EXFOR data in resonance region and spectrometer's response function

Consultants' Meeting "EXFOR Data in Resonance Region and Spectrometers' Response Function" was held in Vienna from 8 to 10 October 2013. Seven consultants Y. Danon, K.H. Guber, F. Gunsing, A. Kimura, G. Noguere, P. Schillebeeckx and G. Žerovnik have attended this meeting. The Meeting was organized in accordance with recommendations of the Consultants' Meeting on Further Development of EXFOR held from 6 to 9 March 2012 in Vienna (Summary Report INDC(NDS)-0614) to store sufficient information in EXFOR to allow meaningful re-evaluation of experimental data. In particular the importance of response and resolution functions of time-of-flight measurements for a correct analysis of the data was emphasised.

Information relevant to the discussions, presentations from the participants, meeting report etc. is included in the Meeting's webpage: http://www-nds.iaea.org/index-meeting-crp/CM-RF-2013/.

Compilation of response (resolution) functions R(E,t) is a new issue for NRDC. It is not a trivial issue to include them in the current EXFOR Format, and it would be feasible to start collection of resolution functions submitted by the participants of the Consultant Meeting on http://www-nds.iaea.org/index-meeting-crp/CM-RF-2013/.

However the participants agreed on a template that will include all essential information for neutron TOF measurements in the resonance region. An example of the template is included below:

Template for Submission of Time-of-Flight Spectra (EXFOR)

A. EXPERIMENT DESCRIPTION

1. Main Reference		[1,2]
2. Facility	GELINA	[3]
3. Neutron production		
Neutron production beam	Electron	
Nominal average beam energy	100 MeV	
Nominal average peak current	70 μA	
Repetition rate (pulses per second)	800 Hz	
Pulse width	1 ns	
Primary neutron production target	Mercury cooled depleted uranium	
Target nominal neutron production intensity	3.4 x 10^{13} s^{-1}	
4. Moderator		
Primary neutron source position in moderator	Above and below uranium target	
Moderator material	2 H_2O filled Be-containers around U-target	
Moderator dimensions (internal) (thickness, height×width×depth,…)	2 x (14.6 cm x 21 cm x 3.9 cm)	
Density (moderator material)	1 g/cm^3	
Temperature (K)	Room temperature	
Moderator-room decoupler (Cd, B, …)	None	
5. Other experimental details		
Measurement type	Transmission	
Method (total energy, total absorption, …)	Good transmission geometry	[4]
Flight path length (m) (moderator –detector)	L = 49.3445 m	
Flight path direction	9º with respect to normal of the moderator face viewing the flight path	
Neutron beam dimensions at sample position (mm × mm, diameter in mm, …)	35 mm in diameter	
Neutron beam profile	-	
Overlap suppression (Filter material and thickness, chopper, …)	^{10}B overlap filter (0.008 at/b)	
Other fixed beam filters	Na, Co, Pb (8 mm)	

6. Detector		
Type	Scintillator (NE912)	
Material	Li-glass	
Surface Dimensions (mm × mm. diameter in mm, …)	101.6 mm in diameter	
Thickness (mm)	6.35 mm in thick	
Distance from samples (mm)	125 mm	
Detector(s) position relative to neutron beam	In the beam	
Detector(s) solid angle	-	
7. Sample		
Type (metal, powder, liquid, crystal)	Metal	
Chemical composition	^{197}Au (100%)	
Sample composition (at/b)	^{197}Au: (1:757 ± 0:004) x 10^{-2} at/b	
Temperature	22˚ C	
Sample mass (g)	-	
Geometrical shape (cylinder, sphere, …)	Foil	
Surface dimension (mm × mm, diameter in mm, …)	50 mm x 50 mm	
Nominal thickness (mm)	3 mm	
Containment description	None	
Additional comment	Stack of 2 foils and 1 disc	
8. Data Reduction Procedure		[4, 5]
Dead time correction	Done (< factor 1.2)	
Back ground subtraction	Black resonance technique	
Flux determination (reference reaction, …)	-	
Normalization	1.0000 ± 0.0025	
Detector efficiency	-	
Self-shielding	-	
Time-of-flight binning	Zone length bin width 1024 4 ns 1024 2 ns 4096 1 ns 5120 2 ns 5120 4 ns 5120 8 ns 5120 16 ns 5120 32 ns 5120 64 ns 5120 128 ns	
9. Response function		
Initial pulse	Normal distribution, FWHM = 2 ns	
Target / moderator assembly	Numerical distribution from MC simulations entry RF.NNNN1	[6, 7]
Detector	Analytical function defined in REFIT manual entry RF.NNNN2	[8]

