Quality Improvement of the EXFOR database

WPEC subgroup 30

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EXFOR

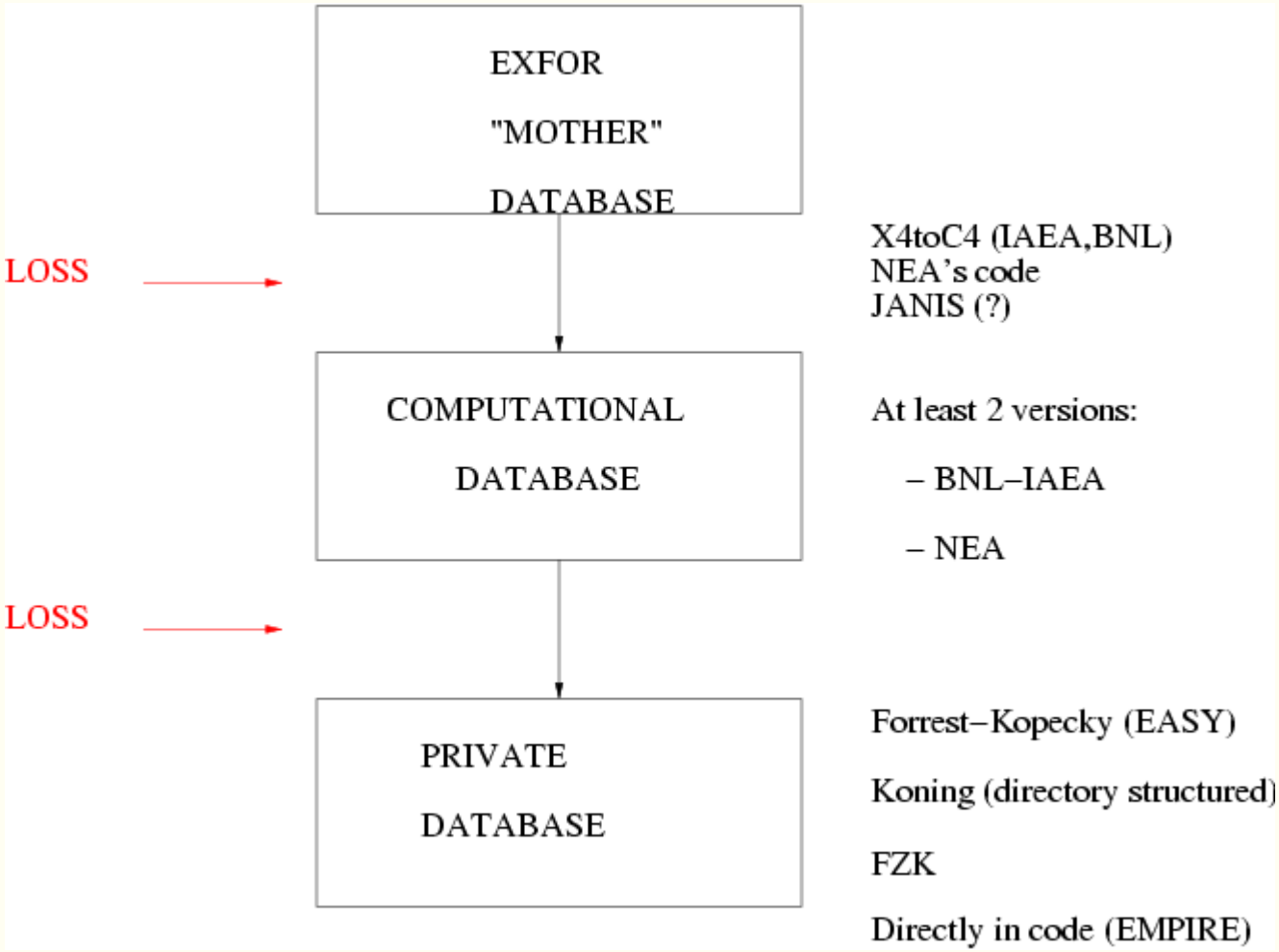
* Most complete nuclear reaction database:
  - More than 15,500 experiments
  - Practically complete for neutrons
  - More and more complete for charged particles
* Maintained/updated by the Data Centers and compilers
* An important treasure for nuclear science and technology.

