

# EXFOR News (August 2011)

## New experimental data available from Nuclear Reaction Data Centres

EXFOR is a world-wide data library for experimental neutron induced, charged-particle induced and photonuclear reaction data compiled by the [International Network of the Nuclear Reaction Data Centres \(NRDC\)](#)<sup>a</sup> coordinated by the [IAEA Nuclear Data Section](#). Regularly updated retrieval database is available at [NNDC](#), [NEADB](#), [IAEA-NDS](#), [JAEA](#), [JCPRG](#) and [CDFE](#).

### Quantity codes

ALF	$\alpha$ -value ( $\sigma_{\text{capt}}/\sigma_{\text{fis}}$ )	FY	Fission product yield
AMP	Length or amplitude	INT	Cross section integral over incident energy
CHG	Fragment charge	KE	Kinetic energy
CS	Cross section	KER	Kerma factor
CSN	Differential with respect to number of particles	MLT	Multiplicity
CSP	Partial cross section	NQ	Nuclear quantity
CST	Temperature dependent cross section	NU	Fission neutron multiplicity $\bar{\nu}$
D3A	Triple differential $d\Omega_1/d\Omega_2/dE'$	NUD	Delayed fission neutron multiplicity $\bar{\nu}_d$
D3E	Triple differential $d\Omega/dE'_1/dE'_2$	NUF	Fragment neutrons
D4A	Quadruple diff. $d\Omega_1/d\Omega_2/dE'_1/dE'_2$	POL	Polarization
DA	Differential $d/d\Omega$	POD	Differential polarization
DAA	Double differential $d\Omega_1/d\Omega_2$	PY	Product yield (other than fission)
DAE	Double differential $d\Omega/dE'$	RI	Resonance integral
DAP	Partial differential $d/d\Omega$	RP	Resonance parameter
DAT	Temperature-dependent Legendre coefficient	RR	Reaction rate
DE	Differential $d/dE'$	SIF	Self indication
DEP	Energy spectrum for specific group	SPC	Gamma spectrum
DP	Diff. by linear momentum of outgoing part.	TSL	Thermal scattering
DT	Diff. by 4-momentum transfer squared	TT	Thick target yield
ETA	$\eta$ -value $\bar{\nu}\sigma_{\text{fis}}/(\sigma_{\text{capt}} + \sigma_{\text{fis}})$	TTD	Differential thick target yield, $d/d\Omega$
EVL	Evaluation	TTP	Partial thick target yield

### Special codes in outgoing particle field

abs	Absorption	fus	Fusion	sct	Scattering	tot	Total
el	Elastic	inel	Inelastic	tcx	Total charge changing		
fis	Fission	non	Nonelastic	ths	Thermal scattering		

### Special codes in incident energy field

Fast	Fast reactor spectrum average	Maxw	Maxwellian spectrum average
Fiss	Fission spectrum average	Spont	Spontaneous (for fission)

<sup>a</sup> [NNDC](#) (USA), [NEADB](#) (France), [NDS](#) (Austria), [CJD](#) (Russia), [CNDC](#) (China), [ATOMKI](#) (Hungary), [BARC](#) (India), [JAEA](#) (Japan), [JCPRG](#) (Japan), [KAERI](#) (Korea), [CAJaD](#) (Russia), [CDFE](#) (Russia), [CNPD](#) (Russia), [UkrNDC](#) (Ukraine)

1 Hydrogen 1										
Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<sup>34</sup> Ar,d	<sup>33</sup> Ar	DA	1USAMSU	3.3+07	3.3+07	Jour	<a href="#">PR/C,83,014606</a>	11	Jennylee+	<a href="#">C1823</a>
<sup>34</sup> Ar,d	<sup>33</sup> Ar	DAP	1USAMSU	3.3+07	3.3+07	Jour	<a href="#">PR/C,83,014606</a>	11	Jennylee+	<a href="#">C1823</a>
<sup>36</sup> Ar,d	<sup>35</sup> Ar	DA	1USAMSU	3.3+07	3.3+07	Jour	<a href="#">PR/C,83,014606</a>	11	Jennylee+	<a href="#">C1823</a>
<sup>36</sup> Ar,d	<sup>35</sup> Ar	DAP	1USAMSU	3.3+07	3.3+07	Jour	<a href="#">PR/C,83,014606</a>	11	Jennylee+	<a href="#">C1823</a>
<sup>46</sup> Ar,d	<sup>45</sup> Ar	DAP	1USAMSU	3.3+07	3.3+07	Jour	<a href="#">PR/C,83,014606</a>	11	Jennylee+	<a href="#">C1823</a>

