



Transfer reactions with light radioactive ions at REX-ISOLDE

-- ISOLDE Workshop 2005/6 --

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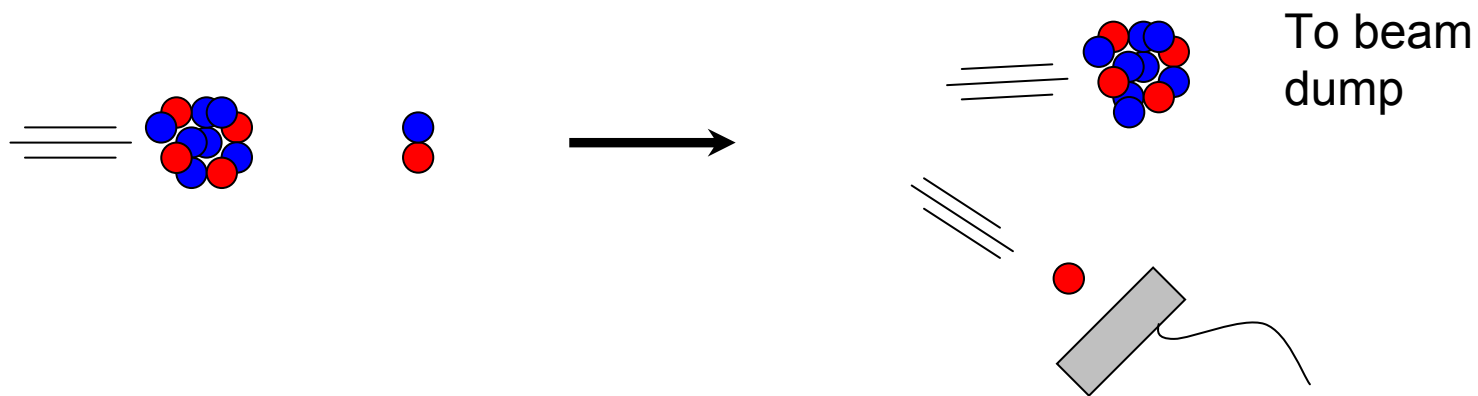
ISOLDE / CERN

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What is the typical case?



- Light nuclei (less than mass 20-30)
 - eg. ${}^9\text{Li}$, ${}^{11}\text{Be}$
- Elastic scattering or one/two nucleon transfer
- Heavy nuclei on light target (p or d target) \Rightarrow inverse kinematics



REX/ISOLDE properties



- ISOLDE beam re-bunched (20ms on 1.2s)
 - 20-50 μ s bunches at 50Hz
- Bunched structure => small decay background
 - Reduce “collection time” by factor of ~ 1000
 - But also limited detection rate – max 50/s!
- Stable background eg: ^{12}C , ^{18}O , buffer-gas ..
 - Carbon stripping foil – reduce factor ~ 100
 - Choose background free charge state

Goal of experiments

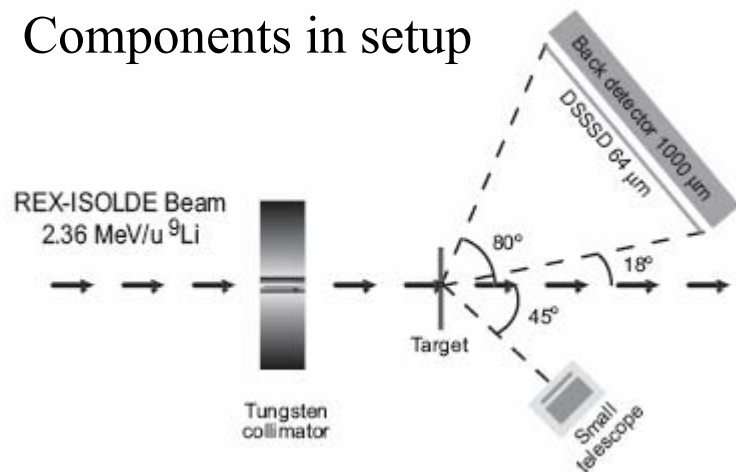


- Low-lying states in light nuclei
 - Position/width/spin
 - Differential cross-section
- Eg. to study ^{10}Li – unbound subsystem of ^{11}Li
 - $^9\text{Li}+d \rightarrow p+^{10}\text{Li}$
 - $^9\text{Li}+p \rightarrow ^{10}\text{Be}^* \rightarrow p+^9\text{Li}$ (IAS of ^{10}Li)
 - $^9\text{C}+p \rightarrow ^{10}\text{N}^* \rightarrow p+^9\text{C}$ (mirror partner of ^{10}Li)