Possible issues for improvement

* Completeness (not considered here)
* Database management and EXFOR format (not considered here, apart from format harmonization)
* Data Retrieval (completeness)
* Quality (correctness)

Objective

* Make EXFOR an easy accessible and correct database, available in computational format. This enables:
  - More efficient data evaluation
  - Easy and extensive validation of model codes
  - More feedback from users to EXFOR maintainers.


EXFOR
"MOTHER"
DATABASE
LOSS
X4toC4 (IAEA,BNL)
NEA's code
JANIS (?)
COMPUTATIONAL
DATABASE
At least 2 versions:
– BNL–IAEA
– NEA
LOSS
PRIVATE
DATABASE
Forrest–Kopecky (EASY)
Koning (directory structured)
FZK
Directly in code (EMPIRE)

Problems

* Too much flexibility for compilers to use the EXFOR format?
  - Various nuclear reactions are stored with 2 or more different identifiers (format harmonization needed!)
  - Not all data can be consistently processed into normal x-y-dy format
  - Many entries unprocessable for current database conversion codes

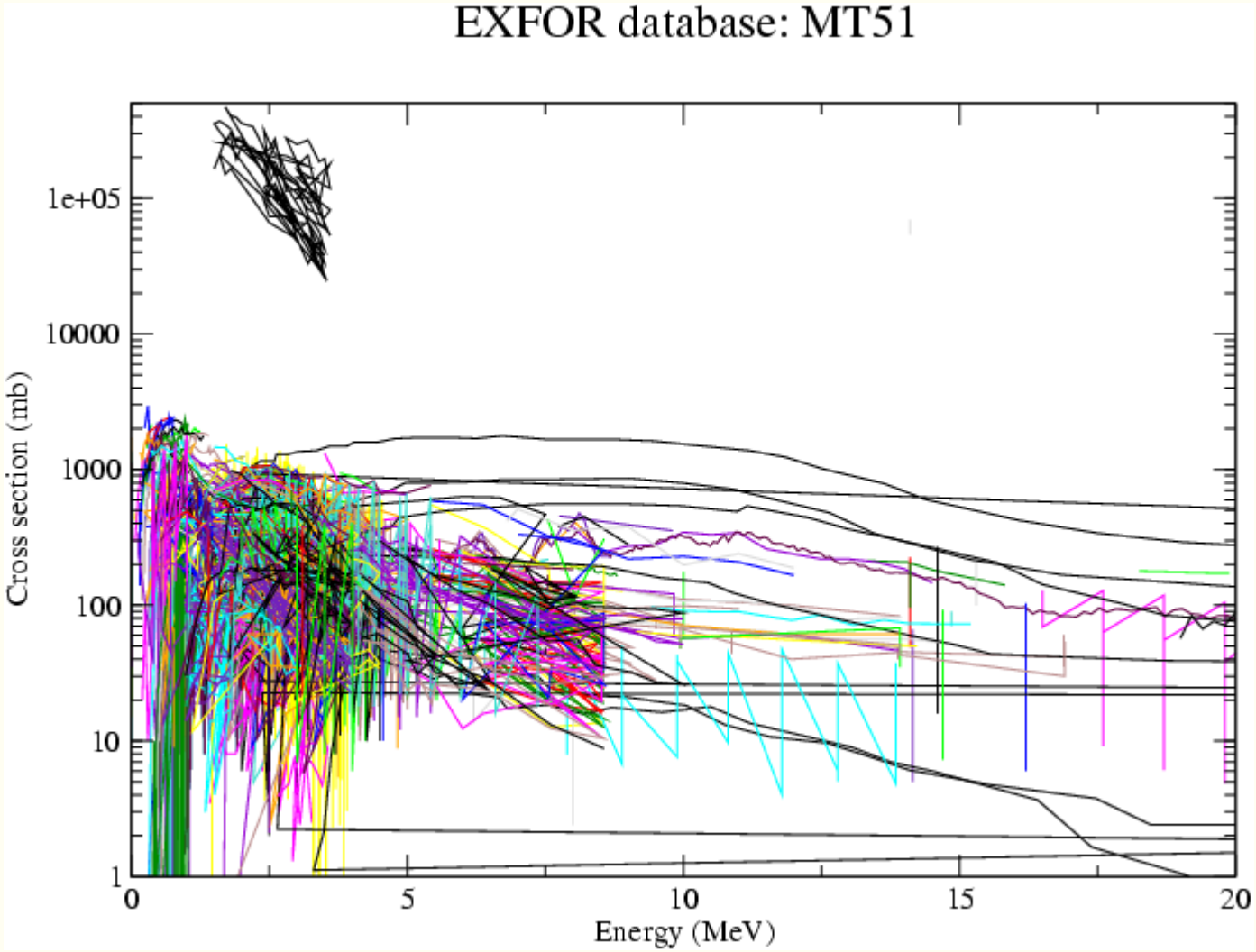
  Are some data “lost” forever?
* Two main problems:
  - Errors in, and wild grow of, format
  - Errors in values themselves

