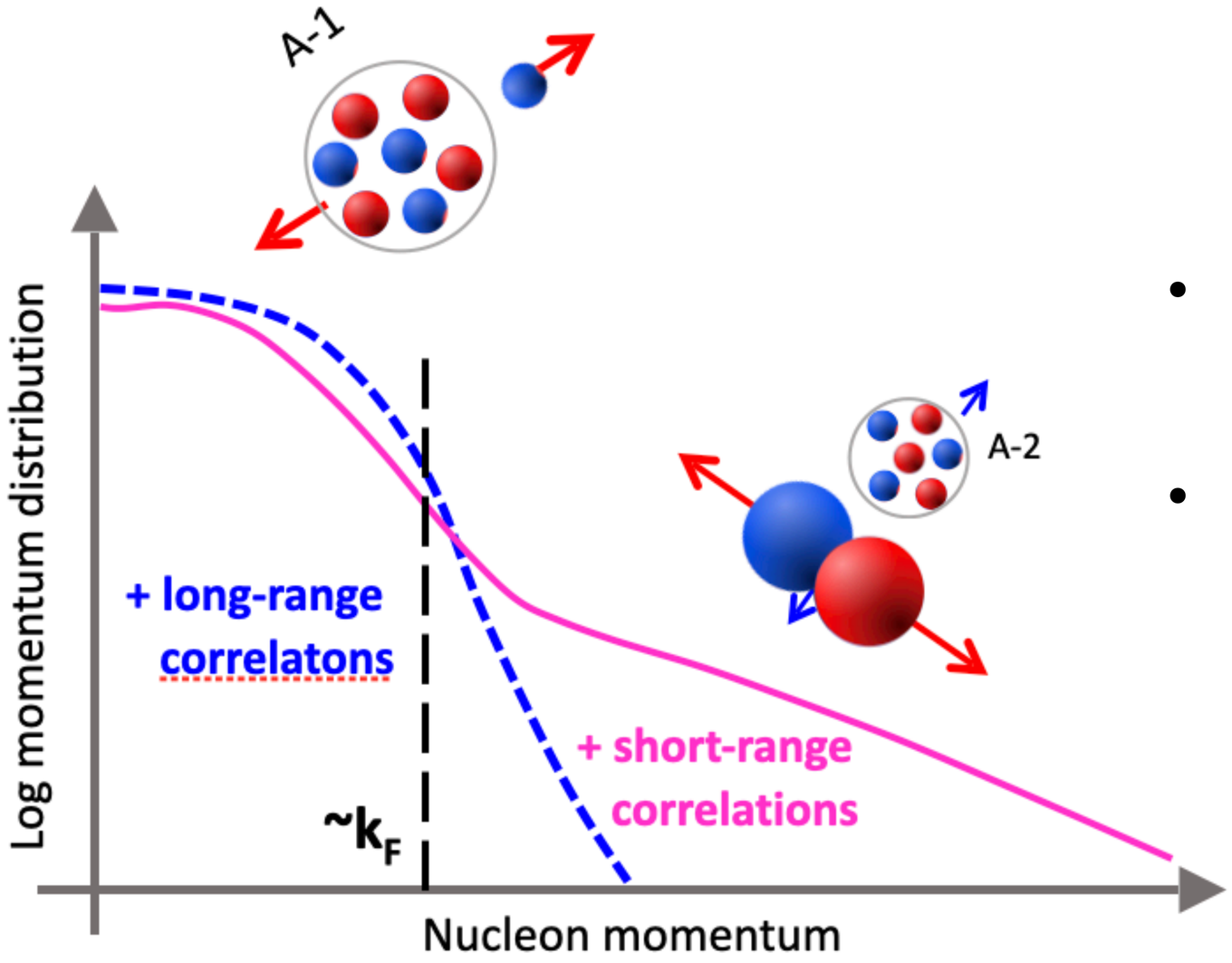
Identifying quasi-elastic events in the SRC experiment

