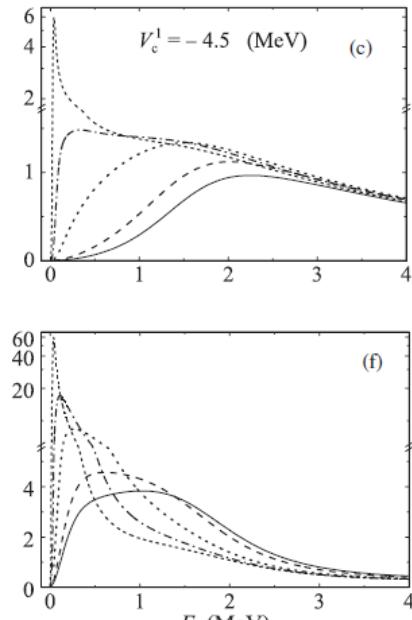
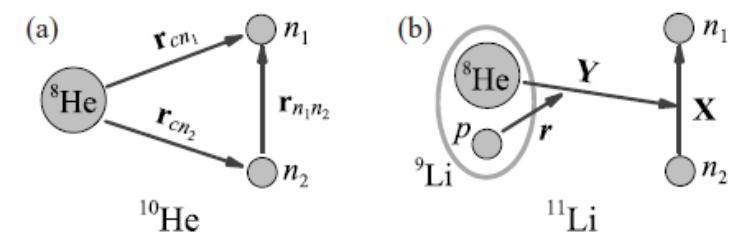
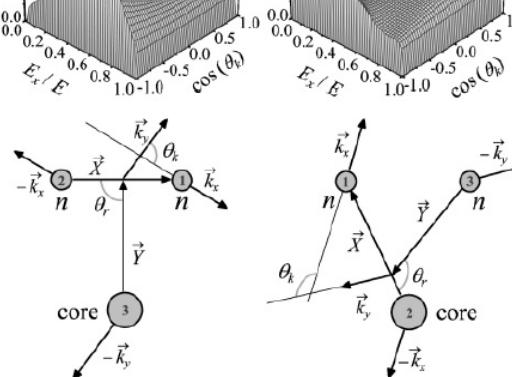
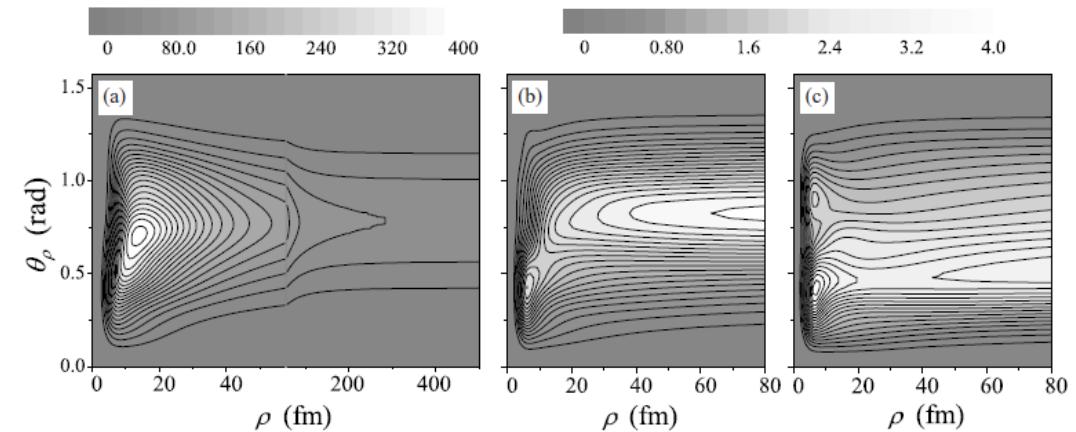
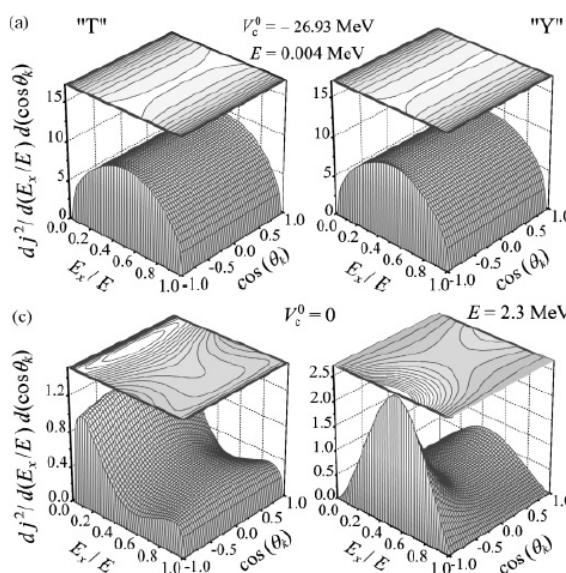


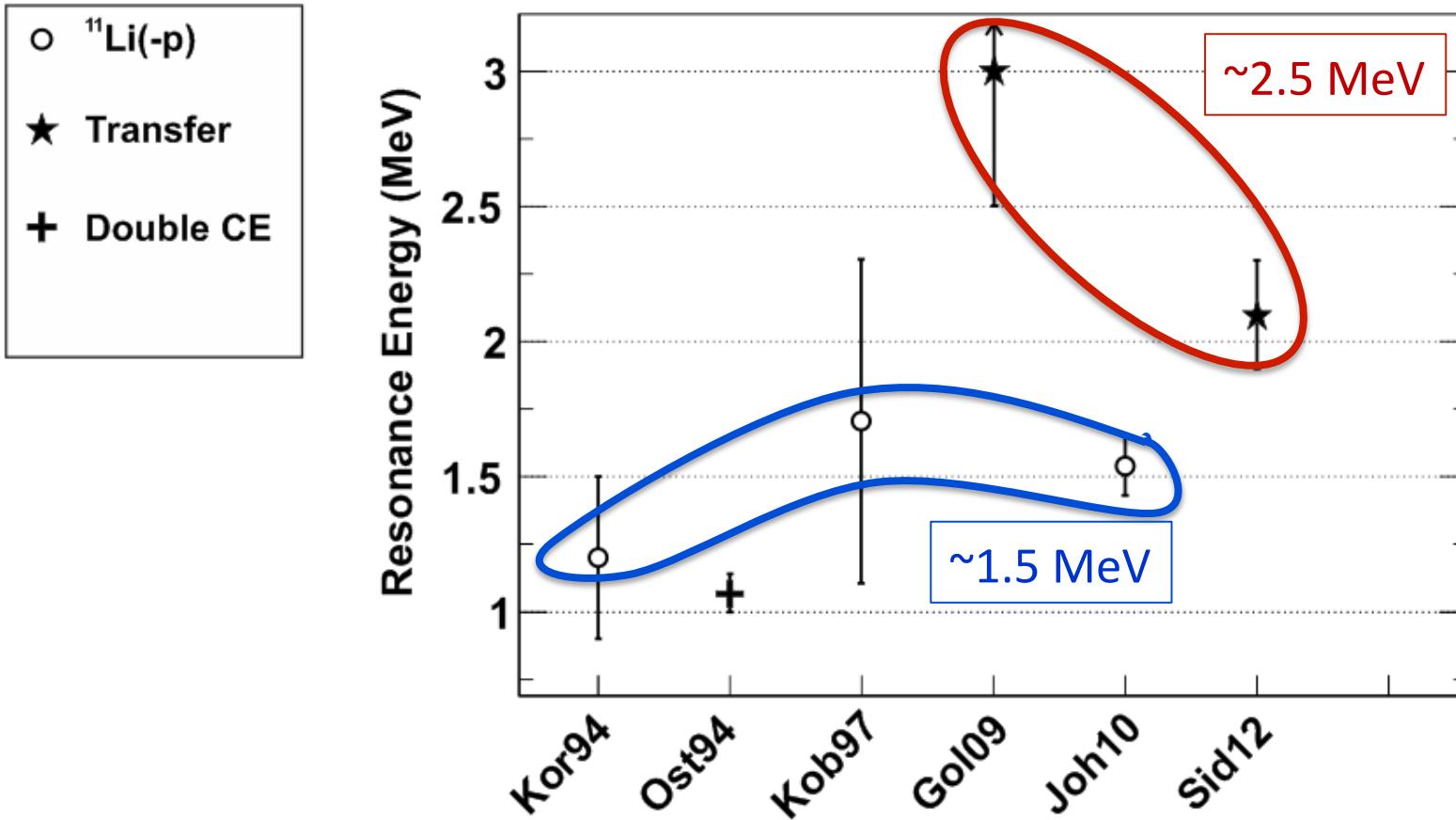
Search for reaction dynamical effects in ^{10}He