Why is it a problem?

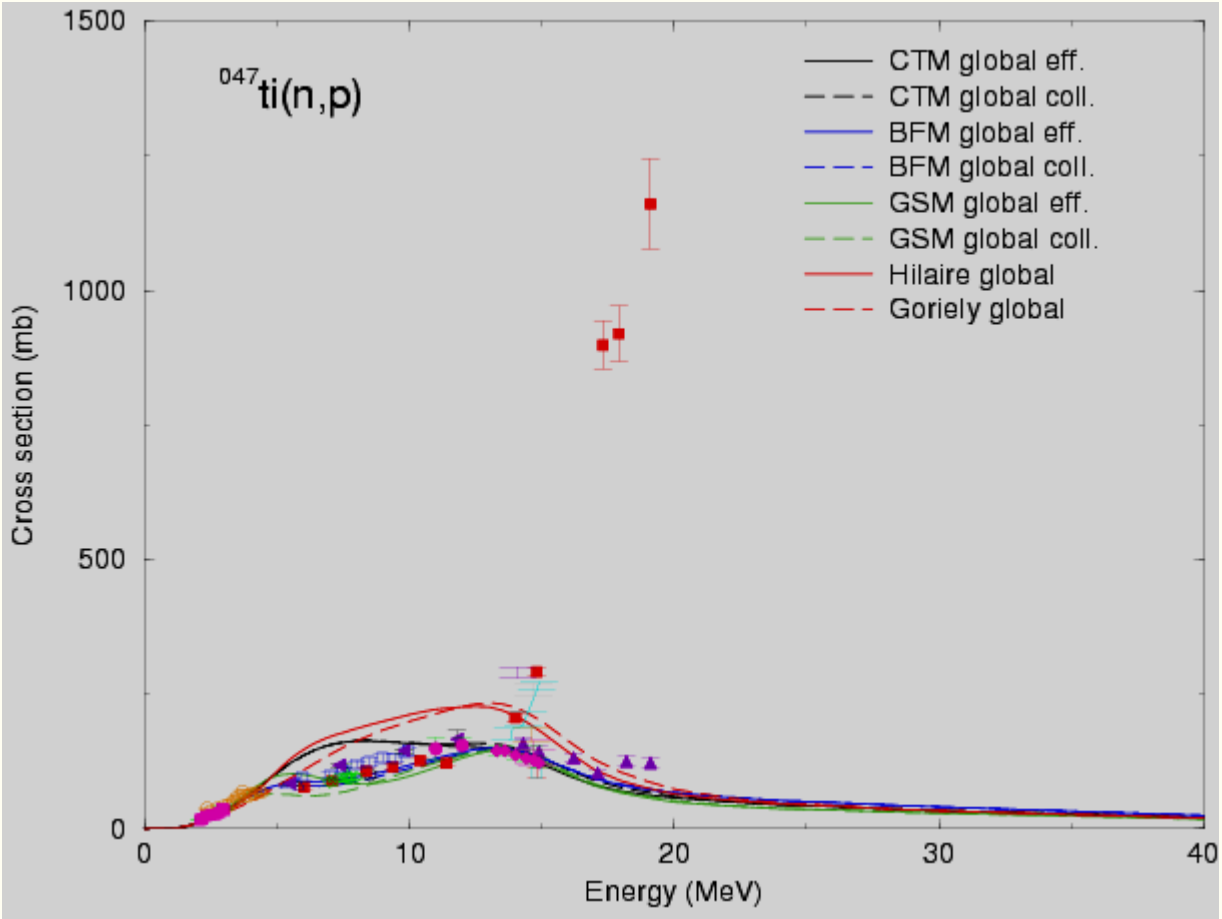
* All other aspects of nuclear data evaluation are well automated:
  1. Robust nuclear model codes
  2. Plotting software
  3. Checking, processing software
  4. `Scriptwise' nuclear data evaluation
* Exp. data retrieval should not become the delaying factor
* Evaluator needs access to all data
* Covariance evaluation requires access to all data
* Experimentalist deserves appropriate credit.

