

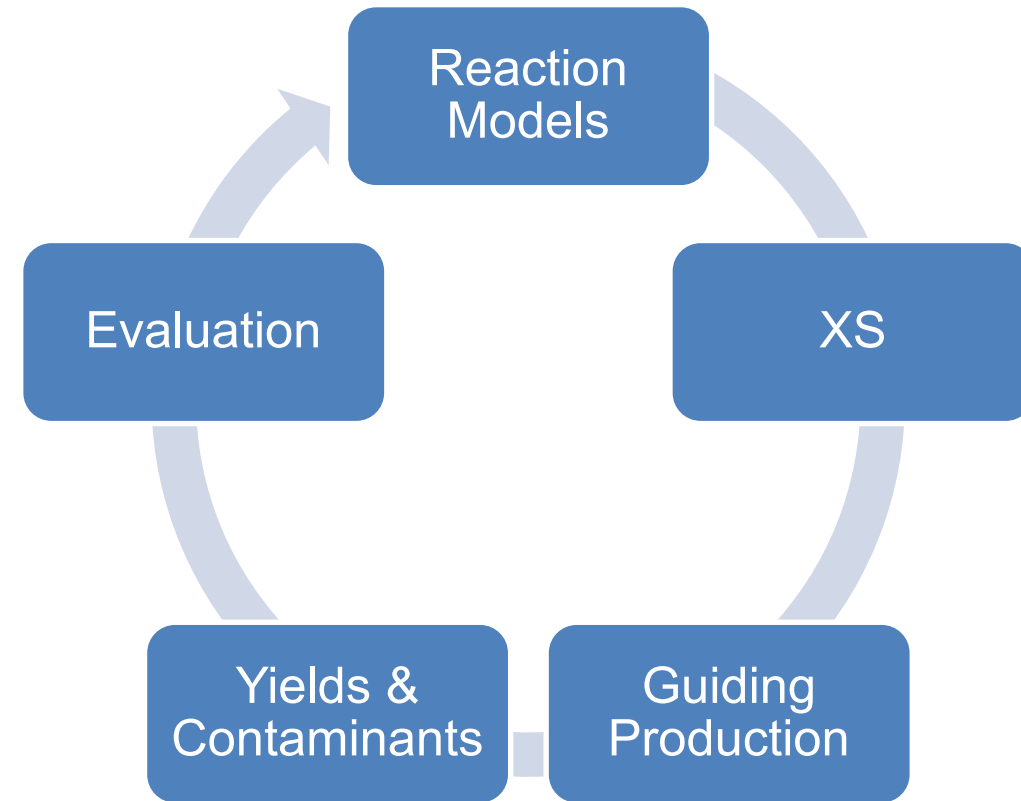
# WANDA 2023 Session Four Summary: Needs for Department of Energy Isotope Program

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# Cross Sections

- Need cross sections for charged particles ( $p < \sim 200$  MeV, light ions  $< \sim 30-50$  MeV/u), neutrons (primary and secondary), photonuclear (both production and reactor heating) as function of energy
  - $< 5\%$  is fidelity goal, different facilities/applications have different sensitivities
  - Need not just products of interest – ALL products, including stable
  - At these energies, *measurements and modeling of (p,f) are vital*
  - We need to think of IP cross section data in same tack as burnup/depletion, Astro – need network calculations?
- Need **reliable** and **evaluated** repository of this data – users in IP community are almost never nuclear data folks, often not even physicists – generally chemists
  - Needed both for single measurements (validation) and for multiple conflicting measurements (evaluation)
  - Tools and repository need to be tailored, accessible, transparent, flexible to updates
  - “Big red button” Request List – compile list of XS needs (new data/evaluation) from community submissions, cross-ref against range of measurement facilities?
- “Grey” Mark – WANDA19 (XS Data), WANDA21 (modeling) (and earlier...)



# Augers

- Meitner-Auger emitting radionuclides have significant potential for therapeutic applications, but clinical applications are still being held up by production XS needs, near-complete lack of measurements for emission spectrum, multiplicity
  - We have models for spectrum (BRICC...), but **clinical use and dosimetry cannot happen without actual measurements**
- Interface between UAB/TAMU/U. Chicago (production) → ANL (spectral measurements) → Roger Howell (dosimetry, small animal studies)
- Microcalorimeters (Geon-Bo Kim, Dan Becker) could be another tool for spectral measurements?
  - Cross-cutting application with Nonproliferation/Safeguards

