US data needs

In recent years, a custom was established that members of the US Nuclear Data Program meet with the managers of various government agencies and of industry who have interest in nuclear data. These meetings are called WANDA (Workshop for Applied Nuclear Data Activities) and serve to shape the US nuclear data program in a way to match the needs of the country. This summary is in large part based on the topics discussed during the WANDA 2021 meeting held virtually from Jan. 25 to Feb. 3, and to which funding is likely to be provided.

Predictive Codes for Isotope Production

Improving predictive power of nuclear reaction codes, especially at higher incident energies is essential to support isotope production. It has also been recognized to be a general necessity. There is a consensus that nuclear level densities are the most critical and relatively poorly understood ingredient of the model calculations. These are responsible for large uncertainties in the calculations at high energies. It is partially due to the very uncertain dumping of the collective enhancements at higher excitation energies, lack of the Do (average spacing of s-wave resonances) data out of the stability line, and uncertain spin distributions.

On the reaction modeling side, a multi-step pre-equilibrium (PE) mechanism, as well as multiple PE particle emission, are needed for incident energies above 30 MeV. The area of the composite particle emission is unexplored. In general, quantum mechanical models should be developed and implemented in the reaction codes, especially for going out of the stability line.

More ‘validated’ experimental data at higher energies are needed to calibrate model parameters.

Expanded Benchmarks & Validation for Nuclear Data

Reconciliation of the reaction (ENDF/B-VIII.0) and the structure (ENSDF) databases was brought to attention. Currently, there are many discrepancies for the same quantities between the two libraries.

There is a need for improved gamma-production cross sections for priority isotopes for validation of the modeling. Existing gamma production cross-sections should be reviewed for validity.

Advanced Computing for Nuclear Data

There is a general interest in Machine Learning and Artificial Intelligence that can augment existing physics models by providing emulators and diagnostic tools, or unveil hidden patterns in data.

Natural Language Processing is of interest, e.g., for nuclear data compilation.

Nuclear Data for Space Application

Large amounts of nuclear data are needed for space exploration, including prompt neutrons and gammas from fission, gamma emissions from fission products' decay, material activation and decay, and neutron and gamma attenuation. Damage cross sections are requested to be included in the ENDF libraries. Nuclear propulsion systems might approach temperatures of 3000 K for fuel and structural materials with H2 as internal propellant. In addition, planetary nuclear spectroscopy needs (n,n'g) and (n,g) gamma-ray production cross sections.

Nuclear Data for Advanced Reactors

Even more specific requirements come from the advanced reactors. Terra Power's Molten Chloride Reactor needs tighter uncertainties for 239Pu, and is very sensitive to 35Cl(n,p). Kairos Power's fluoride-salt cooled High Temperature Reactor needs thermal scattering data for Graphite and Flibe and cross sections for 19F, 9Be, 6Li, and 7Li. Molten Salt Reactors require (α,n) for light elements 19F(α,n) and 17,18O(α,n) along with the related neutron energy spectra.

Charged-particle production reactions

It was reported that there were two requests to IAEA-NDS from the US nuclear data community, where data science across the borders of nuclear data experiment, evaluation, and processing might be involved.

Advanced techniques for nuclear data measurement often require precise particle transport simulations to characterize the detector characteristics, such as the efficiency. Although such efforts are sort of experimental apparatus specific, issues in utilization of current nuclear data libraries and techniques for performing the Monte Carlo code simulations are common, since each of experiments usually perform their own Monte Carlo simulations with MCNP/Geant4/PHITS. As an example, LANL recently published a paper on the importance of energy and angular distributions for measurements of charged-particle production reactions [H.I. Kim, et al. NIMA **963**, 163699 (2020)], where missing information of such angular distributions in the evaluated nuclear data library may cause large uncertainties in the deduced experimental data. We believe NDS is an ideal place to offer opportunities to bring scientists in different areas - measurement, evaluation, and transport simulation, to discuss such common issues residing in understanding experimental techniques. We foresee experimental groups in many countries are interested in participating in such activities if NDS decides to proceed.

Interconnection among different areas of nuclear data

Similarly, stronger interconnection among theoretical nuclear physics, production of evaluated nuclear data files, and data processing has also become important nowadays to produce reliable nuclear data for applications. In March 2021, NDS organized an online consultancy meeting of "model code output and application nuclear data form structure," where experts in these different areas were invited and discussed on what is the most reasonable way to preserve and transfer information given by theoretical calculations to actual application codes. We believe such meetings are very unique and useful activities organized by NDS, besides on-going CRPs that focus on a more specific topic. We request that NDS keeps providing opportunities for nuclear data scientists in different areas to interact with each other. This is particularly important to maintain high quality nuclear data.