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U.S. DEPARTMENT OF ENERGY
Office of Science

Presentation of the Nuclear Data Interim Report

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Update to the NDIAWG
September 28, 2022

Special Thanks

- **USNDP contributors**: *Shamsu Basunia, Jon Batchelder, Dave Brown, Bethany Goldblum, Aaron Hurst, Filip Kondev, Hye-Young Lee, Libby McCutchan, Boris Pritychenko, Michael Smith, Ramona Vogt*
- **Major NSAC-ND Contributors**: *Rike Bostelmann, Mike Carpenter, Mark Chadwick, Vivian Dimitriou (IAEA), Ayman Hawari, Calvin Howell, Arjan Koning, Caroline Nesaraja, Syed Qaim, Jo Ressler, Cathy Romano, Artemis Spyrou, Etienne Vermeulen.*
- ***Copy Editing***: *Cathy Romano, Ramona Vogt*

The First Part of the Charge (due 9/15/22)

1. Assess USNDP Status, which would include the following actions:
   a) Assess and document recent achievements in nuclear data and their impact.

   b) Survey current and future federal and non-federal needs for reliable, accurate, secure, accessible nuclear data.

   c) Assess the role, competitiveness, and importance of the USNDP in an international context.

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Input from USNDP staff

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Input from USNDP and IAEA Staff

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   b) Survey current and future federal and non-federal ***needs*** for reliable, accurate, secure, accessible nuclear data.

   Input from Subcommittee Members & Workshop Whitepapers

   c) Assess the role, competitiveness, and importance of the USNDP in an ***international context***.

   Input from USNDP and IAEA staff

The NSAC Nuclear Data (NSAC-ND) Charge Subcommittee

Person	Org	Person	Org
Friederike Bostelmann	ORNL	Arjan Koning	IAEA/Petten
Mike Carpenter	ANL/Atlas	Ken LaBel & Tom Turflinger	NASA & Aerospace
Mark Chadwick	LANL	Caroline Nesaraja	ORNL
Max Fratoni	UCB	Syed Qaim	Jülich
Ayman Hawari	NC State	Catherine Romano	Aerospace
Lawrence Heilbronn	UTK	Sunniva Siem	Univ. of Oslo
Calvin Howell	TUNL	Artemis Spyrou	MSU
Jo Ressler	LLNL	Etienne Vermeulen	LANL
Thia Keppel	J-lab	Ramona Vogt	LLNL

The subcommittee split into topical groups on Energy, Basic Science Nonproliferation, National Security, Medical and Space Applications

Compilation of the First Report

- Over the last 2½ months the topical subgroups provided input
- This information, together with the input from the USNDP, was compiled into a report including:

1. Recent Accomplishments of the USNDP solely and in collaboration with domestic and international partners;
2. Complementary International ND Efforts
3. ND needs for each application area;
4. Data needs that apply across multiple application areas

e.g., *Crosscutting* nuclear data needs

The report by the numbers…

– Totals: 95 pages, 6 Chapters, 33 figures, 7 tables, 293 references

1. Recent USNDP Accomplishments: 25 items; 23 pages
2. International efforts/collaborations: 4 pages
3. Nuclear Data needs (50 pages): Basic Science (8); Energy (9), including 4 detailed tables); Medical (8); National Security (3); Nonproliferation (8); Space (10).
4. Crosscutting Needs: Workforce Development; Ongoing Fission Evaluation; Accelerated Decay Data Evaluation; Statistical Structure Evaluation; (n,x) data & High energy data (5 pages).

A number of important topics were not covered due to lack of time (e.g., fusion, materials damage) – hence interim

USNDP Major Accomplishments

1. 2018 ENDF/B-VIII.0 Release
2. 2020-2022 XUNDL Pre-publication review
3. 2020, 2022 GNDS-1.9 & GNDS-2.0 & ENDF modernization
4. 2022 EXFOR-NSR PDF database
5. 2020 AME 2020, NUBASE 2020
6. 2021 ENSDF Code Modernization
7. 2020 Beta delayed neutron emitters CRP (published 2021)
8. 2021 Baghdad Atlas compilation/publication
9. 2022 Natural Language Modernization of Nuclear Science References
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12. 2021 Solar r-process Abundances using Nuclear Data
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Release of the primary database used by most applications

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Improving the flow through the nuclear data pipeline

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Creating special purpose topical databases for specific applications

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Providing new tools to aid in nuclear science research

