# WP 14

# Development of Charged Particle Nuclear Reaction Data Retrieval System on Recent Computational Architectures

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We develop the charged particle nuclear reaction database system with recent computational architectures. On this report, current status of our system developments is demonstrated. It is still an experimental software, but we develop it toward the "effective" use of nuclear data resources**:** It will be supported **– I. "Re-produce, Re-edit, Re-use"**, **II. "Circulation, Evolution"**, **III. "Knowledge discovery" –** from nuclear data and tools. We also plan to include the EXFOR in our system. Further developments are under way.

## 1. Introduction

The systematic information of the nuclear reaction data can't be missed in the development of atomic energy problems. Nuclear Reaction Data File (NRDF)[1,5] is an data compilation especially for the charged particle nuclear reaction. NRDF have over 20,000 of data files, each of that is taken from the experimental paper originate from Japanese experimental groups [1]. In order to distribute NRDF, the data compilation, storage and retrieval system of NRDF was constructed at a mainframe computer of Hokkaido University [2] more than 15 years ago. Furthermore, a system which transforms the NRDF data to the EXFOR was implemented, thus NRDF contributed as an important part of the charged particle data of EXFOR data compilation[3]. However, as we shown in the Ref. [4], The current system of NRDF on the mainframe computer is out of date. With the foregoing background, and to get benefit of recent computer and network technologies, such as multimedia, object-oriented system construction, graphical user interface and so on, we mainly select to use the following computational architecture.

I. **WWW : [Network based data distribution]**
Recent progress of network can takes us easier data distribution using WWW framework. We develop the web distribution to access the NRDF data, **http://nucl.sci.hokudai.ac.jp/~nrdf** ,and simple search system are developed(Fig .1).

II. **IntellignetPad : [Using more recent techniques of computational architecture research]**
For the further development , We select to use IntelligentPad. It is a kind of object-oriented "graphical user

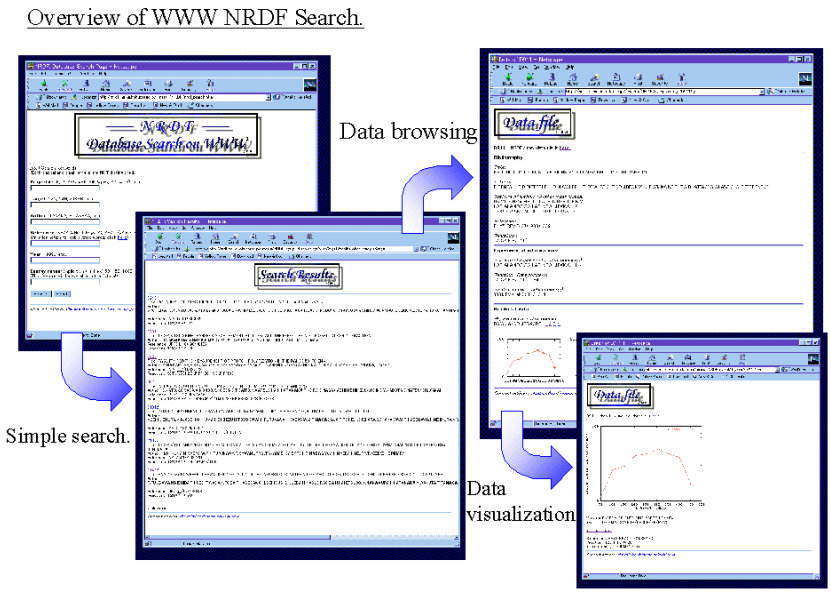


**Fig.1. Overview of NRDF WWW search system. Some simple index search and 2D-data visualization is available.**

interface (GUI) based" system construction environment. It was proposed in 1989 by Japanese informational scientists[6]. Research and development of this architecture is now still strongly evolved by informational scientists (See. Ref.6) , but some commercial software[8] is available as of now. A "pad" can be treated as an object of the graphical user interface on the screen of computer, like a view of "real paper pad", and each "pad" have functions as data control programs, input/output devices between other pads, and so on. On the "pad" environment, programming of any tools on GUI is can be done by 'intuitively' cut and paste action of

pad. In the following sections, we focus to discuss about the system development with IntelligentPad architecture.

## 2. System design of the trial system

Fig.2 shows an image of the basic design of this system. The recent trend of the computer environment is expressed as words "Network", "Graphical", "Interactive", "Reuse of resources". The fundamental concepts of our data retrieval system are based on them. Using an database management system(DBMS) based on SQL, we construct the NRDF data management server on the UNIX WS. (SUN Ultra1). UniSQL[9] is adopted at the present. Provided that common gateway interface(CGI) on this server, The network communications between the NRDF server and clients are achieved.