2 Helium 3										
Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>p,el</i>	<sup>3</sup> He	POD	1USATNL	2.3+06	5.5+06	Jour	<a href="#">PR/C,82,034002</a>	10	T.V.Daniels+	<a href="#">C1818</a>

3 Lithium 7										
Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,n+α</i>	<sup>4</sup> He	POD	2ITYCAT	1.0+06	1.0+06	Jour	<a href="#">NC/A,22,313</a>	74	V.D'Amico+	<a href="#">F0253</a>

5 Boron 10										
Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,n</i>	<sup>11</sup> C	DAP	2UK CAV	9.0+05	4.0+06	Jour	<a href="#">NP,25,282</a>	61	A.N.James+	<a href="#">F1106</a>

5 Boron 11										
Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>p,el</i>		RP	2FR STR	3.1+06	4.1+06	Jour	<a href="#">JPR,38,17</a>	77	Y.Rihet+	<a href="#">F1095</a>
<i>p,el</i>	<sup>11</sup> B	DA	2FR STR	3.0+06	5.0+06	Jour	<a href="#">JPR,38,17</a>	77	Y.Rihet+	<a href="#">F1095</a>
<i>p,el</i>	<sup>11</sup> B	DAP	2FR STR	3.4+06	3.4+06	Jour	<a href="#">JPR,38,17</a>	77	Y.Rihet+	<a href="#">F1095</a>

6 Carbon 12										
Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,el</i>	<sup>12</sup> C	DA	2UK MAN	4.5+06	5.6+06	Jour	<a href="#">NP/A,109,288</a>	68	R.L.A.Cottrell+	<a href="#">F1077</a>
<i>d,p</i>	<sup>13</sup> C	DAP	2UK CAV	1.7+06	1.7+06	Jour	<a href="#">NP,69,481</a>	65	J.H.Williamson	<a href="#">F1074</a>
<i>d,p</i>	<sup>13</sup> C	DAP	2UK MAN	4.7+06	4.7+06	Jour	<a href="#">NP/A,109,288</a>	68	R.L.A.Cottrell+	<a href="#">F1077</a>

<sup>3</sup>He,el <sup>12</sup>C DA 2UK MAN 2.0+06 6.2+06 Jour NP,80,565 66 J.P.Schapira+ F1092

6 Carbon 13

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,α</i>	<sup>11</sup> B	DAP	2UK MAN	3.9+06	4.7+06	Jour	NP/A,109,288	68	R.L.A.Cottrell+	F1077
<i>d,el</i>	<sup>13</sup> C	DA	2UK MAN	4.5+06	5.7+06	Jour	NP/A,109,288	68	R.L.A.Cottrell+	F1077
<i>d,p</i>	<sup>14</sup> C	DAP	2UK MAN	3.9+06	5.6+06	Jour	NP/A,109,288	68	R.L.A.Cottrell+	F1077

7 Nitrogen 15

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>p,γ</i>	<sup>16</sup> O	CS	1USANOT	3.4+05	1.0+06	Jour	PR/C,82,055804	10	P.J.Leblanc+	C1825
<i>p,γ</i>	<sup>16</sup> O	CSP	1USANOT	1.2+05	1.7+06	Jour	PR/C,82,055804	10	P.J.Leblanc+	C1825
<i>p,γ</i>	<sup>16</sup> O	RR	1USANOT	Maxwl		Jour	PR/C,82,055804	10	P.J.Leblanc+	C1825