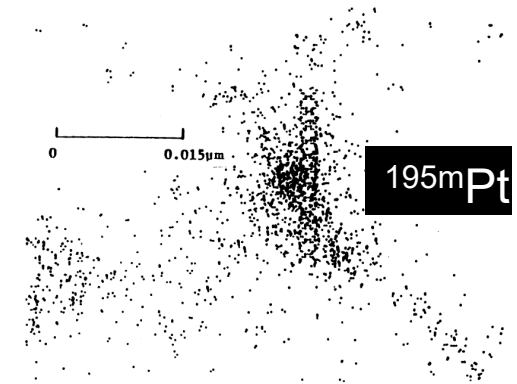
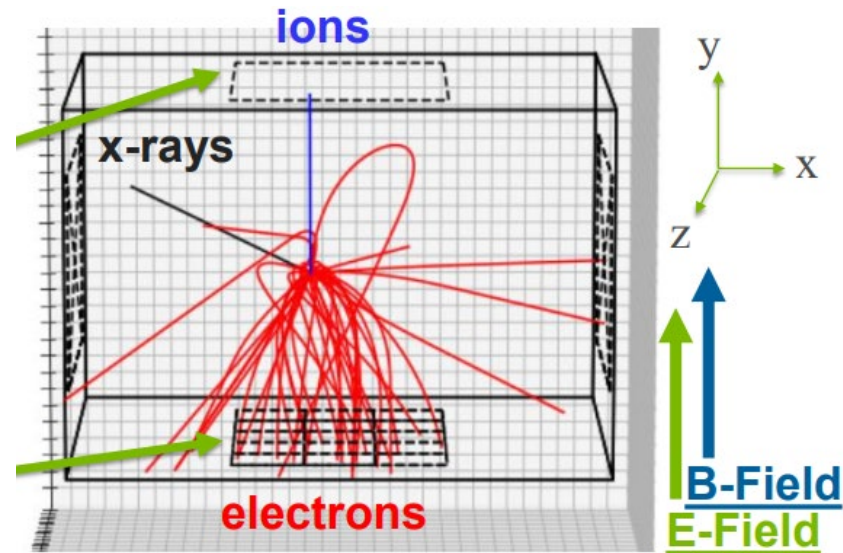


## A renaming proposal: “The Auger–Meitner effect”

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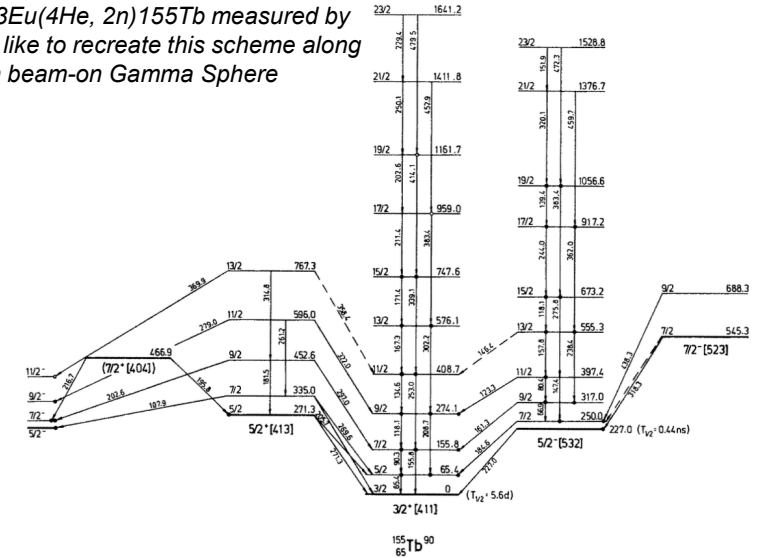
Physics Today 72, 9, 10 (2019); <https://doi.org/10.1063/PT.3.4281>



# Structure & Decay

- IP has strong connection to near-stability discrete structure – need level schemes, for prompt measurements
  - (n,x) coincidence measurements in prompt-gamma studies will be invaluable in constraining reaction modeling
- Nuclei far from stability often get attention for HEP, astrophysics applications, near-stability structure “was done years ago”
  - Again, current applications often demand higher fidelity data than existing evaluations
- Need improved decay data also: lifetimes, decay radiation branching ratios, branching ratios for populations of excited states

Figure 5: Decay scheme of  $^{153}\text{Eu}(4\text{He}, 2n)^{155}\text{Tb}$  measured by Winter et al. (1971). We would like to recreate this scheme along with  $^{154}\text{Tb}$  and  $^{156}\text{Tb}$  through beam-on Gamma Sphere measurements vs. energy.



PHYSICAL REVIEW C **101**, 064619 (2020)

## Resolution of a discrepancy in the $\gamma$ -ray emission probability from the $\beta$ decay of $^{137}\text{Ce}^g$

M. S. Basunia<sup>a,1</sup>, J. T. Morrell<sup>b,2</sup>, M. S. Uddin,<sup>3</sup> A. S. Voyles<sup>a,1,2</sup>, C. D. Nesaraja<sup>a,4</sup>, L. A. Bernstein<sup>a,1,2</sup>, E. Browne,<sup>1</sup> M. J. Martin,<sup>4</sup> and S. M. Qaim<sup>5</sup>



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journal homepage: [www.elsevier.com/locate/apradiso](http://www.elsevier.com/locate/apradiso)



Precision measurement of relative  $\gamma$ -ray intensities from the decay of  $^{61}\text{Cu}$

