Comprehensive New Evaluation of the ^{8}Be System

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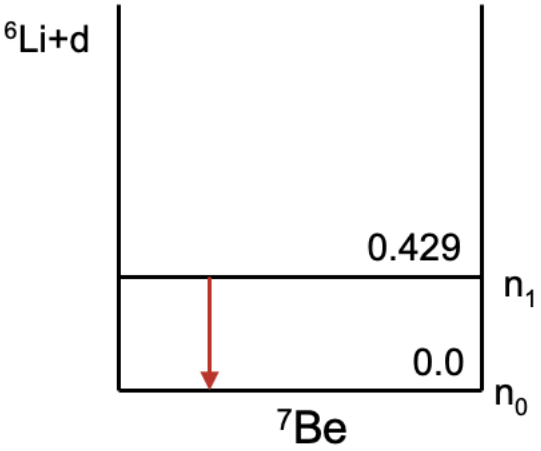
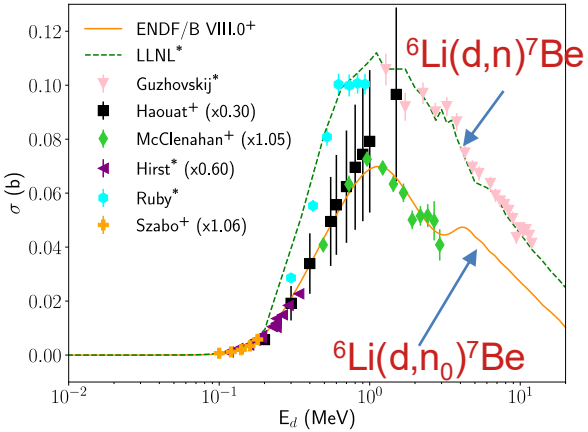
Outline

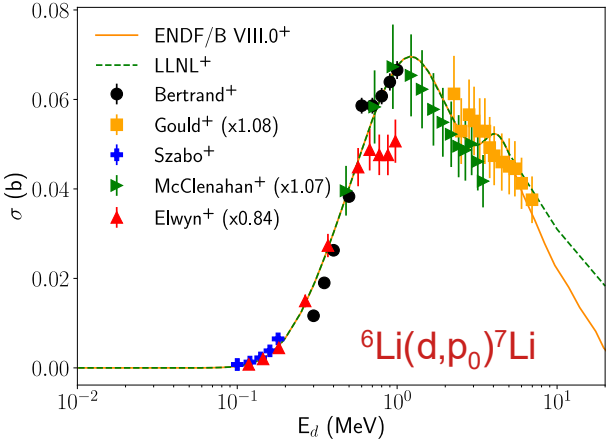
- Motivation
- *R*-matrix analysis of ^{8}Be
  - Updates on Energy Dependent Analysis (EDA) analysis of ^{8}Be system.

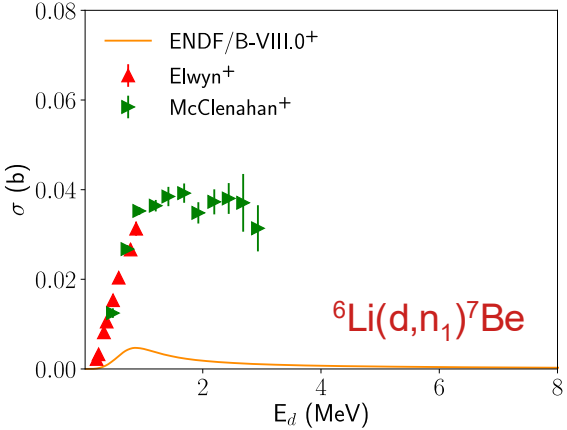
Motivation

- Charged particle-induced reactions on light nuclei are important for nuclear astrophysics and nuclear applications.
- All the charged particle-induced reactions that forms an intermediate compound nucleus is described in *R*-matrix formalism.
- For the case of ^{8}Be compound system, the existing ENDF evaluation only includes reactions channels resulting in the ground state of residual nucleus such as ^{6}Li(d,n$_0$)^{7}Be, ^{6}Li(d,p$_0$)^{7}Li thereby excluding the reactions resulting the residual nucleus in excited state such as ^{6}Li(d,n$_1$)^{7}Be, ^{6}Li(d,p$_1$)^{7}Li, etc.
- Incompleteness shown in recent publications by S. N. Paneru *et al* (Phys. Rev. C 110, 044603 (2024) and Phys ReV C 111, 064609 (2025))





