EXFOR Checking and Quality Scores

E. Dupont (NEA), A.J. Koning (NRG), N. Otsuka (IAEA-NDS)

1. Post-SG30 Activities
2. Quality Assignment by NRG
3. Proposal on Quality Scores

NB: See WP2013-19 for more detailed information

1. Post-SG30 Activities

- SG30 achievements were only the *"end of the beginning"*

- SG30-like activities are continuing at NRG and Data Centres, e.g.
  - System to collect and apply correction on C4 data (V. Zerkin)
  - Compilation and monitoring of feedback list by IAEA-NDS
  - Various checking performed at the IAEA-NDS (incident energies, level energies, charge and mass conservation…)
  - Implementation of SG30 methods at NEA DB

- EXFOR review by NRG now goes far beyond the initial SG30 scope
  - Automatic comparison of C4 data with TALYS/TENDL/Libraries
  - In-depth review of suspicious data by checking the publication
  - Quality classification of the data

2. Quality Assignment – Deviation Factor

- Comparison between experimental and evaluated data is done with the three following deviation factors,

$$F = 10^{\sqrt{\frac{1}{N}\sum_i^N \left(\log \frac{\sigma_T^i}{\sigma_E^i}\right)^2}} \quad \chi^2 = \frac{1}{N}\sum_i^N \left(\frac{\sigma_T^i - \sigma_E^i}{\Delta\sigma_E^i}\right)^2 \quad \Delta = \frac{1}{N}\sum_i^N |\sigma_T^i - \sigma_E^i|$$

where T stands for TALYS/Library and E for exp. data (with N points).

- Deviation factors are available per data point, per data set (as above), per reaction, per projectile and for the whole library.

2. Quality Assignment – Example ^{72}Ge(n,p)

^{72}Ge(n,p)^{72}Ga
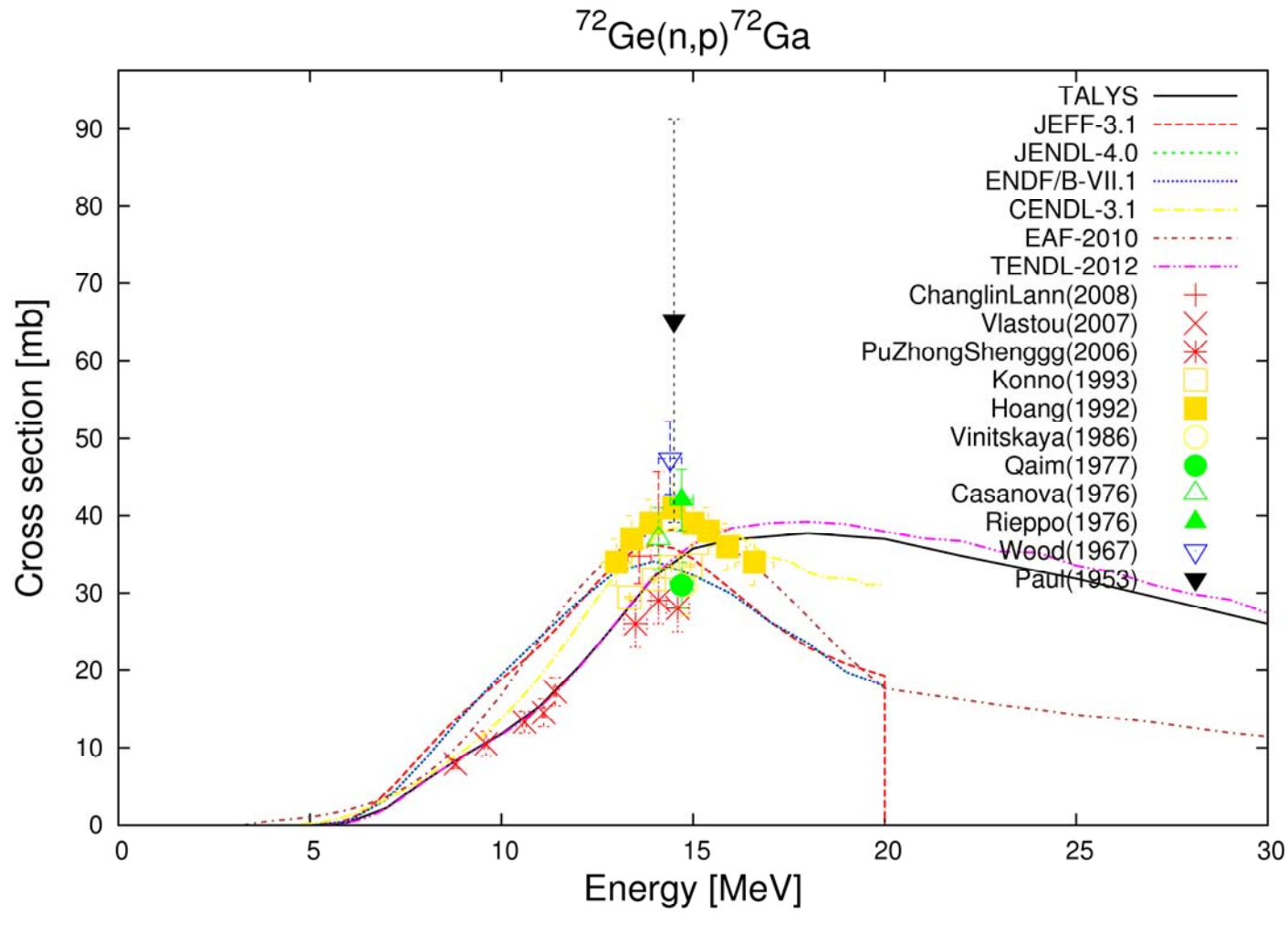
2. Quality Assignment – Example ^{72}Ge(n,p)

