JRC
EUROPEAN COMMISSION

European Commission

Reporting of experimental data in the resonance region

EC – JRC – IRMM

SG – 36, 23 – 05 -2012, WPEC, NEA Paris

Reporting of experimental data

Requirements:

- **Experimental observables and relations to model parameters are defined ⇒ reporting of experimental conditions**
- **All uncertainty components (uncorrelated & correlated) are identified & quantified**
- **All uncertainty components are documented and reported**

⇒ Proposal NDS-IAEA / IRMM based on AGS

Data reduction process

Reaction yield + Self-indication

$$Y_{exp} = N \frac{\sigma_\varphi}{\varepsilon_r} \frac{C'_w - B'_w}{C'_\varphi - B'_\varphi}$$

C’ dead time corrected counts
B’ background contribution
N normalization factor

Transmission

$$T_{exp} = N \frac{C'_{in} - B'_{in}}{C'_{out} - B'_{out}}$$

Histogram operations + Covariance information

Y_{exp} + covariance
$Y_{SI,exp}$ + covariance
T_{exp} + covariance

input

Models

Data reduction : AGS concept

Analysis of Geel Spectra (AGS)

- Transform count rate spectra into observables (transmission, yield)
- Full uncertainty propagation starting from counting statistics
- Output: complete covariance information
- Special format for covariance information
  - Reduce space for data storage (EXFOR)
  - Document and report all sources of uncertainties due to each step in the data reduction process
  - Covariance matrix always well defined (positive definite)

Uncertainty propagation in AGS

Conditions :

(1) Data reduction starts from spectra subject only to uncorrelated uncertainties

(2) Additional computations using parameters with well defined covariance matrix

(3) Channel – channel operations (+, - , x , ÷) and log, exp, …

$$Z = F(\vec{a}, Y) \quad \text{e.g.} \quad Z(t) = Y(t) - (a_1 + a_2 t^{a_3})$$

Covariance matrix V_a well defined

$\Rightarrow$ symmetric and positive definite

$\Rightarrow$ Cholesky transformation

$$V_{\vec{a}} = L_{\vec{a}} \, L_{\vec{a}}^{T}$$

L_a : lower triangular matrix

V_Y only diagonal terms :