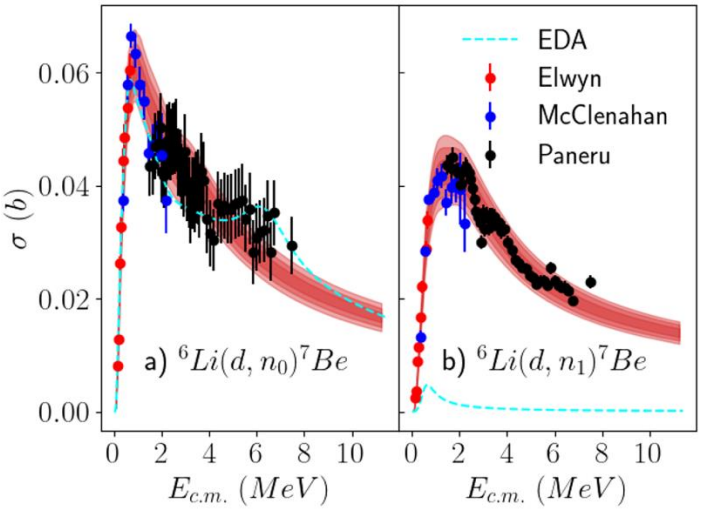


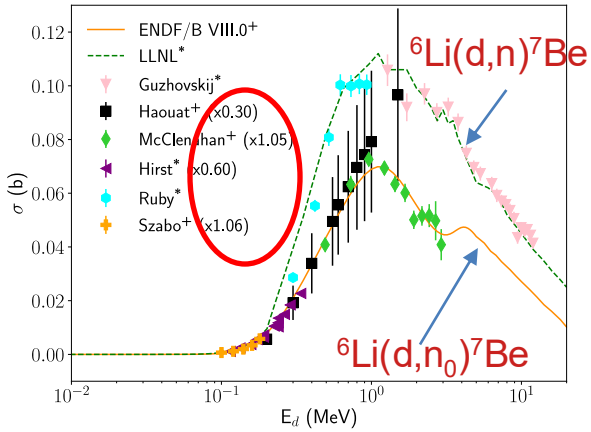


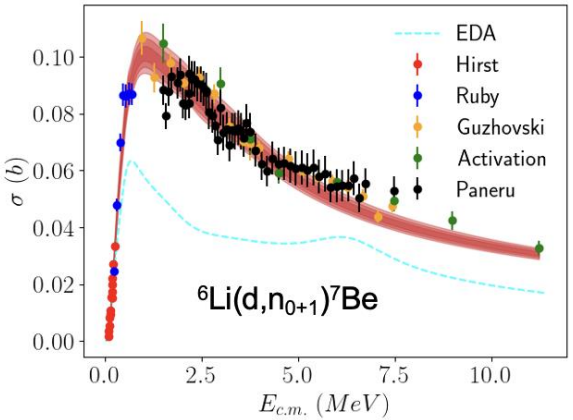
S. N. Paneru *et al.*, Phys. Rev. C 110, 044603 (2024)

Motivation

- Recent publication: S. N. Paneru *et al* , Phys ReV C 111, 064609 (2025), used modern Bayesian techniques to fit the subset of the data available in the literature using AZURE2. Provided the realistic uncertainty estimates.
- Incorrect assignment of the partial cross sections and the total cross sections lead to the non-physical normalization factors.

