LANL report for US Nuclear Data Program in FY20

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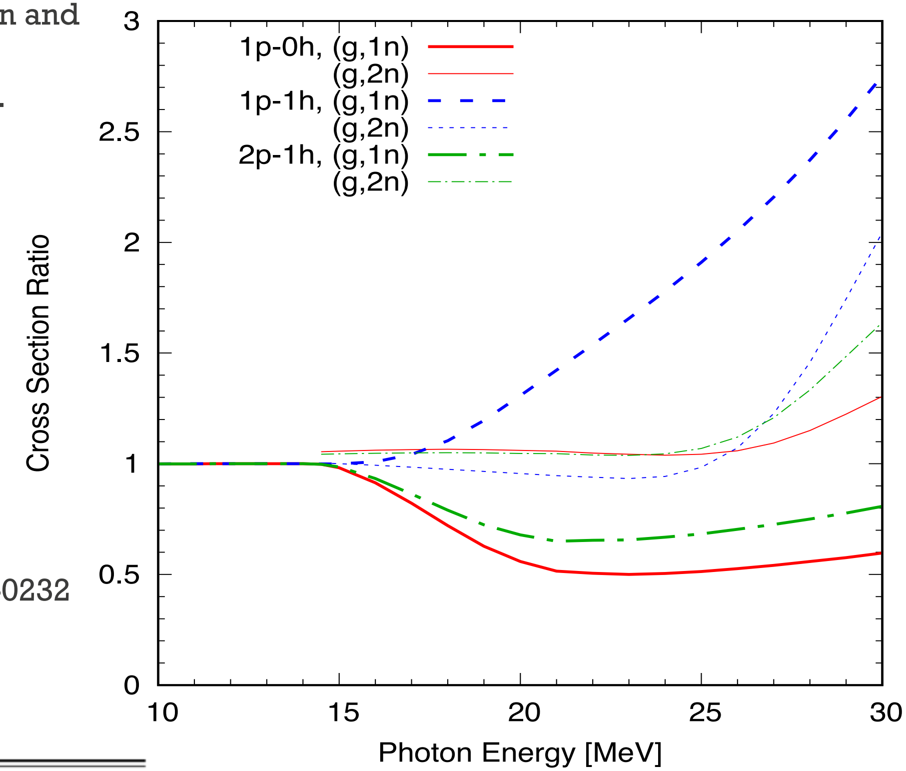
LANL

Staffing changes:

1. *Sean Kuvin, converted to be a new staff in P-27 group*

IAEA Photonuclear Data Library 2019

- IAEA Coordinated Research Project on photon strength function and photonuclear data library update
- Final report (NDS **163**, 109 (2020)) published, coordinated by T. Kawano
- LANL investigated photo-induced preequilibrium process, especially the impact of initial particle-hole configurations
  - CoH$_3$ splits the reaction mechanisms into Giant Dipole Resonance (GDR) and Quasi-Deuteron (QD) photo-absorption, and use different configurations for each mechanism, while other codes emulate photo-induced reactions by neutron-induced
  - High energy part could have larger uncertainties due to the model assumption, but the impact is marginal (cross sections small)
- Data processing test with IAEA, report published in IAEA-NDS-0232
  - NJOY issue reported, and LANL fixed



Calculated ^{181}Ta(γ,n) and (γ,2n) cross sections for different particle-hole configurations, ratio to CoH$_3$

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Nuclear Data Sheets

Nuclear Data Sheets 163 (2020) 109–162

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IAEA Photonuclear Data Library 2019