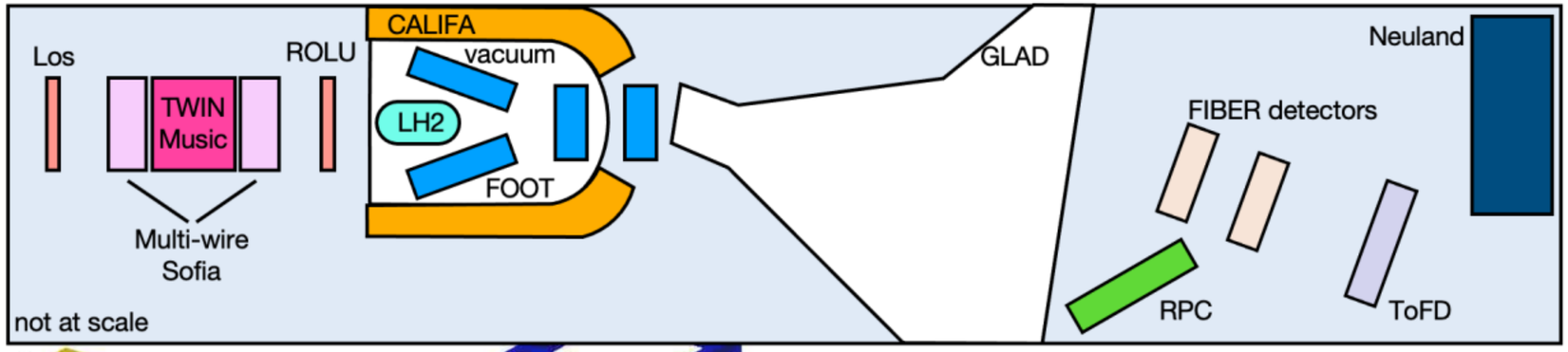
Hang Qi, 05/23/2023

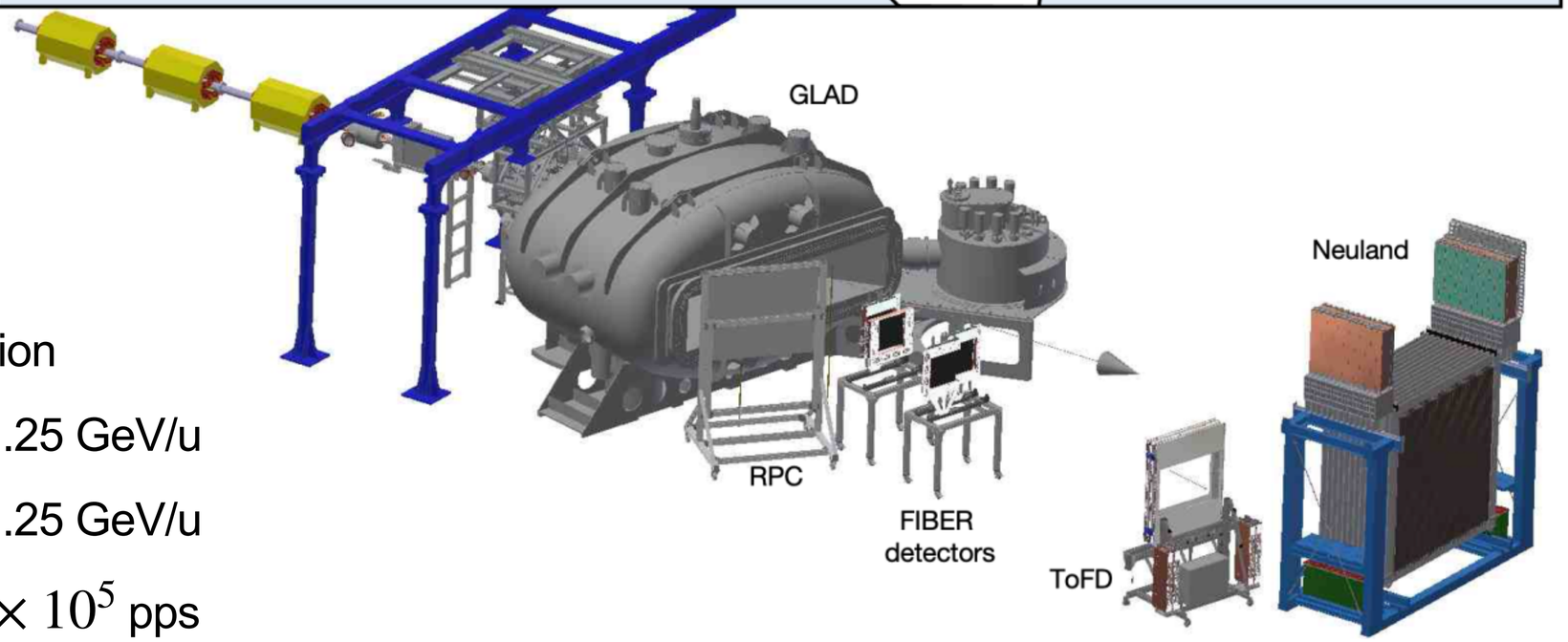
Short-range Correlation in asymmetric nuclei



- Identify SRC in ^{12}C and ^{16}C using missing mass method
- Using mean field reaction $^{12}C(p,2p)^{11}B$ as reference channel

Experimental setup





- Beam information
  - ^{16}C beam, 1.25 GeV/u
  - ^{12}C beam, 1.25 GeV/u
  - Intensity: 1×10^5 pps