Once the NRDF server is constructed, data retrieval "client" is constructed with the IntelligentPad architecture. A connection between a server and a client based on CGI through the network connection. We construct the Windows95, 98/NT-based IntelligentPad[8]. Fig.3 shows the overall appearance of the trial product of the NRDF data retrieval system. Let us show in detail with the next section.

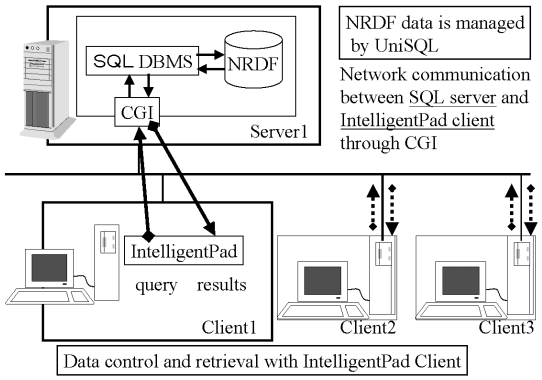


**Fig.2 Network-based system.**

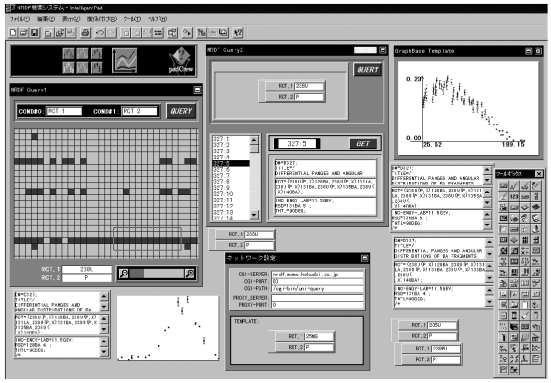

**Fig.3 Overview of the system.**

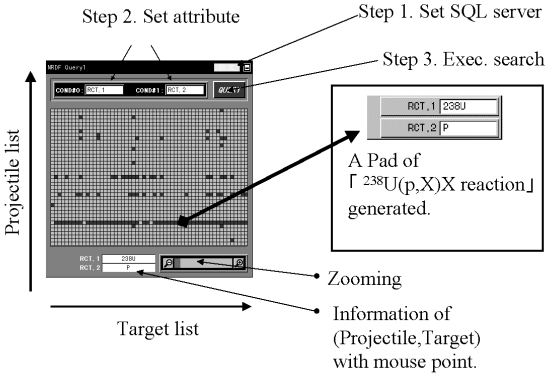


**Fig.4. Data navigation.**

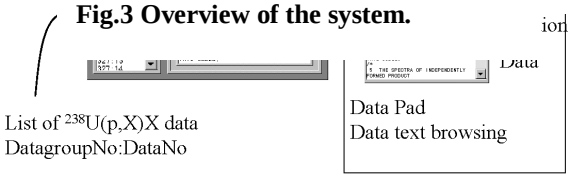


**Fig.5. Data retrieval.**

## 3. Reference example and functions of the trial system

Showing some reference example, let us discuss about features of this trial product. Suppose you want to get the data of the $^{238}$U(p,X)X reaction, Fig.4-Fig.6 shows the process of data retrieval step by step.

**1). Examine the existence of the $^{238}$U(p,X) reaction data**.

Fig.4. shows the Pad to search whether the $^{238}$U(p,X) data is exist or not : i) Set the network address of SQL server. ii) Specify the two attributes of the NRDF database, e.g., Target and Projectile. iii) Execution of a search. As a result, the grid which placed in the middle region of the Pad displays the 2-dimensional information that displays the current status of the NRDF database from a point of view of target and projectile. colored crossing point (X,Y) shows NRDF have some reaction data about target = X, projectile = Y. In this way, we find NRDF have some data about X = $^{238}$U, Y = p , thus we get the "$^{238}$U(p,X)X reaction" Pad using click and drag operation of the Pad.

**2). Data retrieval.**

Once you get the Pad connected with "$^{238}$U(p,X)X reaction", you retrieve the data using the Pad shows in Fig.5. We can get the list of "$^{238}$U(p,X)X reaction" data, and generate the specific data as a text browsing Pad. Consequently, we get the "$^{238}$U(p,X)X reaction" data.

