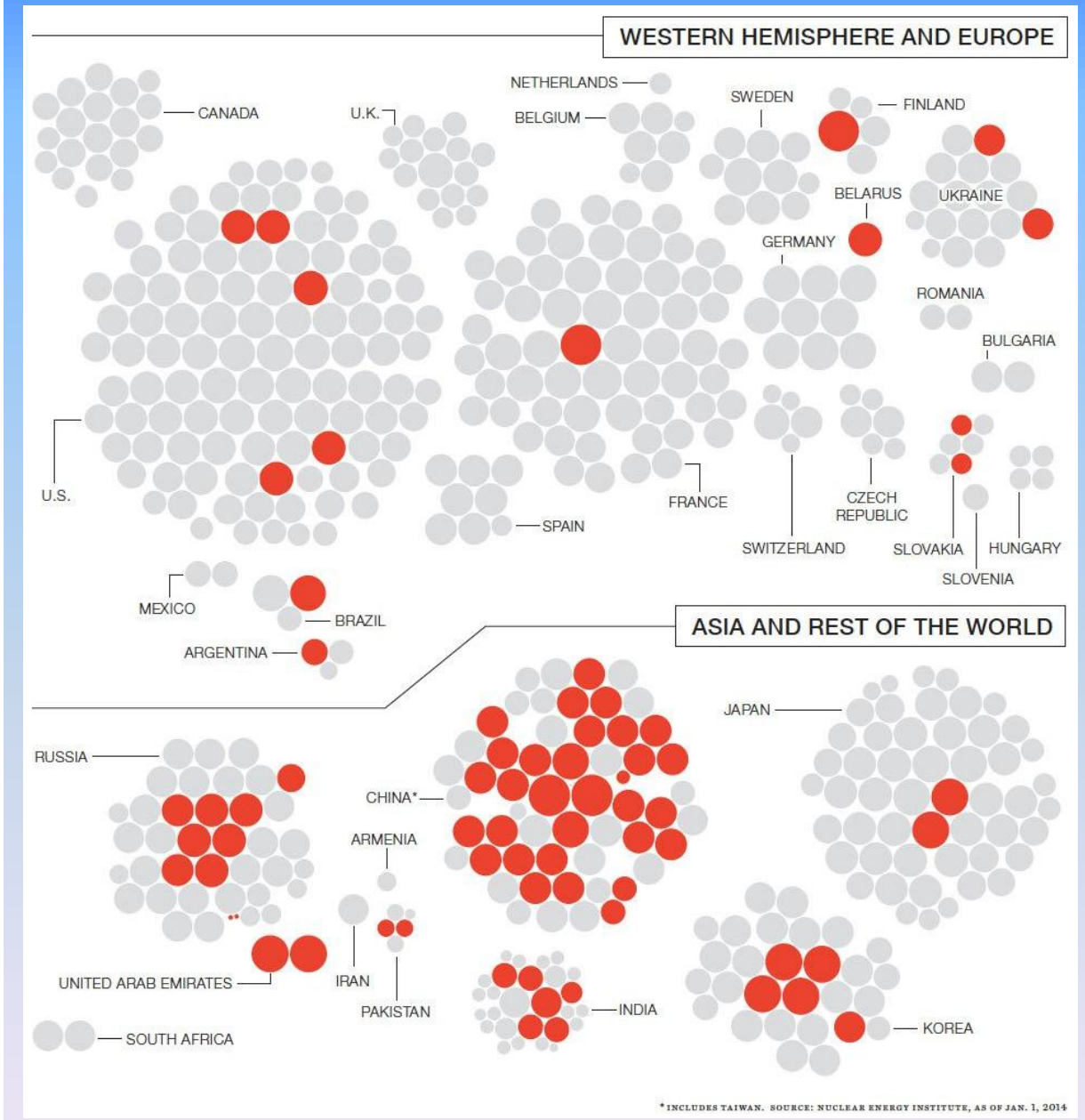
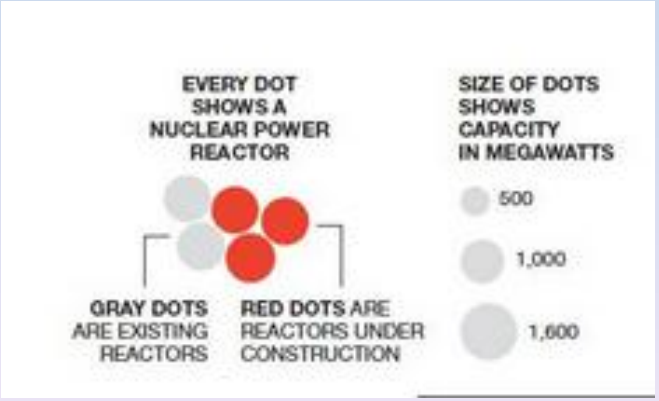
Nuclear Power Reactors: Present & Future