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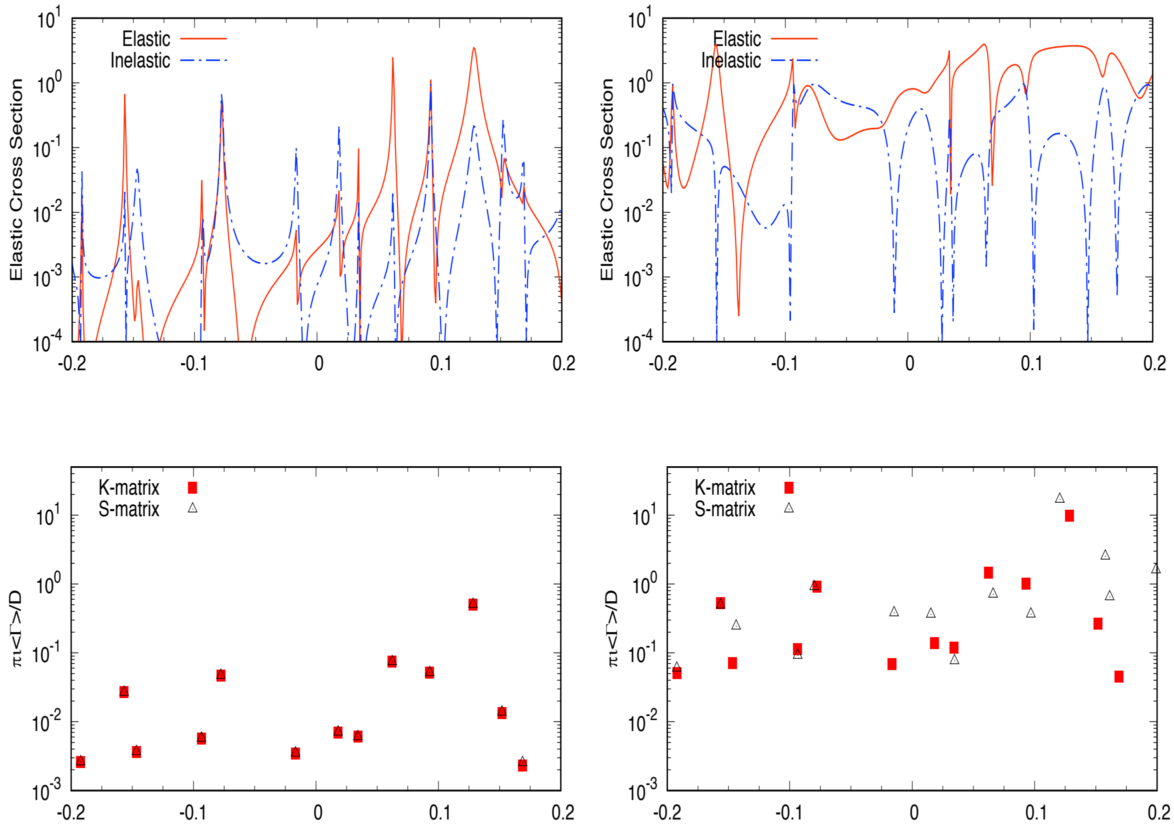
GOE Statistical Theory Development

- Relation between the average decay width <Γ> and compound reaction cross section studied in terms of the S and K-matrices representation
  - Widths by S and K-matrices agree when absorption is weak
  - They differ in the strong absorption regime
- Statistical model expressed by the transmission coefficient always give the correct average cross section, while expression by <Γ> is ambiguous