Author	F	TALYS	ENDF	JENDL	JEFF	CENDL	EAF	TENDL
Casanova	1.08	1.13	1.09	1.09	1.02	1.01	1.02	1.13
Konno	1.11	1.05	1.08	1.08	1.12	1.16	1.18	1.04
Changlin Lan	1.13	1.20	1.13	1.13	1.08	1.05	1.06	1.20
Hoang	1.15	1.19	1.18	1.18	1.13	1.05	1.03	1.18
Vinitskaya	1.16	1.16	1.05	1.05	1.13	1.24	1.23	1.15
Qaim	1.16	1.14	1.06	1.06	1.14	1.24	1.23	1.14
Rieppo	1.20	1.18	1.28	1.28	1.19	1.09	1.10	1.19
Zhong-Sheng	1.26	1.18	1.22	1.22	1.30	1.34	1.36	1.17
Wood	1.35	1.38	1.42	1.42	1.32	1.24	1.24	1.39
Vlastou	1.44	1.05	1.64	1.64	1.62	1.25	1.51	1.04
Paul	1.85	1.88	1.96	1.96	1.82	1.69	1.71	1.89
Average	1.29	1.21	1.33	1.33	1.31	1.21	1.30	1.21

2. Quality Assignment – Quality Classes

The following quality classes are defined:

• "1" for data deviating in average by less than 20% ($1 \leq F \leq 1.2$);
• "2" for data deviating in average between 20% and 100% ($1.2 < F \leq 2$);
• "3" for data deviating by more than a factor 2 ($F > 2$).

In addition, subentries are sorted in 4 main categories:

• "T" for automated comparison of data with TALYS/Libraries;
• "R" for data reviewed against the original publication;
• "E" for data stored in EXFOR with error;
• "N" for data that could not be cross-checked with the publication.

At present, class 3 data are all reviewed, while class 2 data are reviewed only if Δ is more than 10% of the non-elastic cross-section and $\chi^2 > 20$.

2. Quality Assignment – Example ^{72}Ge(n,p)

The data set measured by Paul was reviewed and flagged as "R2"

Author	F	TALYS	ENDF	JENDL	JEFF	CENDL	EAF	TENDL
Casanova	1.08	1.13	1.09	1.09	1.02	1.01	1.02	1.13
Konno	1.11	1.05	1.08	1.08	1.12	1.16	1.18	1.04
Changlin Lan	1.13	1.20	1.13	1.13	1.08	1.05	1.06	1.20
Hoang	1.15	1.19	1.18	1.18	1.13	1.05	1.03	1.18
Vinitskaya	1.16	1.16	1.05	1.05	1.13	1.24	1.23	1.15
Qaim	1.16	1.14	1.06	1.06	1.14	1.24	1.23	1.14
Rieppo	1.20	1.18	1.28	1.28	1.19	1.09	1.10	1.19
Zhong-Sheng	1.26	1.18	1.22	1.22	1.30	1.34	1.36	1.17
Wood	1.35	1.38	1.42	1.42	1.32	1.24	1.24	1.39
Vlastou	1.44	1.05	1.64	1.64	1.62	1.25	1.51	1.04
Paul	1.85	1.88	1.96	1.96	1.82	1.69	1.71	1.89
Average	1.29	1.21	1.33	1.33	1.31	1.21	1.30	1.21

2. Quality Assignment – In-Depth Review

Review of all 6827 (n,2n), (n,p), (n,α) partial and total cross-sections

Reaction	All	Reaction	Number	Reaction	Number	Reaction	Number
Composite	5791	Total	4493	Elastic	1118	Non-elastic	425
(n,γ)	5699	(n,γ) (tot)	4932	(n,γ)g	287	(n,γ)m	480
(n,f)	1259						
(n,n')	579	(n,n') (tot)	303	(n,n')g	7	(n,n')m	269
(n,n'$_k$)	1162	(n,n'$_1$)	517	(n,n'$_2$)	160	(n,n'$_3$)	64
(n,2n)	2866	(n,2n) (tot)	1677	(n,2n)g	402	(n,2n)m	787
(n,p)	2561	(n,p) (tot)	1878	(n,p)g	219	(n,p)m	464
(n,α)	1400	(n,α) (tot)	1081	(n,α)g	96	(n,α)m	223
part prod	515	(n,xn)	20	(n,xp)	94	(n,xα)	181
Other	665	(n,3n)	127	(n,nα)	83	(n,np)	116
Total	23490						

Table 1: Total number of neutron-induced *cross section* subentries available in XC4 format.

2. Quality Assignment – Results (April 22)

X-Section Score \	(n,2n)	(n,p)	(n,a)
T1	684	320	153
T2	402	452	270
T3	100	95	127
R1	309	265	84
R2	292	454	179
R3	87	162	143
N1	495	277	116
N2	380	386	190
N3	80	120	115
E1	0	0	0
E2	4	5	1
E3	6	11	2

1: $F < 1.2$
2: $1.2 < F < 2$
3: $F > 2$

T: Automated comparison
R: Reviewed paper
N: No PDF for review
E: Error in EXFOR

T3: should be empty
N3: PDF should be
made available

3. Proposal on Quality Scores

Valuable information available from the NRG review of EXFOR:

• Quantitative indication of consistency/deviation from other experimental and evaluated data (T1, T2, T3);

• Identification of errors in EXFOR (E1, E2, E3);

• Quantitative (reviewed) Quality scores (R1, R2, R3).

This work should be:

• Completed, peer-reviewed and released/published

• Preserved in EXFOR Master (and Viktor's System)

$\Rightarrow$ A specific Quality keyword with associated coded information (e.g. R1/R2/R3 or R<F-value>) would be helpful to inform the users and software in the most efficient way.

Thank you for your attention