Collaborative Accomplishments

1. The Nuclear Data Working Group and the Nuclear Data Interagency Working Group
2. Tri-laboratory Effort in Nuclear Data
3. Correcting a long-standing error in decay data: the ^{137}Ce story
4. Production and positron emission intensities for the medical radionuclide ^{86}Y
5. Recommended Nuclear Data Library for Medical Isotopes Production
6. Fission Yield Covariance Database
7. Gamma-X-ray coincident database
8. Improved fission modeling (FREYA)
9. 35Cl(n,p) for Molten Chloride Fast Reactors
10. 2022 Stellar Modeling for Nuclear Astrophysics Summer School
11. 2022 NSSC Nuclear Data Summer School (August 1-12, UC-Davis)
12. Recent Ph.D. Graduates

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Coordination with the broader application community

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Improved data for medical Isotope Production (DOE-IP)

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Improved data for Nonproliferation (NNSA/NA-22 and DTRA)

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Improved data for Nuclear Energy (DOE-NE)

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Workforce Development (NNSA/NA-22, Universities and Others)

International Efforts

1. Nuclear Structure and Decay Data: international collaboration
2. ICTP Workshops
3. Project to improve ENSDF processing codes
4. Decay Data for Monitoring Applications
5. Decay Data for Decay Heat and Anti-neutrino spectra calculations
6. Beta-delayed neutron emission data
7. New Decay Data Library for Monitoring Applications
8. Future perspectives

Contributions from Annual Review of Nuclear Data Article* and P. Dimitriou (IAEA)

*Annu. Rev. Nucl. Part. Sci. 2019. 69:109–36. https://doi.org/10.1146/annurev-nucl-101918-023708

Overview of Nuclear Data Needs Sections

1. **Basic Science:** Nuclear Structure and Nuclear Astrophysics
2. **Nuclear Energy:** Key nominal/uncertainty, covariance and thermal scattering data, decay data consistency and time-dependent analyses
3. **Medical Applications:** Decay Data, Production using High and Low Energy Ions and Gamma-rays, Integral Validation and Ion Beam Therapy
4. **National Security**: Support for ENDF databases and the NNDC, Training, Facilities and detectors/instruments and Simulation Codes
5. **Nonproliferation:** Nuclear Forensics, Safeguards, Emergency Response, Detection of Fissionable Materials Production FPY, (α,n), $(n,x\gamma)$, (γ,x) cross sections, benchmark & UQ studies and code development)
6. **Space Applications:** Radiation Protection, Planetary Spectroscopy, Space Reactors, Planetary Defense and Space-Based Detonation Detection

Several cross-cutting themes emerged

1. Workforce development
2. Ongoing Fission Evaluations
3. Accelerated *Decay Data* Evaluations
4. Improved Reaction Modeling via Extended Nuclear Structure Data Evaluation
5. (n,x) Data from thermal to 20 MeV (including structure, γ-ray production

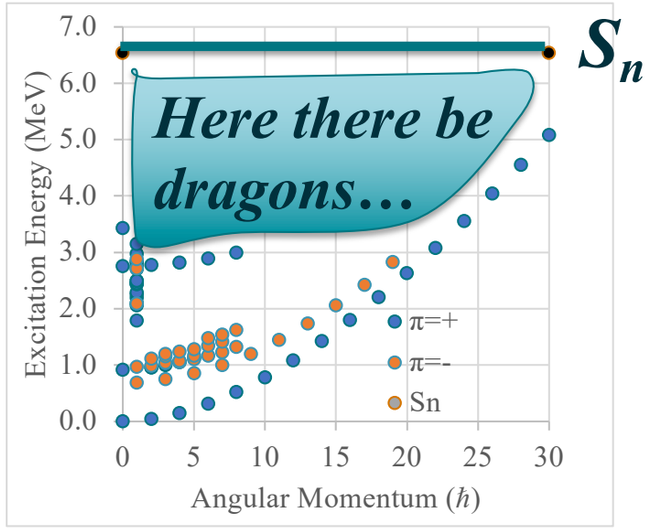
Reaction AND structure data

6. High Energy reactions, and stopping powers

All areas need this!

