

The Proton Activation Data File PADF-2007

A.Yu. Konobeyev, C.H.M. Broeders, U. Fischer, L. Mercatali, I. Schmuck and S.P. Simakov
Institute for Reactor Safety, FZK, Postfach 3640, 76021 Karlsruhe, Germany

Introduction

To satisfy the growing needs in nuclear data at intermediate energies the Proton Activation Data File has been developed.

Preparatory work to define nuclear models providing the best agreement with experimental nuclide yields:

- > 17,000 individual measurements of radionuclide yields in neutron induced reactions for target nuclei from Al to Bi at energies above 0.1 MeV
- ~ 19,000 experimental points for proton induced reactions for targets from Mg to Bi at incident energies up to 150 MeV

TALYS:

- Fermi gas with $\alpha(U)$ [Ignatyuk, Smirenkin, Tishin] combined with constant temperature model,
- Goriely et al approach

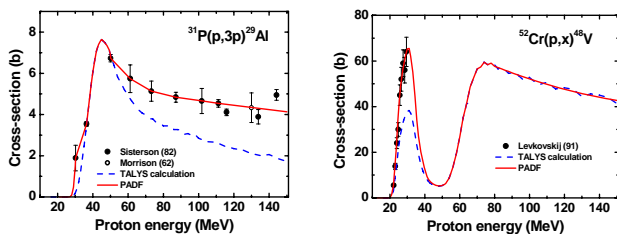
ALICE/ASH:

- Fermi gas model
- Generalized superfluid model [Ignatyuk]

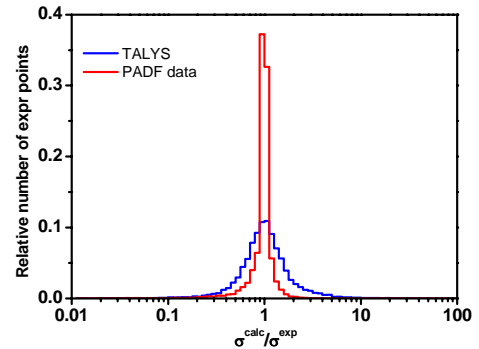
Calculations:

TALYS: $\alpha(U)$, ALICE/ASH: GSM

Corrections using experimental data



Examples of the correction



Content of PADF

PADF contains calculated and evaluated excitation functions for

- 418,575 proton induced reactions (p,x)
- 2355 stable and unstable target nuclei ($T_{1/2} \geq 1$ sec) from Mg to Ra
- proton incident energies up to 150 MeV

Origin of cross-sections included in PADF

- TALYS code calculations for targets with $T_{1/2} \geq 10$ min corrected if experimental data are available
- ALICE/ASH code calculations for nuclei with $T_{1/2} < 10$ min,
- EXFOR

Data format

Pointwise data format: ENDF/B-6, MF/MT=3/5, 6/5.

Groupwise data format: 256 group data files generated using the NJOY code:

- 175 group structure of VITAMIN-J at $E_p \leq 20$ MeV,
- energy bin of 1 MeV at E_p from 20 to 50 MeV,
- energy bin 2 MeV for energies from 50 to 150 MeV.

Values of deviation factors obtained using (p,x) reaction cross-sections calculated with the help of various codes and taken from various data libraries for target nuclei with the atomic number from 12 to 83 at the incident proton energy from 0 to 150 MeV. Number of experimental points is equal to 4125.

Deviation factor	TALYS-072	ALICE/ASH	Bertini/MPM/Dresner	ENDF/B-VI (8)	ENDF/B-VII	JENDL-HE	PADF
$H = \left(\frac{1}{N} \sum_{i=1}^N \left(\frac{\sigma_i^{\text{exp}} - \sigma_i^{\text{calc}}}{\Delta \sigma_i^{\text{exp}}} \right)^2 \right)^{1/2}$	9.09	16.3	22.8	9.59	8.14	9.43	4.58
$D = \frac{1}{N} \sum_{i=1}^N \left \frac{\sigma_i^{\text{exp}} - \sigma_i^{\text{calc}}}{\sigma_i^{\text{exp}}} \right $	0.406	0.643	0.621	0.450	0.360	0.426	0.118
$R = \frac{1}{N} \sum_{i=1}^N \frac{\sigma_i^{\text{calc}}}{\sigma_i^{\text{exp}}}$	1.10	1.14	0.886	1.11	1.01	1.14	0.973
$F = 10^{\left(\frac{1}{N} \sum_{i=1}^N [\log(\sigma_i^{\text{exp}}) - \log(\sigma_i^{\text{calc}})]^2 \right)^{1/2}}$	1.78	3.68	11.3	1.79	1.74	1.74	1.29
$L = \left[\frac{\sum_{i=1}^N \left(\frac{\sigma_i^{\text{calc}}}{\Delta \sigma_i^{\text{exp}}} \right)^2}{\sum_{i=1}^N \left(\frac{\sigma_i^{\text{calc}} - \sigma_i^{\text{exp}}}{\Delta \sigma_i^{\text{exp}}} \right)^2} \right]^{1/2}$	0.435	0.699	0.829	0.513	0.456	0.547	0.285