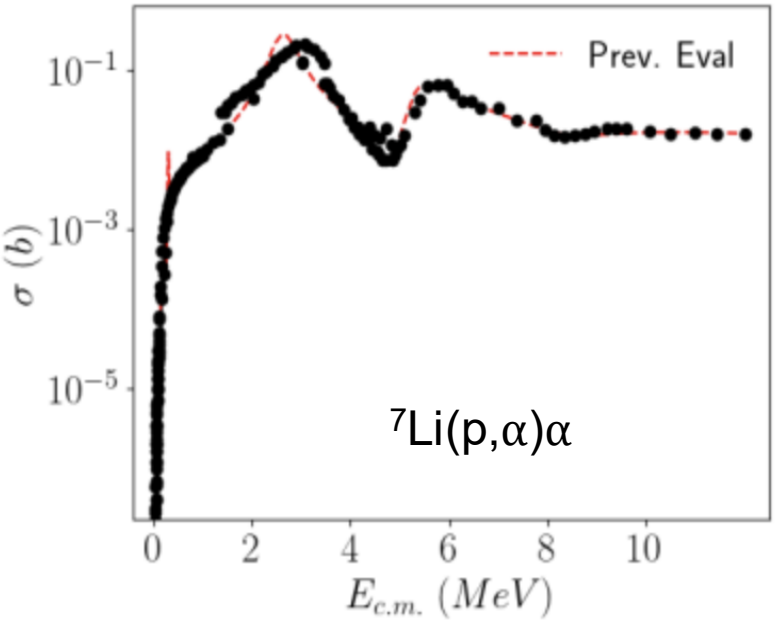






Identical Particles

- Inconsistencies were observed for the reaction channels with identical particles in exit channels such as for ^{7}Li(p,α)α, ^{6}Li(d,α)α.
- Leading to non-physical structures in the evaluation.

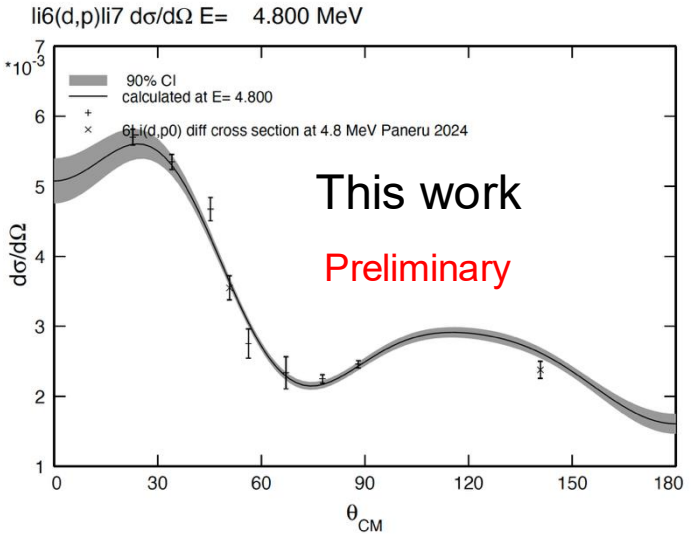


A new evaluation of ^{8}Be system using EDA code (developed at LANL) was started to address these limitations.

Ongoing Work:

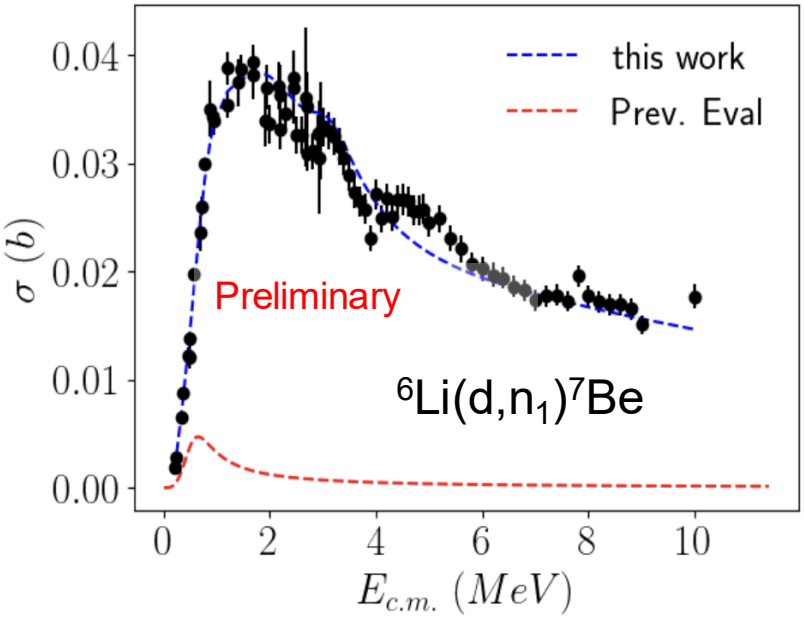
- The data included in the evaluation is reviewed again for consistency checks and additional information.
- The orbital angular momentum for each partition have been increased from previous evaluation keeping the channel radius same based on the original publication.