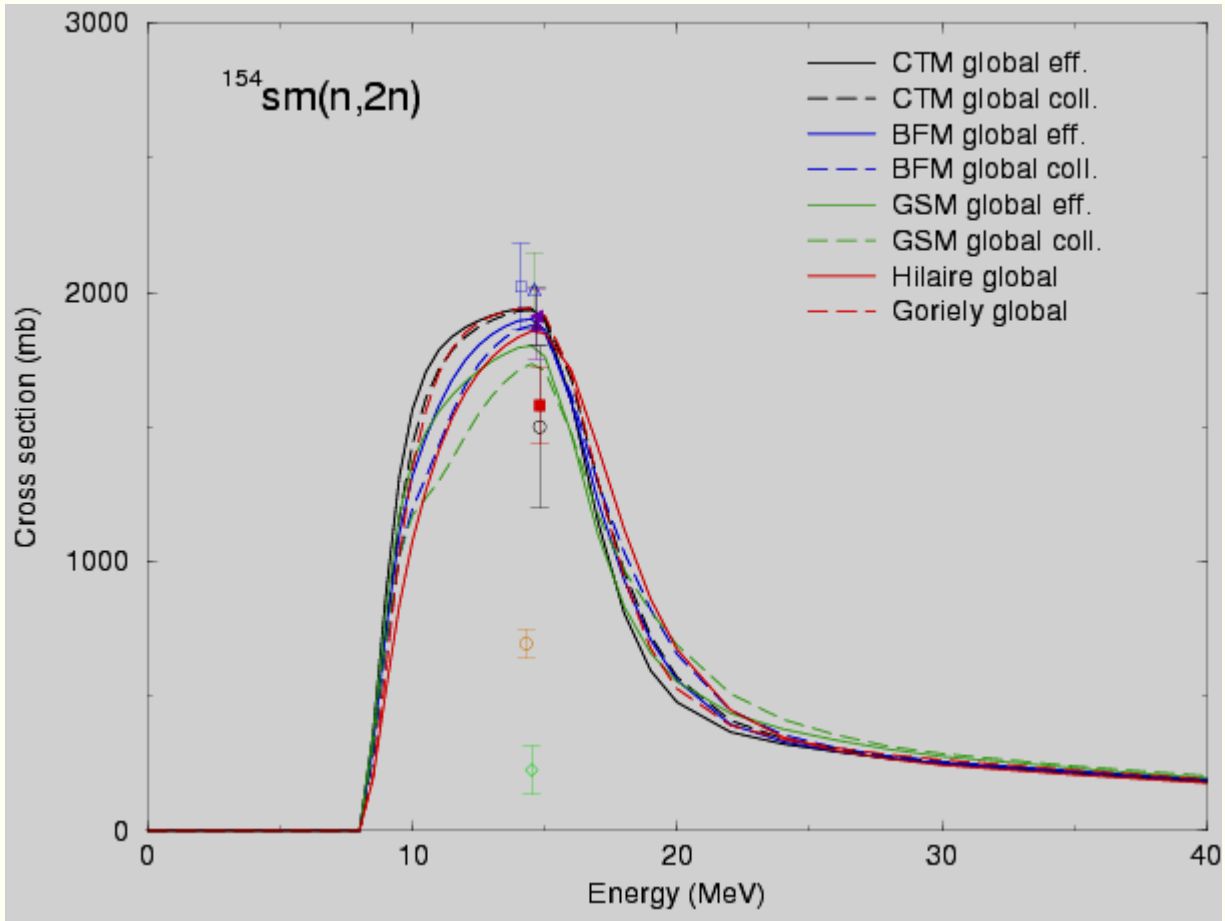
Approach

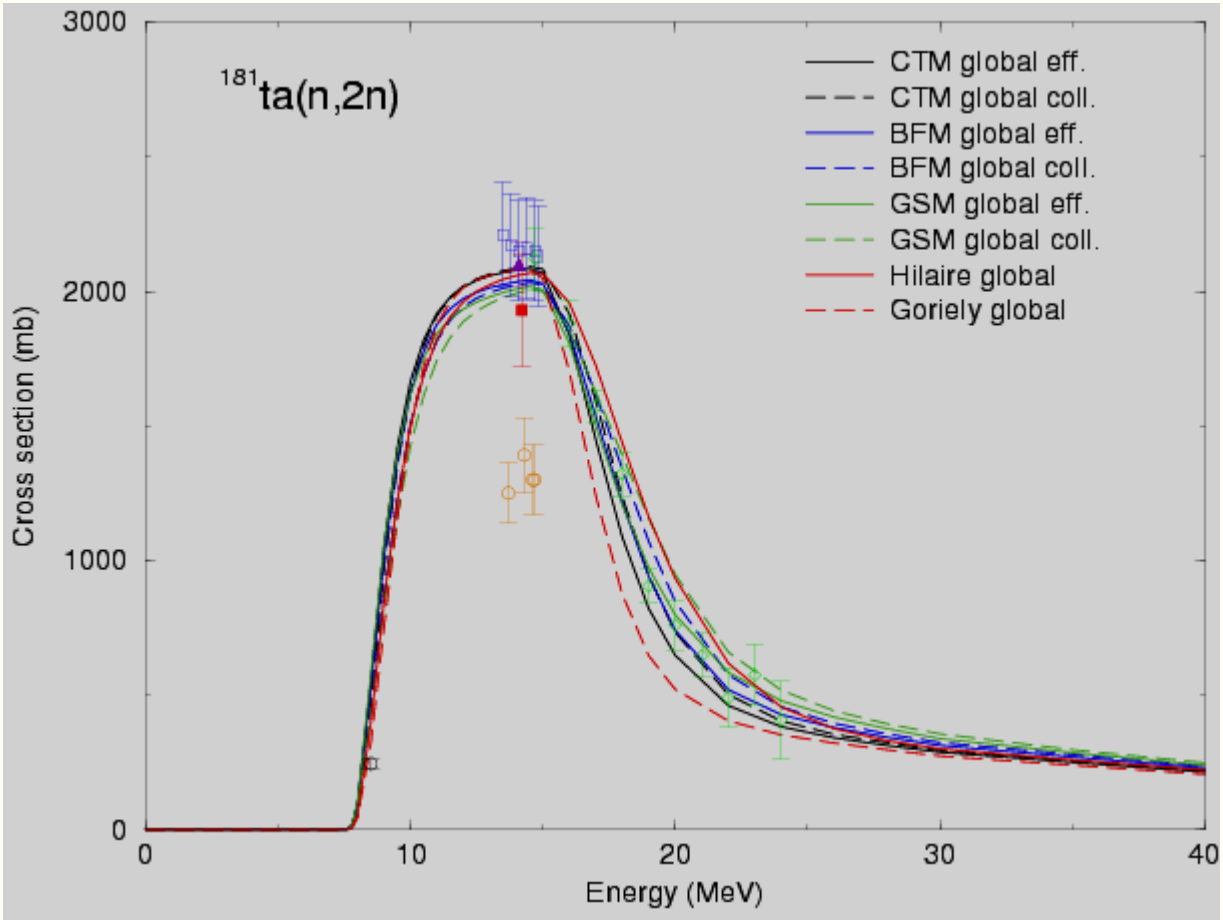
* Use format converters and checking routines
  - Record how many % is converted
  - E.g. check for negative cross sections
  - E.g. check for xs > 4 barns for E > 0.1 MeV
* Some errors are obvious just by plotting the values
* Use the power of nuclear model codes:
  - Chi-square checks
  - Visual inspection


