Future for Nuclear Data Research
― Human Resources –

M. Baba
Cyclotron and Radioisotope Center, Tohoku University
980-8578, Sendai Japan
e-mail: babam@cyric.tohoku.ac.jp

A comment is given on the problem of human resources to support the future nuclear data activity which will be indispensable for advanced utilization of nuclear energy and radiations. Emphasis is put in the importance of the functional organization among the nuclear data center (JAEA), industries and universities for provision of human resources.

1. Introduction

The nuclear data is a fundamental data base for nuclear technology and science. It has played a crucial role in the course of nuclear energy development of fission reactors and fusion reactors, and will be so also in the future because the nuclear power is expected to support the future human activity as the energy source with low load to nature such as a green room effect and chemical pollution. Nowadays, the data requirement is not restricted to nuclear energy but extending over various fields from basic to application areas such as astrophysics, space technology and medical application and so on [1].

Sometimes it is pointed out that the nuclear data reaches to “satisfactory level” both in quantity and quality. It may be partially true so long as the nuclear data for traditional fields is concerned. It should be noticed that, nevertheless, nuclear data requirement is extending to “exotic fields” like minor actinides, high energy region, basic fields and medical fields and so on to develop new concept and/or technology for advanced utilization of nuclear energy and radiations [2,3,4]. The nuclear data will continue to be a “fundamental infrastructure” for the modern society which utilizes nuclear energy and radiation. Recently, in particular, the nuclear data requirement in non-energy fields like radiation application to medicine, space and industries etc seems extending. Therefore, in the future, the filed which nuclear data should cover will be much wider than in the past, covering atomic and molecular data and also a macroscopic material like radiation transport.

It is also true that, however, the man power and the funding for nuclear data activity is decreasing as the world wide trend [1]. Therefore, it is necessary to look for the way of effective organization of nuclear data activity and keep the human resources which is the most essential base for the activity.

2. Nuclear Data activity

The characteristic and important point of “nuclear data” is the “completeness of the data” which means the coverage of all the items required e.g., a type of cross sections/physical quantities, energy and nuclides in a consistent manner with accuracy as high as achievable. The accuracy required is very high, e.g., the accuracy required for fission cross section and number of prompt fission neutron of ^{235}U is as high as 1 %

or higher.

Such high performance of nuclear data has been achieved and maintained through well-organized collaboration among experiment/ measurement, evaluation and compilation, and the feed back from benchmark analysis. In Japan, systematic benchmark analyses were undertaken by reactor physicists/ engineers and radiation engineers to assess the accuracy and to pickup problems prior to the release of the file. Owing to the systematic work, JENDL has achieved highest quality-assurance among nuclear data libraries over the world. Therefore, one important point in the nuclear data activity is such collaboration among different fields. Such characteristics will be stronger in the future because of inter-disciplinary nature of the nuclear data.

In addition to such traditional and newly arising nuclear data, as proposed by Niita in the next talk [5], the problem of integral radiation transport should also be covered by the nuclear data because it is strongly correlated with the nuclear data itself. The unification of nuclear data and the particle transport through an appropriate computer code like PHITS [5] will provide various benefits to the user of both items and also a new “market” of the nuclear data.

3. Importance of human resources

To meet such a wide requirement with keeping the activity of nuclear data society, sew up of good human resources is most essential as well as effective organization among scientists or engineer who have motivation on nuclear data. Peoples who are expected to support nuclear data activity may be divided into three types:1) experimenters who produce experimental data, 2) evaluators who produce evaluated data, and 3) bench-marker doing quality assurance of the evaluated data. As mentioned in sect. 2, evaluators are highly desired to cover the modeling and/or the development of computer codes treating radiation transport including new transport analysis schemes. To support such highly inter-disciplinary jobs, well-organized collaboration of peoples in different fields are required as well as supply of new human resources.

From the above mentioned view points, I would like to point out two recommendations;

One is the promotion of collaboration with peoples in nuclear physics, particle physics, mathematics and other related fields to promote the production of “exotic nuclear data” taking account of new models and theories developed in the physics fields. For the reason, establishment of an appropriate scheme is highly required to promote the collaboration in particular with young people. A good example of such collaboration can be seen in EU and USA; young peoples graduated from physics departments look to be working very actively in the nuclear data fields having challenging subjects [6]. This is also true for the experimental area for production of new nuclear data because experiments required for “exotic” data should be more complicated and comprehensive than in traditional nuclear data experiments. In such experiments, sophisticated detector and data acquisition systems which have been developed and employed in the physics filed will open a new possibility of nuclear data. Examples are seen in the n-TOF project in CERN [7] and Nuclear Data Project in Japan lead by Dr. Igashira [8] which enable new high sensitive and functional radiation detectors providing very detailed and redundant out put data.

The second one is to provide young people with opportunities to do nuclear data work like internship. Nuclear data research will be attractive for young peoples owing to its deep underlying contents on

nuclear/particle physics, nuclear engineering, data engineering, mathematics and computer technology and so on. The presently-carried out tutorial course on nuclear data and the seminar like one on PHITS seem very effective as well as the nuclear data symposium to encourage the young people and provide the chance to touch such a fascinating subject. They are expected to continue and even extended. Universities in the nuclear engineering field will be expected to encourage students to learn such subjects and nurture specialists with strong motivation on nuclear engineering. The problem is a very limited number of jobs after graduation, but such basic knowledge will useful in any fields around nuclear engineering.

The nuclear data center JAEA and/or the Sigma Committee is expected to act as an organizer of collaboration with other fields including physics society and young people.

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馬場　護
東北大学サイクロトロン・ラジオアイソトープセンター
仙台市青葉区荒巻字青葉 6-3