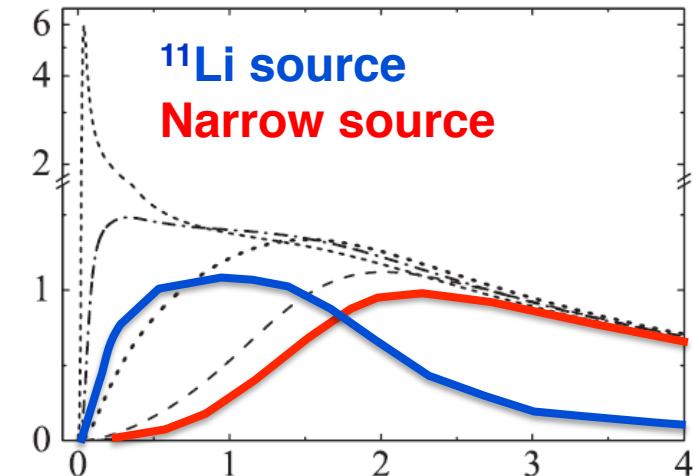
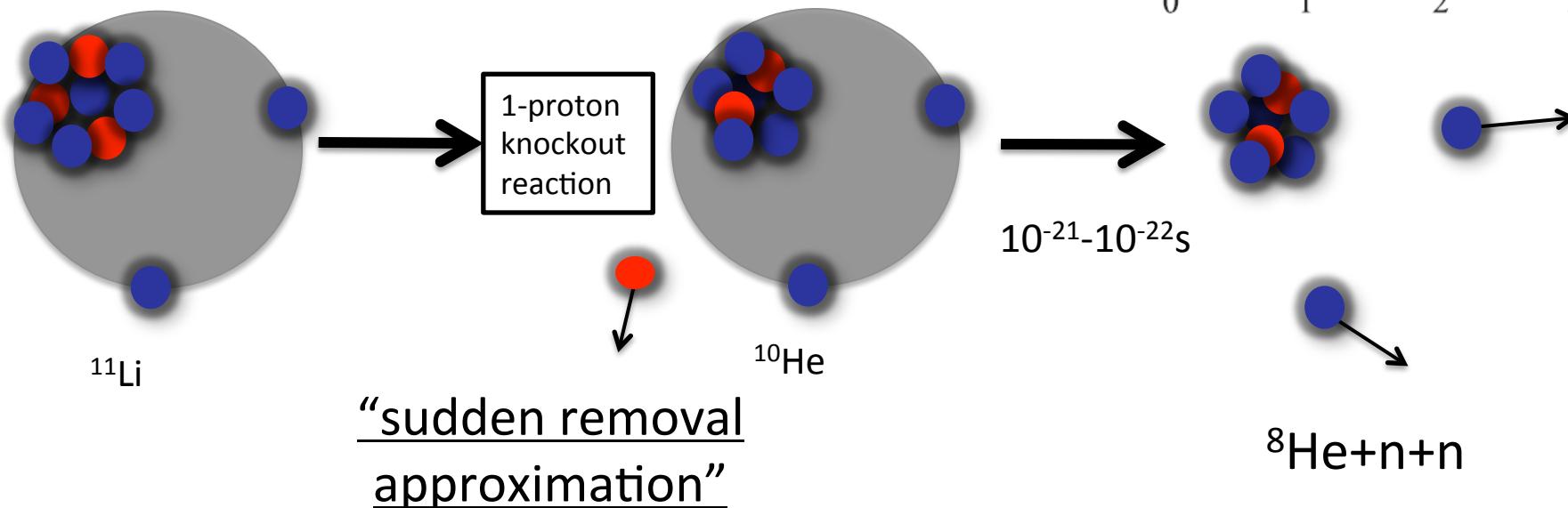
M. Thoennessen
Michigan State University
INPC - 2016



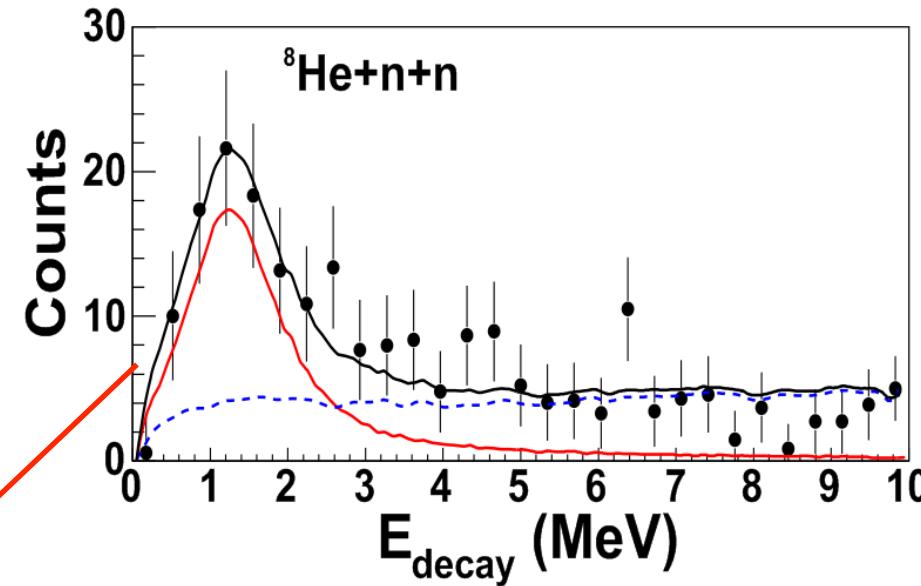
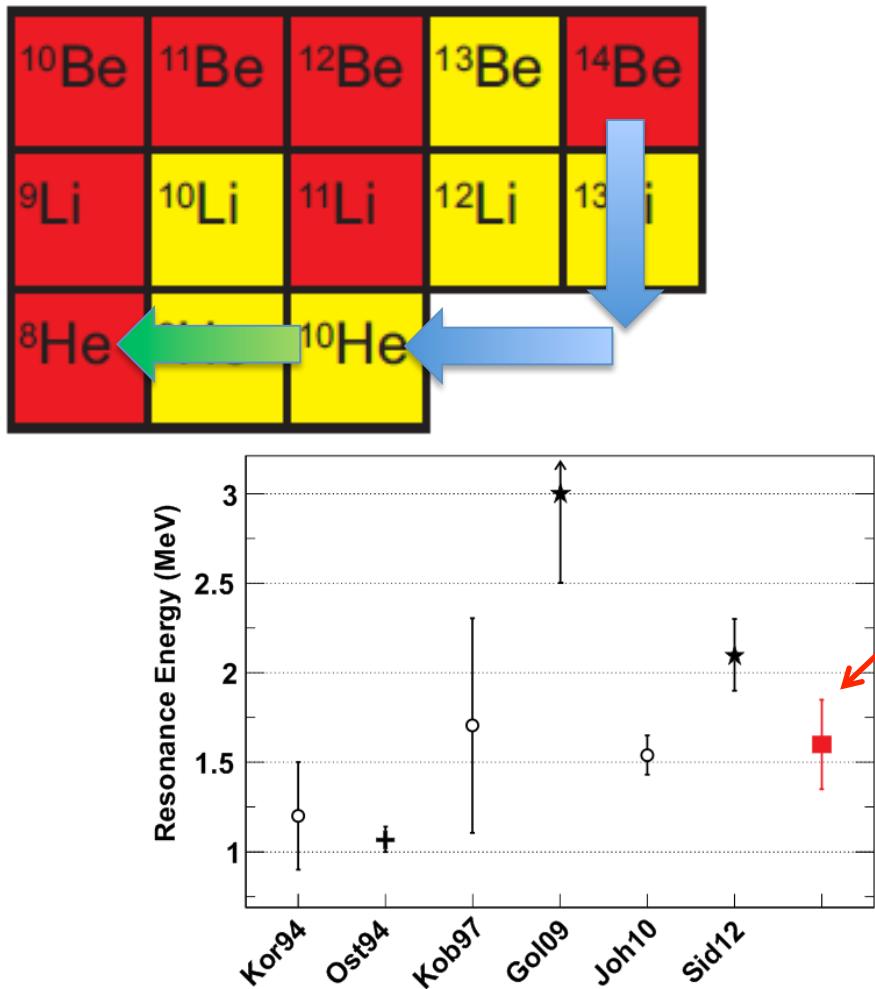
Discrepancy in ^{10}He resonance energy



Source size effect

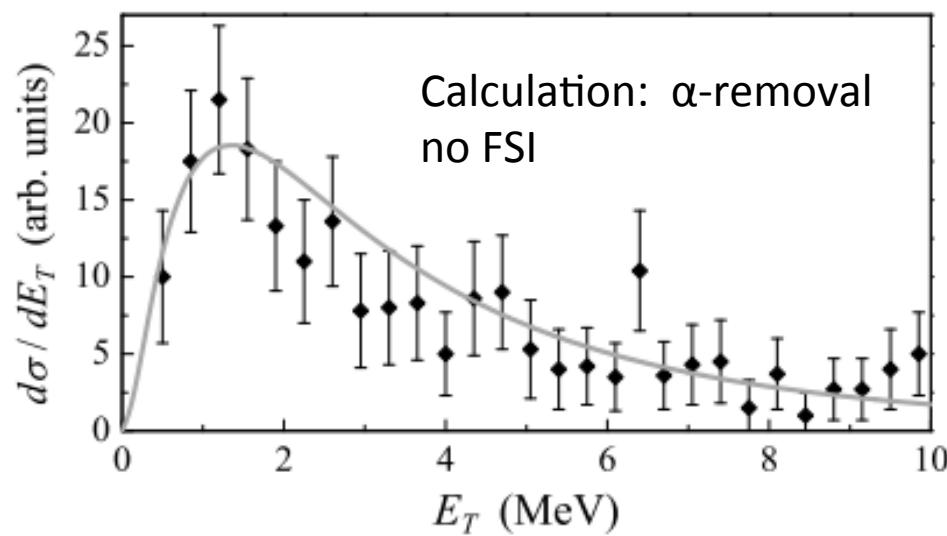
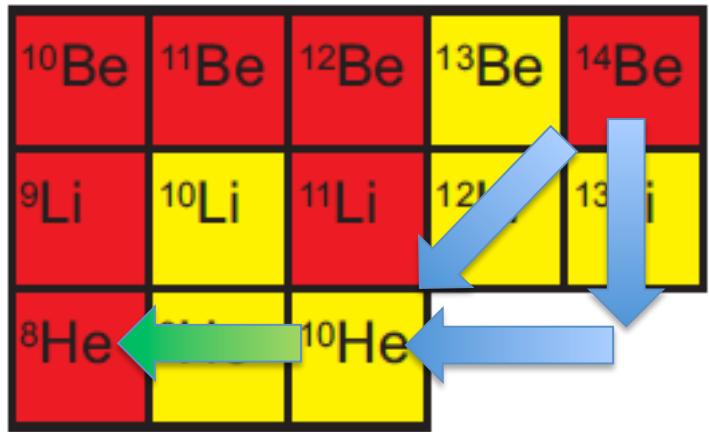