8 Oxygen 16

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,α</i>	<sup>14</sup> N	CSP	3BZLUSP	2.0+06	3.6+06	Jour	NP/A,114,330	68	D.Dietzsch+	F1099
<i>d,α</i>	<sup>14</sup> N	DAP	3BZLUSP	2.0+06	3.6+06	Jour	NP/A,114,330	68	D.Dietzsch+	F1099
<i>d,el</i>	<sup>16</sup> O	DA	3BZLUSP	1.9+06	3.6+06	Jour	NP/A,114,330	68	D.Dietzsch+	F1099
<i>d,el</i>	<sup>16</sup> O	DA	3ARGCNE	2.6+07	2.6+07	Jour	NP,36,615	62	S.Mayo+	F1101
<i>d,n</i>	<sup>17</sup> F	CSP	3BZLUSP	2.2+06	3.3+06	Jour	NP/A,114,330	68	D.Dietzsch+	F1099
<i>d,n</i>	<sup>17</sup> F	DAP	3BZLUSP	2.1+06	3.3+06	Jour	NP/A,114,330	68	D.Dietzsch+	F1099
<i>d,p</i>	<sup>17</sup> O	CSP	3BZLUSP	2.0+06	3.6+06	Jour	NP/A,114,330	68	D.Dietzsch+	F1099
<i>d,p</i>	<sup>17</sup> O	DAP	3BZLUSP	1.9+06	3.6+06	Jour	NP/A,114,330	68	D.Dietzsch+	F1099
<i>d,p</i>	<sup>17</sup> O	DAP	3ARGCNE	2.6+07	2.6+07	Jour	NP,36,615	62	S.Mayo+	F1101
<i>α,0</i>		RP	1USANOT			Jour	PR/C,82,035802	10	H.Costantini+	C1819
<i>α,el</i>	<sup>16</sup> O	DA	1USANOT	2.2+06	3.4+06	Jour	PR/C,82,035802	10	H.Costantini+	C1819
<i>α,γ</i>	<sup>20</sup> Ne	MLT	1USANOT	2.4+06	2.6+06	Jour	PR/C,82,035802	10	H.Costantini+	C1819
<i>α,γ</i>	<sup>20</sup> Ne	RR	1USANOT	Maxwl		Jour	PR/C,82,035802	10	H.Costantini+	C1819
<i>α,γ</i>	<sup>20</sup> Ne	?	1USANOT	1.1+06	3.4+06	Jour	PR/C,82,035802	10	H.Costantini+	C1819

13 Aluminium 27

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,α</i>	<sup>25</sup> Mg	DAP	2UK CAV	1.2+06	2.0+06	Jour	NP,69,481	65	J.H.Williamson	F1074
<i>d,el</i>	<sup>27</sup> Al	DA	3POLITJ	1.3+07	1.3+07	Jour	NP,55,386	64	H.Niewodniczanski+	F1102
<i>d,inel</i>	<sup>27</sup> Al	DAP	3POLITJ	1.3+07	1.3+07	Jour	NP,55,386	64	H.Niewodniczanski+	F1102

**14 Silicon 28**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>p,el</i>	<sup>28</sup> Si	DA	2UK ALD	1.1+07	1.2+07	Jour	<a href="#">NP,24,529</a>	61	A.V.Cohen+	<a href="#">F1105</a>
<i>p,inel</i>		RP	2UK ALD	1.0+07	1.2+07	Jour	<a href="#">NP,24,529</a>	61	A.V.Cohen+	<a href="#">F1105</a>
<i>p,inel</i>	<sup>28</sup> Si	DAP	2UK ALD	1.0+07	1.2+07	Jour	<a href="#">NP,24,529</a>	61	A.V.Cohen+	<a href="#">F1105</a>
<i>d,el</i>	<sup>28</sup> Si	DA	3POLITJ	1.3+07	1.3+07	Jour	<a href="#">NP,55,386</a>	64	H.Niewodniczanski+	<a href="#">F1102</a>
<i>d,inel</i>	<sup>28</sup> Si	DAP	3POLITJ	1.3+07	1.3+07	Jour	<a href="#">NP,55,386</a>	64	H.Niewodniczanski+	<a href="#">F1102</a>

**17 Chlorine 37**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>p,α</i>	<sup>34</sup> S	DAP	2NEDUTR	1.1+06	1.7+06	Jour	<a href="#">NP/A,110,233</a>	68	B.Bosnjakovic+	<a href="#">F1098</a>
<i>p,el</i>	<sup>37</sup> Cl	DA	2NEDUTR	1.1+06	1.7+06	Jour	<a href="#">NP/A,110,233</a>	68	B.Bosnjakovic+	<a href="#">F1098</a>
<i>p,γ</i>	<sup>38</sup> Ar	DA	2NEDUTR	1.7+06	1.7+06	Jour	<a href="#">NP/A,110,233</a>	68	B.Bosnjakovic+	<a href="#">F1098</a>

