The DOE Isotope Program
Perspective on Nuclear Data

Workshop for Applied Nuclear Data Activities (WANDA 2021)
Connecting the humans behind the nuclear data
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Dr. Ethan Balkin
Program Manager for Isotope R&D
Office Isotope R&D and Production, Office of Science, U.S. Department of Energy
DOE IP is both a producer and consumer of nuclear data.

Briefly:
1) We produce isotopes in short supply
2) We develop novel, cutting edge, approaches to isotope production (often the only producer globally)
3) As the facilities we utilize are upgraded or newly commissioned (FRIB), we need to be able to optimize production
4) This means we need a lot of new and updated nuclear data
Programmatic Needs

- Cross sections for reactor production
  - Effective cross sections
  - Excitation functions
- Energy resolved cross sections for accelerator production with
  - High energy protons
  - High energy neutrons
  - Photons

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<tr>
<th>p,2n</th>
<th>p,p</th>
<th>γ,n</th>
<th>n,2n</th>
<th>Target Nucleus</th>
<th>n,γ</th>
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<td>p,p2n</td>
<td>n,3n</td>
<td>p,2p2n</td>
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<tr>
<td>p,pa</td>
<td>n,α</td>
<td>p,3pn</td>
<td>n,α</td>
<td>p,3p</td>
<td>n,γ</td>
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Accelerators (high energy protons)
Accelerators (photons)
Reactors (neutrons)
Accelerators (high energy secondary neutrons)
Expanding measurement capability to multiple facilities to better cover proton energy ranges up to 200 MeV

- Berkeley (<60 MeV) - includes Faraday cup style chamber for monitor reaction measurements
- LANL – IPF (40-100 MeV) – includes new low beam current measurement capability for monitor reaction measurements (100 nA with 1% accuracy)
- BNL – BLIP (100-200 MeV)
Ongoing Measurements

- **High Energy Protons**
  - Th+p for production of therapy isotopes $^{225}\text{Ac}$, $^{227}\text{Th}$ and $^{223}\text{Ra}$
  - natSb, $^{121}\text{Sb}+p$ for production of $^{119}\text{Te}/^{119}\text{Sb}$, a promising Auger e-emitter for therapy
  - La+p for production of $^{134}\text{Ce}/^{134}\text{La}$ (PET analogues for $^{225}\text{Ac}$ and $^{227}\text{Th}$)
  - Fe+p, Cu+p for production $^{52}\text{Mn}$, $^{54}\text{Mn}$, $^{48}\text{Cr}$, $^{55}\text{Co}$, $^{58m}\text{Co}$, $^{57}\text{Ni}$
  - Nb+p for $^{93}\text{Nb}(p,4n)^{90}\text{Mo}$ as monitor reaction
  - As+p for production of $^{72}\text{Se}$ – generator for $^{72}\text{As}$ (PET imaging isotope of the $^{72}\text{As}/^{77}\text{As}$ theranostic pair)

- **High Energy Neutrons**
  - Production of $^{193m}\text{Pt}$, $^{64}\text{Cu}/^{67}\text{Cu}$, $^{47}\text{Sc}$, $^{77}\text{As}$ via (n,p)

- **Photonuclear**
  - $^{48}\text{Ti}(\gamma,p)^{47}\text{Sc}$, $^{196}\text{Pt}(\gamma,n)^{195m}\text{Pt}$

- **Low energies**
  - $^{232}\text{Th}(p,x)^{229}\text{Th}$ for production of $^{229}\text{Th}/^{225}\text{Ac}$
  - $^{238}\text{U}(p,xn)$ and $^{235}\text{U}(d,xn)^{235-237}\text{Np}$ for Production of $^{236g}\text{Np}$
The need for reliable evaluated nuclear data is true across all user communities

- Neutron induced reactions for isotope production

- Isotope Production is not limited to neutron induced reactions
- At best charged particle data is old
- Many times it is non-existent

- Charged particle Evaluated Nuclear Data File or ChENDF
  - Evaluated Reliable Resource
  - Underpinned by predictive codes
DOE IP has, and will continue to have, significant nuclear data needs requiring investment from it’s R&D portfolio.

Our investments have a direct impact on the products and services that we are able to provide.

Pathways exist for programs to partner with us to accelerate and/or add scope to our ongoing activities.
Thank You!