$\text{Be}(\text{Be}^{14}, \text{He}^8 + 2\text{n})$

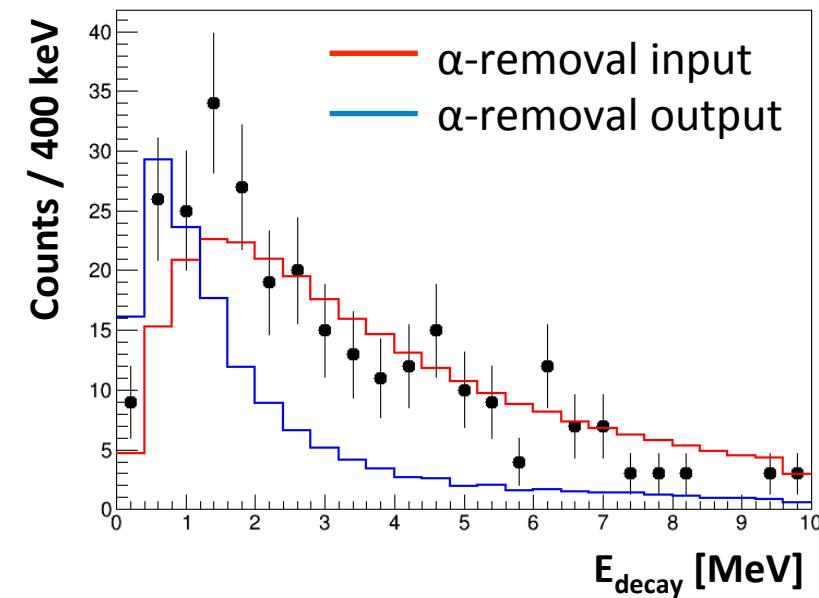


- ^{10}He ground state measured at $E = 1.60$ MeV
- Excellent agreement with GSI $^{11}\text{Li}(-p)$ appears to invalidate the “shift” theory
- Discrepancy remains with the transfer reaction results

2p2n or α removal?

