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Nuclear Science References as a Tool for Data Evaluation

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Abstract. For several decades, the Nuclear Science References database has been maintained as a tool for data evaluators and for the wider pure and applied research community. This contribution will describe the database and recent developments in web-based access.

INTRODUCTION

Nuclear Science References (NSR) is an indexed bibliography of nuclear physics papers and reports. The database is updated on a continuing basis, to stay current with published literature. More than 70 journals are currently checked for articles of interest, and approximately 4200 references are added to NSR each year.

In addition to standard reference, author, and title information, most entries in the NSR database include "keyword abstracts", which make it possible to search for references relevant to specific quantities or topics. The following sections will describe the scope of the database, the structure of the keyword abstracts, and the recently developed web-based interface.

SCOPE OF NSR

In the 1960's and 1970's, the focus of NSR was on low-energy nuclear structure studies. Over the years, the scope has widened to include more references related to reaction data and high-energy nuclear physics. Today, the scope of NSR is roughly comparable to the range of papers found in *Physical Review C* or *Nuclear Physics A*, and in fact all articles from those journals have been entered into NSR since the mid 1990's.

An effort is made to include all articles of interest from "primary" sources (refereed journals). In order to avoid unecessary duplication, and to use available manpower efficiently, not all articles from secondary sources such as reports and conference proceedings are included.

In Fig. 1, the distribution of NSR references by decade published is shown. Note that the five decades from 1910 to 1959 are combined into one data point, and that the distinction between primary and secondary references was not always made before 1973. One obvious feature of the chart are that many more secondary references

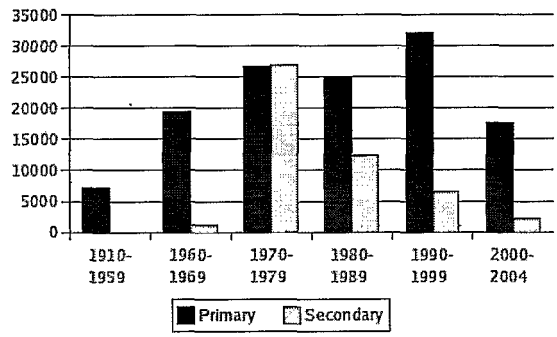

FIGURE 1. NSR entries by decade published.

were included in the 1970's than in later decades. During the years 1971-1977 many more laboratory reports were included each year than is the case today. Another feature worth noting is that the overall number of primary references included has increased in recent years. This is primarily a reflection of the change in scope in the 1990's.

Fig. 2 shows the overall distribution of reference types in NSR. Roughly three-quarters are journal articles. (It should be noted that conference proceedings published in journals are considered journal articles, for the purposes of this chart).

KEYWORD ABSTRACTS

The feature that makes the NSR database particularly useful as a research tool is the inclusion of keyword abstracts with most entries. These keywords, prepared primarily at the NNDC, serve two purposes: they are used to generate indexing variables for the database, and they can help users identify articles of interest once list of entries has been retrieved.

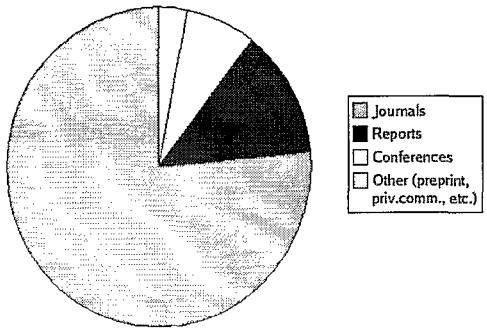

FIGURE 2. Sources of NSR entries.

The format of the keyword abstracts is designed to convey information about *specific* nuclides or reactions. Typically, each keyword string consists of a few sentences. Each sentence will start with a nuclide or reaction specification, followed by one or more phrases enumerating measured, deduced, or calculated quanties. There is often one or more sentences at the end of the keyword abstract containing more general information about the paper, but this information is not indexed.

Before entries are added to the NSR database, a preprocessor is run which adds a "selector" field of quantities to be indexed, based on the keyword abstract.

Each set of keywords is prefaced by a "major topic" such as NUCLEAR REACTIONS or RADIOACTIVITY. For historical reasons, most of these refer to the type of experiment being carried out, rather than to the overall results of the paper. For example, papers that use heavy-ion reactions to study high-spin states will have NUCLEAR REACTION keywords rather than NUCLEAR STRUCTURE. In general, NUCLEAR STRUCTURE keywords refer to calculations, or to analysis of previously published data.

Because the keyword abstracts are designed to facilitate the indexing of information on specific systems, some articles are entered into the database without keywords. These papers might include, for instance, theory or review papers that fall within the database scope. Although they are not indexed by nuclide or measured/calculated/deduced quantity, these references can still be retrieved by author or *via* text-string searches.

More information about keyword formats can be found in the *NSR Coding Manual*[1].