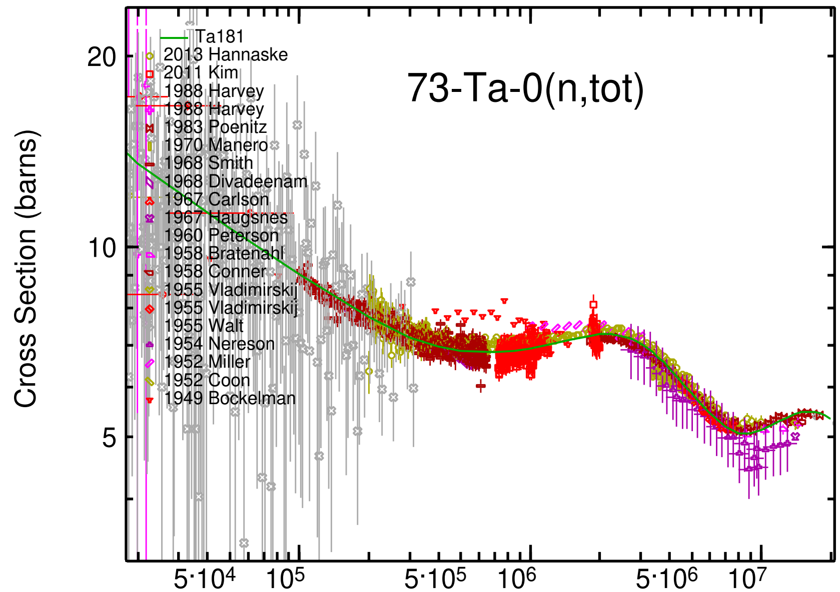
Weak absorption

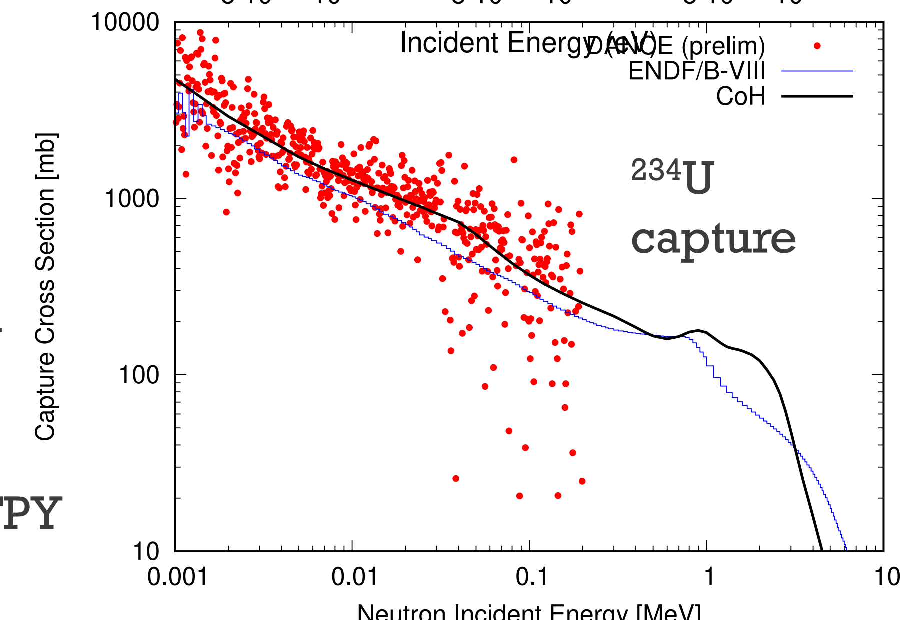
Strong absorption

Evaluation of ^{181}Ta, ^{234,236}U, and FPY

On-going new evaluations

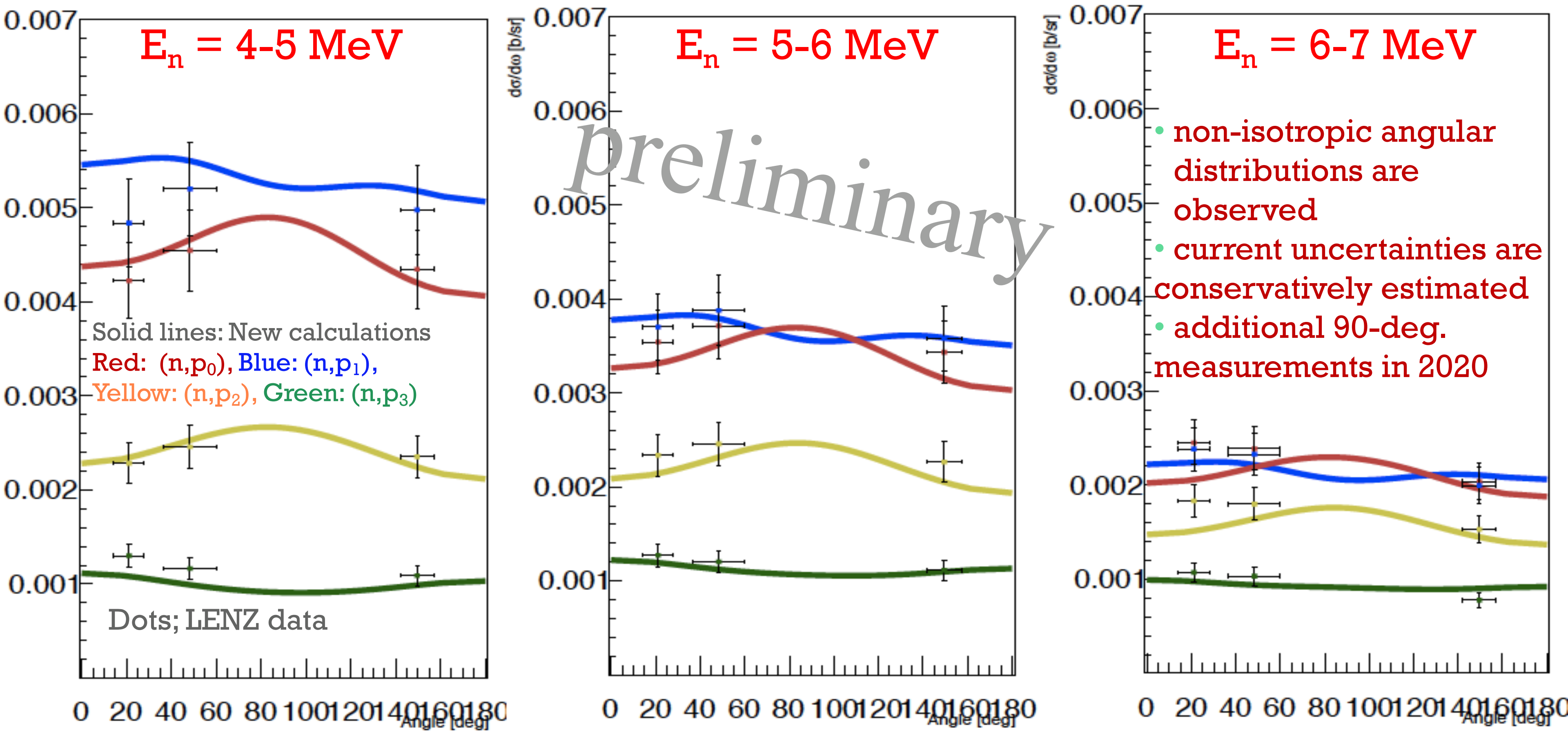
- ^{181}Ta, reported by M. Herman
  - Interesting deformed nucleus, work on-going
  - Paper on unified Coupled-Channels Hauser-Feshbach model will be published (EPJA)
- ^{234,236}U, reported by I. Stetcu
  - Submitted to NNDC
  - SOK code for fission evaluation
  - New KALMAN code applied for parameter optimization
- FPY evaluation
  - Funded by NNSA/NA22, but theoretical modeling aspect by USNDP
  - CoH_3/BeoH significantly utilized
  - PRC paper on energy dependence of FPY submitted (A. Lovell)