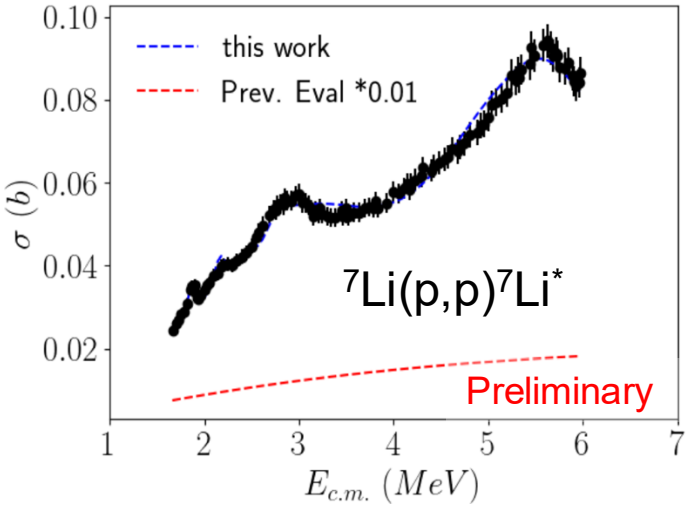
P	Particle Pair	Orbital Angular momentum (l)	Channel radius (fm)
1	$\alpha+\alpha$	8	4.0
2	$^{7}Li+p$	4	4.15
3	$^{7}Li+p_1$	4	5.0
4	$^{7}Be+n$	4	4.15
5	$^{7}Be+n_1$	4	5.0
6	$^{6}Li+d$	4	6.4639
7	$^{8}Be+\gamma$	2	50.0

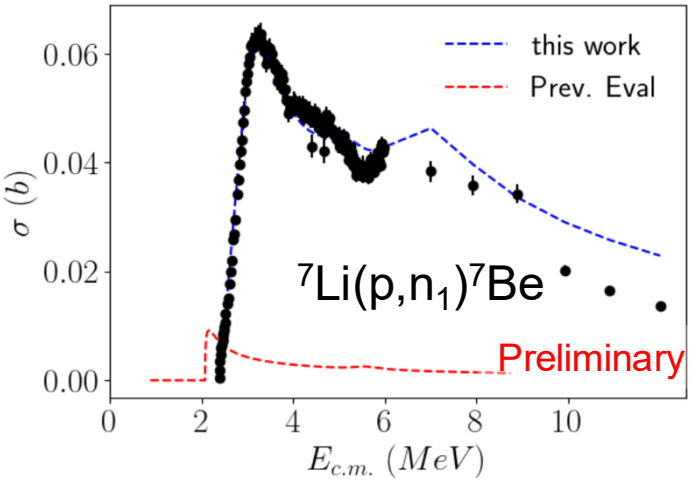


Ongoing Work

- Added data to reactions resulting the residual nucleus in excited state such as $^{6}Li(d,n_1)^{7}Be$, $^{6}Li(d,p_1)^{7}Li$, etc.