Experimental setup for ${}^9\text{Li}$

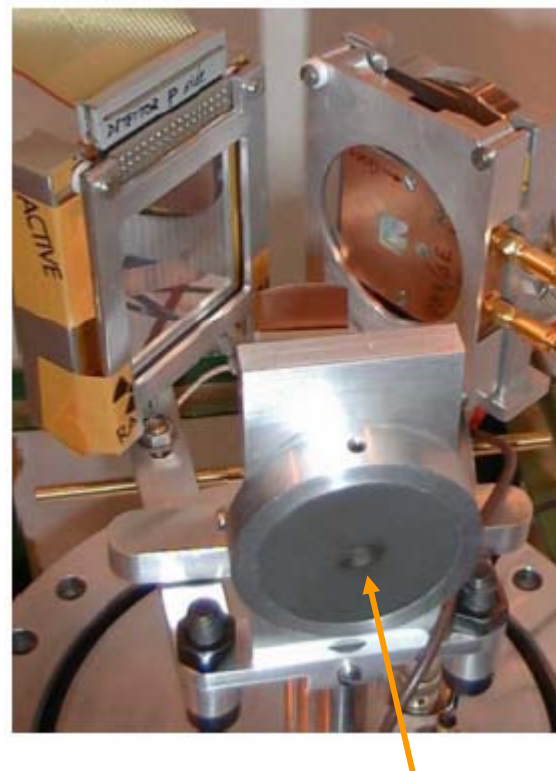


Components in setup



One DSSSD (thick window) backed by Si-pad detector to form telescope and one smaller telescope (three layers; 10, 300 and 700 μm)

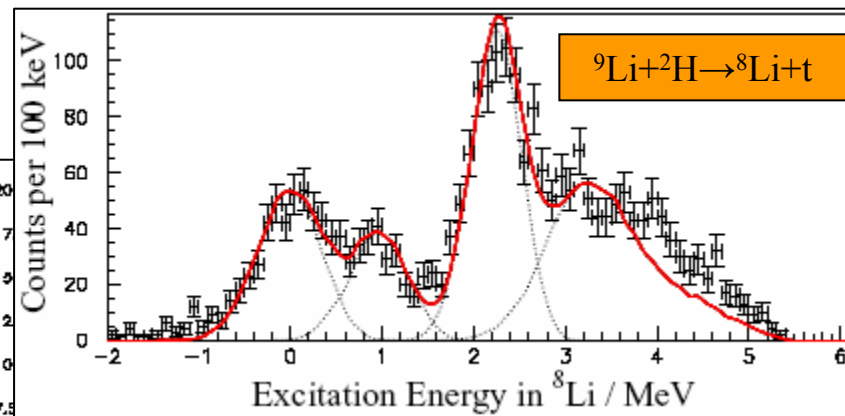
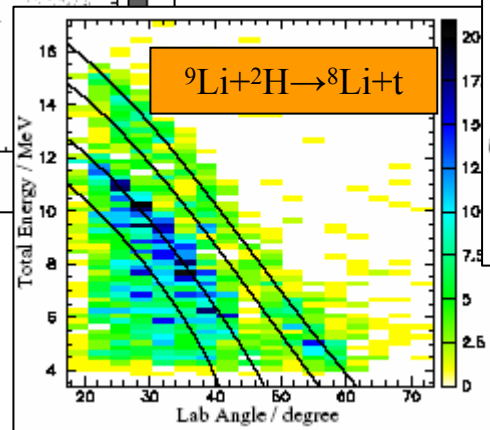
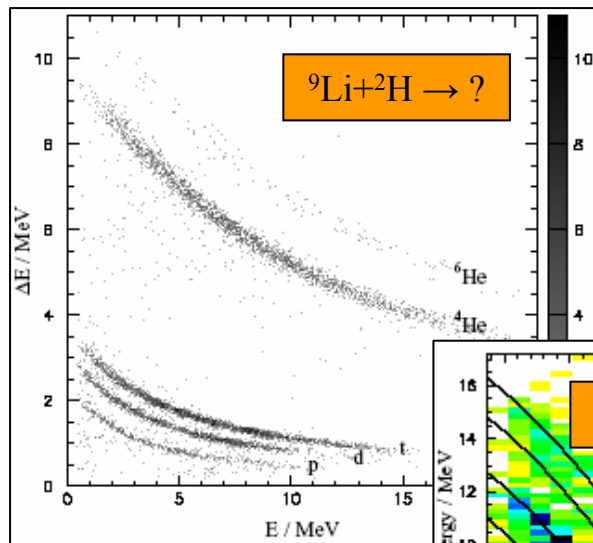
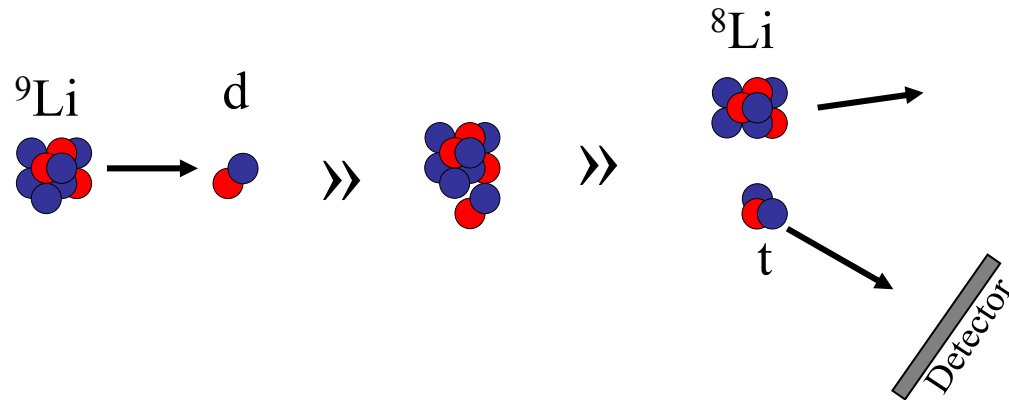
6.4 μm deuterated polypropylene target



