

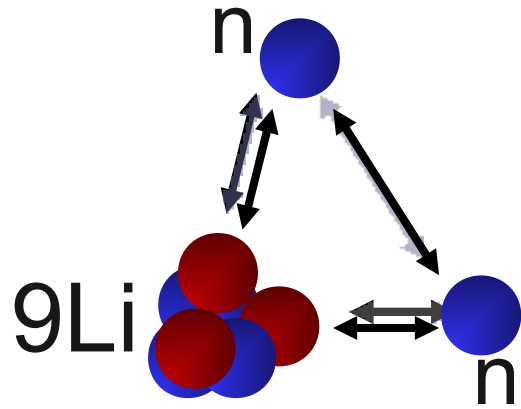
Investigation of low-lying
resonances in ^{11}Li and ^{10}Li
via $^{11}\text{Li}(p,p')$ and $^{11}\text{Li}(p,d)$
reactions

Hicham Al Falou

for the S1147 collaboration

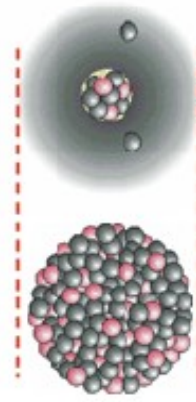
TUDA II

Two-neutron halo nucleus ^{11}Li



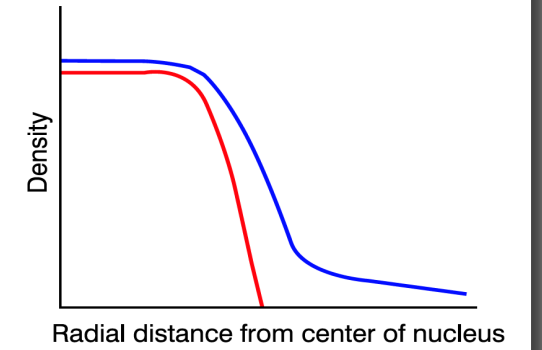
Neutron Halo

Stable nuclei



^{11}Li

^{208}Pb



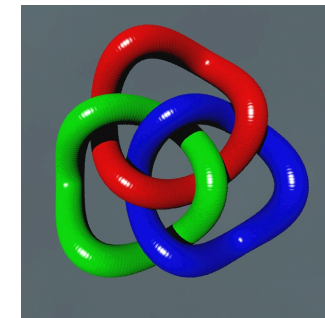
- Very diffuse neutron surfaces caused by
- loosely bound neutrons
 - states of low angular momentum

Distribution of **neutrons** and **protons** in halo nuclei

Borromean nucleus

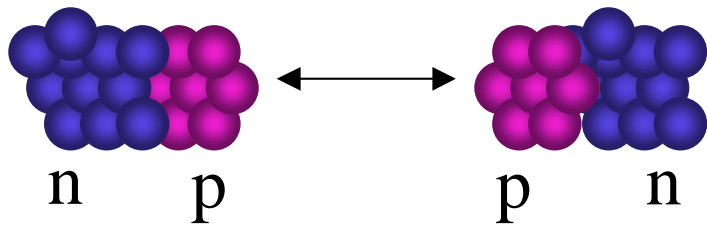
→ ^{11}Li is bound

→ ^{10}Li and $2n$ are unbound



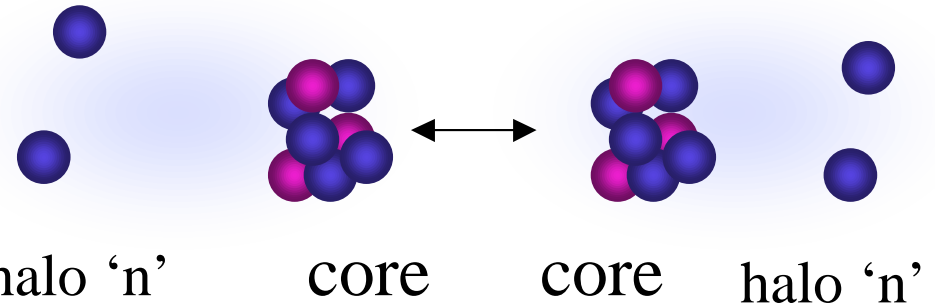
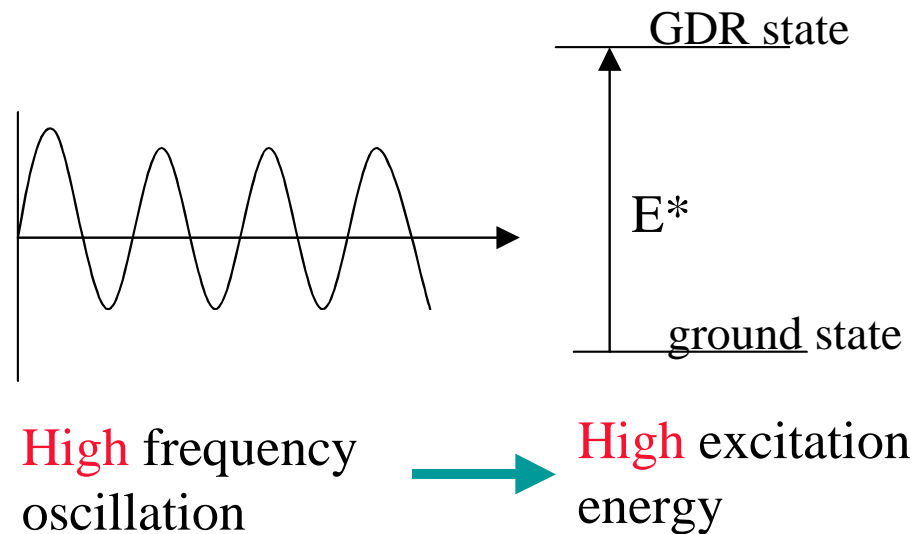
→ ^{10}Li : input for 3-body models