thermal syst.





http://fortune.com/2014/04/10/asias-fission-frenzy/

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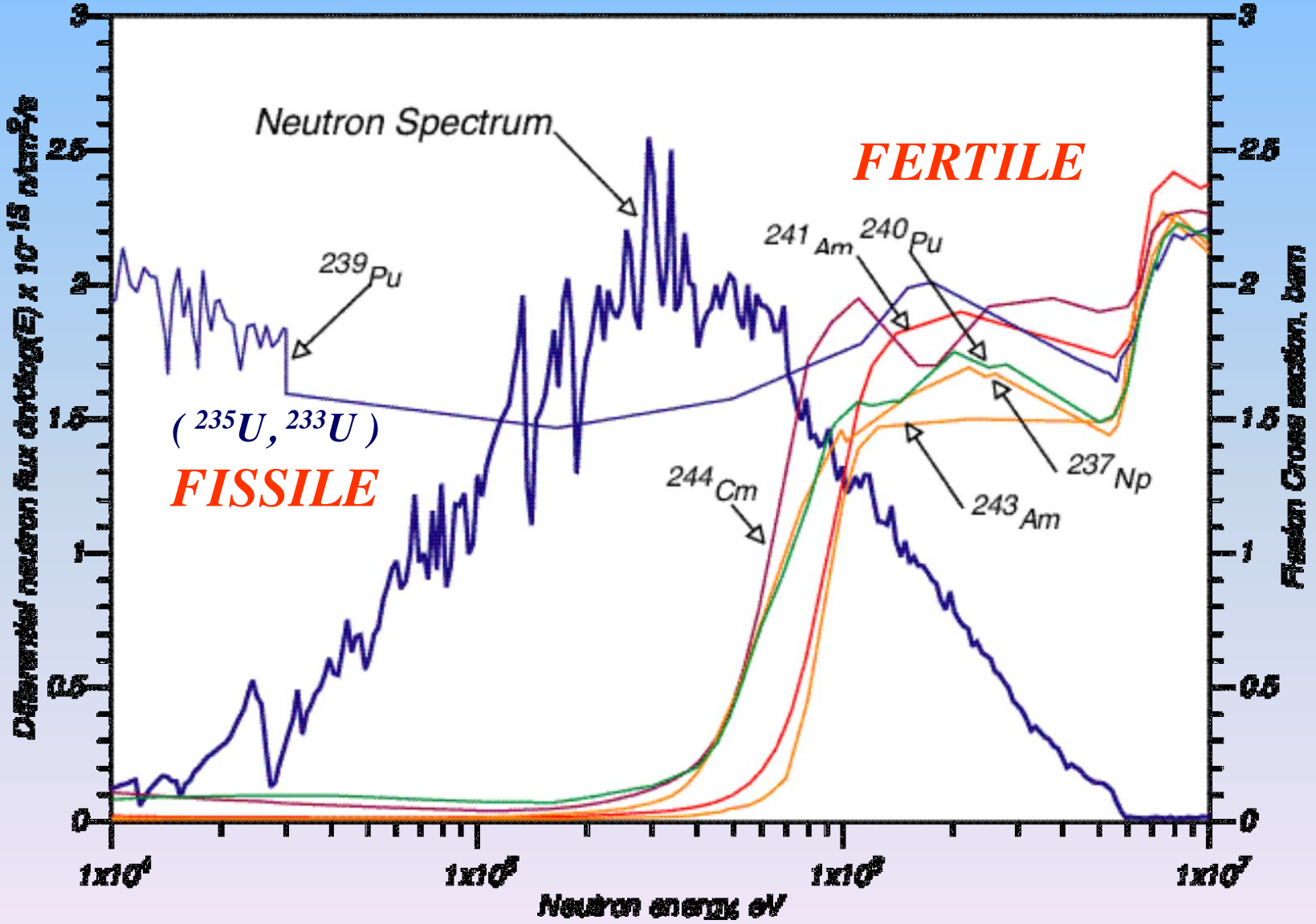
Why we need ADS/fast reactors?