2.36 MeV/u ${}^9\text{Li}$ REX beam

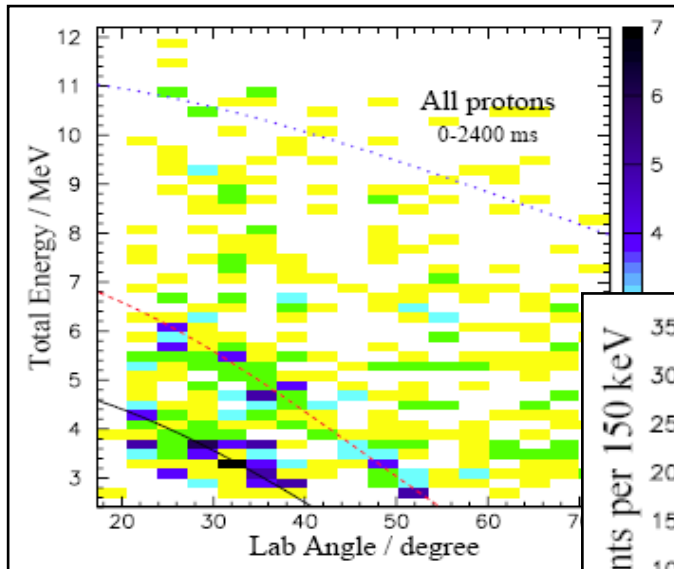
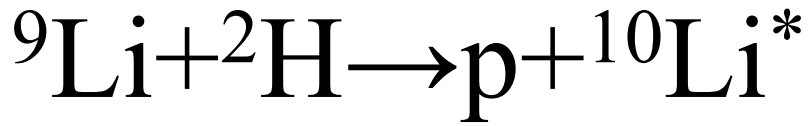


Example of neutron transfer
from ${}^9\text{Li}$ to a deuteron –
forming a triton