SRC channels

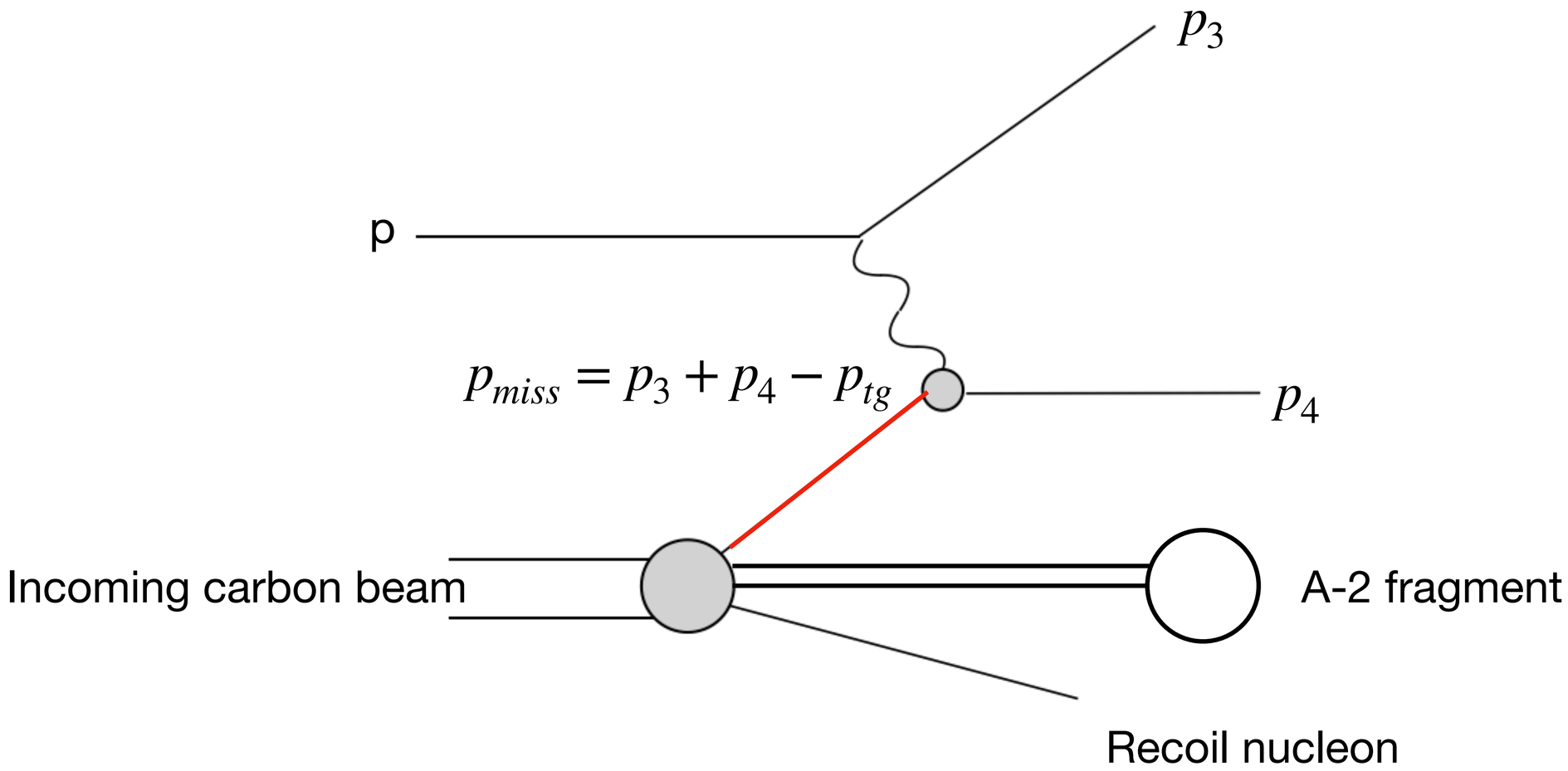
^{16}C(p,2pn)^{14}B*

^{16}C(p,2pp)^{14}Be*

^{12}C(p,2pn)^{10}B*

^{12}C(p,2pp)^{10}Be*

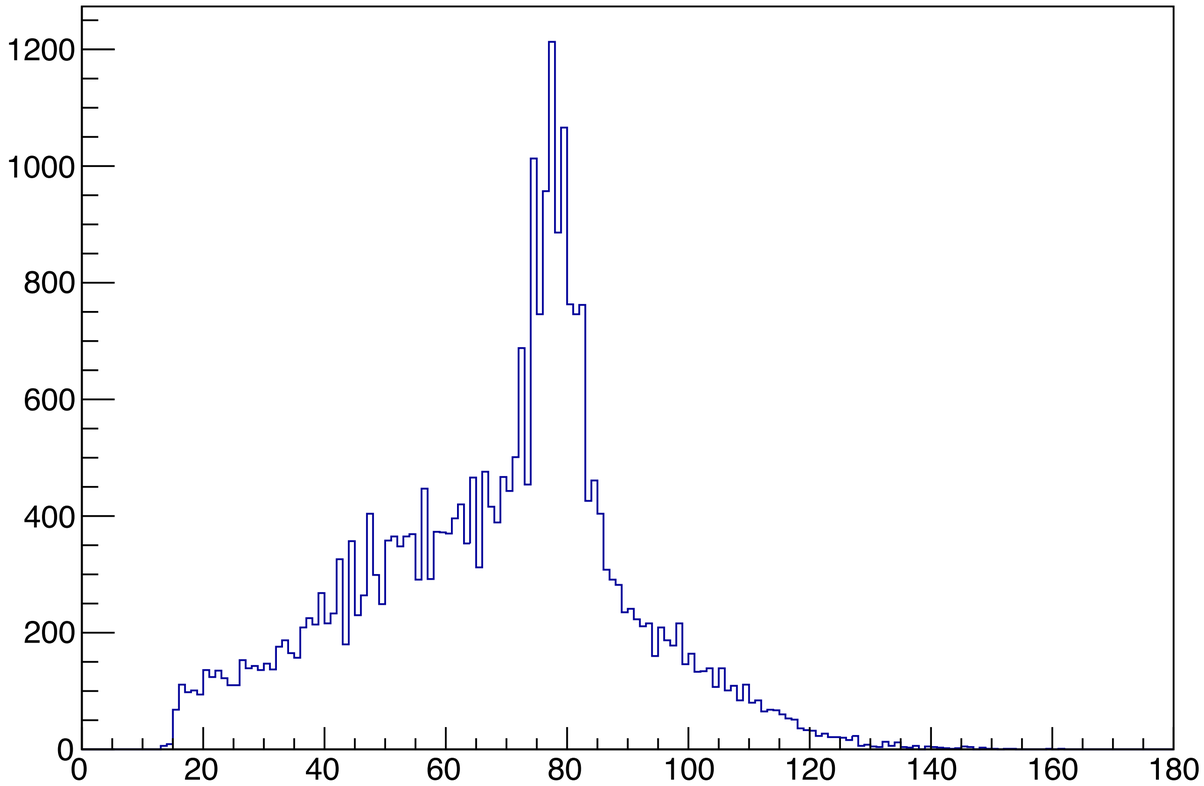
