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# Nuclear Data Information-Reference System NDX

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At present in the area of evaluated data support for nuclear and physics calculations, a wide arsenal of sources of various nuclear data is available in electronic form and used in practice. In essence, the data can be both the result of direct experimental measurements and estimates received from different theoretical models. The International Atomic Energy Agency (IAEA, Austria) distributes in electronic form both individual files of atomic nucleus structure data as well as libraries of evaluated data on the characteristics of particle-nucleus interactions. Developed at RFNC-VNIIEF the information reference system of nuclear data, NDX (Nuclear Data eXpert studio) combines not only the evaluated data under a single graphic interface, but also specialized databases with information on nucleus structure, reaction energies, nuclei states et al. Graphic interface allows to represent both in table and graphic form practically the whole capacity of the magnitudes and dependencies stored and perform the comparison of these magnitudes. Computer codes included into the NDX system allow carrying out some evaluated data processing. The given system has been created using state-of-the-art programming techniques and represents a friendly tool for experts dealing with nuclear data issues.

***KEYWORDS: atomic nucleus structure, international database, evaluated neutron data, graphic interface***

## I. Introduction

A wide range of sources publishing diverse nuclear data in electronic form are currently available and actually used in the sphere of nuclear physics constant support. The data, by its essence, might be both result from direct experiments and evaluations obtained from various theoretical models. International Atomic Energy Agency (IAEA, Vienna, Austria) distributes both separate files with the data describing the atomic nucleus structure and also entire libraries of evaluated constants with information on processes of particle-nucleus interaction.

The practice of using these various nuclear data files has allowed to formulate two key statements for the further development of service software for constant support:

- integration of diverse data sources (not only evaluated) within a single software graphical shell;
- creating such shell as an information – reference system with subset of databases personalized for particular user needs.

These statements form the basis of the NDX system (Nuclear Data Expert's Studio).

At present the NDX system, using a unified graphic interface, includes both the databases containing the information on nuclear structure (tables of nuclear masses and reaction energies, radioactive decay information etc.) and most of available international databases of evaluated data. Graphic interface allows to represent both in table and graphic form practically the whole capacity of the magnitudes and dependencies stored and perform the comparison of these magnitudes.

Computer codes included into the NDX system allow carrying out some evaluated data processing:

- reconstruct pointwise cross-section from the resonance parameters;
- calculate Doppler broadened cross-sections at given temperatures;
- perform calculation of various integral characteristics, such as average cross sections in various spectra (Maxwell spectrum, NBS, Watt spectrum), resonance integrals, Westcotts G-factors, etc.

The given system has been created using state-of-the-art programming techniques and represents a friendly tool for experts dealing with nuclear data issues.

## II. User Interface

The NDX system user interface consists of a main window and special windows for data representation. NDX runs with the actually available set of database files in the data directory on the disk, assigned for that. The user interface provides rendering and access only to actually available data.

The main window of the system is designed in the form of Periodic Table of Elements (Fig.1). When selecting a specific cell of the table the whole element-related data is loaded from all databases present. In our mind, such an organization of the main window is intended to provide a friendly mechanism of selecting a necessary isotope and a further-on access to the data available on it. Besides that, the main window reflects some reference information of general character, such as natural isotope composition of the current chosen element in the table and also some chemical and physical properties of the element. Most of interface controls display on-screen hints provided to ease user work with NDX.