**3). Interactive data visualization and comparison.**

The data pad shown in Fig.5 have features not only text browsing of data but visualization. Once you drug in the Data pad to 2D data plot pad, you can see the graph representation of the data. Data comparison is also achieved by just a drug and drop!

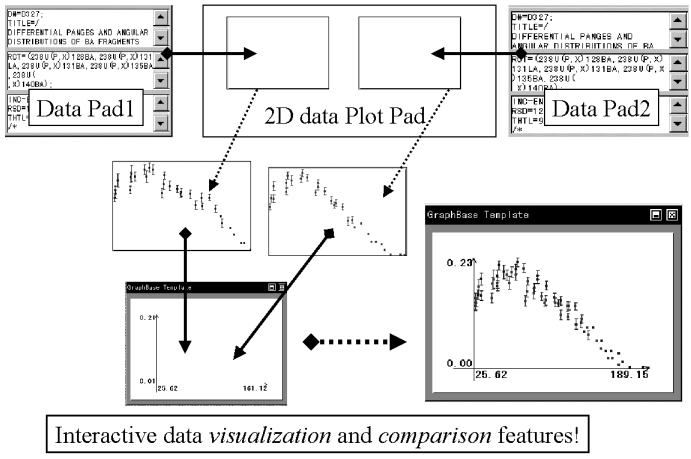


**Fig.6. Interactive data visualization and comparison.**

## 4. The aim of nuclear reaction database towards the effective use

In the previous section, we show the features of current trial system. In particular, major features of this system are : i) interactive data visualization and comparison, ii) 2-dimensional display function of the status of database. Furthermore, we determined the aim of the system towards support of the effective use of nuclear reaction data with computer facilities.

I) **Re-produce, Re-edit, Re-use.**

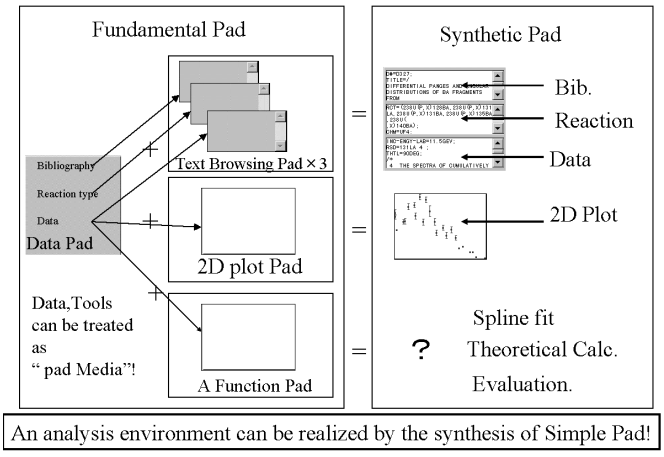


**Fig.7. Synthetic feature of IntelligentPad.**

Any tools can be decomposed to more fundamental pad, thus you can re-use such fundamental pads for re-constructing another tool. Such synthetic feature of IntelligentPad should be achieved by many user's co-operative activities of "Re-,produce, edit, use" of both nuclear data and useful tools.

II) **Circulation and evolution.**

IntelligentPad supports co-operative fundamentals through the networks. Once we make an network site to distribute and circulate not only tools but also data, It is already the basis of the circulation field of nuclear data and tools. Fig.8. shows a schematic figure for the circulation system of data and tools as pad media. Constructing such a sharing space on the network, many user can retrieve many tools and data through the pad media

III) **Knowledge discovery.**

The amount of nuclear reaction data is getting huge, and increasing day by day. In addition, variety of the data will also be complex. It will be more difficult to get essentially important information from huge databases. Fig.9. shows the pad same as we shown in Fig.3. Development of such pad is related to easier navigation to needed data, and will be supported something new discovery of knowledge connected with nuclear data.