^{54}Fe(n,p) angular distributions ($d\sigma/d\Omega$ (b/sr) vs. θ_{lab} (deg))

Work by A. Georgiadou, prepared for Phys. Rev. C submission



New Angular distributions are performed by calculating Legendre coefficients explicitly with CoH by Kim, Kawano, et al.

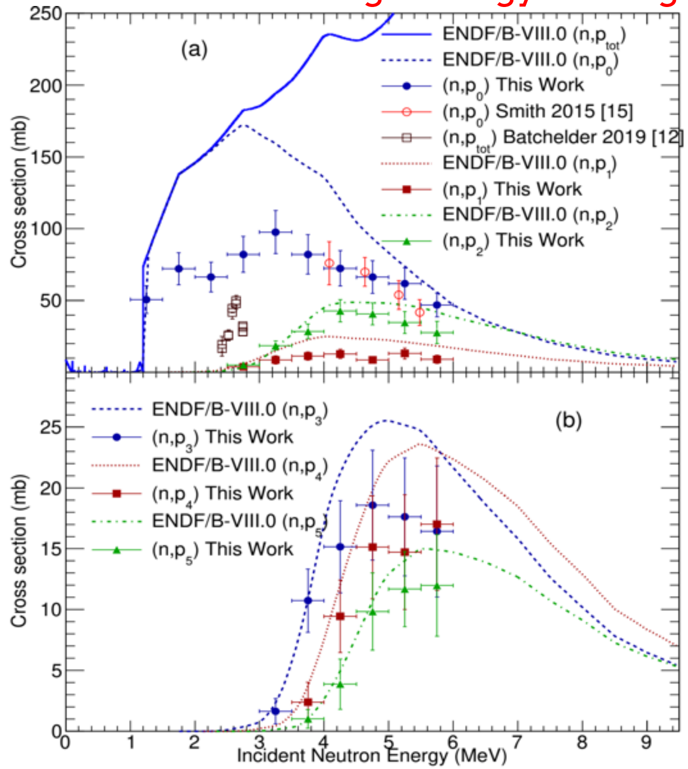
"New Evaluation on Angular Distributions and Energy Spectra for Neutron-induced Charged Particle Measurements", H. I. Kim, H. Y. Lee, T. Kawano, A. Georgiadou, S. A. Kuvin, L. Zavorka, and, M.W. Herman, Nucl. Instr. Meth. A 963, 163699 (2020)

^{35}Cl(n,p) cross section at fast-neutron energy

Our results suggest a full evaluation of this reaction including a new measurement below 1 MeV