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What is NUCLEAR DATA EVALUATION?

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Definition of (ND) Evaluation

A properly weighted combination of

- selected experimental data
- nuclear reaction modelling results

(if needed)

Bayesian approaches (may use prior knowledge):

- ❑ "Non-model" GLSQ fit (standards)
- ❑ Model prior + experimental data:

  Deterministic: Model Prior (Sens) + GLSQ

  Stochastic (MC): BFMC, UMC, FMC (TENDL)

  Hybrid: Model Prior (MC) + GLSQ

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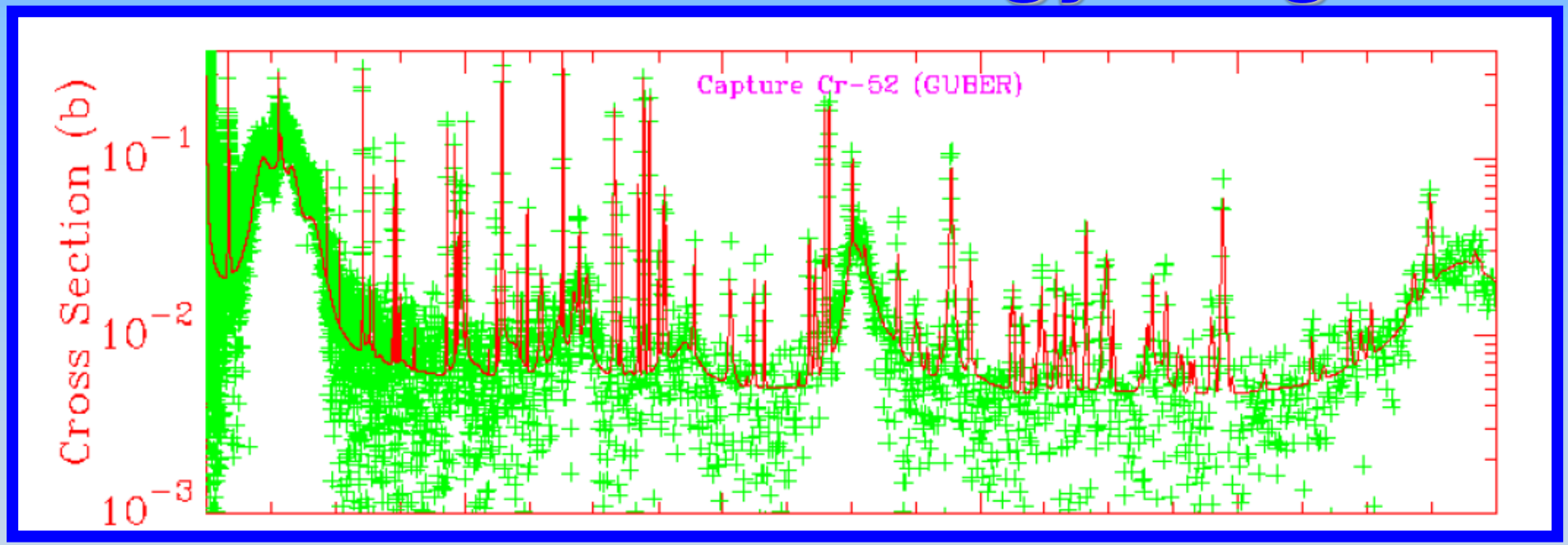
ND evaluation: energy ranges