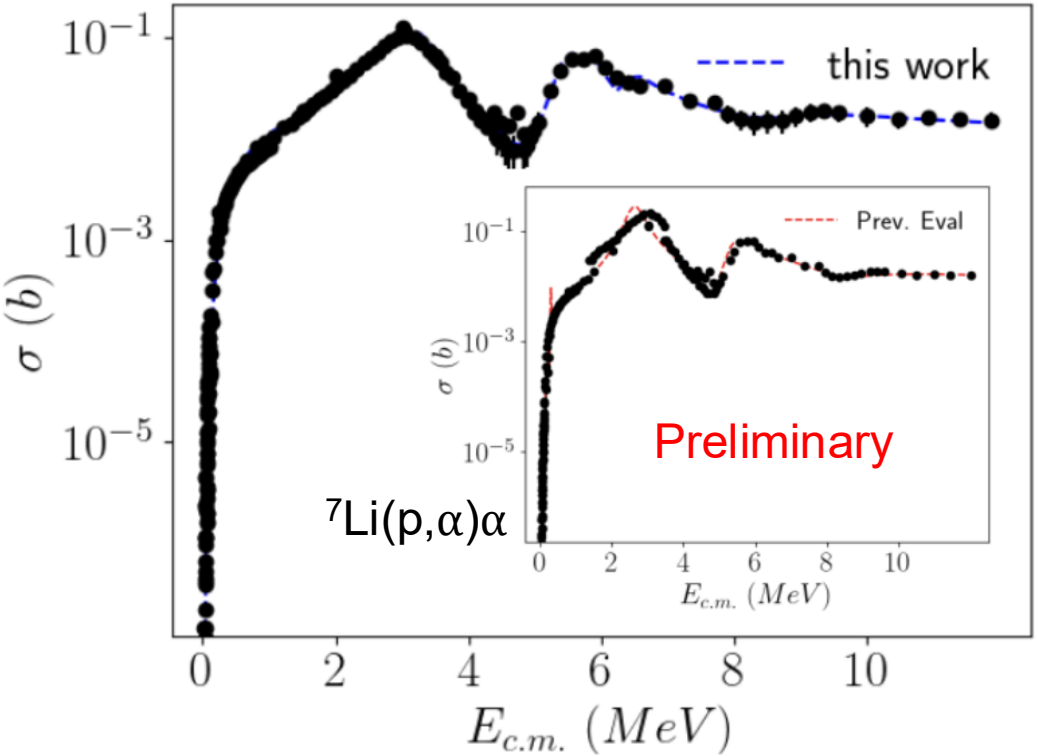






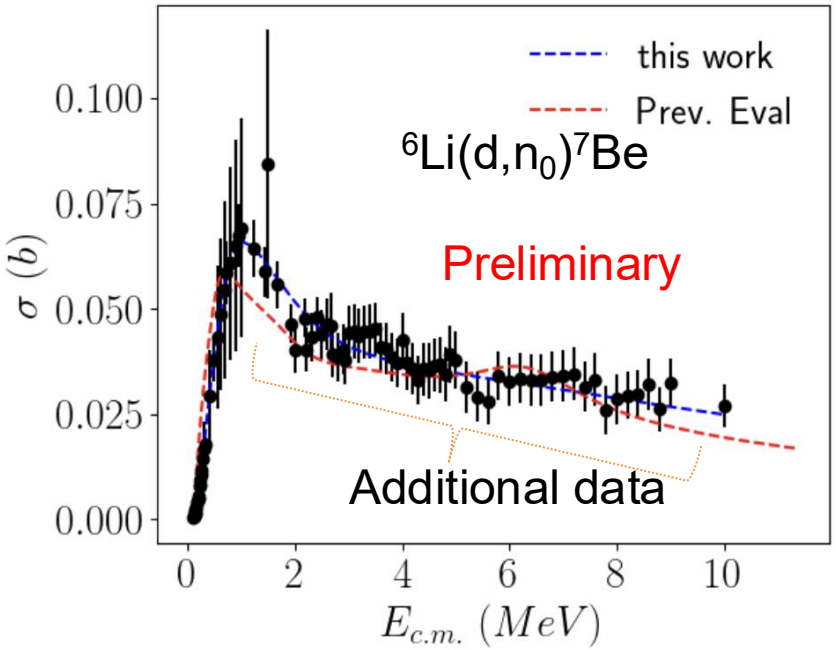
Ongoing Work

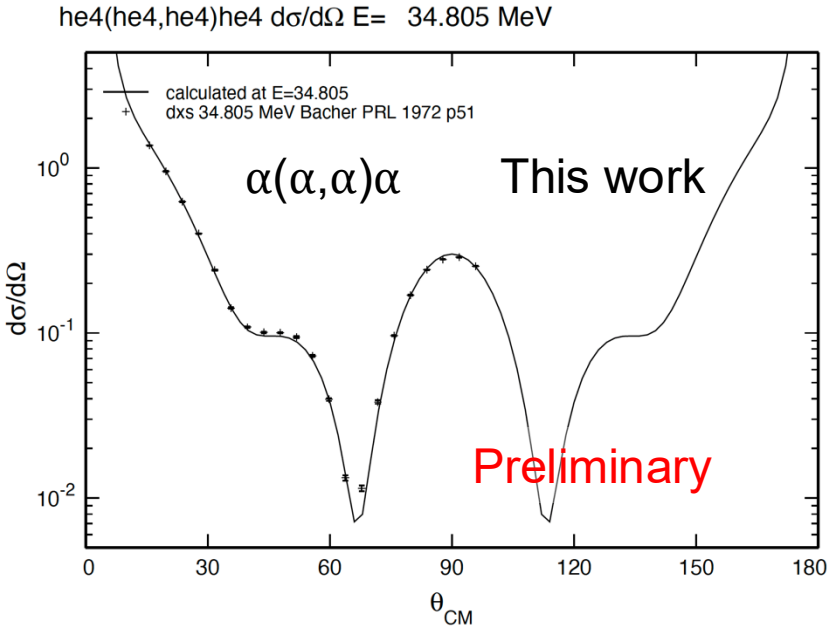
- Issues with the data normalization for the reactions involving identical particles is resolved.
- Correct normalization treatment led to data consistency and better fits.