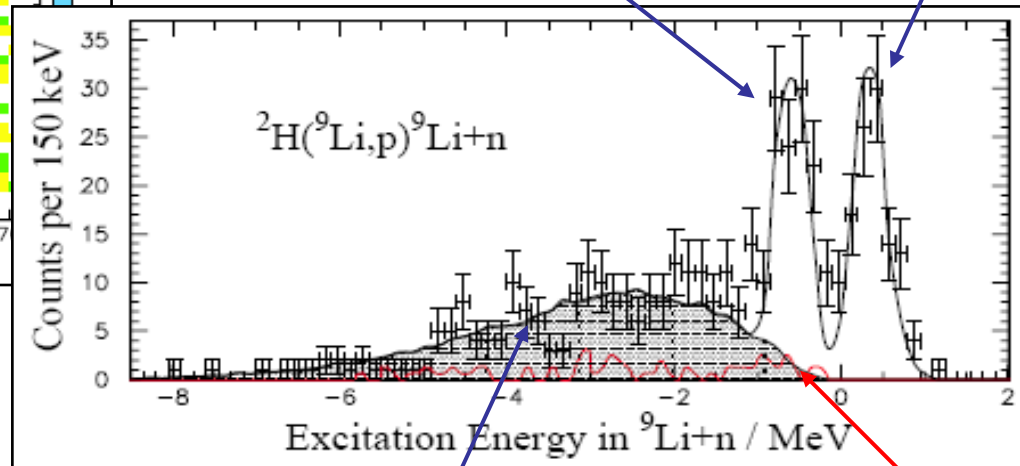
H.B.Jeppesen *et al.* Nucl. phys. **A748** (2005) 374

H.B.Jeppesen *et al.* submitted to Phys. Lett. **B**



${}^9\text{Li} + \text{p}$
elastic
scattering

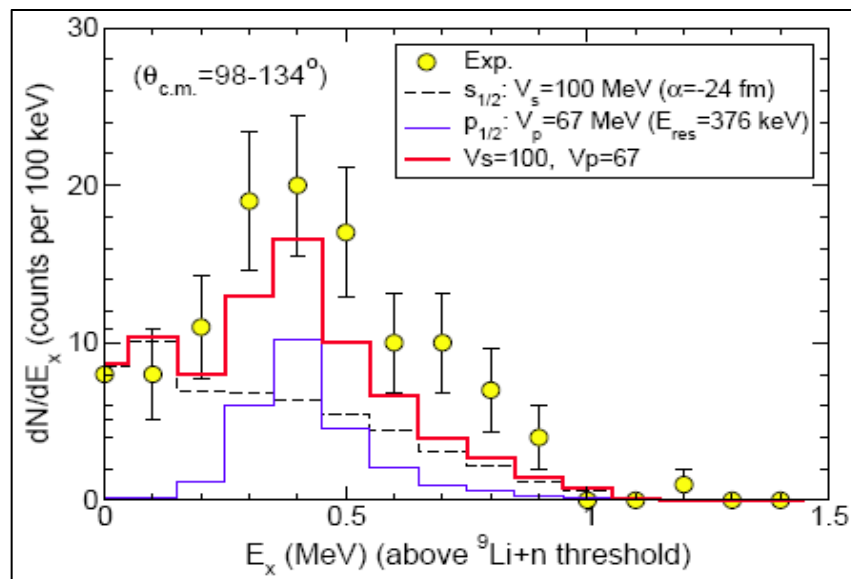
${}^9\text{Li} + {}^2\text{H} \rightarrow \text{p} + {}^{10}\text{Li}^*$



${}^9\text{Li} + {}^{12}\text{C}$
Compound

Stable
background

Comparison to theory



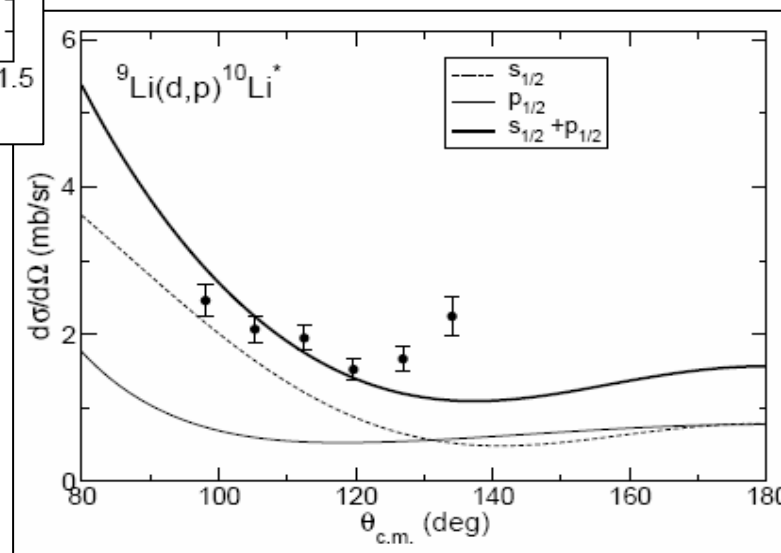
CCBA calculations

- Performed by A.M. Moro
- Only potential-depth varied (2 free parameters)