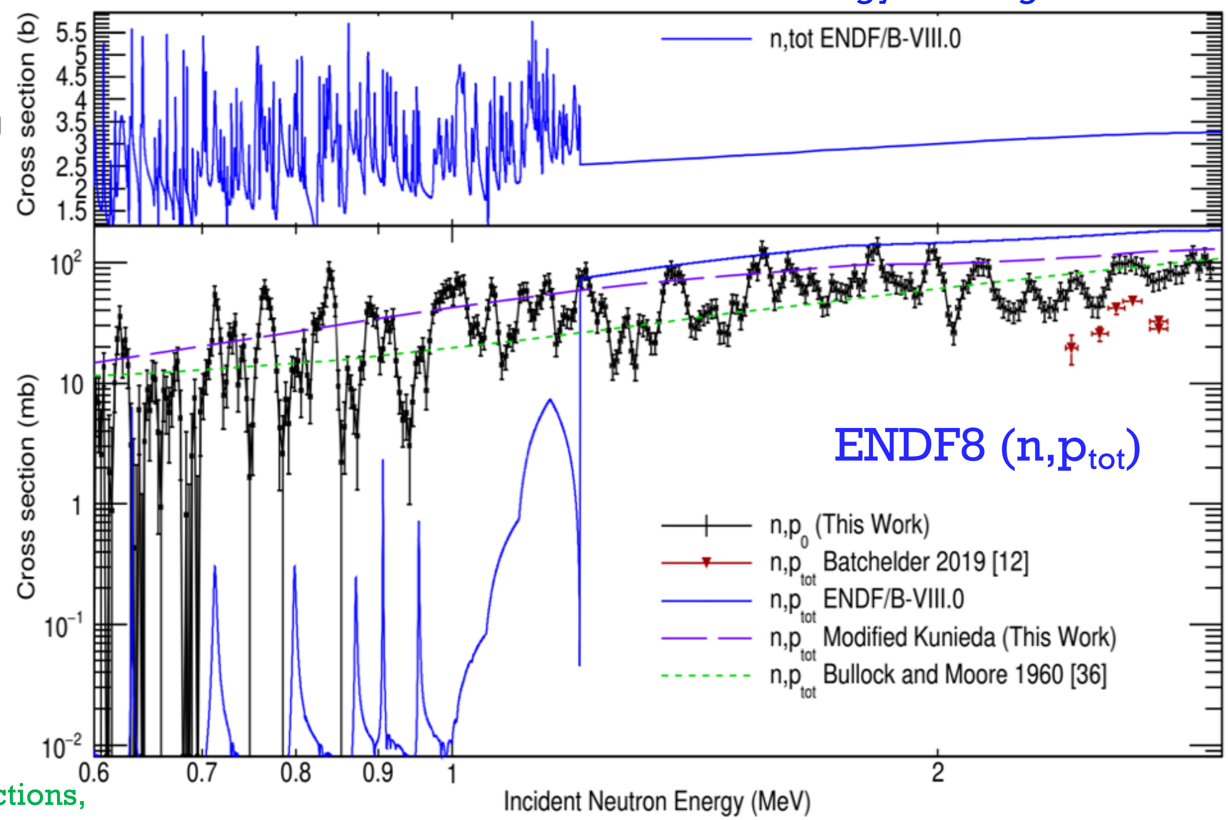
"Nonstatistical fluctuations in the ^{35}Cl(n,p)^{35}S reaction cross section at fast-neutron energies from 0.6 to 6 MeV", S. A. Kuvin, H. Y. Lee, T. Kawano, B. DiGiovine, A. Georgiadou, C. Vermeulen, M. White, L. Zavorka, and H. I. Kim, Phys. Rev. C 102, 024623 (2020)

En > 1 MeV with large energy binning



ENDF/B-VIII.0 overpredicts discrete cross sections, however we explored the modified Kunieda potential which reproduced the measure cross sections reasonably well

En > 0.5 MeV with small energy binning

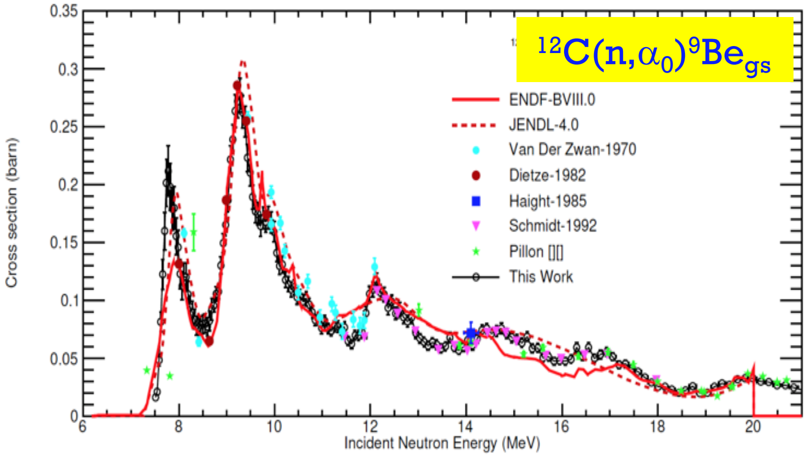


Comparing to Batchelder's data (red dots), we confirmed non-statistical behavior, which is in particular consistent with the transmission data (top panel) for neutron energy below 1 MeV.