WEB-BASED ACCESS

Historically, NSR was begun as a bibliography of references used in nuclear structure evaluations, and was published periodically in *Nuclear Data Sheets*. In the mid-1980's, terminal-based remote access to NSR was made available *via* dial-up and telnet. In the mid-1990's web-based access was added. Over the last few years, NSR has been migrated to a relational database platform, and a new web interface (`http://www.nndc.bnl.gov/nsr/`) has been developed.

Indexed Search, Text Search, and Keynumber retrieval

The new web interface, based on Java Server Pages (JSP) technology, provides three forms for selecting search criteria: indexed quantities, text search, and keynumber retrieval. In addition, a small form on the front page provides a "quick search" on author or nuclide. The web application is session-based, meaning that a given user's parameter settings and retrievals are remembered as the user moves from page to page within the application. The user has the option of clearing the information at any time, and a session "times out" and closes after a period of inactivity (30 minutes).

An example of the Indexed Search form is shown in Fig. 3. The top section, "Initialization parameters", is used to select parameters that the user is likely to want to keep constant over a number of searches. These include publication year range, output format, and whether to search all entries or only those added to the database since a certain date. This latter option, along with the option to require measured quantities, can be particularly useful in data evaluations.

The next portion of the form allows the user to choose one, two, or three parameter/value pairs. Parameters are chosen from drop-down lists, and values are typed into the adjoining text box. For each parameter type, there are a finite set of allowed values. Users can choose from among these values by using the "browse" buttons to the right of the text boxes.

When searching by nuclide on the indexed search page or in the "quick search" form, the formats "60Co" and "Co-60" are both recognized. In addition, if one wants to search over all nuclides with a given charge or mass number, the formats "Z=nnn" and "A=nnn" are allowed in the "nuclide" field.

The form shown in Fig. 3 is set to search for articles that discuss cross-section measurements for (n,γ) reactions published since 2000 and added to the database since January 1, 2004.

As mentioned earlier, some NSR entries do not have keywords, and for those that do only a limited set of values are indexed. The Text Search option allows the user to perform a "free-form" search for articles that have specific text in the title and/or keyword fields. The form for entering text queries is similar to the one for indexed quantities, and uses the same sub-form for initialization

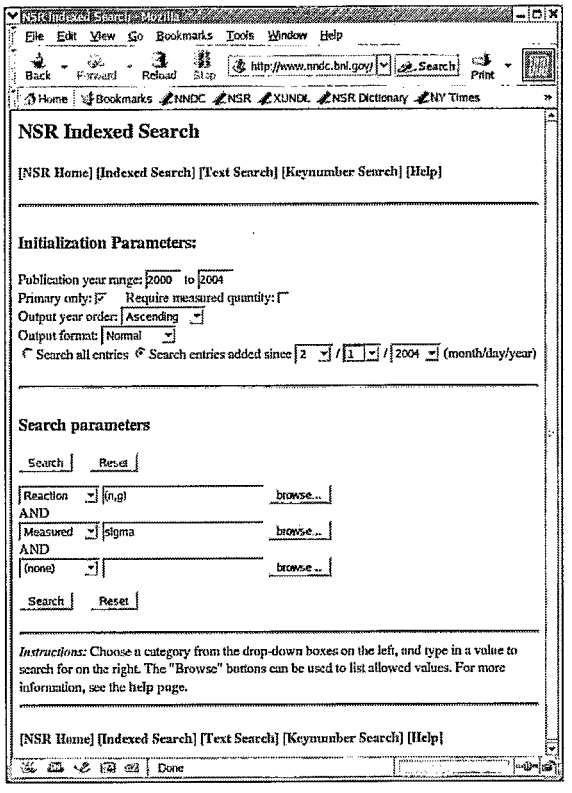

FIGURE 3. Input form for indexed quantity search.

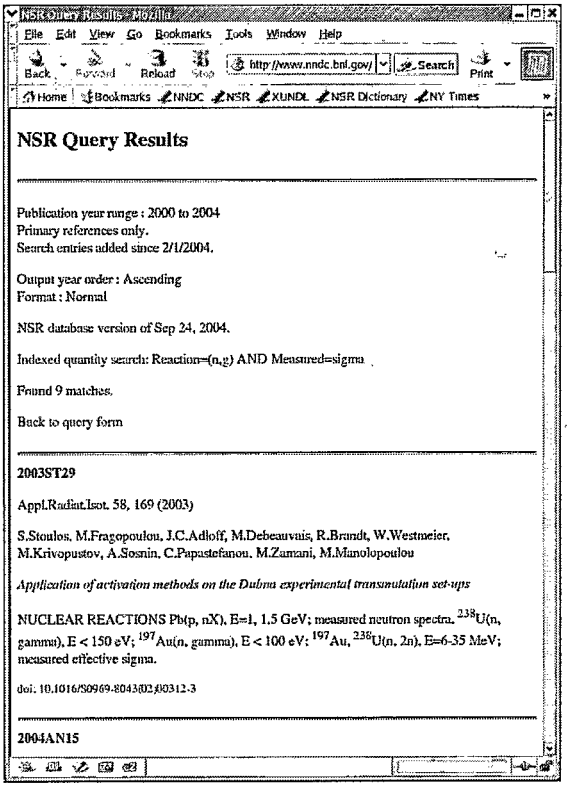

FIGURE 4. Sample of NSR output.

parameters.