$\Rightarrow D_Y = V_Y \qquad v_{Y,i \neq j} = 0$

$$V_Z = U_Z + S_{\vec{a}} \, S_{\vec{a}}^{T}$$

diagonal : n values

dimension: n x k

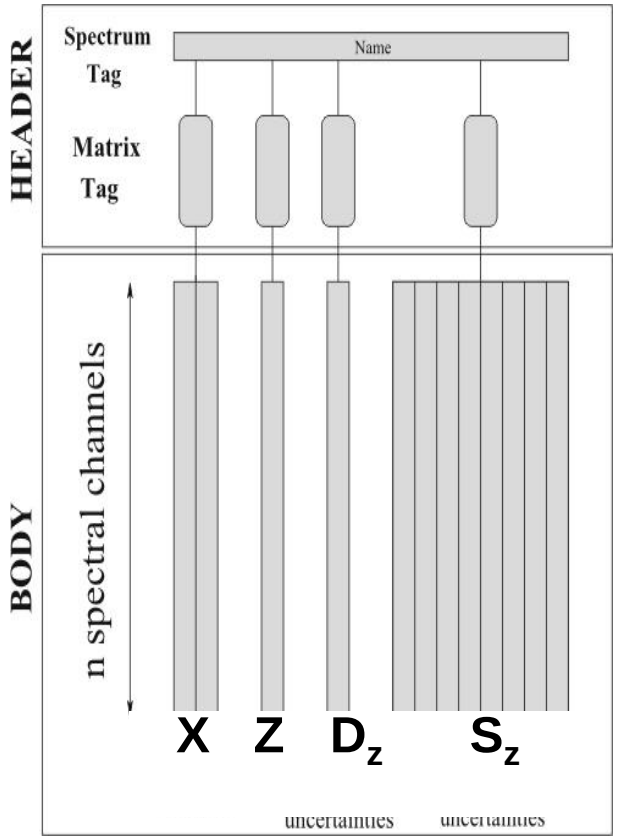
Data reduction : AGS concept

Observable Z (dimension n) with
k sources of correlated uncertainties

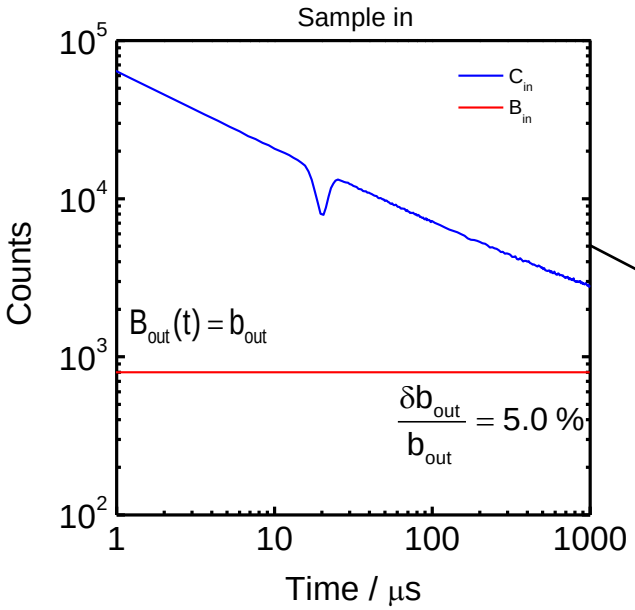
$$V_z = D_z + S_z S_z^T$$

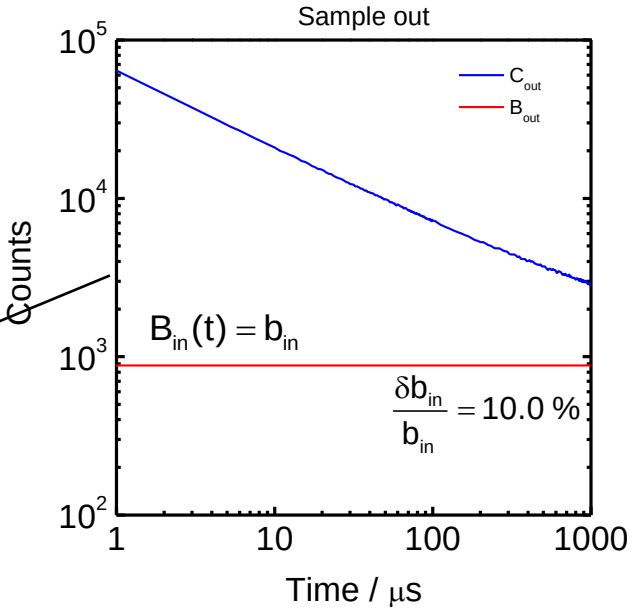
D_Z : uncorrelated part
n values

S_Z : correlated part
dim. (n x k)

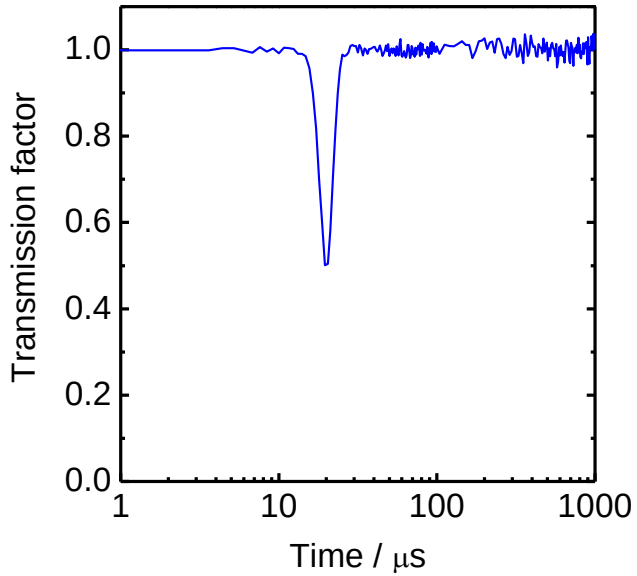


Data reduction of transmission : T_{exp}



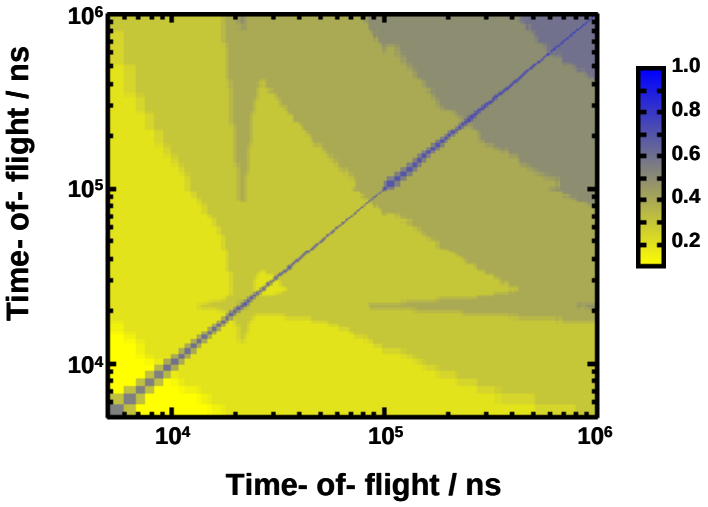


$$T_{exp} = N \frac{C_{in} - B_{in}}{C_{out} - B_{out}}$$



Output AGS_PUTX

$\delta B_{in} / B_{in}$: 10.0 %
$\delta B_{out} / B_{out}$: 5.0 %
$\delta K / K$: 0.5 %