Conclusion:

Need s - and p -wave component to describe energy spectrum

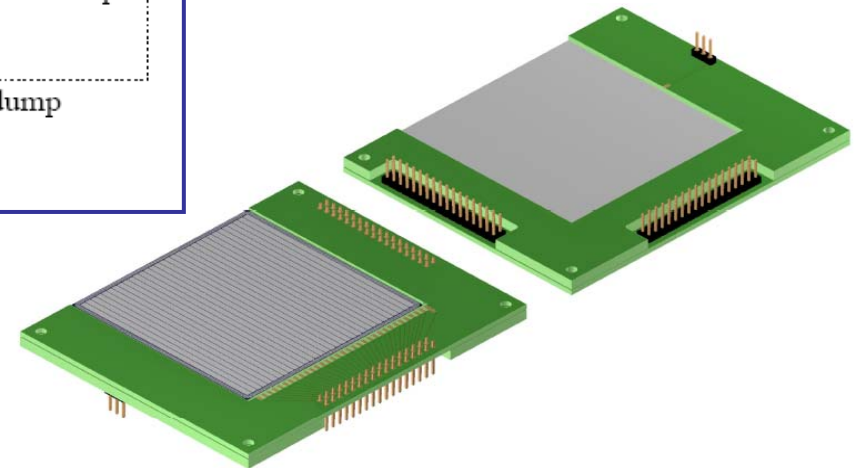
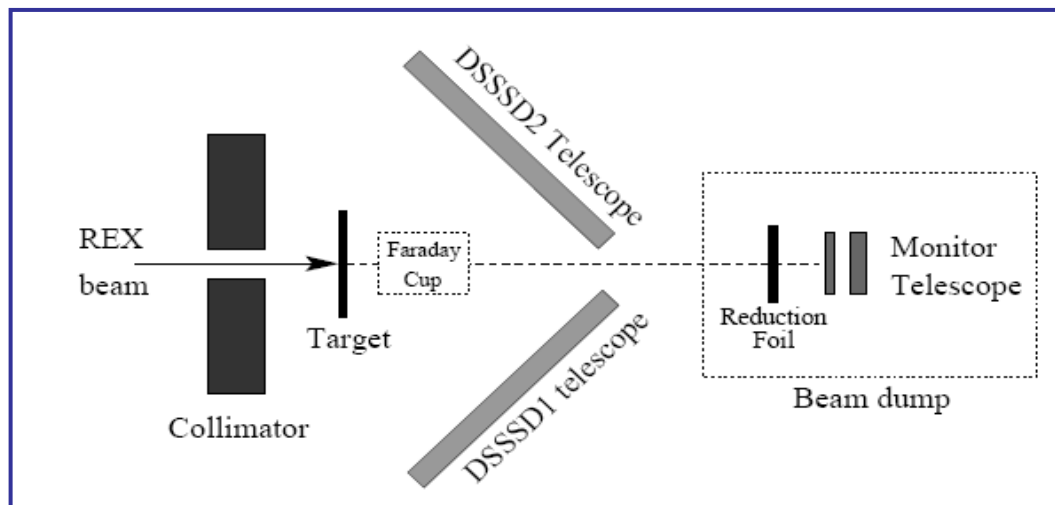
H.B. Jeppesen *et al.* in preparation



Experimental setup $^{11}\text{Be}/^9\text{Li}$



- Experiments autumn 2005
- New 32×32 strip $60\mu\text{m}$ DSSSD + $1500\mu\text{m}$ Si-pad