Inverse kinematics



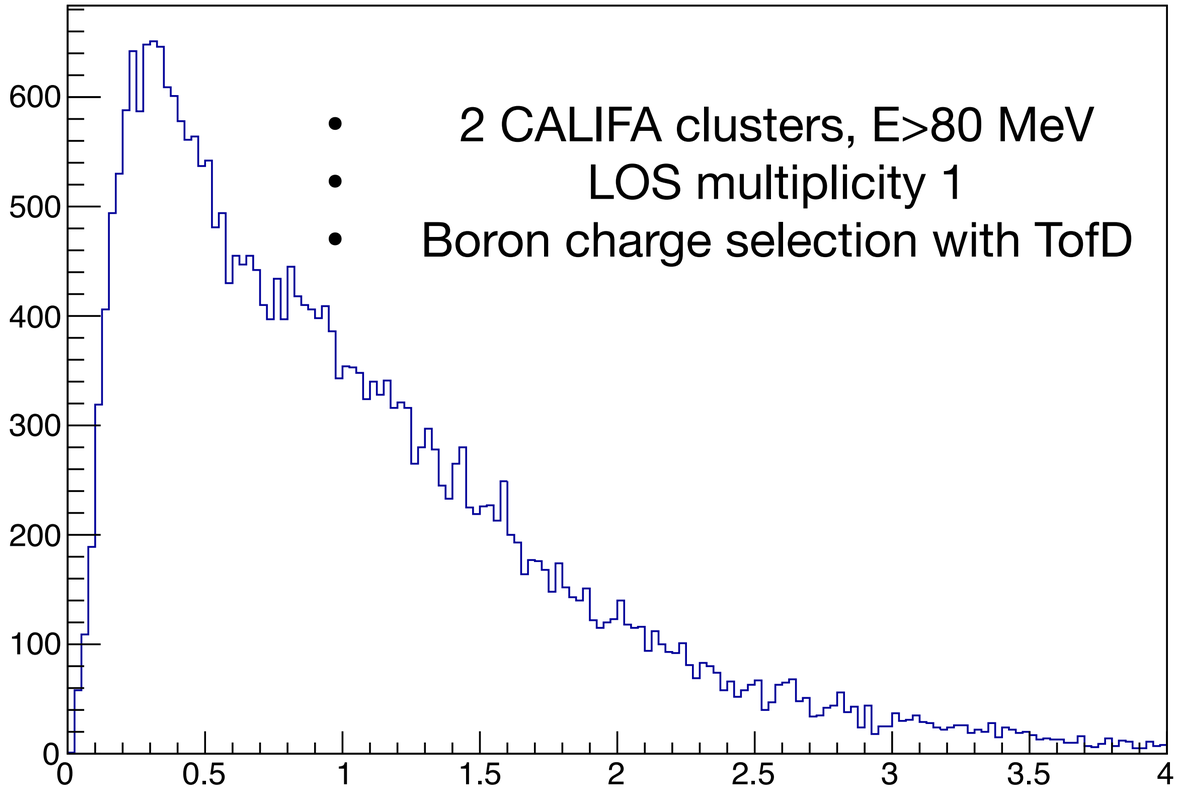
p2p selection

^{12}C data, ~ 1/10 of total ^{12}C data

- Large contamination from inelastic and FSI



pp Opening Angle [Degree]