New mode of excitation: Soft dipole resonance



Giant dipole resonance

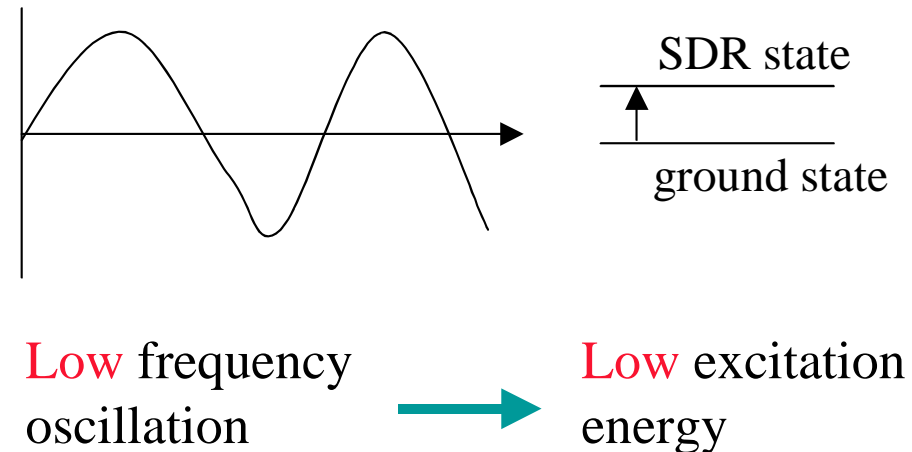
Neutrons oscillate against protons



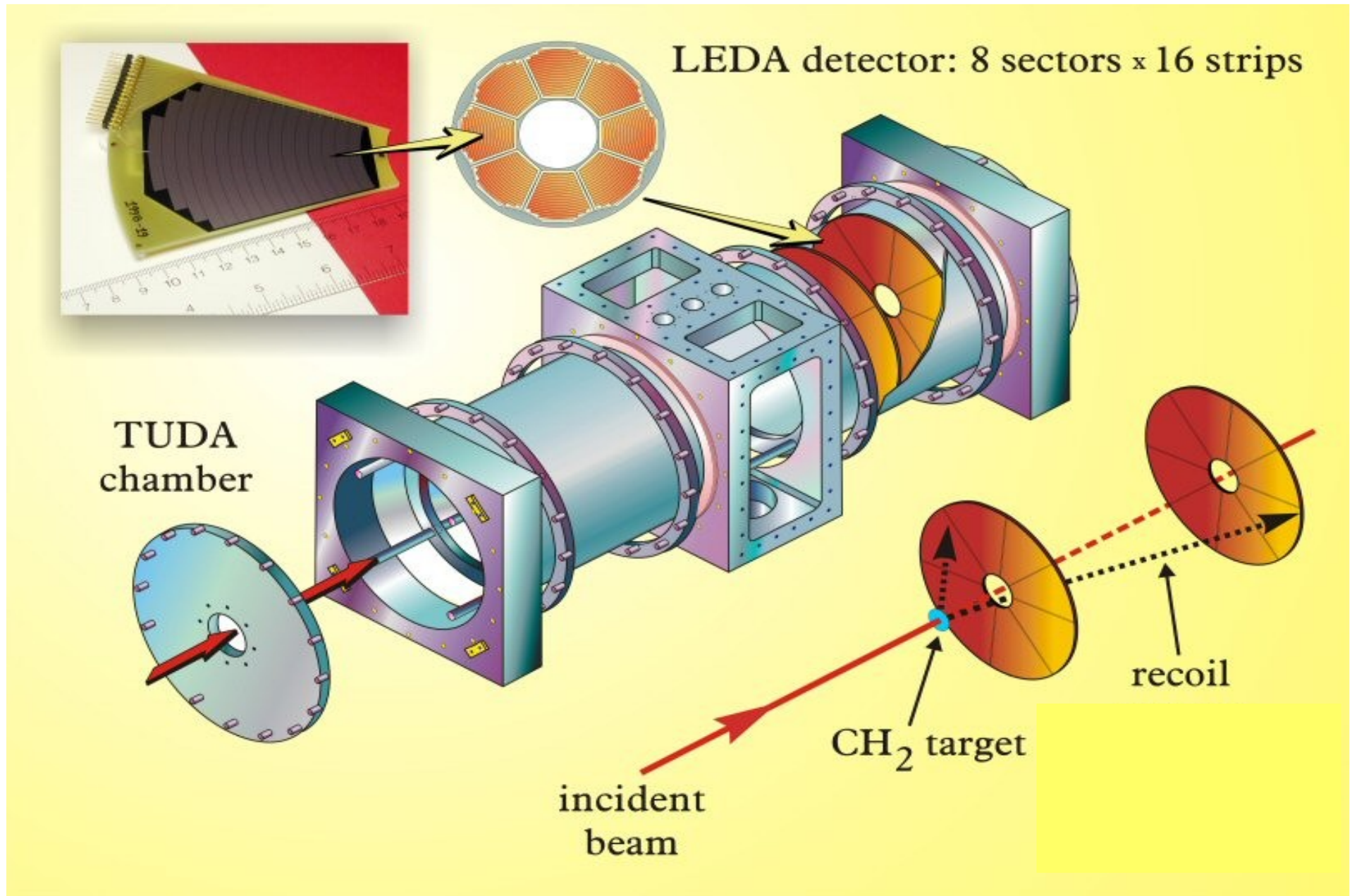
Soft dipole resonance

Halo neutrons oscillate against the core

K. Ikeda, Nucl. Phys. A 538 (1992) 355c



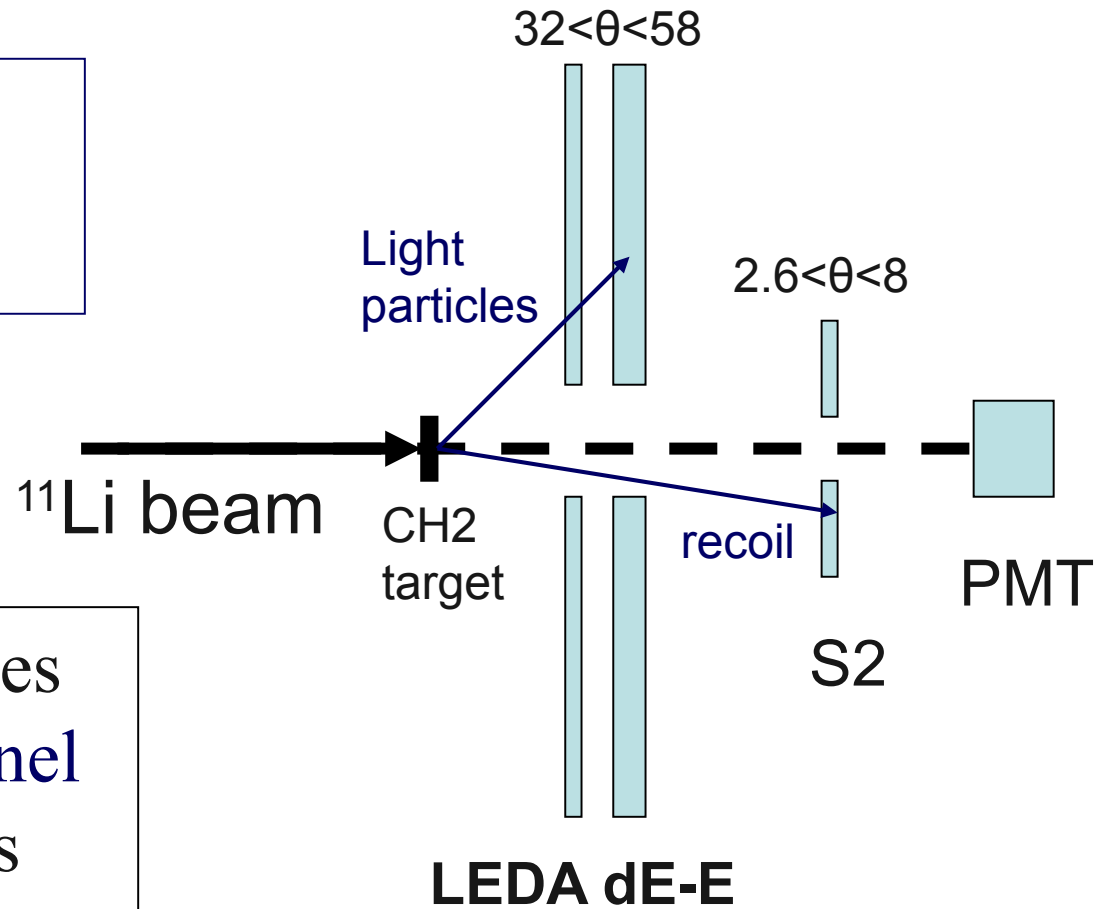
TUDA (TRIUMF UK Detector Array)



Experiment: $^{11}\text{Li}(p,p')^{11}\text{Li}^*$ & $^{11}\text{Li}(p,d)^{10}\text{Li}$

- Silicon detectors : $dE - E$ (YY1) LEDA + S2
- Scintillator + PMT to count the beam

- ^{11}Li @ 4 A MeV
- $260 \mu\text{g}/\text{cm}^2$ CH2 target



$dE-E$: detect light particles
→ identify reaction channel
S2 : detect heavy residues
→ reduce background