Each NSR entry is assigned a unique 8-character "keynumber" that can be used to retrieve the entry directly. These keynumbers are used to identify references within various nuclear structure databases and related publications. The keynumber retrieval form allows the user to enter a single keynumber or a list of keynumbers to fetch the associated NSR entries.

Display

Results of a query to NSR can be displayed in one of four ways: normal (HTML) format, exchange format, plain text, or keynumber. An example of "Normal" format is given in Fig. 4. The reference list is prefaced by information about the query parameters and database "version date". This information can be useful if the results are printed out for later reference. For each entry retrieved the keynumber, reference, author, and title information are listed along with the keywords. If the publisher provides a "digital object identifier" (doi) for the paper, a link to the publisher's page for the article is included in the NSR output, as shown in the entry in Fig. 4. Additional links are included if data from the reference is used in the XUNDL database, or if the reference refers to an evaluation in the ENSDF database.

The "plain-text" output is similar, but no character formatting is done (i.e. italics, superscripts, etc.), and no external links are included. The exchange format output gives a standard eighty-character form of the entry used for internal storage and to transfer NSR updates between data centers. Finally, keynumber output gives a simple list of keynumbers. The header information is provided for all formats.

Viewing and combining lists

The results of each retrieval, in keynumber form, are saved within the web application as long as a session is active. Users can review and combine retrievals using the "Combine/View Lists" page. (Note: links to this page don't appear until two queries have been made). On this page, previous queries are listed, and users may view them in any of the four formats. Any two lists may be combined using boolean functions "and", "or" and "and not", allowing the user to construct arbitrarily complex booleans in a pairwise fashion.

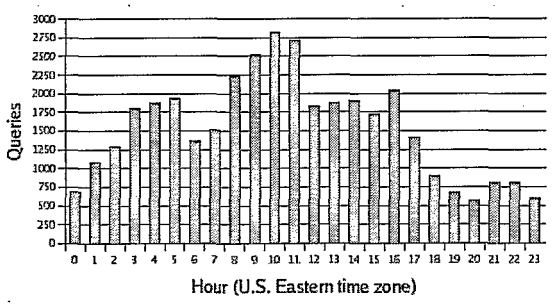

FIGURE 5. Distribution of queries to the NSR database, by hour of day.

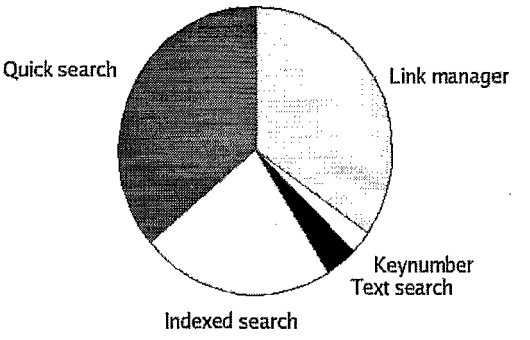

FIGURE 6. Types of queries made to the NSR database.

Link Manager

In addition to forms-based queries, the NSR web application provides a url-based retrieval mode, which allow single-reference retrievals to be embedded directly into web pages as hyperlinks. The format for this is `http://www.nndc.bnl.gov/nsr/nsrlink.jsp?{keynum}[,{mode}]` where keynum is the eight-character NSR keynumber, and mode is an optional one-letter mode specifier. Mode "H" is for normal html output, and is the default if no specifier is given. Mode "X" gives exchange-format output. If the entry has a doi associated with it, mode "B" redirects to the publisher's web page for the article, otherwise it acts the same as "H".

USAGE STATISTICS

Since the new NNDC web portal went public in April, 2004, the NSR web application has received an average of about 300 queries a day, where "query" is defined as an action that retrieves a reference or list of references. This number, and all following, exclude retrievals by known crawlers such as googlebot.com. In the following, usage statistics collected in the four-month period between May 1 and August 31 2004 are considered.

Over all, there were 37017 queries made during this period, coming from 2560 distinct ip addresses. Fig. 5 shows the distribution of queries by time of day. It is a fairly wide distribution, with a distinct maximum during the morning hours in the eastern United States.

Of particular interest is the type of query being used. In Fig. 6 the relative distribution of query types is shown. The front-page "Quick search" and link manager options each account for about one third of all retrievals. Of the "Quick search" queries, about 60% are by author, and the rest are by nuclide.

SUMMARY

The Nuclear Science References database is designed to provide reference lists focussed on particular nuclear systems or subjects. The development of a new web interface has helped enhance the utility of the database for research community, and continuing improvement of the service is planned.

ACKNOWLEDGMENTS

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1. S.Ramavataram and C.L.Dunford, *Nuclear Science References Coding Manual*, BNL-NCS-51800 (Rev. 08/96) (1996).

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