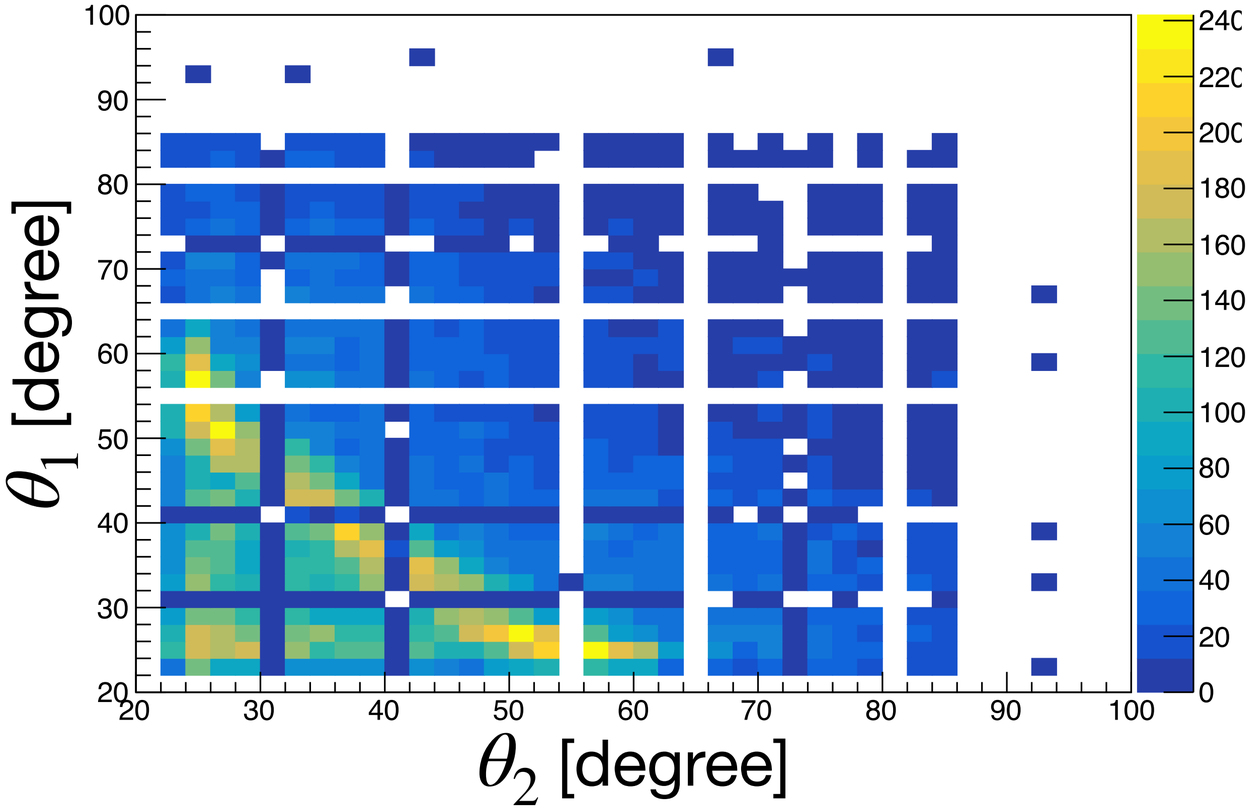


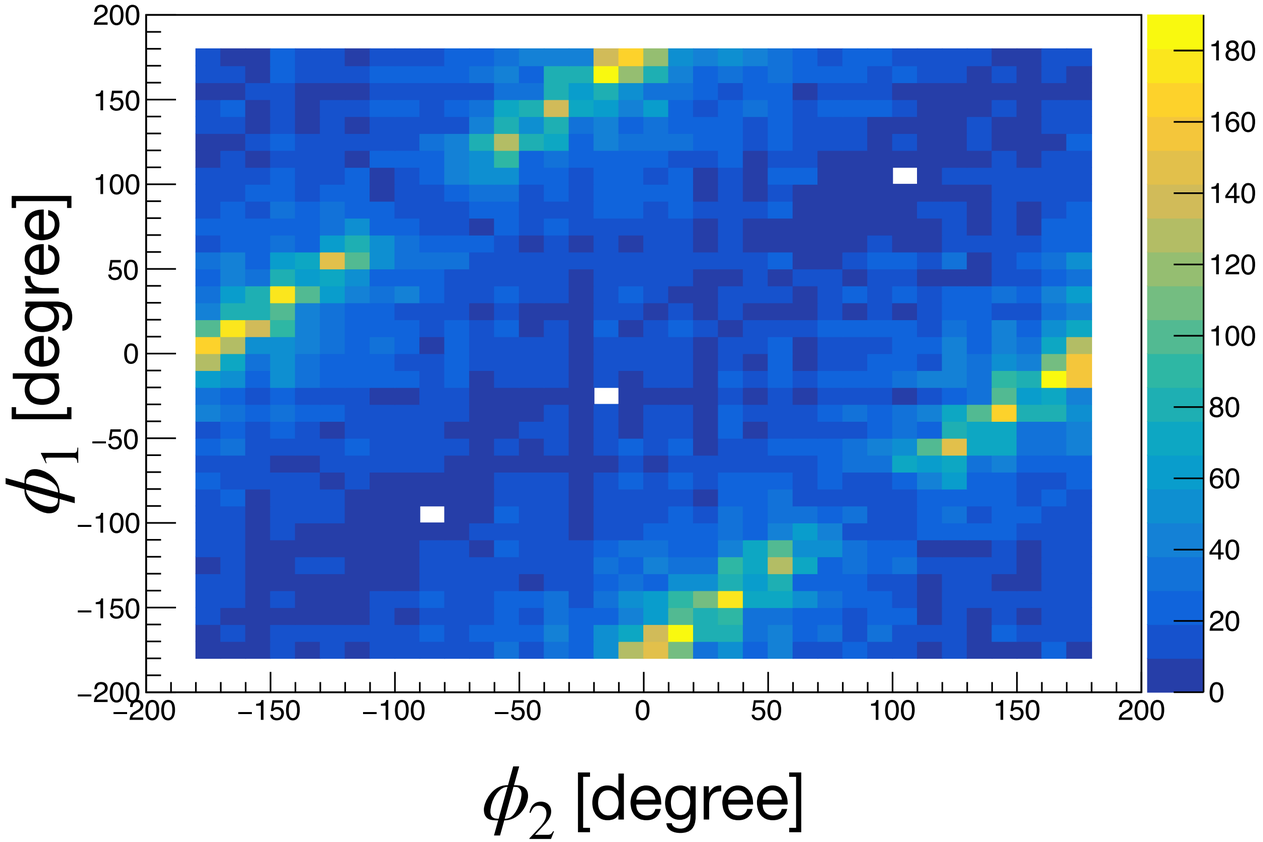
- 2 CALIFA clusters, E>80 MeV
- LOS multiplicity 1
- Boron charge selection with TofD