11Li Beam

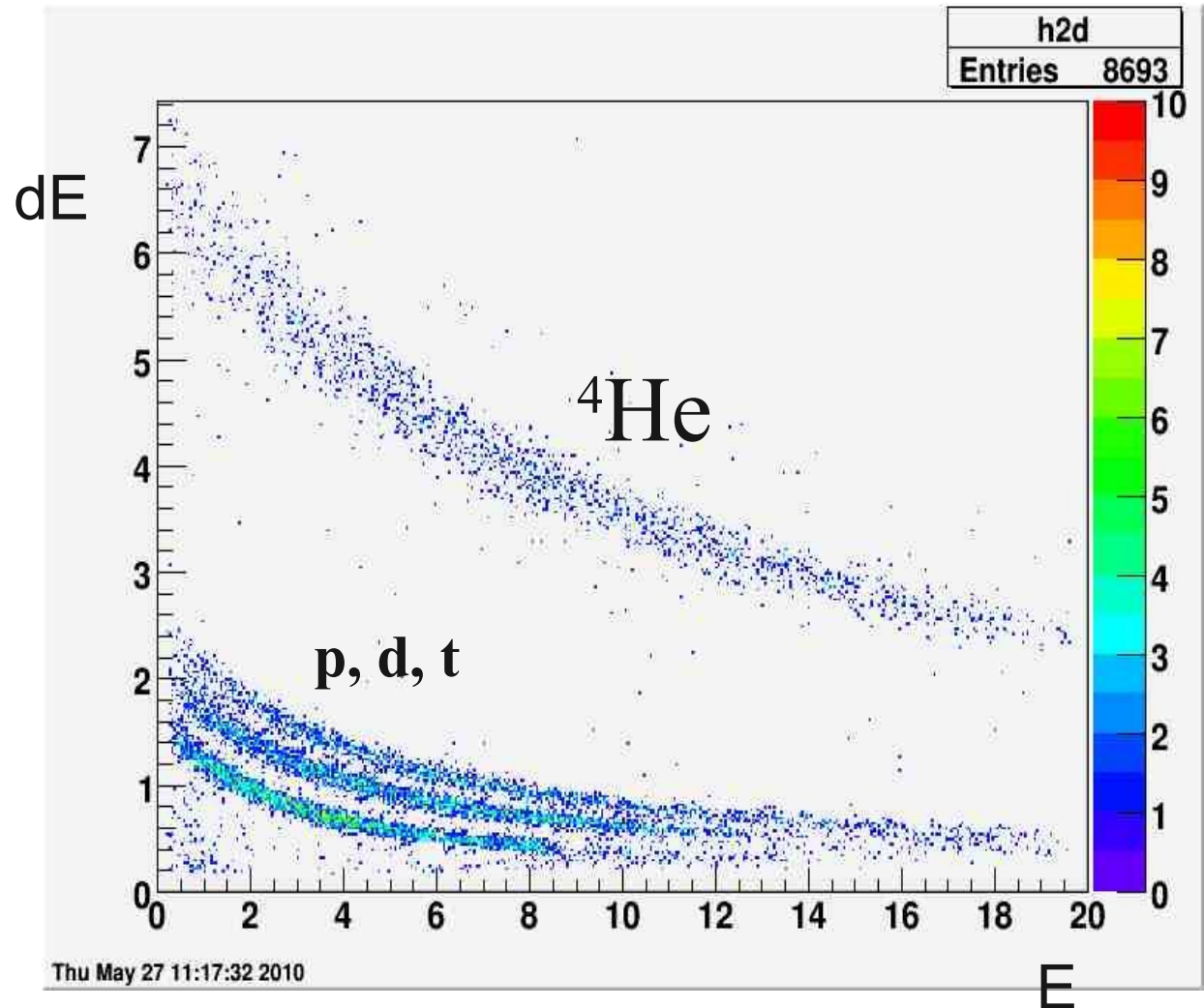
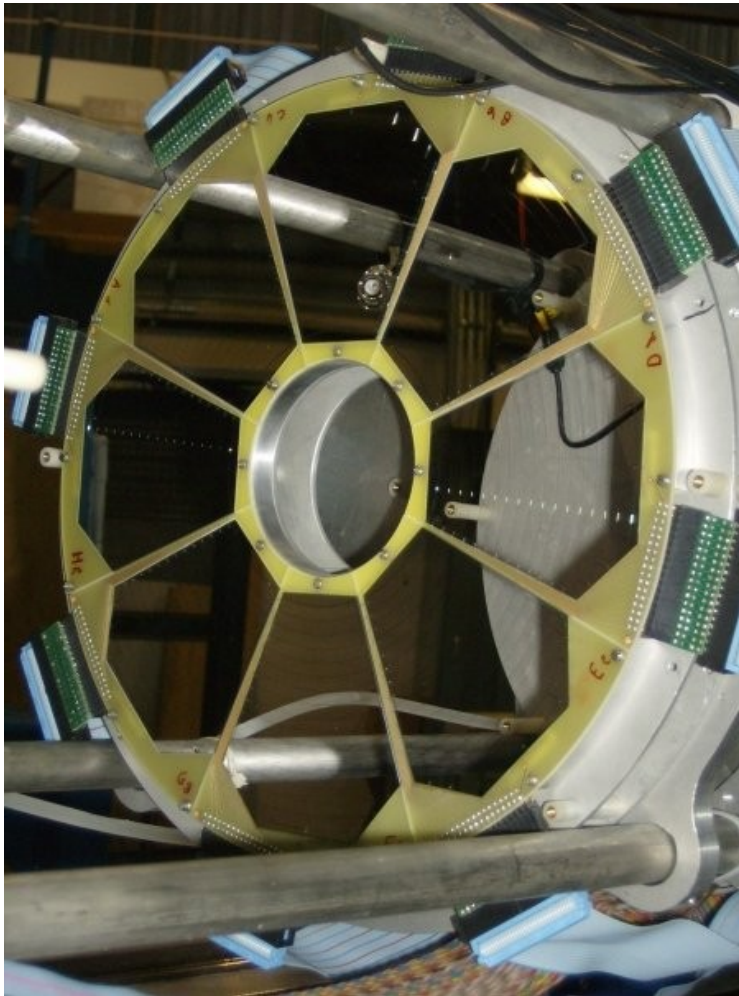
- 203.4 hrs over 348 hours of scheduled beamtime (~58% of beamtime)
- Beam energy variations over > 1 day (~ 414.7 keV lower) (observed in the S2 detector)
- Beam intensity ~ 2200 pps (proposal beamtime requested for 5000 pps)
- 4 days of beamtime taken from S1203 experiment (might run in Fall or Winter 2010)