- Resonance energy range (Γ << D)
- Unresolved resonance range (in between)

  (self-shielding)
- Fast neutron range (Γ >> D stat models)

  keV for actinides, MeV for Ni, Fe, Cr,…

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Nuclear Data Evaluation ~ cooking

Evaluated cross sections and covariance matrices

Experimental Input

Inter and -intra experiment correlations

Experimental cross sections

Prior Knowledge

Model Defects

Parameter Uncertainties

Model cross sections

From D. Neudecker, S. Gundacker, H. Leeb *et al.*, ND2010, Jeju Isl., Korea

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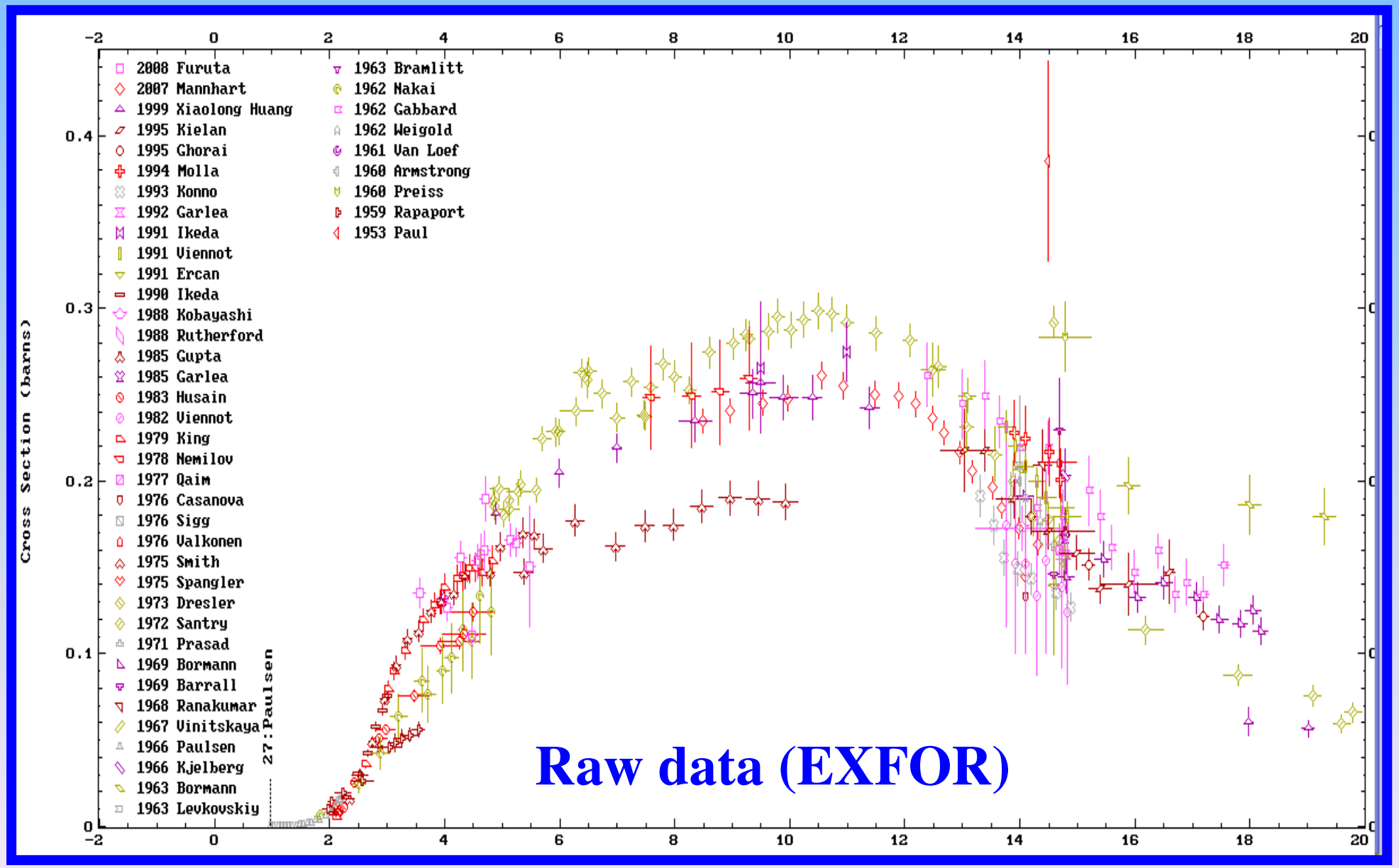
Selection of experimental data (1)