Missing Momentum [GeV]

p2p selection

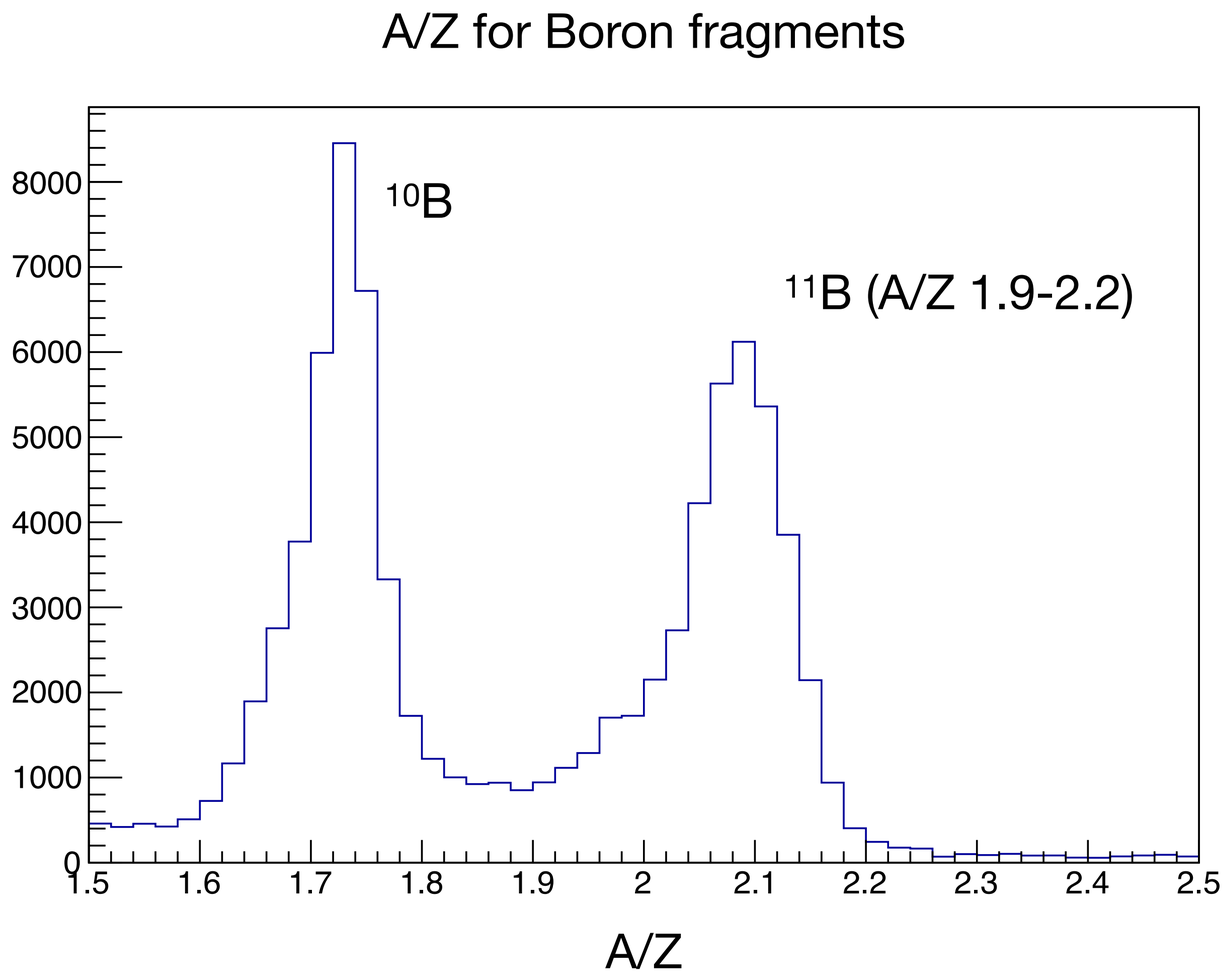
- Coplanar angular correlation visible
- Contamination from inelastic events at small θ angles