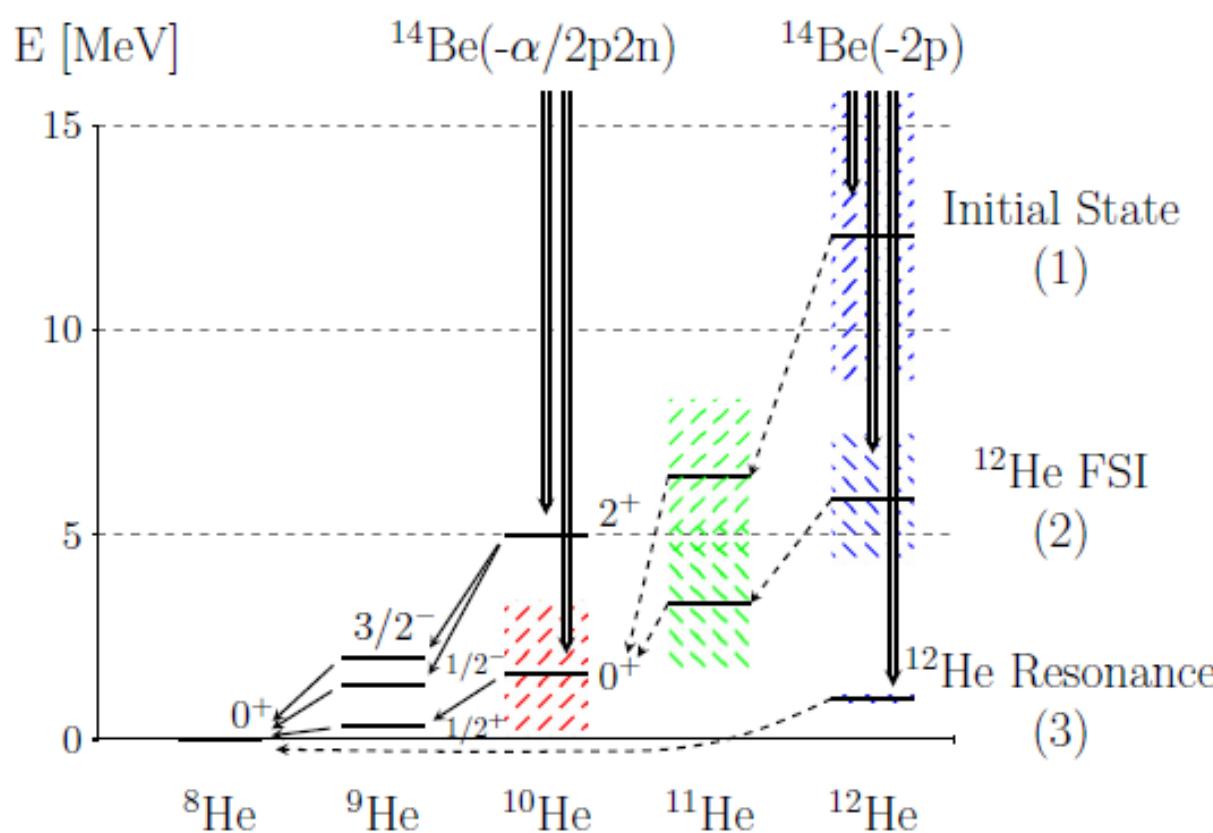


Sharov *et al.* did not take detector response into account

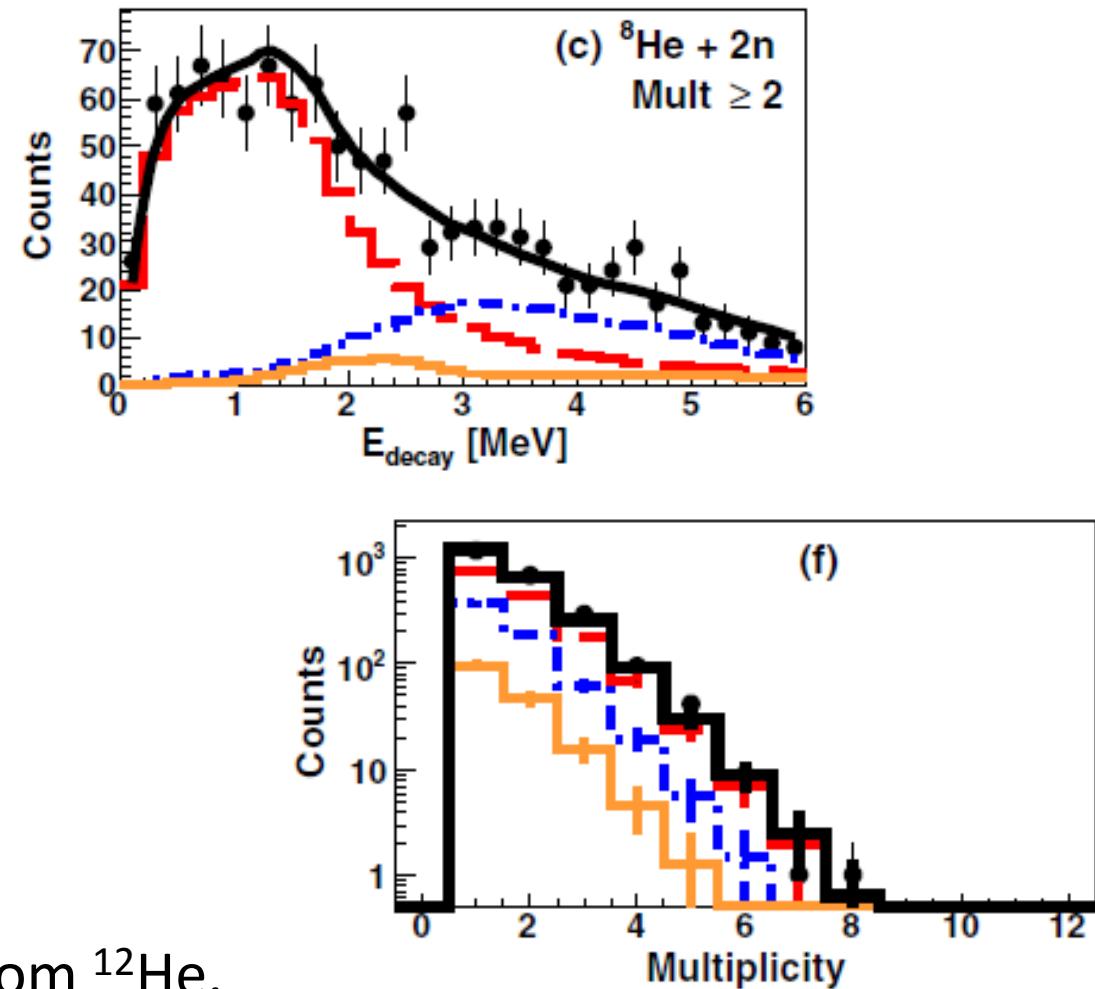


"Direct" α -removal does not describe the data

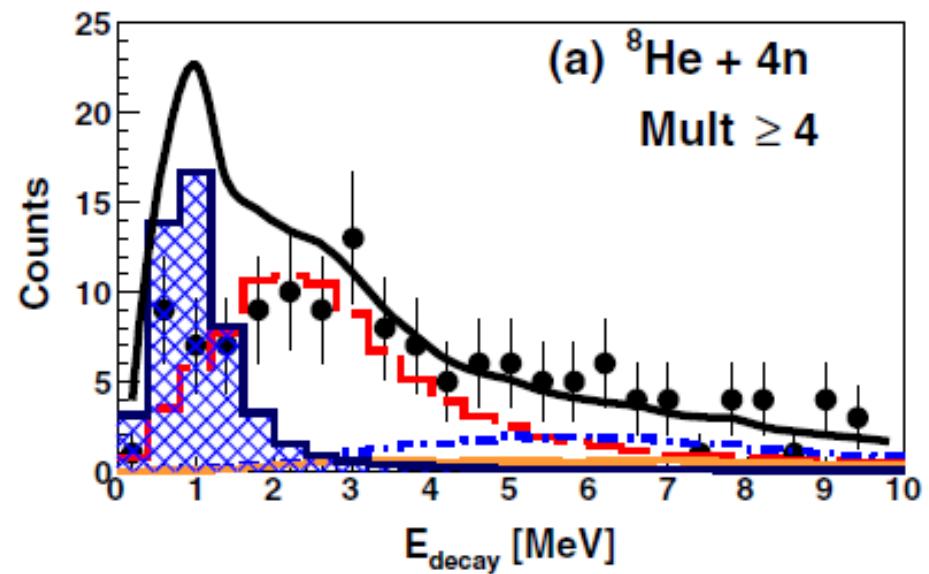
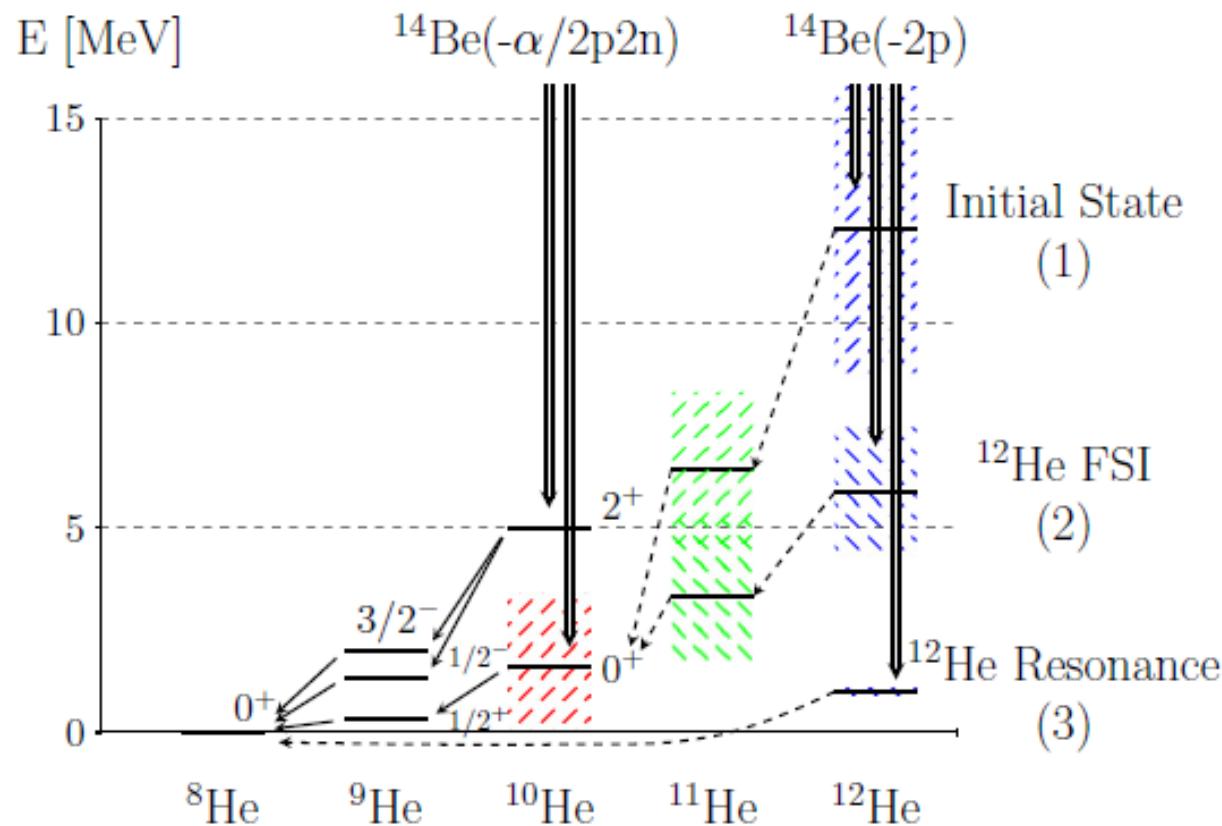
Evidence for α removal



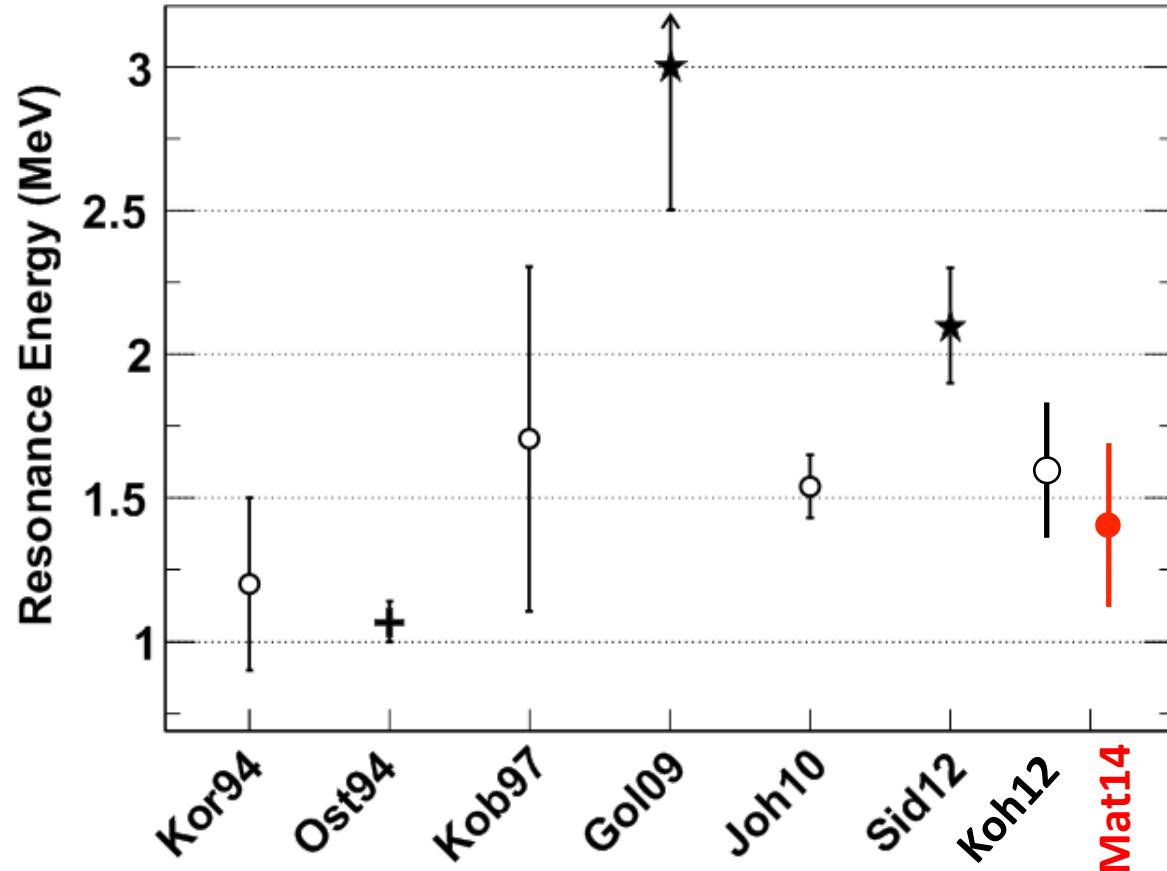
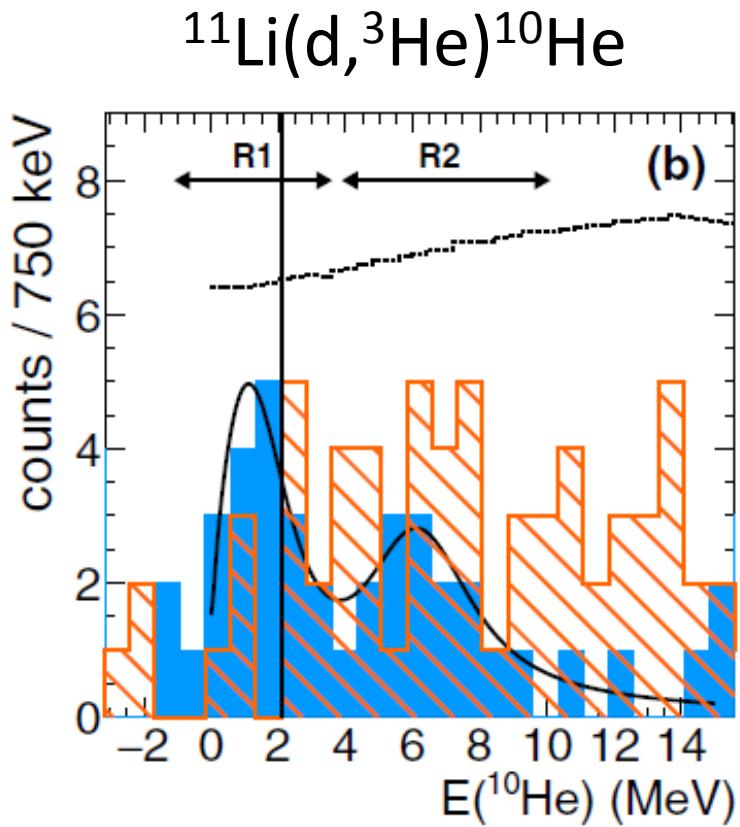
Data could be fitted with no 4n contributions from ^{12}He .