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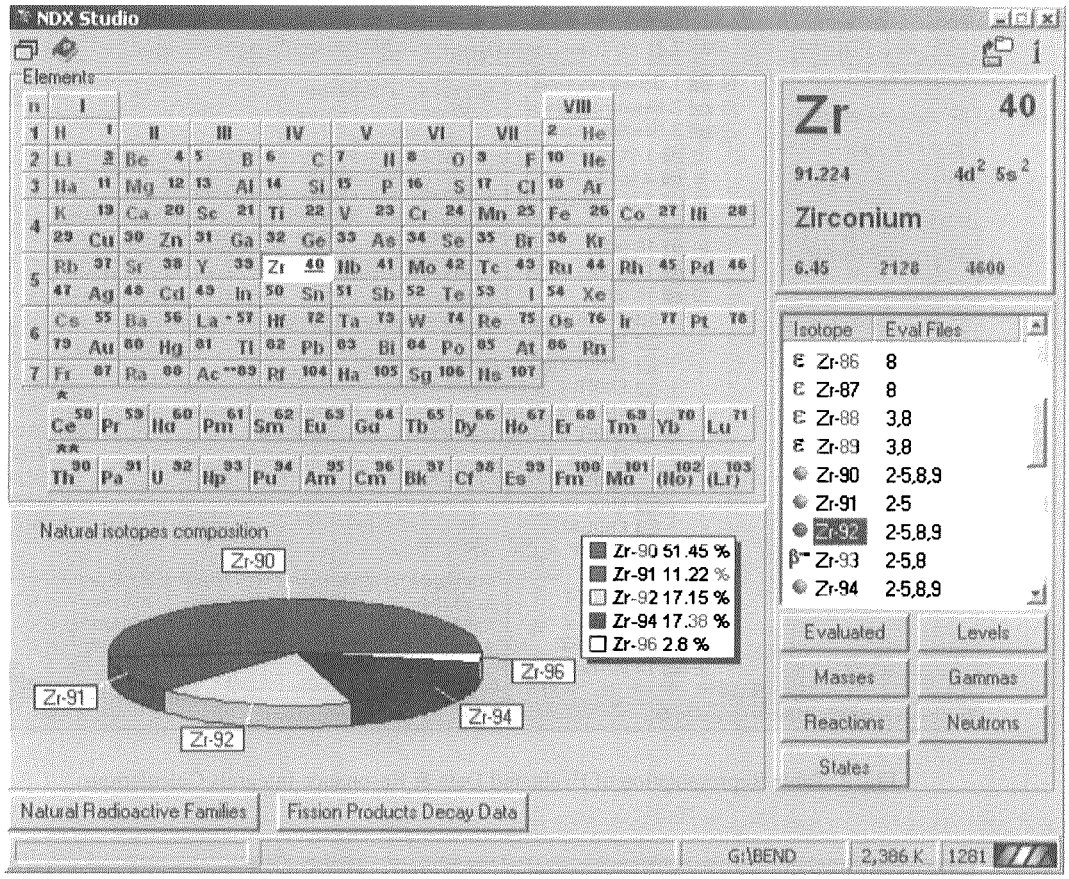


**Fig.1**. NDX system main window.

## III. Data Representation

Besides the archive of evaluated spectral data (ENDF format[2)], let us conventionally call this source "**Evaluated**"), the current NDX version includes the data from the following sources:

- tables of nuclear masses (hereinafter as "**Masses**") and reaction energies (experimental and those recommended, in the text below as "**Reactions**"), published by Audi and Wapstra[3)] ;
- ENSDF data[4)], including:
  - nuclear gamma-radiation ("**Gammas**");
  - nuclear excitation level ("**Levels**");
  - nucleus-neutron interactions (scattering, capture, fission – "**Neutrons**");
  - properties of ground and metastable states ("**States**").
- radioactive decay chains.

### 1. Evaluated Data

Work with evaluated data provides the following possibilities:

- examination of table data from the evaluated constants libraries;
- composition of 2D and 3D plots for various values and the possibility to merge the dependencies on one plot in order to compare them (See Fig.2-3);
- saving extracted and calculated data in tabular and plot form;
- a point by point cross sections reconstruction from resonance parameters;
- a Doppler broadening calculation at different medium temperatures;
- some integral characteristics calculation, such as average cross section in various spectra (Maxwell spectrum, NBS, Watt spectrum), resonance integrals, G-factors by Westcott, etc. The given integral values might be used to assess the quality of evaluated data, obtained from these or those sources by comparing them with published or experimental values. Besides, the results of resonance integrals and thermal point cross section calculations can be compared with corresponding values from "**Neutrons**" table.

