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To: Distribution
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Subject: **Total cross section in photo-nuclear reaction data**

Cross sections compiled in entry M0041 give the sum of both nuclear and atomic contribution measured by the transmission technique. The first equation of the M0041 article [1] defines their "absolute cross section" as

$$\sigma = \sigma_{\mathrm{nucl}} + \sigma_{\mathrm{at}} = \frac{1}{A}\log\frac{N_0(E)}{N(E)}$$

, where σ_{nucl} is the nuclear "absorption" cross section, σ_{at} is the cross sections of pure electromagnetic processes (photoelectric effect, Compton effect, pair production in the Coulomb field of the nucleus and electron fields), and $N_0(E)$ and $N(E)$ are the numbers of photons in a given incident photon energy bin E with and without the absorber in the photon beam.

Though atomic physicists often refers the cross section to "*absorption* cross section", "*total absorption* cross section" or "attenuation cross section", this is close to our definition of "*total* cross section" in EXFOR. We propose to use SF3=TOT in M0044.

We also propose to exclude the atomic part from total cross sections in EXFOR. That is, atomic scattering like Rayleigh scattering and Compton scattering is excluded from the total cross section, while nuclear resonance scattering (fluorescence) is included in the total cross sections in EXFOR. We may keep total cross sections including atomic interaction with SF9=MSC. Because data sets in M0041 contain atomic interaction contribution, SF9=MSC is proposed in M0044.

"Tables of X-Ray Mass Attenuation Coefficients and Mass Energy-Absorption Coefficients" provided by NIST (http://www.nist.gov/physlab/data/xraycoef/) is an example of atomic interaction database which is used by nuclear reaction experimentalists to subtract the atomic part from their measured cross section.

Springer Handbook [2] classifies the photon-atom interactions from 1 keV to 1 MeV as follows:

Elastic process:
Rayleigh scattering, nuclear Thomson scattering, Delbrück scattering, nuclear resonance scattering

Inelastic process:
Photo-excitation (incl. ionization), Compton scattering, pair production

Note that the latter is corresponding to "*Non*elastic" in the EXFOR terminology.

The following addition is also proposed for LEXFOR "Total" and "Absorption":

LEXFOR "Total"
Total cross section
Definition: the sum of all energetically possible interactions.
Note: Photo-atomic interaction contribution (e.g. Rayleigh scattering, Compton scattering, photo-ionization) is excluded from processes considered in photo-nuclear reaction data. (γ,tot) = (γ,n) + (γ,p) + (γ,2n) + … + (γ,f) + nuclear scattering

LEXFOR "Absorption"
***Examples of cases which are not coded under absorption*:**
…
c.) The "photoabsorption cross section" below the nucleon emission threshold must be coded as (γ,sct), (γ,el) or (γ,inl), since only scattering is possible under the threshold. (γ,abs) = (γ,n) + (γ,p) + (γ,2n) + … + (γ,f)

References:
[1] G. M. Gurevich *et al*., Nucl. Phys. **A338**(1980)97.
[2] B. Crasemann, Springer Handobook of Atomic, Molecular, and Optical Physics, p.915.

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