No evidence for narrow resonance in ^{12}He

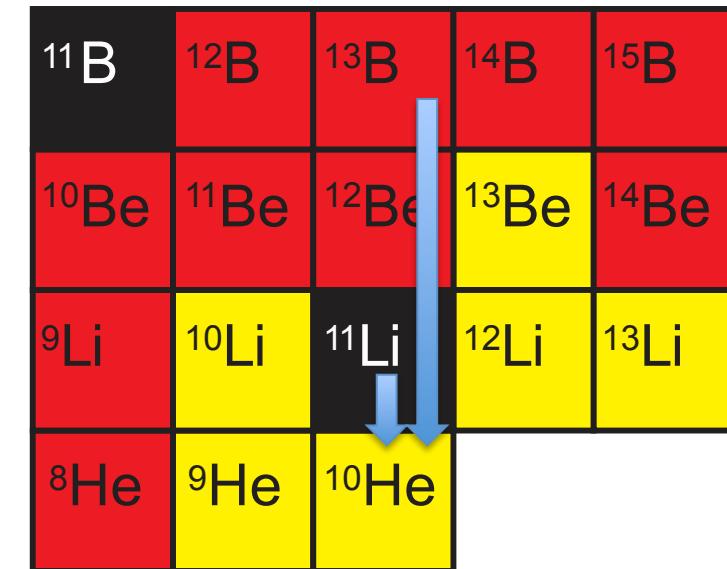
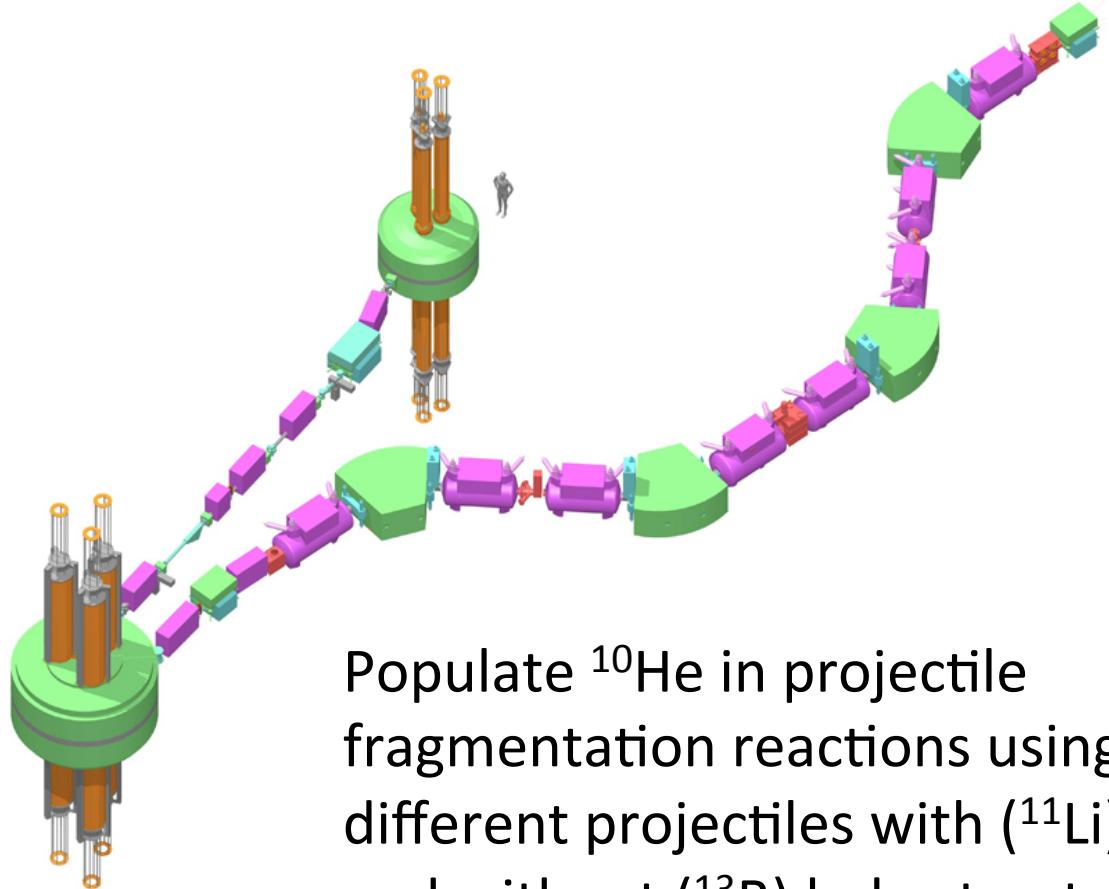


Missing mass spectroscopy of ^{10}He



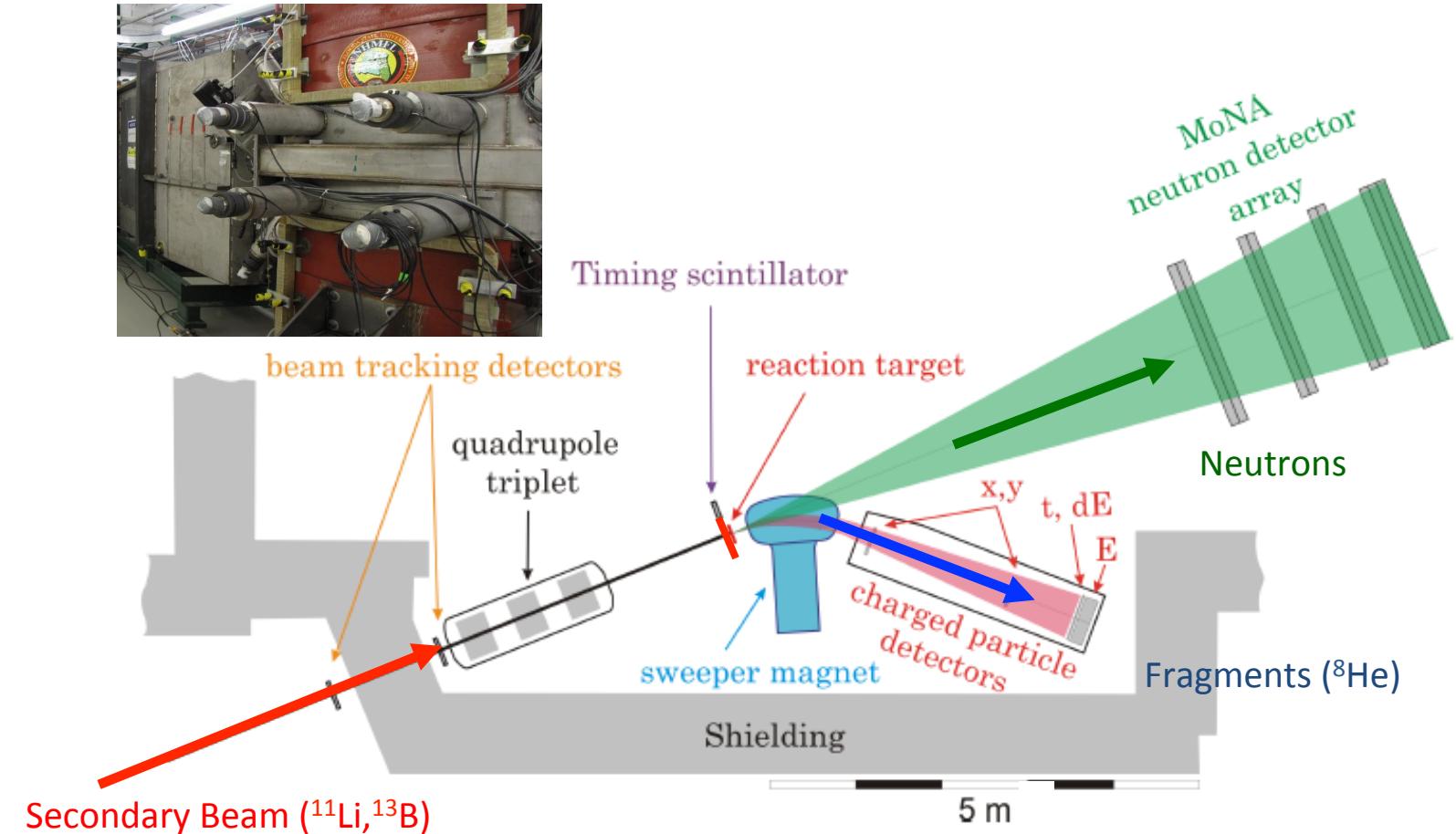
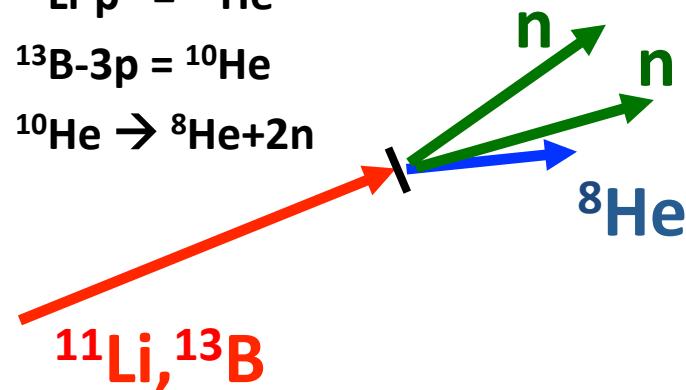
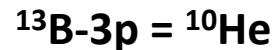
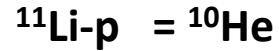
Data agree with $^{11}\text{Li}(-\text{p})$ and $^{14}\text{Be}(-2\text{p}2\text{n})$ results

