

## Cross-Section Data Library MENDL-2P to Study Activation and Transmutation of Materials Irradiated by Nucleons of Intermediate Energies

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### ABSTRACT

The Medium Energy Nuclear Data Library, MENDL-2P, includes more than 87.000 threshold reactions induced with protons on nuclei from Al to Po at energies up to 200 MeV. The data are presented for 505 stable and unstable nuclei having half-life more than 1 day. The library is the development of MENDL-2 library and was obtained using calculations with the ALICE-IPPE code and corrections based on threshold reaction systematics and available experimental data.

### 1. Introduction

To satisfy the needs on intermediate nuclear data for accelerator driven technologies the library MENDL-2 was elaborated [1]. For the neutron induced reactions MENDL-2 includes data for 505 nuclei from Al to Po at neutron energies up to 100 MeV [1]. For proton induced reactions the MENDL-2P includes data for the same nuclei at proton energies up to 200 MeV. To develop proton data the ALICE-IPPE code was used.

### 2. Cross section calculation

The ALICE-IPPE version of ALICE code differs from the previous ones in several aspects. Algorithm for the level density calculation according to the generalized superfluid model was tested, corrected and improved. The corrections were made for the algorithm of multiple precompound proton emission spectra calculation near threshold, Kalbach systematic treatment and optical model parameters. The correction was made for cross-sections calculations taking into account gamma-ray emission. The method to obtain cross section was based on the evaporation Weisskopf-Ewing model and geometry dependent hybrid exciton model [2]. Preequilibrium cluster emission calculation is included in the code. Calculation of the alpha-particle spectra is performed taking into account the pick-up and knock-out processes [4] combined with hybrid exciton model, the phenomenological approach is used to describe direct channel for the deuteron emission. The triton and He-3 spectra are calculated according to the coalescence pick-up model [3]. Exciton state density was defined according to the Ericson-Strutynsky formula taking into account the Pauli principle. To calculate intranuclear transition rate nucleon-nucleon interaction cross sections corrected for the Pauli principle were used for nucleon transitions, and imaginary part of the optical model potential for alpha-particle and deuteron emission. Level density in evaporation cascade was calculated individually for every nucleus in frame of generalized superfluid model with collective enhancement factor [1]. Total reaction and inverse reaction cross-sections were calculated by optical model. Calculated cross sections are corrected using available experimental data. The comparison with experimental data for proton induced reactions was made. The results of the comparison with available experimental data [5-18] are presented for some reactions in Figure 1.