EXFOR database: MT51
Cross section (mb)
1e+05
10000
1000
100
10
1
0
5
10
15
20
Energy (MeV)

See www.talys.eu




^{154}sm(n,2n)
CTM global eff.
CTM global coll.
BFM global eff.
BFM global coll.
GSM global eff.
GSM global coll.
Hilaire global
Goriely global
Cross section (mb)
Energy (MeV)
0
1000
2000
3000
0
10
20
30
40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Deliverables

* EXFOR database in computational format. Annual, or more frequent, releases in increasing quality and completeness (also for “mother” database)
  - Responsible: Data Centers
  - Input: Users
* Final report:
  - Status in 2007
  - Description of improvements and tools
  - Final status in 2009

Milestones

* 6 months:
  - Collect and compare all software that processes EXFOR(X4toC4, JANIS, etc.) and merge this into one strategy for conversion into computational format.
  - Correction of EXFOR with first lists of errors (Forrest, Koning, etc.)
* 12 months:
  - Computational library #1: All cross sections

Milestones

* 24 months:
  – Computational library #2: All cross sections + angular distributions + single- and double-differential energy spectra + everything else

Conclusions

* Steps to take:
  - Make the entire EXFOR database available in computational format (First step!!!)
  - Repair the errors
* This will enable:
  - Much more efficient evaluation of data files
  - Minimal delay between publication of experiments and their adoption in data files
  - More efficient nuclear model code validation

A short history of SG-30

* April 20 2007: SG-30 approved at WPEC meeting (compromise: remove quality flagging)
* June 2007: Initial emails sent:
  - Lots of moral support
  - Mailing list created: sg30@nea.fr
  - About 30-40 members of mailing list
* June/July 2007: Extended C4 format by V. Zerkin. Bilateral communication with A. Koning

A short history of SG-30

* July 2007: Correction/investigation of AK's first list of errors by S. Dunaeva and O. Schwerer.
* September 2007:
  - Statistical tests by Emmeric Dupont
  - Preparing JANIS for SG-30 by NEA
  - October 10-11 2007: first SG-30 meeting at IAEA

A list of problems

* Obvious (?) dimensional errors: barns instead of millibarns, eV instead of MeV, etc.
* More than one identifier to store data: e.g. (n,inl) and (n,x)0-NN-1, etc. (to be solved in X4 or X4toC4?)
* Reporting (n,inl) as (n,n'gamma) data and vice versa.
* Storage of fission yields as (n,f) (MF3,MT18) data, e.g. entries O0777 and O0020
* Ratio's given as cross sections (e.g. entry 21863)
- Incomprehensible reaction strings in X4 (e.g. entry O1004, Heinz 2003, 1 GeV p + U238)

A list of problems

- How to identify the level for (n,inl) to a specific level automatically?
- High energy proton reactions: residual products given as many, many subsections
- X4toC4 translation problems if uncertainties are suddenly missing inside a data block
- Total cross sections labeled as isomeric and vice versa.
- Change of nuclear reaction inside a data block and NO change of sub ID (e.g. entry O0290)