New NSCL Coupled Cyclotron Experiment



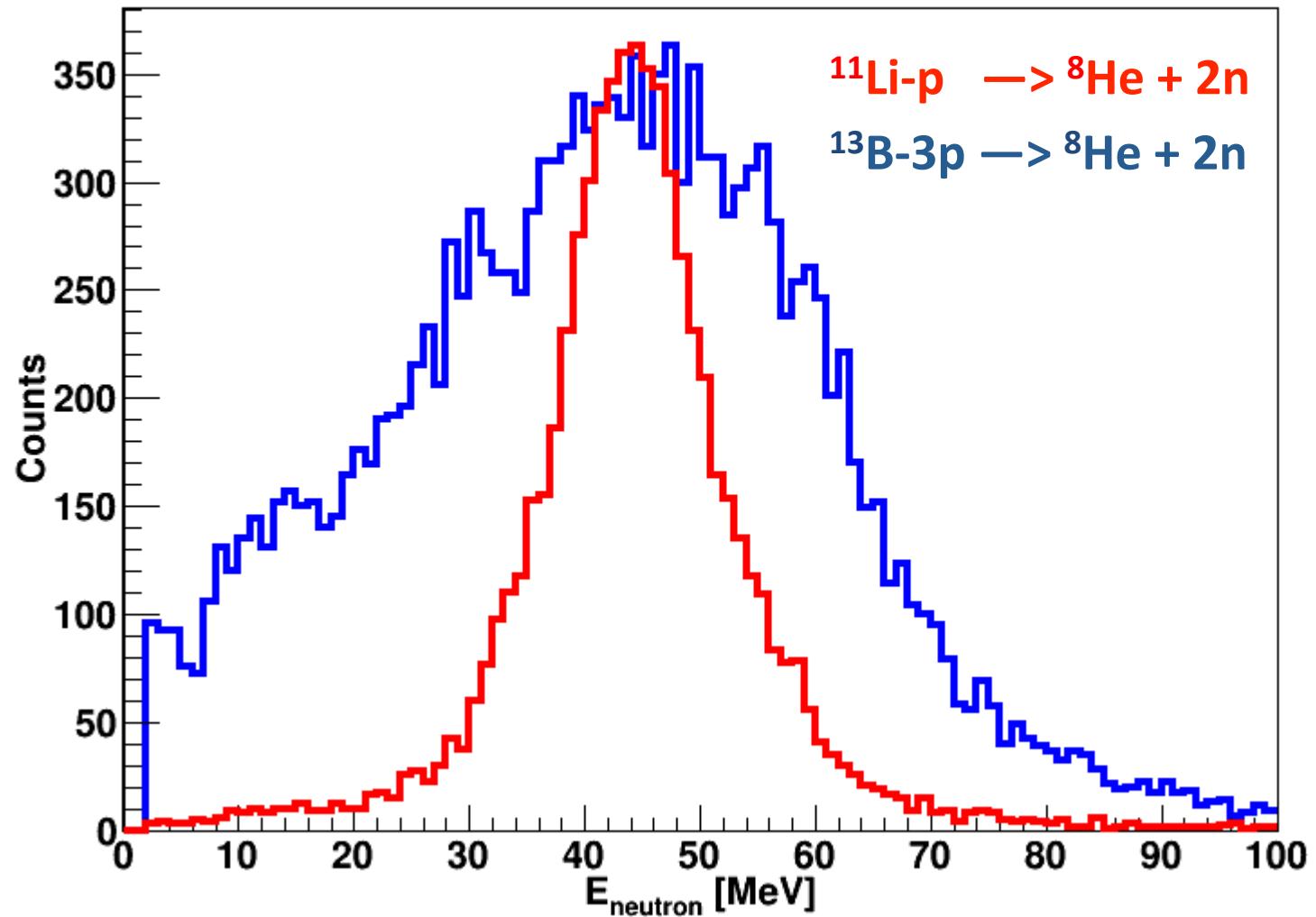
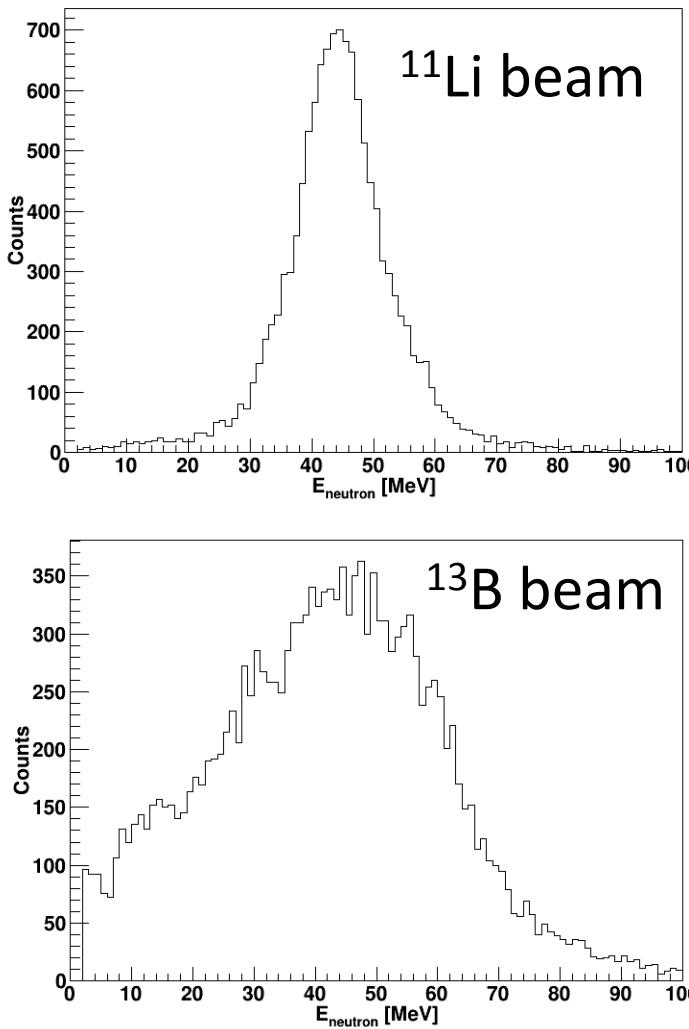
Invariant mass spectroscopy with MoNA

At the target:

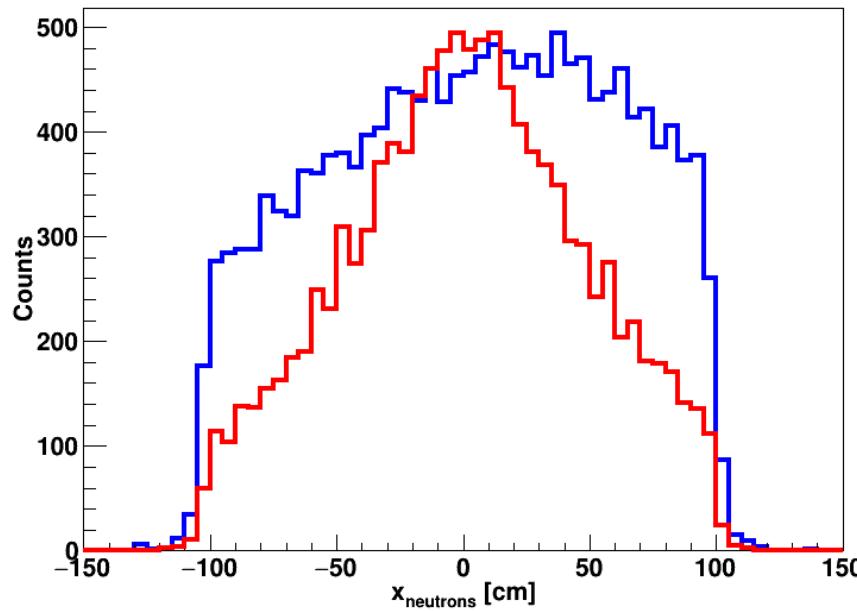
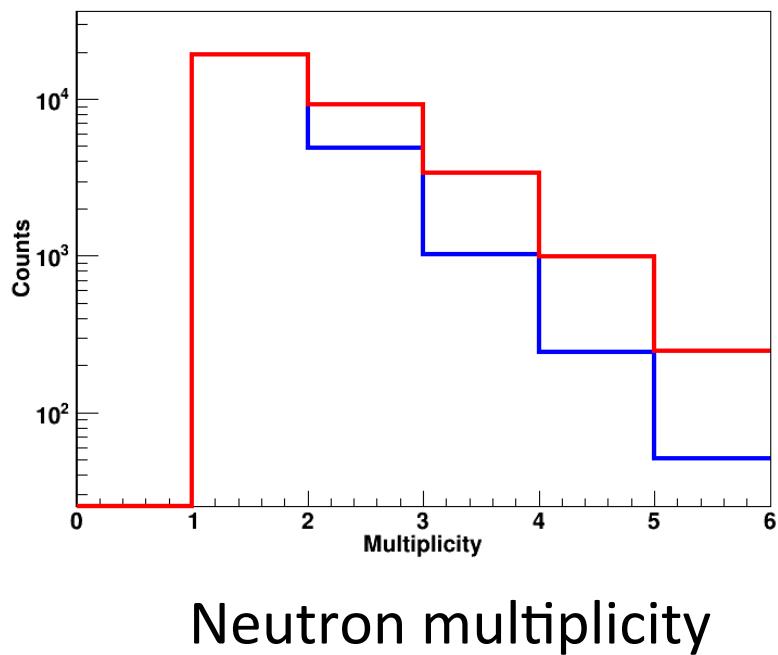
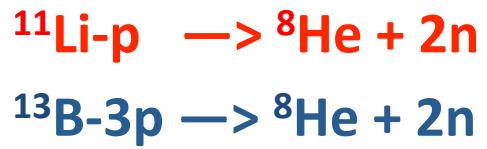


$$E_{\text{decay}} = M_{N\text{body}} - M_{^8\text{He}} - \sum_{i=1}^{i=N-1} m_n$$

