Review of Gamma Spectra Compiled in EXFOR

(N. Otsuka, 2012-04-13, CP-D/739 with a minor addition)

Addition to the working paper:
In this paper, "gamma spectra" means gamma multiplicities (not normalized to cross section units, e.g., barn) defined with a secondary energy.

There has been an action to me since the NRDC 2007 Meeting,

> "Review the various types of gamma spectra in EXFOR, as well as the related quantities and units".

Various REACTION codes for gamma spectra allowed in the current rule are summarized at the end of this memo. I found that discrete gamma spectra given in [gammas/capture], [gammas/incident particle] etc. have been compiled with SF6=SPC or SF5-6=PAR,XX (XX=MLT when G is in SF3 or SF7, and XX=PY when 0-G-0 in SF4).

LEXFOR "Gamma Spectra" explains that the γ-ray energies are discrete and coded under the heading E when SPC is in SF6. This implies SF6=SPC is not applied when the multiplicity is for continuous spectra integrated over a range of radiation energy (e.g., from E-MIN to E-MAX). To verify this assumption, I checked the correlation between quantity codes and data headings.

	E	**E*MIN* E*MAX***	**Other**
SF6=SPC	369	28	37
SF5-6=PAR,XX	8	19	1

(E*MIN* match with E-MIN, E-CM-MIN etc.)

I propose to use SPC for discrete gamma line(s) as explained in LEXFOR, while use PAR,MLT or PAR,PY for continues gammas. Many existing data sets can live with this solution.

One may worry about discrete gamma multiplicities in fission, because fission yields (multiplicities) are coded with SF6 = FY except for fission neutron multiplicities NU. There are however only 6 entries (9 data sets) coded with heading E + SF6=SPC, and they are given in [gammas/incident particle] or in arbitrary unit. This means there is no discrete gamma multiplicity given in [gammas/fission] in EXFOR, and hence we can apply SF6=SPA codes even if they ask a unit code belonging to the unit family YLD (e.g., [gammas/incident particle]).

Table: Various discrete and continuous gamma spectra can be compiled in EXFOR
(Italicized example is allowed within the rule, but no real data set in the current database)

Type of spectra	**SF5-SF6**	**Dim.**	**Example of REACTION code**	**Example of unit code**
discrete or group γ in SF3 or 7	PAR,MLT	YLD	(40-ZR-91(N,G)40-ZR-92,PAR,MLT)	PRT/REAC (i.e., gamma/capture)
	,SPC	YLD	(40-ZR-91(N,G)40-ZR-92,,SPC)	PRT/REAC (i.e., gamma/capture)
discrete or group γ in SF4	*PAR,PY*	*YLD*	*(66-DY-164(N,X)0-G-0,PAR,PY)*	*PRT/INC (i.e., gamma/inc. neutron)*
	,SPC	YLD	(66-DY-164(N,X)0-G-0,,SPC)	PRT/INC (i.e., gamma/inc. neutron)
discrete or group γ not in any SF	,SPC	YLD	(46-PD-105(N,INL)46-PD-105,,SPC)	PRT/INC (i.e., gamma/inc. neutron)
discrete or group γ per fission	PAR,FY	FY	(92-U-235(N,F)0-G-0,PR/PAR,FY)	PRD/FIS (i.e., gamma/fission)
	PR,SPC	SPC	(92-U-235(N,F),PR,SPC)	? (no unit code belonging to the dimension SPC)
continuous γ in SF3 or 7	,MLT/DE	1/E	(34-SE-77(N,G)34-SE-78,,MLT/DE)	PT/RCT/MEV (i.e., gamma/capture/MeV)
continuous γ in SF4 or 7	*,PY/DE*	*1/E*	*(66-DY-164(N,X)0-G-0,,PY/DE)*	PD/RCT/MEV (i.e., gamma/capture/MeV)
continuous γ per fission	,FY/DE	FYDE	(92-U-235(N,F)0-G-0,PR,FY/DE)	PD/FIS/MEV (i.e., gamma/fission/MeV)