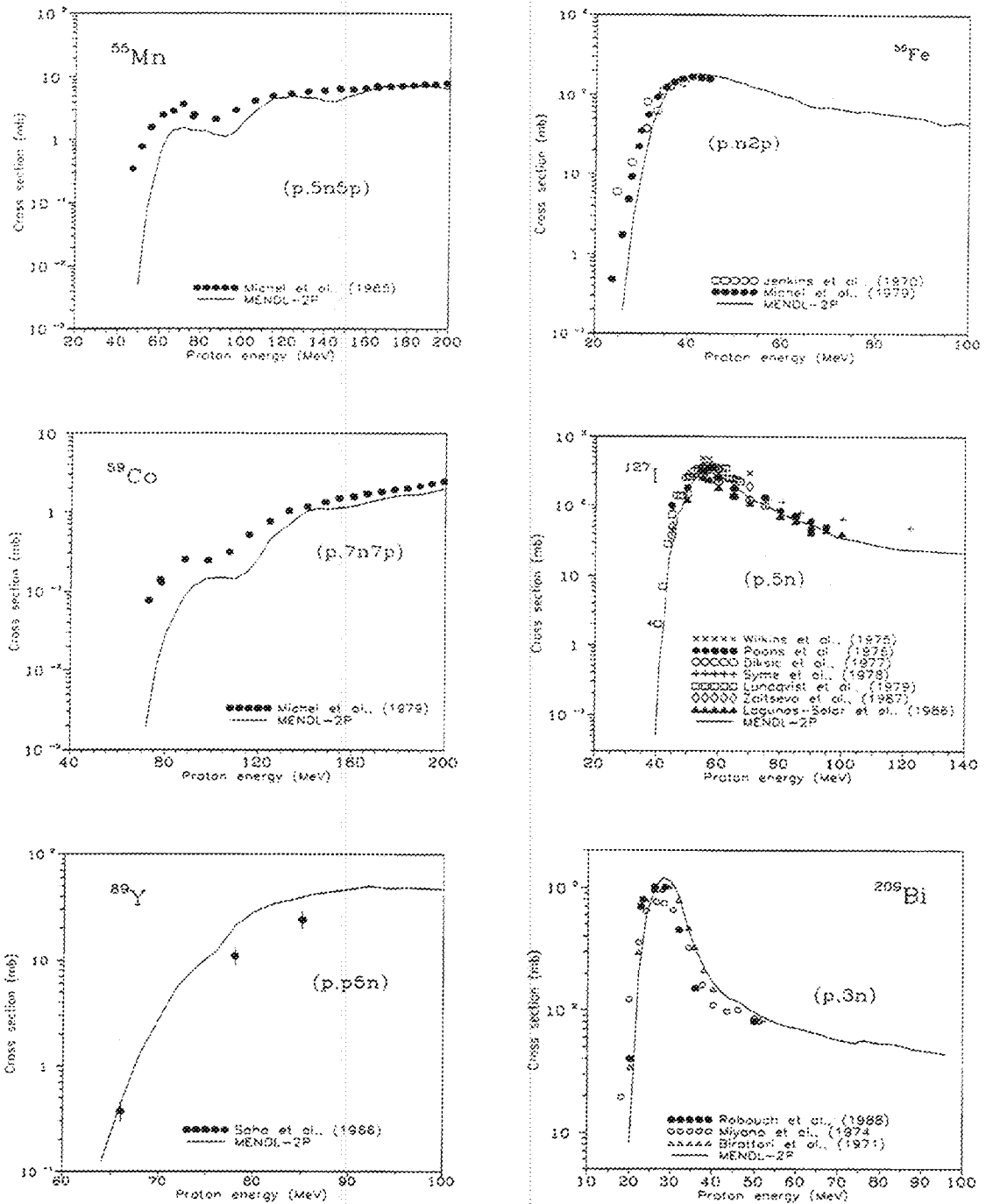


Fig. 1. Comparison of various cross-sections from MENDL-2P with available experimental data.

### 3. MENDL data format

The data of MENDL library are presented in the ENDF-6 format. The files MF=1 and MF=3 are used for the data recording. File MF=1 contains the general description of the type of cross-sections presented and the file MF=3 includes the obtained cross-section values. The standard ENDF MT sections as well as the new assigned sections are used to record the information in file MF=3. The detailed description of the new assigned sections is given for each nuclide in the file MF=1.

### 3.1 MENDL catalogue

The MENDL-2 catalogue includes the following information.

The line beginning with symbol "\*" contains the characteristics of target nucleus with indication atomic number, name of element, atomic mass number, half-life and total number of reactions considered nucleus and contained in MENDL files.

The line with reaction description indicates:

- a) Atomic number (Z), name of element and mass number (A) for target nucleus;
- b) Reaction type; "(N,X)" symbols mean the sum of cross sections for all possible reactions resulting in the same residual nucleus without taking into account radioactive decay chains;
- c) Z, name and A for nucleus produced;
- d) Half-life of the product nucleus; Symbols "S", "M", "H", "D" and "Y" signify Second, Minute, Hour, Day and Year, correspondingly;
- e) The number of energy points for which the cross-sections for given reaction are available in MENDL;
- f) The minimum reaction energy (Q) in MeV for all reactions resulting in considered product nucleus;
- g) The indication of the origin of cross sections presented.

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