B. DATA FORMAT

Column	Content	Unit	Comment
1	Energy	eV	Relativistic relation using a fixed FP length of 49.345 m and average TOF
2	t_l	ns	
3	t_h	ns	
4	T_{exp}		Transmission
5	Total Uncertainty		
6	Uncorrelated uncertainty		Uncorrelated uncertainty due to counting statistics
7	AGS-vector (K)		Background model (u_K/K = 3%)
8	AGS-vector (N)		Normalization (u_N/N = 0.25%)

References

[1] S. Kopecky, B. Becker, J.C. Drohe, A. Moens, P. Schillebeeckx, D. Vendelbo, R.Wynants, "Results of transmission measurements for ^{197}Au at GELINA", this JRC Scientific and Policy Report, (2013)

[2] I. Sirakov, B. Becker, R. Capote, E. Dupont, S. Kopecky, C. Massimi, P. Schillebeeckx, Eur. Phys. J. A **49**, 144, (2013). DOI: 10.1140/epja/i2013-13144-2
[3] W. Mondelaers, P. Schillebeeckx, Notiziario Neutroni e Luce di Sincrotrone **11** no.2, 19 (2006).
[4] P. Schillebeeckx, B. Becker, Y. Danon, K. Guber, H. Harada, J. Heyse, A.R. Junghans, S. Kopecky, C. Massimi, M. Moxon, N. Otuka, I. Sirakov, K. Volev, Nuclear Data Sheets **113**, 3054 (2012). DOI: 10.1016/j.nds.2012.11.005
[5] B. Becker, C. Bastian, F. Emiliani, F. Gunsing, J. Heyse, K. Kauwenberghs, S. Kopecky, C. Lampoudis, C. Massimi, N. Otuka, P. Schillebeeckx, I. Sirakov, JINST **7**, P11002 (2012). DOI: 10.1088/1748-0221/7/11/P11002
[6] M. Flaska, A. Borella, D. Lathouwers, L.C. Mihailescu, W. Mondelaers, A.J.M. Plompen, H. van Dam, T.H.J.J. van der Hagen, Nucl. Instr. Meth. A **531**, 392–406 (2004). DOI: 10.1016/j.nima.2004.05.087
[7] D. Ene, C. Borcea, S. Kopecky, W. Mondelaers, A. Negret, A.J.M. Plompen, Nucl. Instr. Meth. A **618**, 54 - 68 (2010). DOI: 10.1016/j.nima.2010.03.005
[8] M.C. Moxon, J.B. Brisland, Technical Report AEA-INTEC-0630, AEA Technology (1991).

List of recommendations were given by the participants of the meeting to EXFOR compilers as follows:

Recommendations for NDS of IAEA, NRDC and EXFOR compilers

• Set up and maintain a repository where information can be collected on response functions of different facilities.
• No constraints on the format should be given, but an implementation in existing codes could be supplied when possible.
• The repository should foresee support for 2 dimensional histograms to report numerical response functions $R(E_n,t)$ as a function of time-of-flight and real neutron energy.
• NDS should inform the NRDC Network about decisions of the meeting in order to establish rules for compilation of all information relevant to the spectrometers' response function.
• Compilers should send a request to authors to provide information according to the template and include all data in the compilation of the experiment.