**19 Potassium 39**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,α</i>	<sup>37</sup> Ar	DAP	3SAFSUN	4.5+06	5.3+06	Jour	<a href="#">NP/A,114,551</a>	68	W.J.Naude+	<a href="#">F1109</a>

**20 Calcium 40**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,el</i>	<sup>40</sup> Ca	DA	2UK ALD	3.0+06	1.2+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>41</sup> Ca	DAP	2UK ALD	1.0+07	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>41</sup> Ca	DAP	3HUNKFI	1.8+06	2.0+06	Jour	<a href="#">NP,73,155</a>	65	I.Fodor+	<a href="#">F1093</a>

**20 Calcium 42**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,el</i>	<sup>42</sup> Ca	DA	2UK ALD	1.0+07	1.2+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>43</sup> Ca	DAP	2UK ALD	1.0+07	1.2+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>

**20 Calcium 44**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>p,el</i>	<sup>44</sup> Ca	DA	2DENNBI	1.6+06	1.7+06	Jour	<a href="#">NP/A,118,641</a>	68	C.Gaarde+	<a href="#">F1097</a>
<i>d,el</i>	<sup>44</sup> Ca	DA	2UK ALD	1.0+07	1.2+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>45</sup> Ca	DAP	2UK ALD	1.0+07	1.2+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>

**20                      Calcium                      48**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,el</i>	<sup>48</sup> Ca	DA	2UK ALD	3.0+06	1.2+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>49</sup> Ca	DAP	2UK ALD	1.0+07	1.2+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>

**22                      Titanium                      50**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>p,el</i>	<sup>50</sup> Ti	DA	2DENNBI	2.5+06	2.6+06	Jour	<a href="#">NP/A,118,641</a>	68	C.Gaarde+	<a href="#">F1097</a>

**24                      Chromium                      50**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,el</i>	<sup>50</sup> Cr	DA	2UK ALD	3.0+06	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>51</sup> Cr	DAP	2UK ALD	1.0+07	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>

**24                      Chromium                      52**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,el</i>	<sup>52</sup> Cr	DA	2UK ALD	1.0+07	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>53</sup> Cr	DAP	2UK ALD	1.0+07	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>

**24                      Chromium                      53**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,el</i>	<sup>53</sup> Cr	DA	2UK ALD	1.0+07	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>54</sup> Cr	DAP	2UK ALD	1.0+07	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>

**24                      Chromium                      54**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>d,el</i>	<sup>54</sup> Cr	DA	2UK ALD	3.0+06	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>
<i>d,p</i>	<sup>55</sup> Cr	DAP	2UK ALD	1.0+07	1.0+07	Jour	<a href="#">NP/A,153,145</a>	70	G.Brown+	<a href="#">F0910</a>





**94                      Plutonium                      241**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>n</i> ,fis		CS	3PAKNIL	1.5+07	1.5+07	Jour	NSE,94,42	86	K.Gul+	<a href="#">31711</a>

**94                      Plutonium                      242**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>n</i> ,fis		CS	3PAKNIL	1.5+07	1.5+07	Jour	NSE,94,42	86	K.Gul+	<a href="#">31711</a>
<sup>48</sup> Ca,4 <i>n</i>	<sup>286</sup> *	CS	1USABRK	2.6+08	2.6+08	Jour	<a href="#">PRL,105,182701</a>	10	P.A.Ellison+	<a href="#">C1822</a>
<sup>48</sup> Ca,5 <i>n</i>	<sup>285</sup> *	CS	1USABRK	2.6+08	2.6+08	Jour	<a href="#">PRL,105,182701</a>	10	P.A.Ellison+	<a href="#">C1822</a>

**94                      Plutonium                      244**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>n</i> ,fis		CS	3PAKNIL	1.5+07	1.5+07	Jour	NSE,94,42	86	K.Gul+	<a href="#">31711</a>

**95                      Americium                      241**

Reaction	Product	Quant.	Lab.	Energy (eV)		Type	Documentation Ref Vol Page	Date	Author	Data #
				Min	Max					
<i>n</i> ,fis		CS	3PAKNIL	1.5+07	1.5+07	Jour	NSE,94,42	86	K.Gul+	<a href="#">31711</a>