Experiment	Approved	Scheduled	Received	Comments
S1147	32 shifts 384h	May3 – May12 240h	May3-May17 203h	Cyclotron off for ~ 6 days
S1203	10 shifts 120h	May14- may17 96h	0	-

Saint Mary's University dE-E telescope (2 arrays)

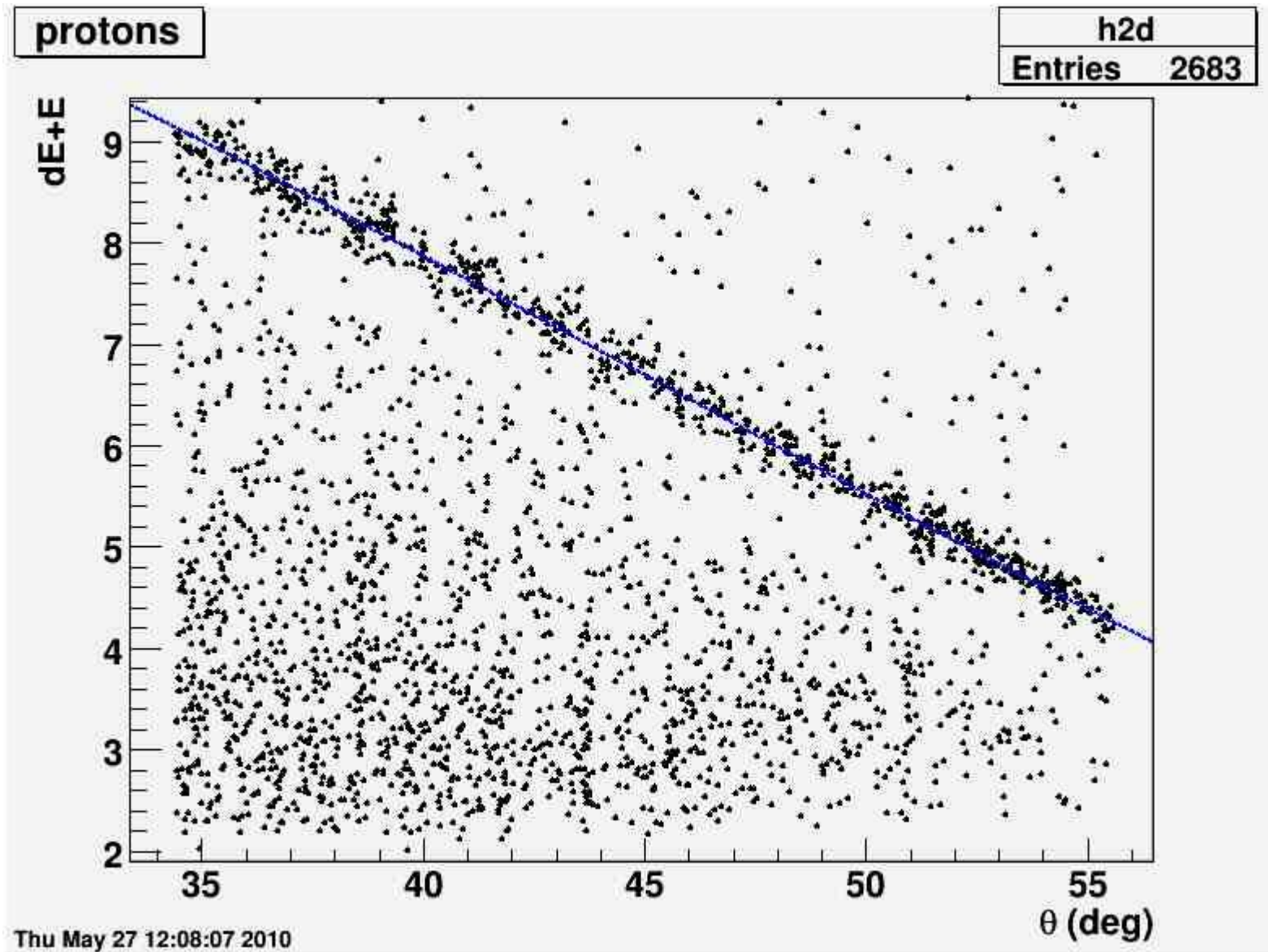
1 array : 8 sectors, 16x8 rings

dE : 45 μm , E : 1000 μm



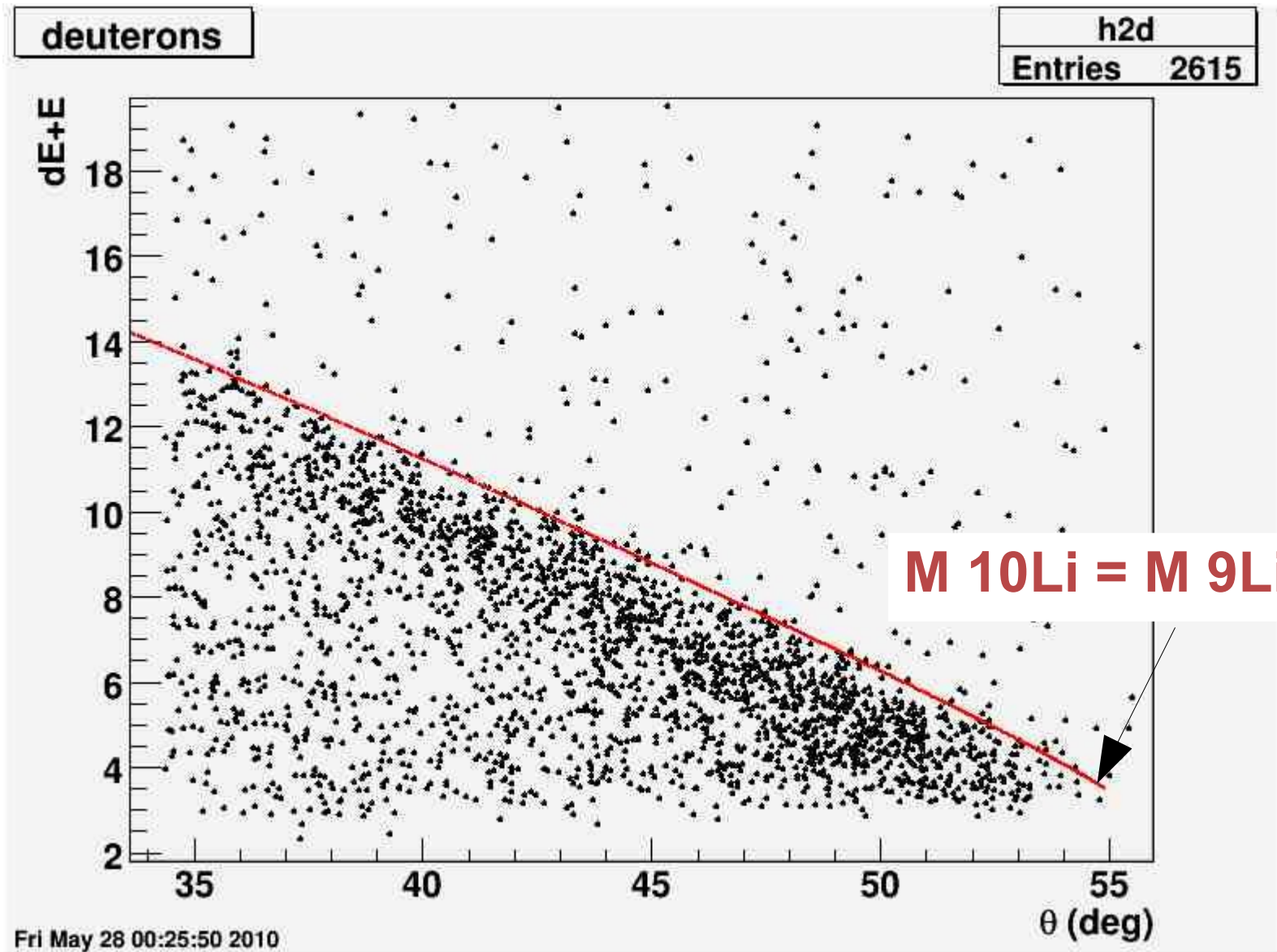
- clear identification of reaction channels
- better angular resolution from dE-E angular constraints