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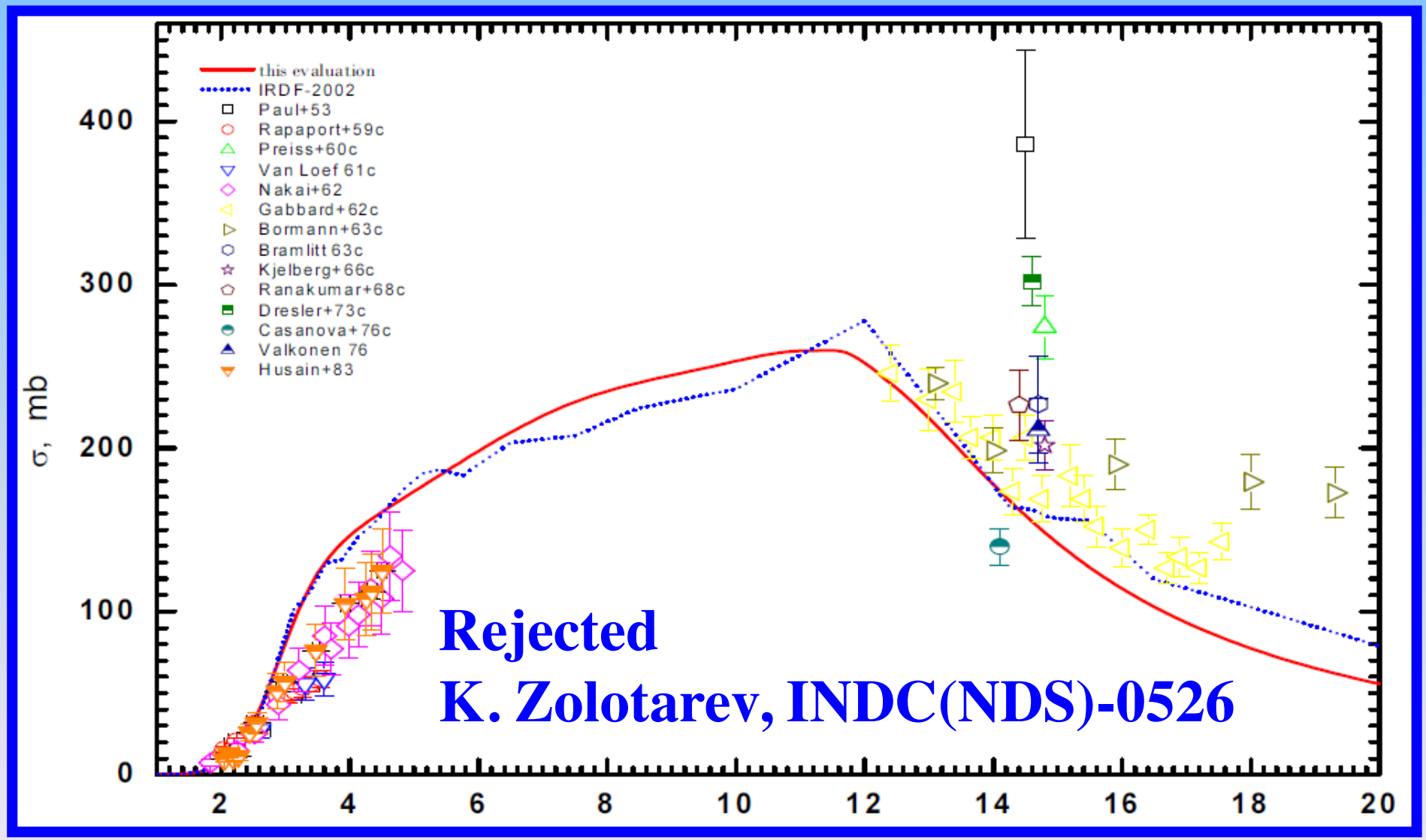
Selection of experimental data (2)