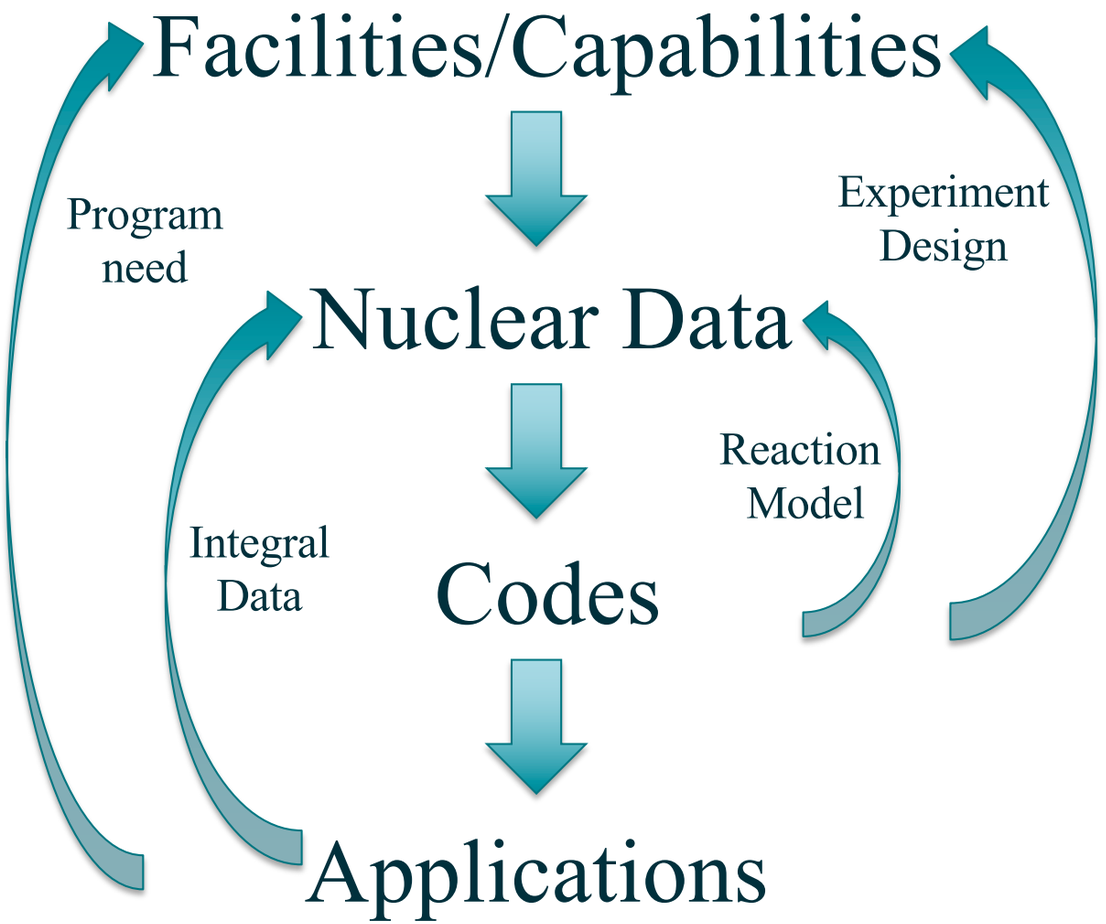
Not just once/30 years for FP Yields

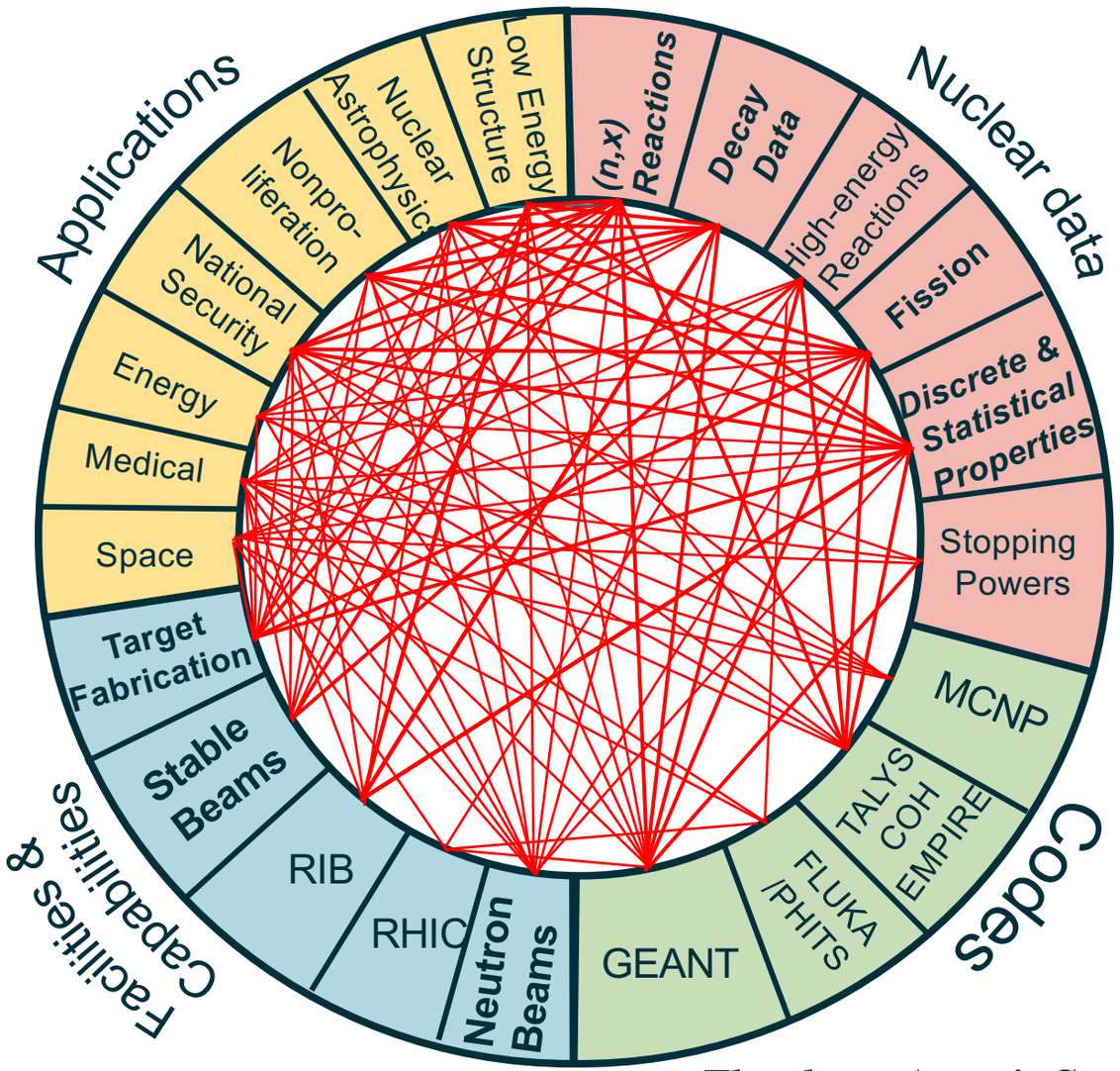
Not all data are created equal



Moving beyond 20 MeV

A new view of nuclear data's role is emerging





Thanks to Artemis Spyrou!

The Second Part of the Charge (due 1/30/23)

2. Based on the USNDP Status Report (from part 1), provide recommendations for maintaining effective stewardship of nuclear data, which includes the following actions:
   a) Identify challenges for nuclear data stewardship in the future, including identifying and prioritizing the most compelling opportunities to enhance and advance NP stewardship of nuclear data and the impact if those opportunities can be realized.
   b) Describe possible ways the Nuclear Data (ND) community can work to train and retain a diverse, equitable, and inclusive workforce capable of sustaining the U.S. ND enterprise.
   c) Identify access needs for facilities and instrumentation, crosscutting opportunities with other federal programs, and potentially mutually beneficial interactions with other domestic and international stakeholders.

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NSAC-ND can help with this **input from the USNDP, Universities+**

Ramona Vogt* has received support from the QCD community for a draft Nuclear Data Initiative

Nuclear data play an essential if sometimes unrecognized role in all facets of nuclear physics. Access to accurate, reliable nuclear data is crucial to the success of important missions such as nonproliferation and defense, nuclear forensics, homeland security, space exploration, and clean energy generation, in addition to the basic scientific research underpinning the enterprise. These data are also key to innovations leading to new medicines, automated industrial controls, energy exploration, energy security, nuclear reactor design, and isotope production. It is thus crucial to maintain effective US stewardship of nuclear data.

- We recommend identifying and prioritizing opportunities to enhance and advance stewardship of nuclear data and maximize the impact of these opportunities.
- We recommend building and sustaining the nuclear data community by recruiting, training, and retaining a diverse, equitable and inclusive workforce.
- We recommend identifying crosscutting opportunities for nuclear data with other programs, both domestically and internationally, in particular with regard to facilities and instrumentation.

*LLNL/UC-Davis

Next Steps

- Much of the information gathered for this report will be of use for the LRP process (e.g., applications and synergies with other federal agencies
- Over the next 2 weeks the topical subgroups will meet to divvy up tasks for generating the second report
- We will likely solicit input from the broader nuclear science and engineering community on workforce development and DEI

Thanks for your attention!