



# OLD DOMINION UNIVERSITY

COLLEGE OF SCIENCES

## OFFICE OF THE DEAN

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April 4, 2023

Dr. Asmeret Asefaw Berhe  
Director, Office of Science  
U.S. Department of Energy  
1000 Independence Ave., SW  
Washington, DC 20585

Dr. Sean Jones  
Assistant Director  
Directorate for Mathematical and Physical Sciences  
National Science Foundation  
2415 Eisenhower Avenue  
Alexandria, Virginia 22314

Dear Drs. Berhe and Jones,

In the letter from your offices dated April 13, 2022, you charged NSAC to establish a subcommittee to assess challenges, opportunities, and priorities for effective stewardship of nuclear data. Two reports were requested – the first is an assessment of the status of the US Nuclear Data Program (USNDP), including accomplishments and needs in basic science and several key applications. The second describes challenges to nuclear data stewardship and a strategic plan to guide federal investment in USNDP.

Attached please find the two reports from the NSAC subcommittee, which was chaired by Professor Lee Bernstein, from UC Berkeley and Lawrence Berkeley National Lab. The subcommittee membership was composed of experts in topical areas dependent on nuclear data, including national security and nonproliferation, medical applications, nuclear energy, basic science, space applications, and nuclear databases/international collaboration.

The subcommittee made 14 recommendations. The first three focus on the existing core USNDP capabilities:

1. Support the nuclear structure evaluation workforce to improve the currency, consistency, and accessibility of the Evaluated Nuclear Structure Data File (ENSDF);
2. Enhance nuclear reaction evaluation within the USNDP in support of the Evaluated Nuclear Data File (ENDF) through expansion of the workforce and integration of high performance computing, automation, and machine learning; and
3. Establish recommended values for fundamental nuclear properties, such as the atomic mass evaluations compiled in the AME, NUBASE and similar databases.



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These are followed by eight recommendations for new cross-cutting initiatives involving measurement, theory, and evaluation to address outstanding nuclear data needs that are not directly addressed by the above efforts:

4. *Astrophysics*: Establish a coordinated effort to improve evaluation and modeling in nuclear astrophysics for stellar dynamics, multi-messenger astronomy and nucleosynthesis;
5. *Statistical nuclear structure*: Develop and maintain nuclear structure evaluation beyond discrete states, including nuclear level densities, photon strength functions, optical model parameters and photonuclear data for improved reaction modeling, and exploring nuclear structure at finite temperature;
6. *Fission*: Establish methods for correlated fission data evaluations, including cross sections, fragment yields,  $n(A)$  and  $n(E_n)$  for nuclear energy, national security, nonproliferation and basic science;
7. *Radioactive Decay*: Strengthen and accelerate measurement, evaluation and dissemination of decay data for targeted nuclides of high-value for national security, nonproliferation and medical applications;
8. *Neutron-induced data reactions and structure*: Provide comprehensive, consistent neutron-induced structure and reaction data for nuclear energy, national security, nonproliferation and planetary nuclear spectroscopy;
9. *Charged-particle stopping powers*: Determine charged-particle stopping powers for detector design, space effects and ion beam therapy;
10. *Expanded reaction modeling*: Enhance nuclear reaction modeling capabilities to include compilation and evaluation of high-energy and charged particle induced data for space exploration, radionuclide production and ion beam therapy, and
11. *Fusion power*: Develop nuclear data for fusion energy systems including tritium production and materials damage cross sections.

In addition, three recommendations are presented to modernize and increase the efficiency of the nuclear data infrastructure, namely:

12. *Modern Data Formats*: Expand the development of new nuclear data formats to accommodate existing and new nuclear data types and improve access by modern software systems;
13. *Artificial Intelligence and Machine Learning (AI/ML) tools*: Develop, design, and incorporate modern methods using AI/ML tools to improve the nuclear data evaluation process, and
14. *Data Preservation*: Create an infrastructure for open data and data preservation for use by the entire nuclear science community.



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The subcommittee reports were presented to NSAC during its March 7, 2023 meeting. Following discussion, the report was approved unanimously.

Sincerely yours,

Gail E. Dodge  
Chair, NSAC

cc: Tim Hallman, DOE  
Allena Opper, NSF  
Denise Caldwell, NSF



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