http://www-nds.iaea.org/reports-new/indc-reports/indc-nds/indc-nds-0526.pdf

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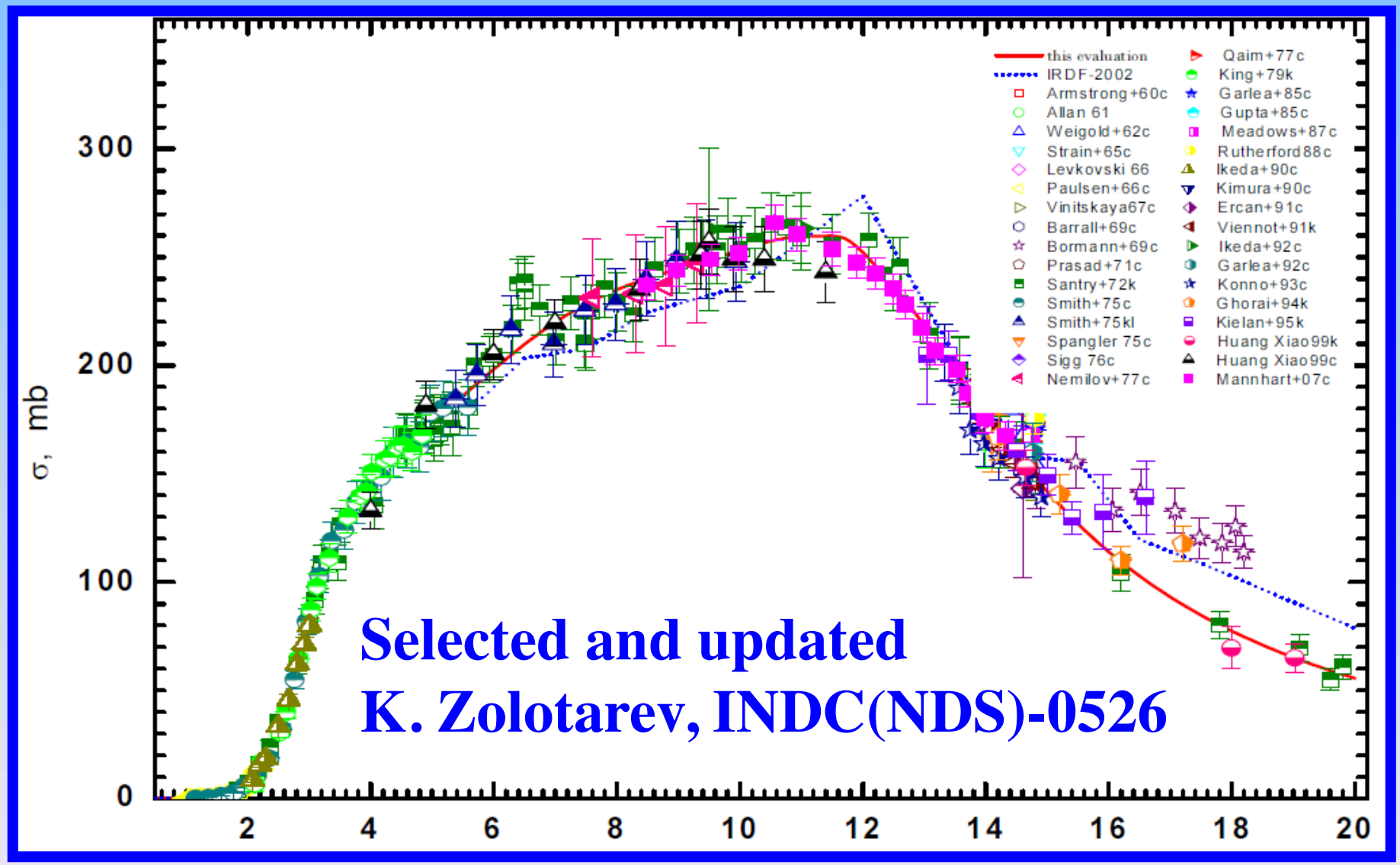
Selection of experimental data (3)