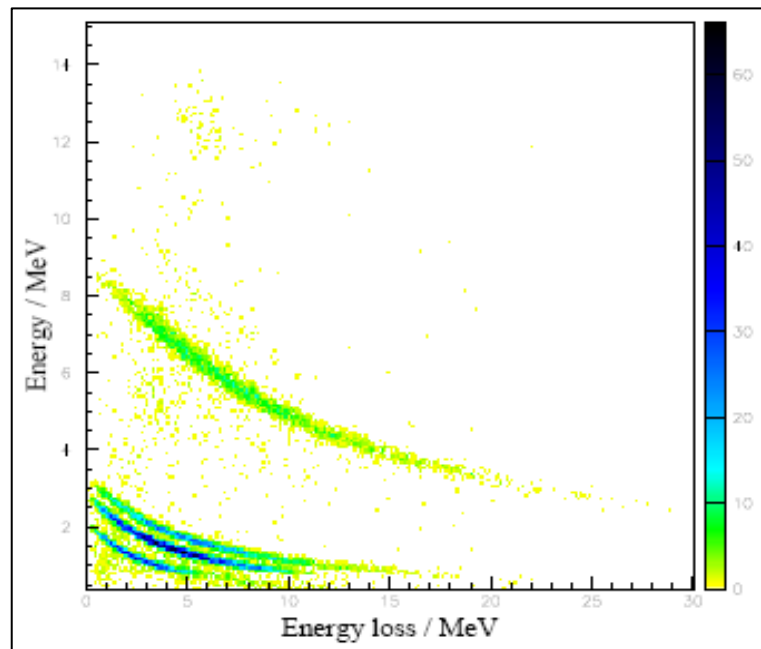


$^{11}\text{Be} + \text{d/p}$ @ 2.25 MeV/u



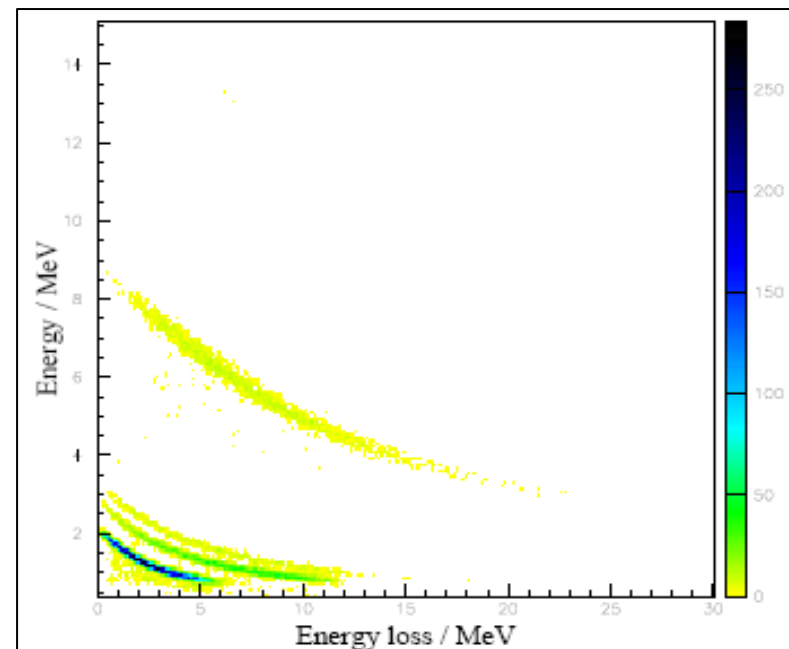
$^{11}\text{Be} + \text{d}$

17 μm deuterated polyethylene



$^{11}\text{Be} + \text{p}$

13 μm polyethylene

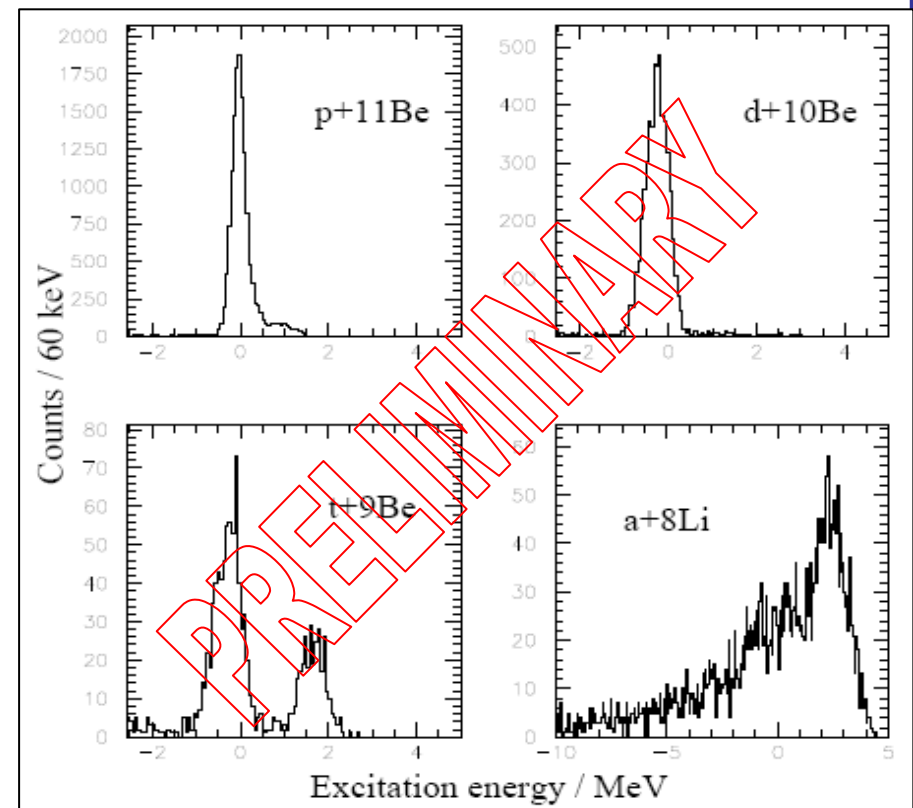
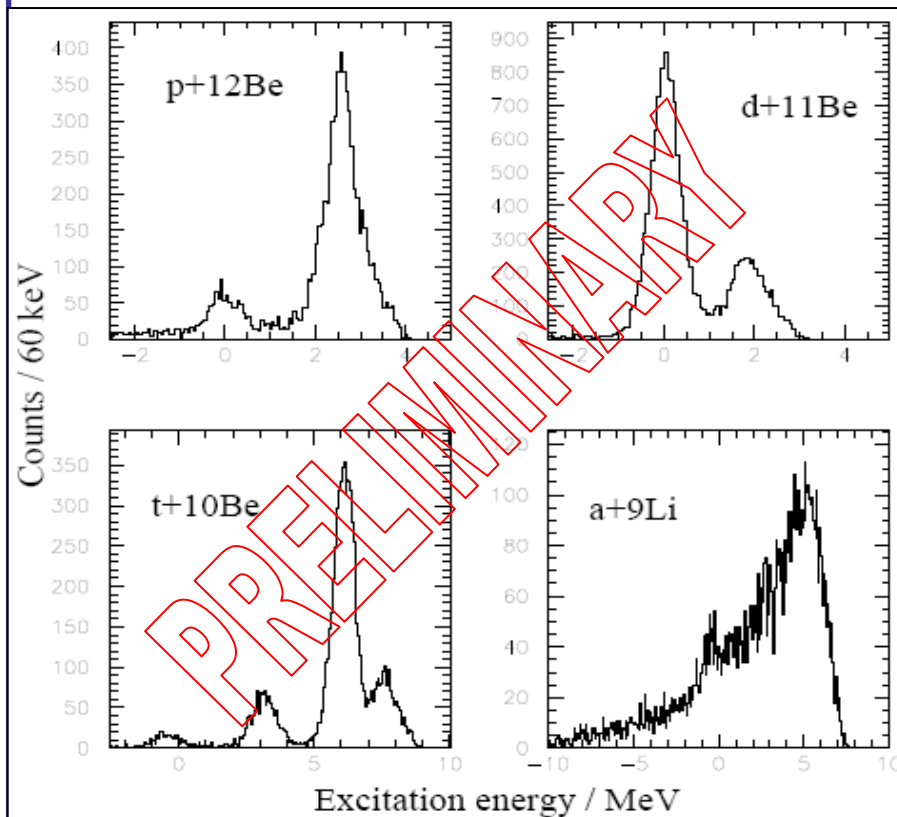


$^{11}\text{Be}+d/p @ 2.25 \text{ MeV/u}$



$^{11}\text{Be}+d$

$^{11}\text{Be}+p$



Conclusion



$^9\text{Li}+d$

- Spectroscopic factors for ^8Li
- *s*- and *p*-wave component seen in ^{10}Li
- New data at 2.77 MeV/u awaiting analysis

$^{11}\text{Be}+d/p$

- Good quality data obtained
- Interesting differences seen between d and p target

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