Ongoing Work

- Included additional data at high energies for various reaction channels with proper treatment of the systematic uncertainties.

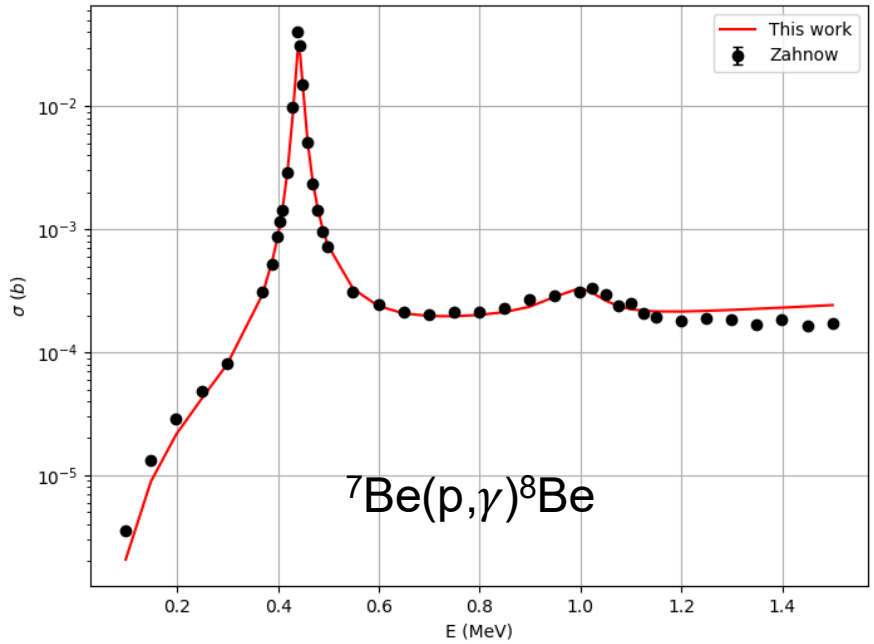




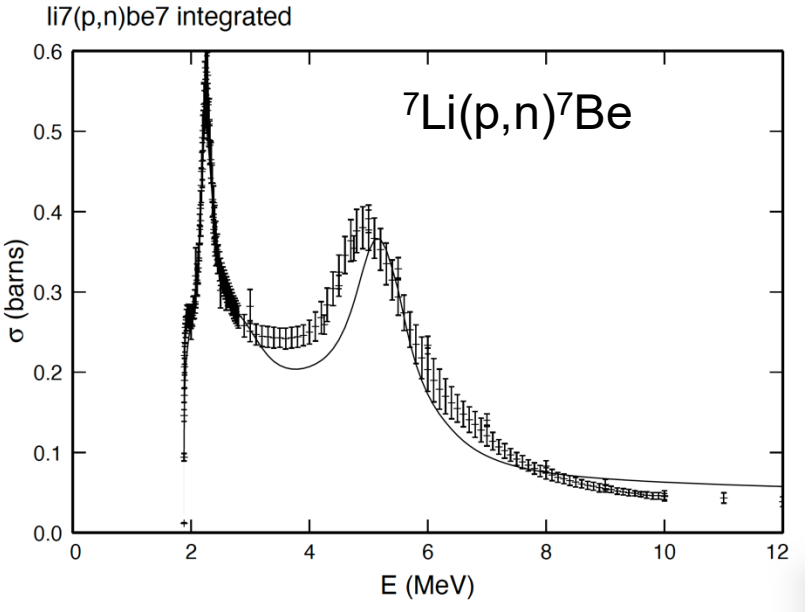
Additional data for α(α,α)α reaction have been added up to E_α~39 MeV.

Ongoing Work

- Included additional $^{7}Be(p, \gamma)^{8}Be$ reaction channel in the evaluation.



- Working on optimizing the fits to all reaction channel now. $^{7}Li(p,n)^{7}Be$ reaction channel has been the difficult one so far.



Summary/ Future Work

- A new evaluation of ^{8}Be system is ongoing addressing the limitations in the previous evaluation.
- Working on the convergence of the *R*-matrix parameters for the ^{8}Be system.
- Sensitivity of the results to the channel radius parameter will be explored.
- Goal: Submit the new evaluation for ENDF/B-IX .
- Consistency checks between the *R*-matrix codes:
  - Check consistency of results from this work to the results from AZURE2 analysis.

Collaborators

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Thank you all for your attention !!