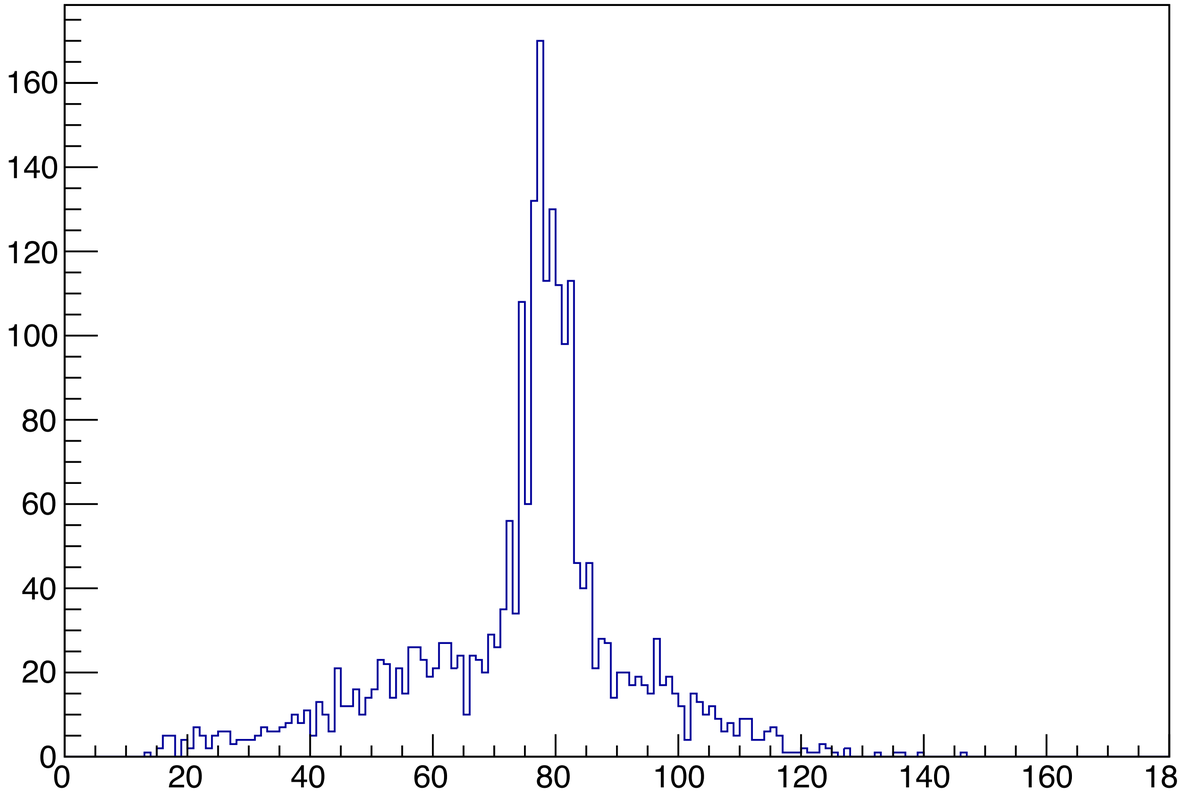
Fragment Identification

Using charge v. A/Z

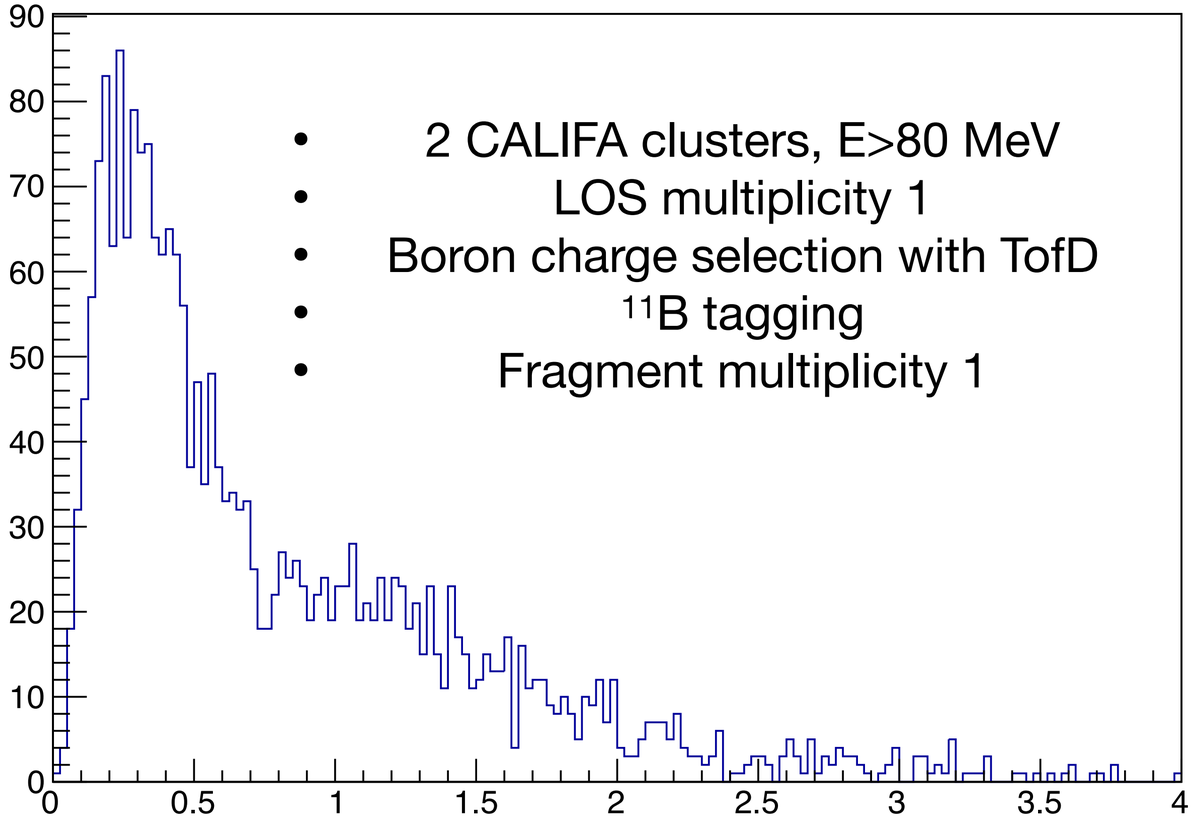


