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# LANL/IAEC Collaboration on Nuclear Physics

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- LANSCE Neutron Beams offer differential measurements on stable and near-stable isotopes
- SARAF Neutron Beams offer unprecedented intensities for integral activation measurements
  - This includes in situ production of unstable isotopes
- Natural complementarity of facilities to answer wide-ranging science questions
- Initial focus used SARAF-I fluxes from A. Shor *et al. PRC* **96** (2017).
- Designed to give a flexible and quick estimate to follow-on for science impact
- New flux profiles from SARAF-II can be trivially implemented

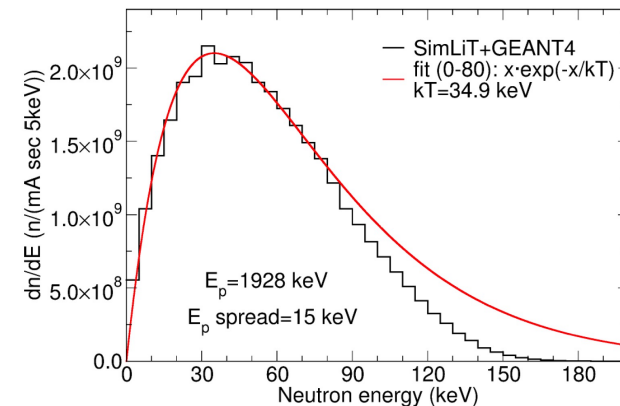


FIG. 8. Actual distribution of neutron flux  $dn/dE_n$  impinging the bismuth target, as simulated by SimLiT and Geant4. A best fit for Maxwellian in the region of 0–80 keV gives  $kT = 34.9$  keV.

# Feasibility Study for Double Neutron Capture

- All possible double capture chains analyzed where the starting material (N+0) has  $t_{1/2} > 2$  yrs, the N+1 isotope and N+2 isotope are both unstable.
  - 1.5 mA of beam for 180 days of irradiation on 1 mol of isotopically pure starting material
  - Cross sections from ENDF used where possible and TENDL otherwise were folded with the neutron spectrum and reaction rates were calculated for capture
  - 99 double capture chains meeting the criteria were examined using an ODE solver to track production and destruction over time and determine the ratio of N+2 to total atoms after irradiation.

Here are a few cases but not an exhaustive list that could be interesting

Several of these need more irradiation time or flux

A (N+1)	Z (N+1)	Element	N+1 $t_{1/2}$	N+2 $t_{1/2}$	N+2/Total	N+2 Decay Mode	Analysis Method
59	26	Iron	44.5 d	2.6E6 yr	9.4E-17	$\beta^-$	AMS
43	33	Arsenic	1.09 d	38.8 hr	2.36E-17	$\beta^-$	AMS
86	37	Rubidium	18.6 d	4.9E10 yr	4.12E-15	$\beta^-$	AMS
150	51	Antimony	60.2 d	2.76 yr	4.6E-14	$\beta^-$	AMS
160	65	Terbium	72.3 d	6.9 d	7.14E-14	$\beta^-$	Activation
170	69	Thulium	128.6 d	1.92 yr	3.96E-13	$\beta^-$	AMS

- Framework is fully scripted and can be adapted for any change to input parameters
- Treatment for double (n,2n) can easily be included with a different flux profile