$^{11}\text{Li}(p,p)$ reaction channel – Kinematics



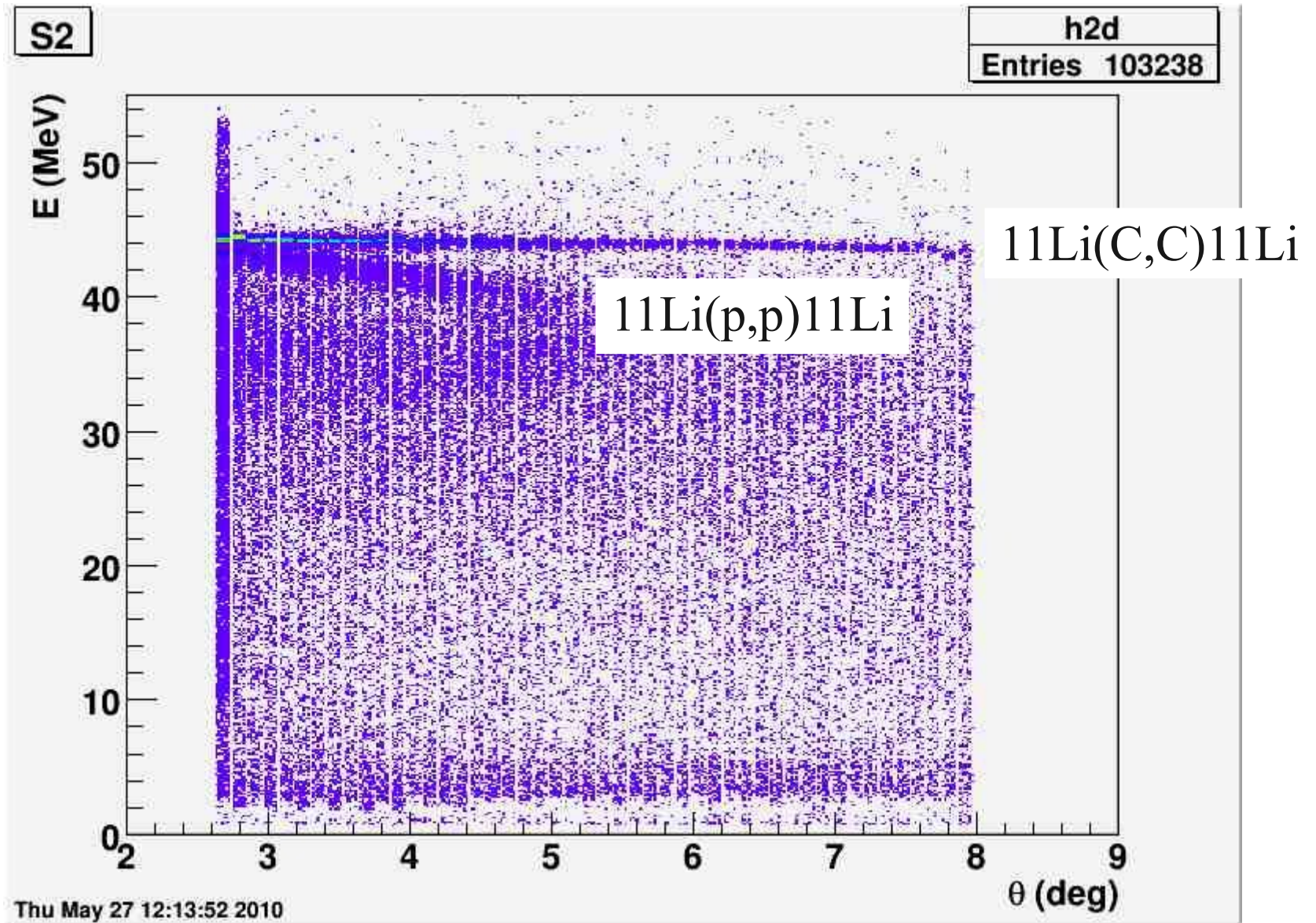
→ excitation energy of ^{11}Li

$^{11}\text{Li}(p,d)$ reaction channel – Kinematics



→ excitation energy of ^{10}Li

Reaction Channels – Kinematics



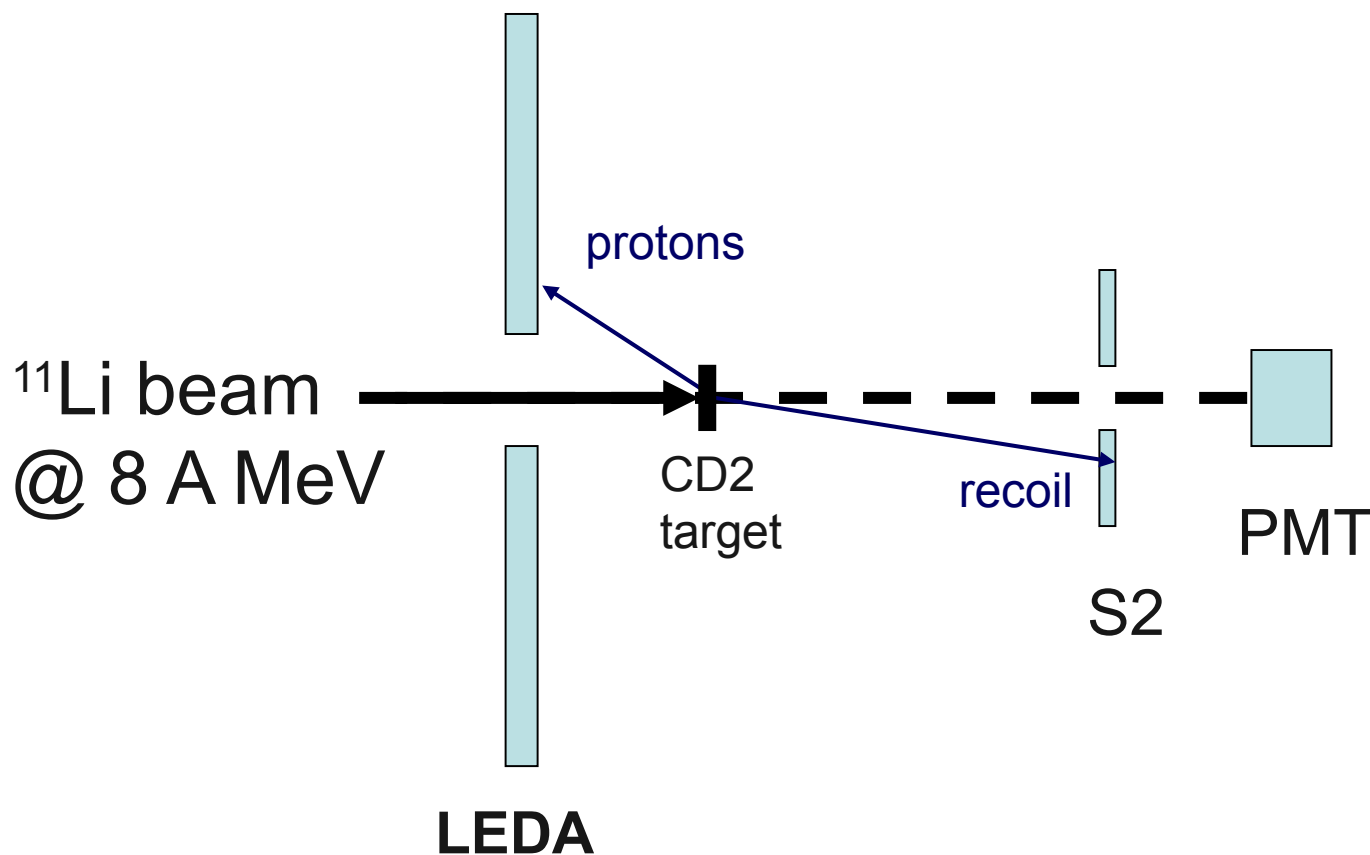
- optical potentials parameters for $^{11}\text{Li}(p,p)^{11}\text{Li}$
- reduce backgrounds