X_L	X_H	Z	δZ	δZ_u	$C_Z = D_Z + S\,S^T$			
					D_Z	S		
					δZ_u^2	B_{in}	B_{out}	N
800	1600	0.999	0.79E-2	0.59E-2	0.35E-4	0.14E-2	-0.08E-2	0.50E-2
1600	2400	0.999	0.86E-2	0.67E-2	0.45E-4	0.18E-2	-0.10E-2	0.50E-2
2400	3200	0.999	0.92E-2	0.73E-2	0.54E-4	0.21E-2	-0.12E-2	0.50E-2
3200	4000	0.999	0.97E-2	0.78E-2	0.61E-4	0.24E-2	-0.13E-2	0.50E-2
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.	.	.	.	.	.	.	.	.
16000	16800	0.899	1.30E-2	1.07E-2	1.15E-4	0.51E-2	-0.25E-2	0.45E-2
16800	17600	0.818	1.24E-2	1.02E-2	1.04E-4	0.53E-2	-0.24E-2	0.41E-2
17600	18400	0.701	1.15E-2	0.93E-2	0.86E-4	0.54E-2	-0.21E-2	0.35E-2
18400	19200	0.594	1.06E-2	0.84E-2	0.71E-4	0.55E-2	-0.18E-2	0.30E-2
19200	20000	0.501	0.98E-2	0.76E-2	0.57E-4	0.56E-2	-0.15E-2	0.25E-2
20000	20800	0.504	1.00E-2	0.77E-2	0.59E-4	0.57E-2	-0.16E-2	0.25E-2
20800	21600	0.581	1.09E-2	0.85E-2	0.73E-4	0.58E-2	-0.19E-2	0.29E-2
21600	22400	0.707	1.22E-2	0.98E-2	0.97E-4	0.60E-2	-0.23E-2	0.35E-2
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964000	972000	0.999	5.91E-2	3.75E-2	14.06E-4	3.98E-2	-2.18E-2	0.50E-2
972000	980000	1.037	6.09E-2	3.89E-2	15.13E-4	4.04E-2	-2.31E-2	0.52E-2
980000	988000	1.001	6.01E-2	3.80E-2	14.46E-4	4.05E-2	-2.23E-2	0.50E-2
988000	996000	1.010	5.92E-2	3.77E-2	14.23E-4	3.96E-2	-2.20E-2	0.50E-2

Reporting of results + experimental conditions

- **Facility**
- **Neutron production**
- **Experimental details**
- **Sample**
- **Flux** *(reaction cross section data)*
- **Normalization (TOF-independent)**
- **Data**
- **Uncertainties (AGS-concept)**

Facility + Neutron production

- **Facility + Reference (GELINA/nTOF/ORELA/POHANG/KAERI/RPI)**

- **Neutron production**

• Primary beam	Electron
• Time resolution primary beam (ns)	1 ns
• Frequency	800 Hz
• Overlap filter	0.002 at/b ^{10}B
• Primary neutron production target	Uranium
• Moderator material	H_2O
• Moderator surface dimensions	2 containers 100 x 100 mm
• Moderator thickness	40 mm
• Response functions	Ref. 4

Experimental details

Measurement type	**transmission**
Method	**sample in / sample out**
Flight path length (moderator – target detector: face to face)	**9.340 +/- 0.006 m**
Angle (moderator – target detector: face to face)	**18^{o}**
Beam dimensions on sample (mm x mm or diameter)	**25 mm diameter**
Detector	
• **Type**	**Li-glass scintillator**
• **Material**	**NE905**
• **Dimensions**	**120 mm diameter & 12.7 mm thick**
• **Geomtery**	**in neutron beam**

Sample details

Type (metal, powder, preparation)	metal disc
Composition	100 % ^{nat}Cd
Weight	1.2814 +/- 0.0001 g
Area	+/- mm^2
Area density	0.02547 g/cm^2
Number area density of main component	1.3643 10^{-4} at/b ^{nat}Cd
Geometry	
• Surface dimensions	(80.004 +/- 0.03) mm diameter
• Thickness	0.03 mm
Backing	none
Containment	none
Temperature	120 mm diameter & 12.7 mm

Reporting results

- **Normalization**
  - method — beam monitors
  - uncertainty — 0.5 %
- **Background**
  - method — saturated resonance
  - Fixed filters — S
- **Data**
  - Energy (L = m) — column 1
  - TOF (low) — column 2
  - TOF (high) — column 3
  - Transmission (yield) — column 4
  - Correction — -
- **Uncertainty components (AGS concept)**
  - Total — column 5
  - Uncorrelated uncertainty — column 6
  - Correlated components
    - Dead time sample in — column 7
    - Background sample in — column 8
    - Dead time sample out — column 9
    - Background sample out — column 10