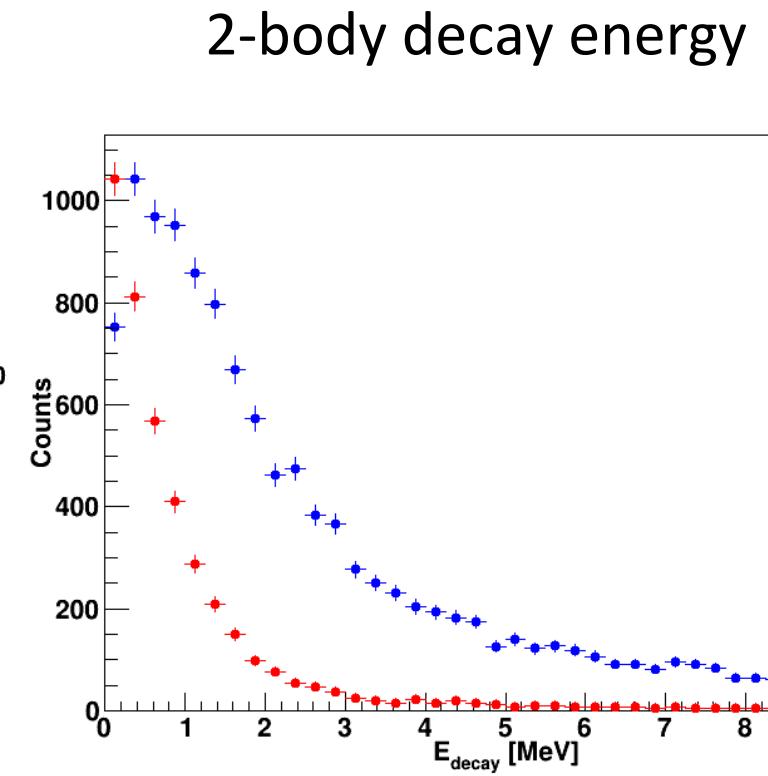
^{10}He Neutron Energy Spectra



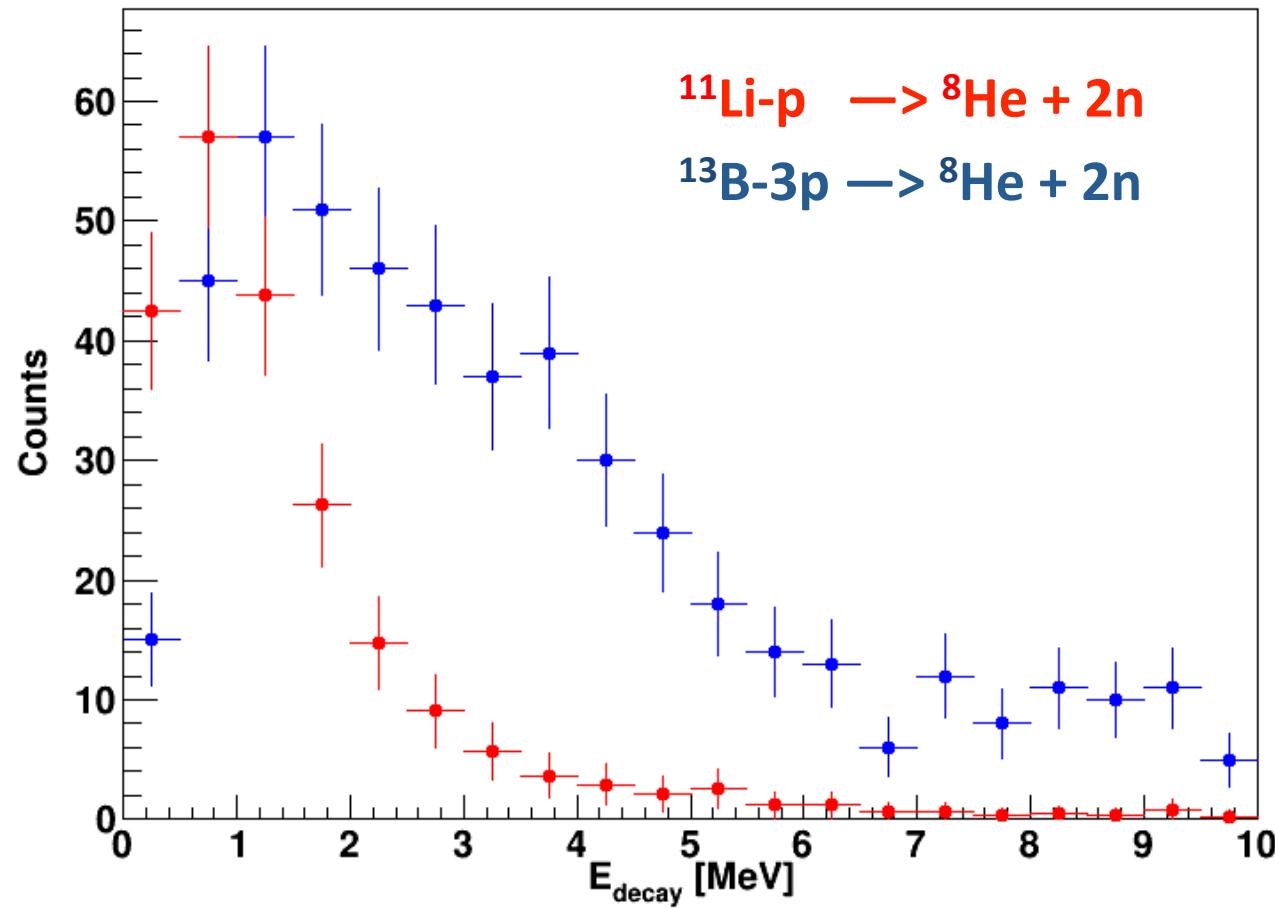
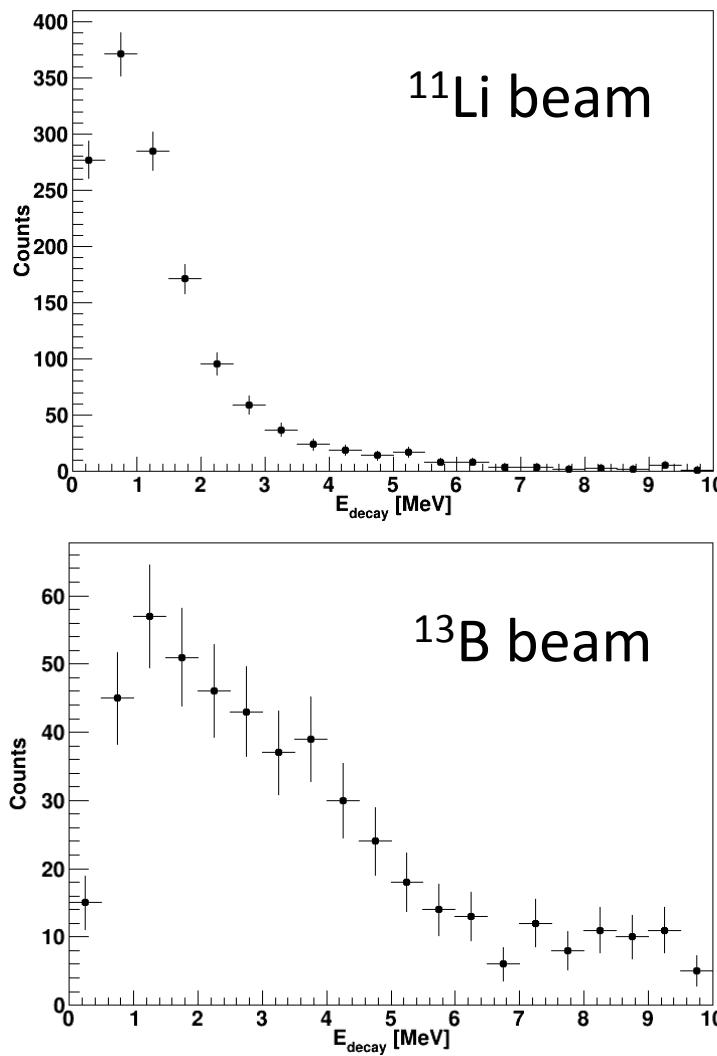
Preliminary data: Other observables