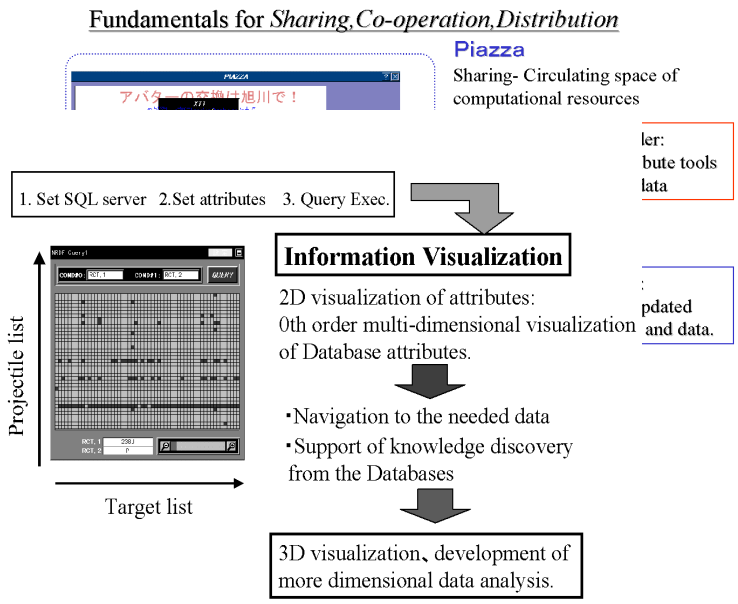


**Fig.9. Support of knowledge discovery.**

You will find the fundamental concepts of IntelligentPad is quite matched with above three aims. Consequently, we will proceed to embody them through IntelligentPad. If it will be done, such as Fig.10, many users can be shared the huge knowledge of nuclear data, thus quite "effective" use of nuclear data is promising.

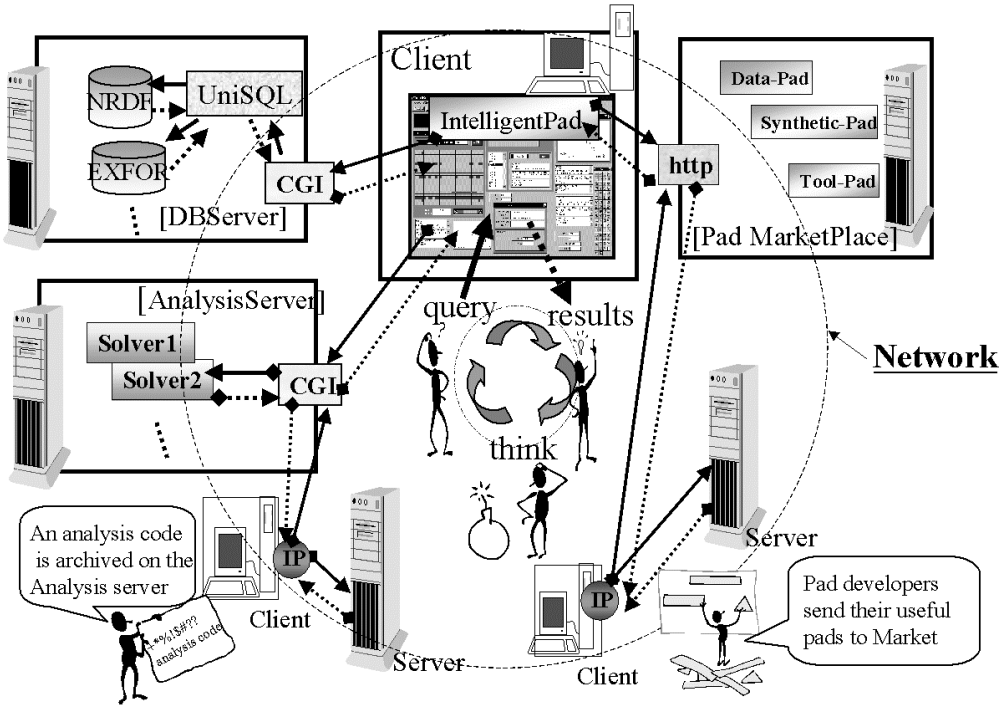


**Fig.10. An ideal system of nuclear reaction database. Exp. data, evaluated data, theoretical solver, ...etc. ,are treated with this system as "pad media".**

## 5. Summary and future extension

We developed the "NRDF" charged particle database system using recent computer properties. We have already have techniques to give the data to anyone who connected with network, e.g. www techniques., although the points at issue are: What kind of system is easy to use and useful. Our answer is : Make a system can be used by huge number of users and should be supported to share and evolve the knowledge of whole users. In other words, we must provide such kind of "media" to the user that needs nuclear data. In this report, we focus on the current experimental system on IntelligentPad is shown. Major features of this system are i) interactive data visualization and comparison, ii) 2D database survey. From now on, we will include the EXFOR data in this system , distribute the system to researchers, repeat test use and blush-up of the trial system. Furthermore, we will develop the system to embody the aim of "effective" use of nuclear reaction data, such as Fig.10.

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