Conclusions

- Experimental setup is ok
- Need more beamtime for S1147 ?
- Need beamtime to run S1203

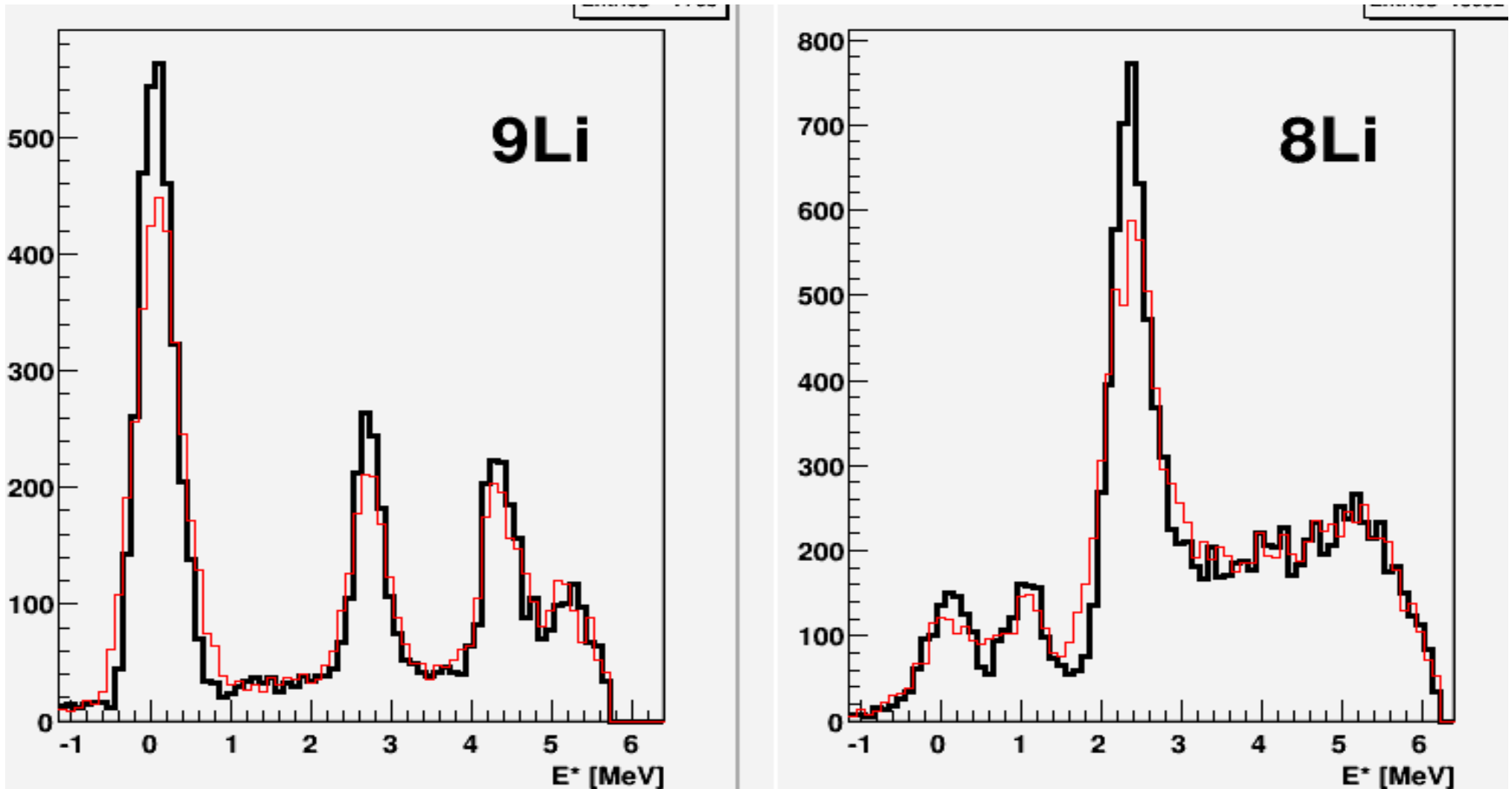
S1203 - Spectroscopy of ^{12}Li via $^{11}\text{Li}(d,p)^{12}\text{Li}$

TUDA II



Ask for beam in next beamtime schedule 2010

${}^9\text{Li}(p,p'){}^9\text{Li}$ – last summer run



- 3 days of ${}^9\text{Li}$ beam @ 5 A MeV into $490 \mu\text{g}/\text{cm}^2$ CH_2 target
- Observed 3 excited states in ${}^9\text{Li}$ → determine spin of states
- better angular resolution using dE-E → better resolution in E^*