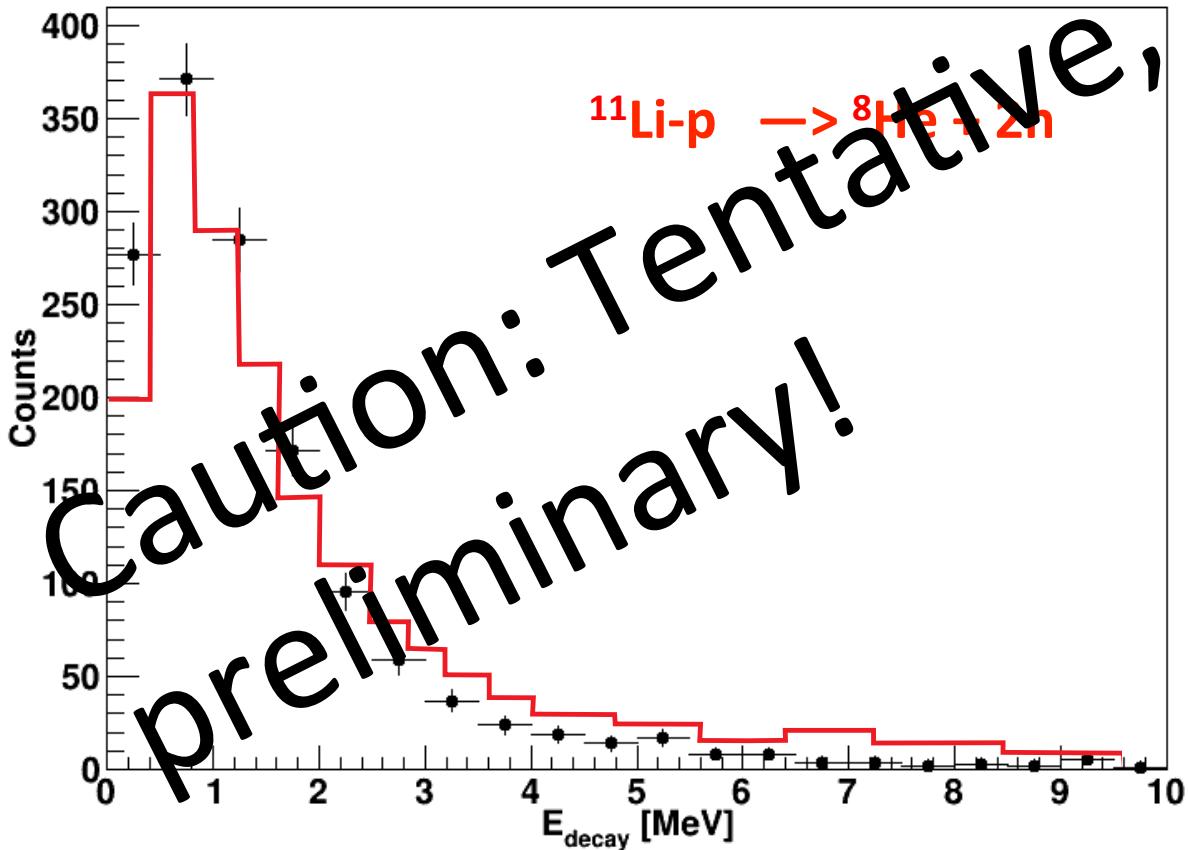
Horizontal neutron distribution



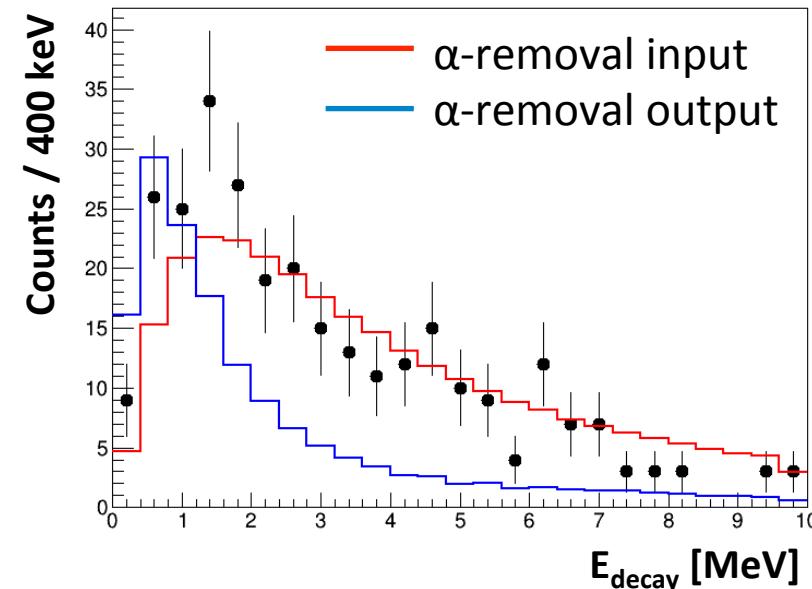
Preliminary data: ^{10}He Decay Energy Spectra



Preliminary data: $^{11}\text{Li}-\text{p} \rightarrow ^8\text{He} + 2\text{n}$

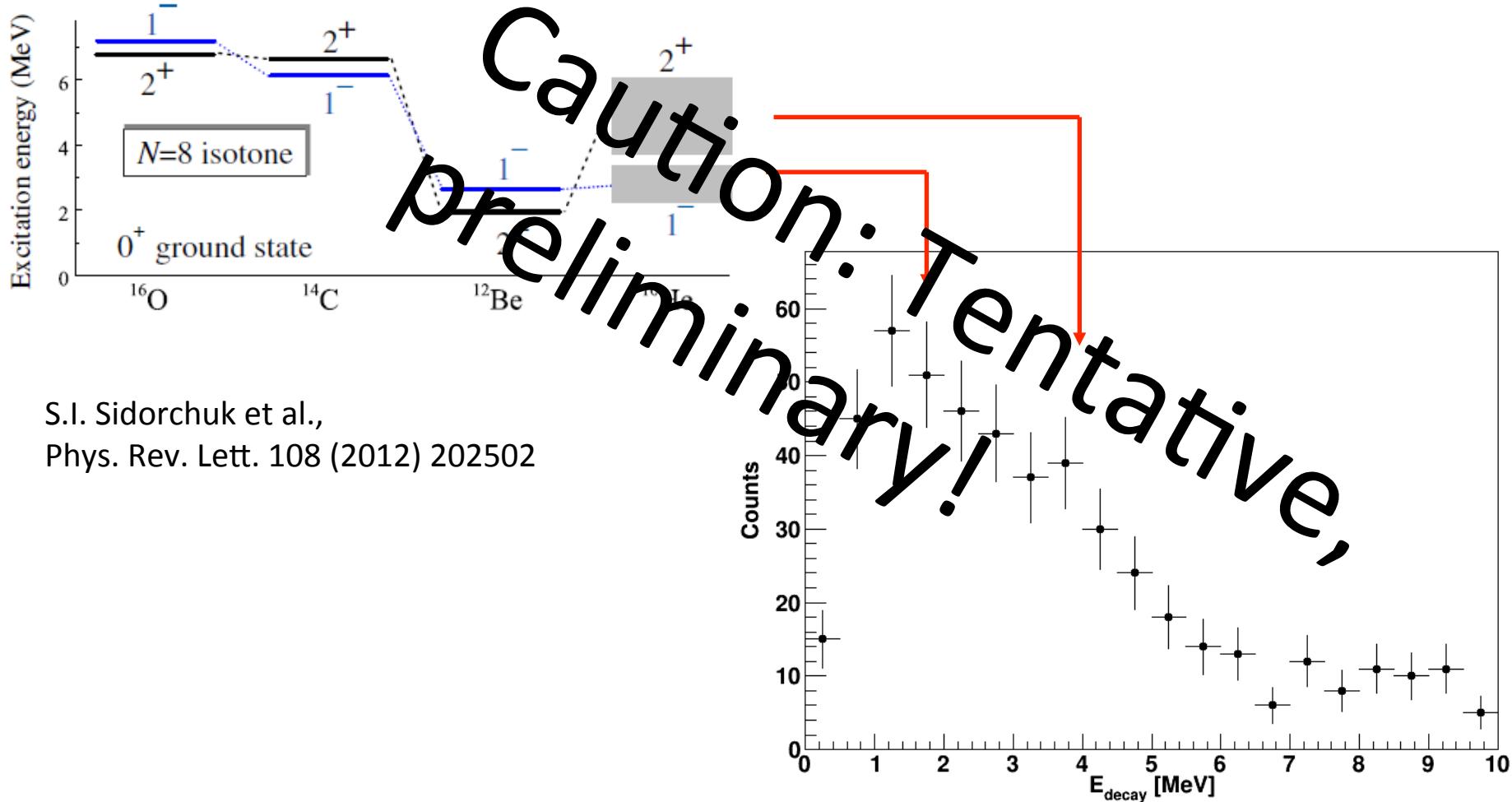


P.G. Sharov, I.A. Egorova, and L.V.



Speculation:
Indications for reaction dynamical
effects of the initial halo state

Preliminary data: $^{13}\text{B}-3\text{p} \rightarrow ^8\text{He} + 2\text{n}$



S.I. Sidorchuk et al.,
Phys. Rev. Lett. 108 (2012) 202502

Conclusions

- Two-neutron decay spectroscopy of ^{10}He was performed with incident ^{11}Li and ^{13}B beams.
- The preliminary decay energy spectra from the halo (^{11}Li) and non-halo (^{13}B) beams exhibit significant difference indicating reaction dynamical effects.
- The apparent resonance energy for the ^{11}Li data is shifted to a lower energy indicating the influence of the initial halo state.

Acknowledgements

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Augustana College, IL

Central Michigan University, MI

Concordia College, MN

Gettysburg College, PA

Hampton University, VA

Hope College, MI

Indiana University South Bend, IN

Michigan State University, MI

Ohio Wesleyan University, OH

Wabash College, IN

Westmont College, CA

MSU Graduate students:

Han Liu

Thomas Redpath