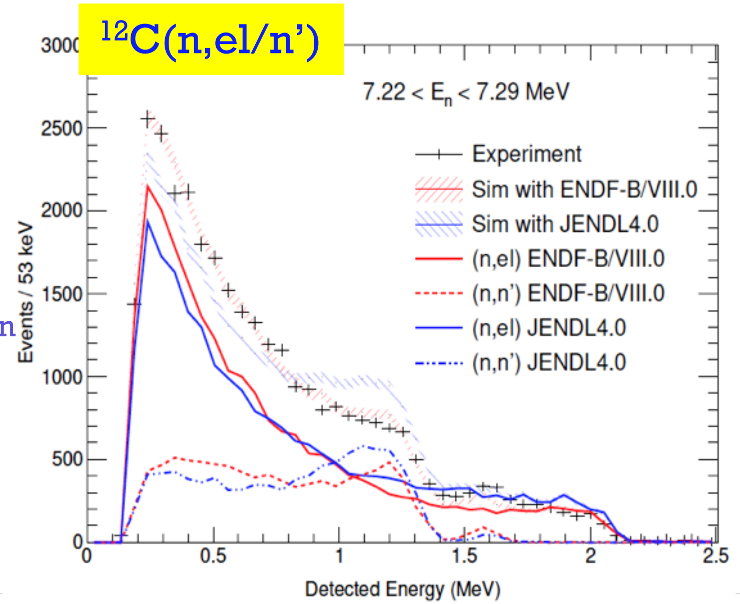
Diamond data- validation of $^{12,13}C(n,x)$ reactions

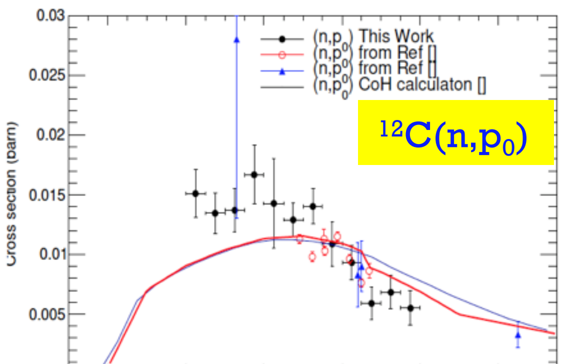
Black dots: LANSCE data

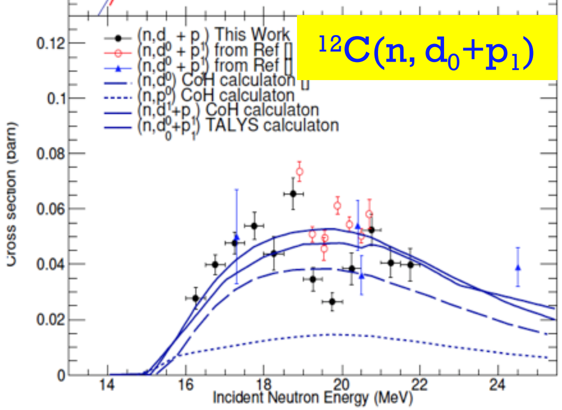
"Validation of neutron induced reactions on natural carbon using an active target at neutron energies from 0.4 to 22 MeV at LANSCE", S. A. Kuvin, H. Y. Lee, B. DiGiovine, A. Georgiadou, and D. Votaw, Phys. Rev. C (in preparation)



Without completely disentanglement of elastic channels from inelastic channels, a pulse height spectrum could validate different evaluations. Our data is better reproduced when simulation used the ENDF/B-VIII.0 evaluation for elastic scattering and inelastic scattering.







For the relevant LANSCE data energy range, the elastic and inelastic scattering cross sections (Resler 1989 measurements at Ohio U.) are compared with the $^{13}C(n,\alpha_0)$ channel. Presented similar structures in both reaction channels.