http://www-nds.iaea.org/reports-new/indc-reports/indc-nds/indc-nds-0526.pdf

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TALYS & EMPIRE modelling codes

TALYS

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More about TALYS
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What is TALYS?

TALYS is software for the simulation of nuclear reactions. Many state-of-the-art nuclear models are included to cover all main reaction mechanisms encountered in light particle-induced nuclear reactions. **TALYS** provides a complete description of all reaction channels and observables, and is user-friendly.

TALYS is a versatile tool to analyse basic microscopic experiments and to generate nuclear data for applications.

News

Download TALYS-1.2!

The official TALYS-1.2 is now available.

Available online at www.sciencedirect.com

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Nuclear Data Sheets 108 (2007) 2655–2715

Nuclear Data Sheets

www.elsevier.com/locate/nds

EMPIRE paper

EMPIRE: Nuclear Reaction Model Code System for Data Evaluation

M. Herman[1,*], R. Capote[2], B.V. Carlson[3], P. Obložinský[1], M. Sin[4], A. Trkov[5], H. Wienke[6], and V. Zerkin[2]

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[6] *Belgonucleaire, Dessel, B2480, Belgium*

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RIPL contents

Nuclear Data Sheets 110 (2009) 3107–3214

RIPL – Reference Input Parameter Library for Calculation of Nuclear Reactions and Nuclear Data Evaluations

R. Capote,[1] M. Herman,[1,2] P. Obložinský,[1,2] P.G. Young,[3] S. Goriely,[4] T. Belgya,[5] A.V. Ignatyuk,[6] A.J. Koning,[7] S. Hilaire,[8] V.A. Plujko,[9] M. Avrigeanu,[10] O. Bersillon,[8] M.B. Chadwick,[3] T. Fukahori,[11] Zhigang Ge,[12] Yinlu Han,[12] S. Kailas,[13] J. Kopecky,[14] V.M. Maslov,[15] G. Reffo,[16] M. Sin,[17] E.Sh. Soukhovitskii,[15] and P. Talou[3]

http://www-nds.iaea.org/RIPL-3/

No	Directory	Contents
1	MASSES	Atomic Masses and Deformations
2	LEVELS	Discrete Level Schemes
3	RESONANCES	Average Neutron Resonance Parameters
4	OPTICAL	Optical Model Parameters
5	DENSITIES	Level Densities (Total, Partial)
6	GAMMA	Gamma-Ray Strength Functions
7	FISSION	Fission Barriers and Level Densities

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ND evaluation in a nutshell: exp.data + model