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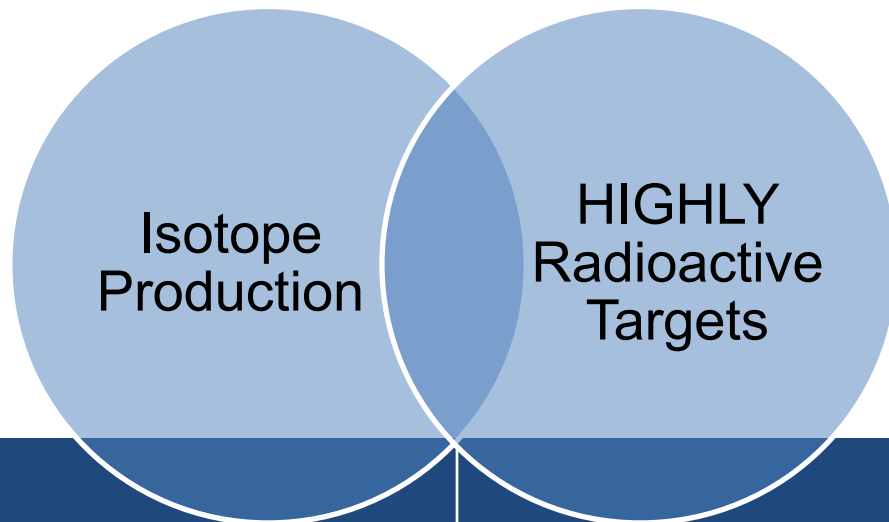
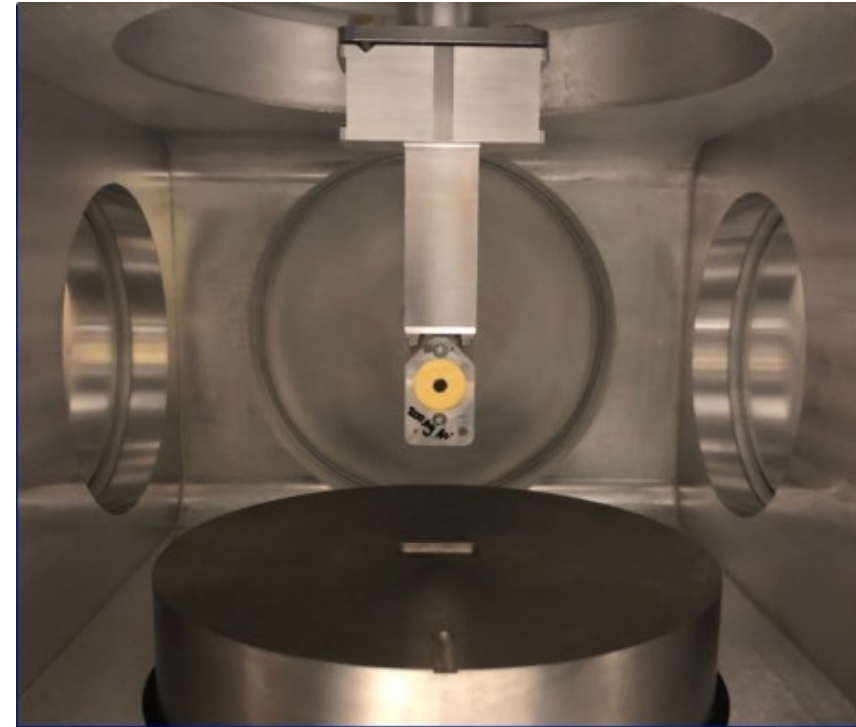
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# Rad Targets

- Will become progressively more important as FRIB, astrophysics, etc. applications continue
  - Relatively short-lived isotopes are turned into radioactive targets, that are used at the facilities they are produced at!
- Rad targets are fundamental capability for all of nuclear physics – stable targets are easy, and “everything easy has been done”
  - HotLENZ, DICER are essential for measuring neutron-induced data, as it is not accessible with FRIB!
- IP is an essential component of making rad targets!



# Stopping Power

- One of the worst-kept secrets affecting all areas of IP – XS measurements, target design, ***and also dosimetry***
- Models were tuned well enough in days of Bethe-Bloch, Andersen-Ziegler, current needs demand higher fidelity
- Cross cutting with space applications, dosimetry/shielding, semiconductors/materials

# University Connections

- National labs often get the spotlight for IP, but universities make up significant share of domestic production efforts
- Universities are essential tool for early R&D, lead translation from mCi-scale production toward labeling studies, small animal studies, clinical/pre-clinical applications
  - Students are also leading the vanguard in evaluating TREND data sets!
  - Capitalize upon universities as “incubators”?
  - TAMU, UAB, UWM, UW, UC.....
- Students are the vanguard for many current cross section measurements, IP is great training pathway for young scientists – workforce development!
- Invaluable for early development of new data evaluators



Please send feedback!

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