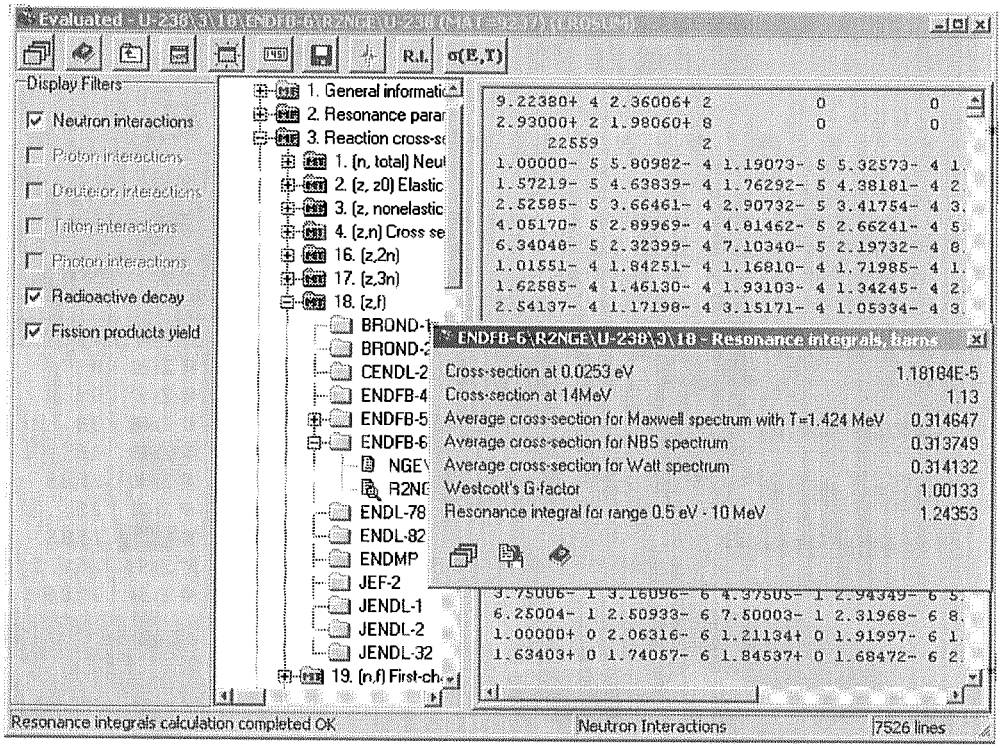


**Fig. 2.** Table Representation of Evaluated Data & Resonance Integrals Calculations.

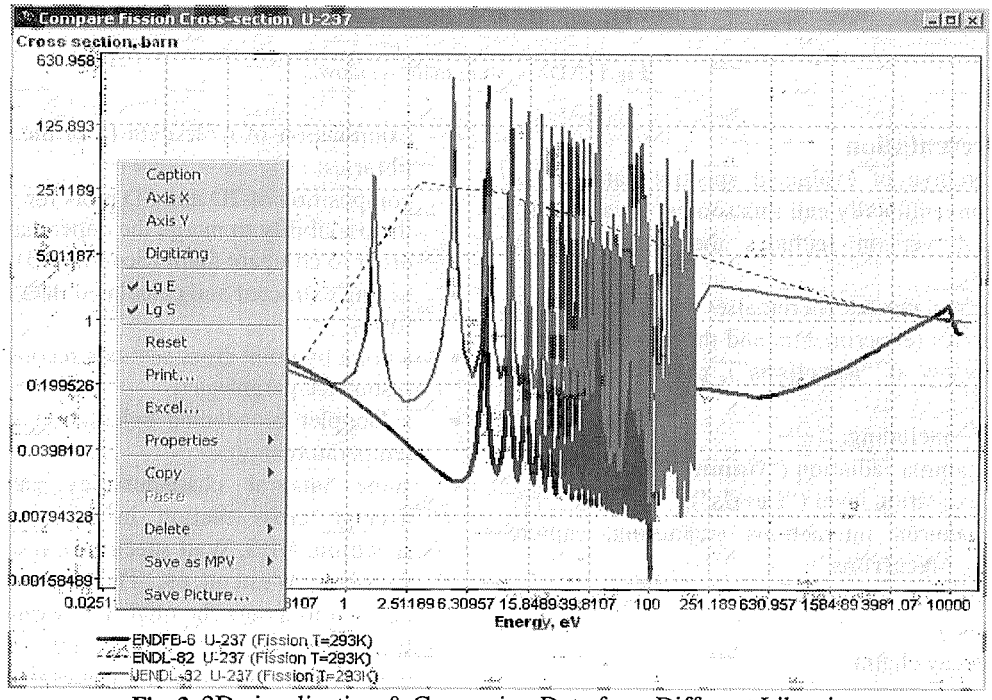


**Fig. 3.** 2D visualization & Comparing Data from Different Libraries.

## 2. Radioactive Decay Data

Radioactive decay data are represented as a two special windows:

- Four basic radioactive decay chains of actinides;
- Radioactive decay chains of fission products. Values of independent or cumulative yields from different actinides from different libraries are represented for selected fission product (Fig.4).

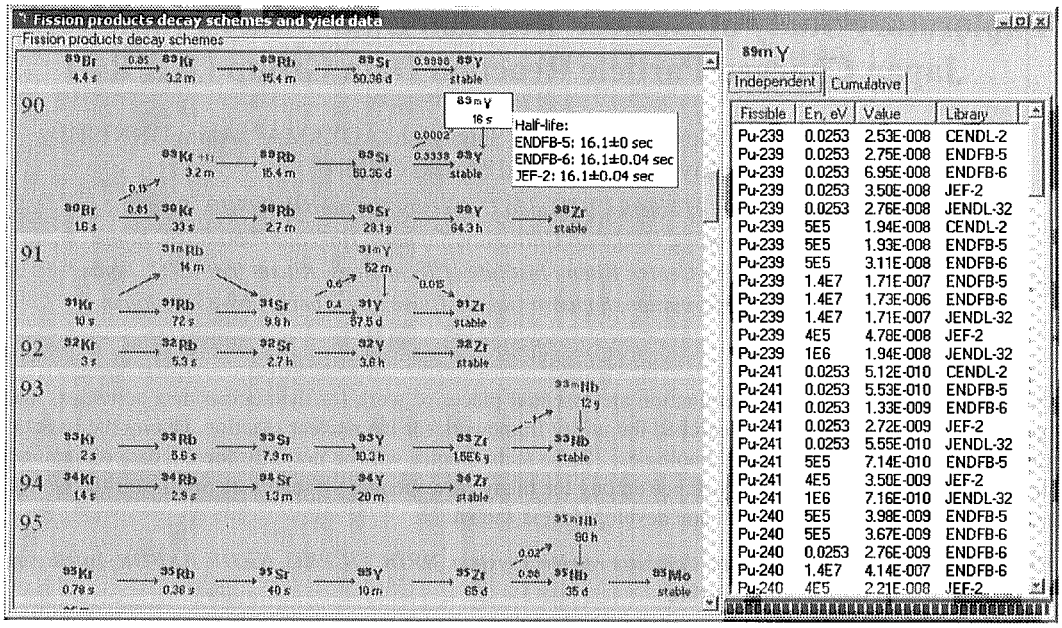


**Fig. 4.** Radioactive decay chains of fission products.

### 3. Other Data

There are much more data types not shown above, among which are:

- Mass Data;
- Reaction Energy Data;
- State and Decay Type Data;
- Excitation Levels Properties;
- Gamma-radiation Levels Data;
- Neutron-nucleus interaction Data.

All of these have proper table presentation and in most cases visual graphics view.

## IV. Conclusion

The described nuclear data information-reference system NDX combines the data from evaluated constant library archive and various data, describing the atomic nucleus structure, under a single graphical shell. The given system has been created using state-of-the-art programming techniques and represents a friendly tool for experts dealing with constant support issues. The further NDX system development seems to be the addition of existing databases and new data classes adoption into the system. For example, the nearest plans of NDX developers are adoption of interaction of charged particles with nuclei properties data into the system.

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