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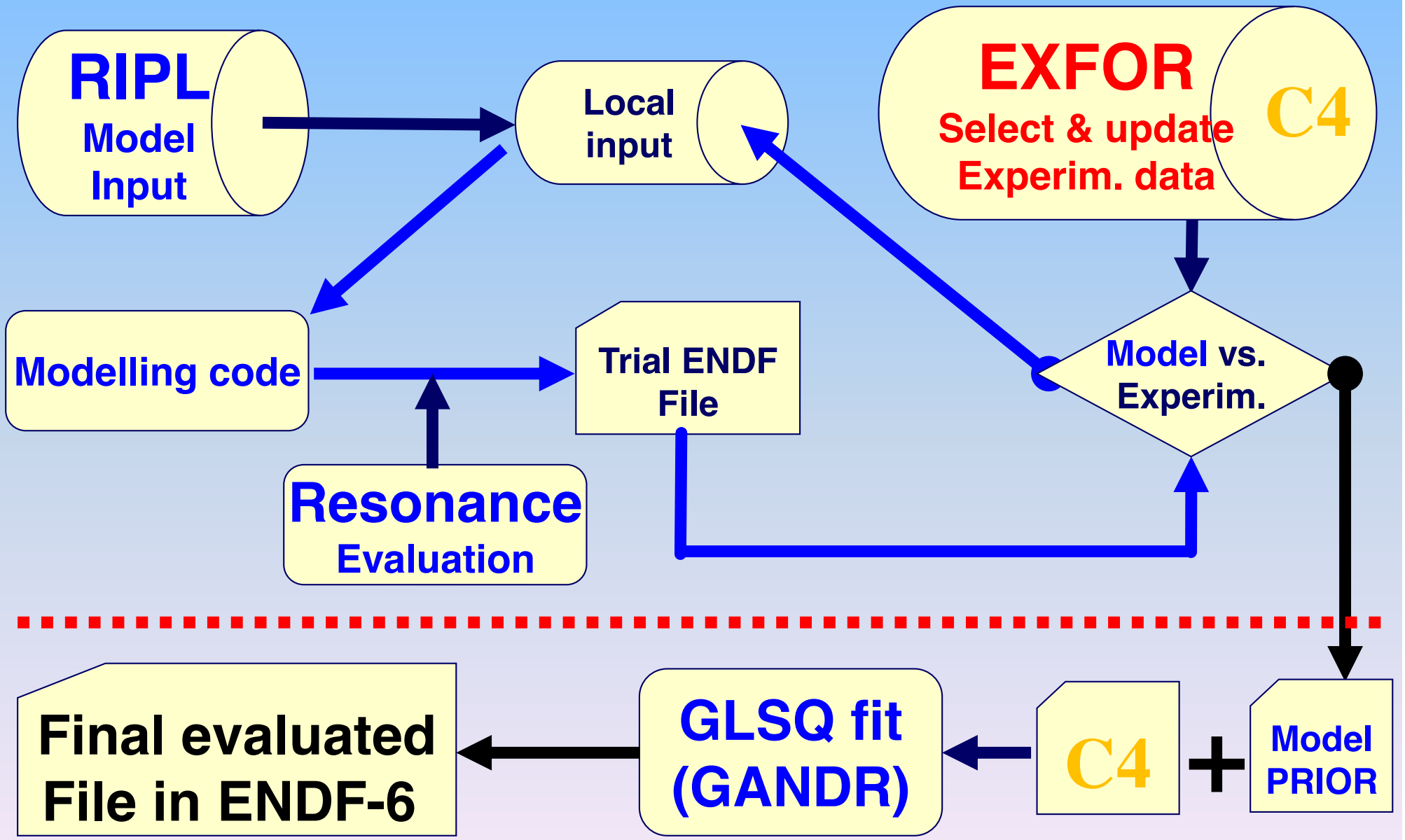
Nuclear Data Evaluation process



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ND evaluation in a nutshell: exp.data + model

Welcome to the ND world !

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