^{11}B tagging

- FSI contributions suppressed but still exist

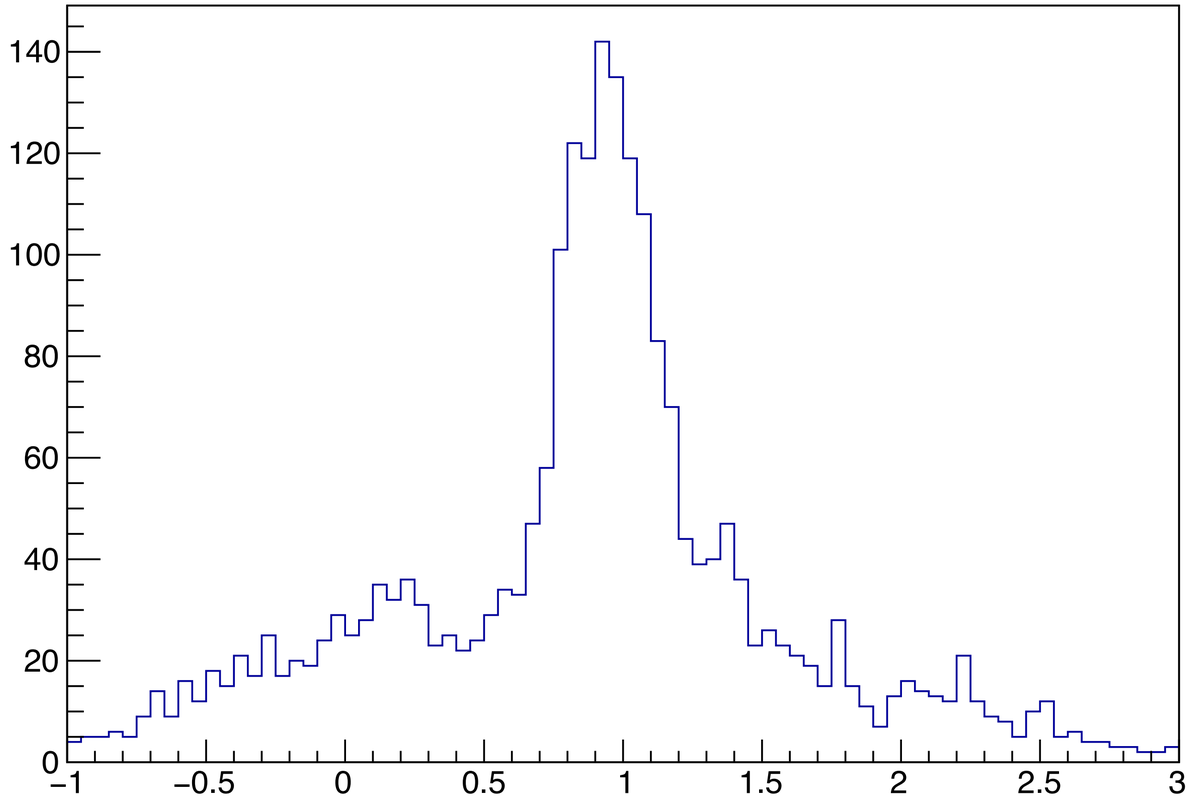


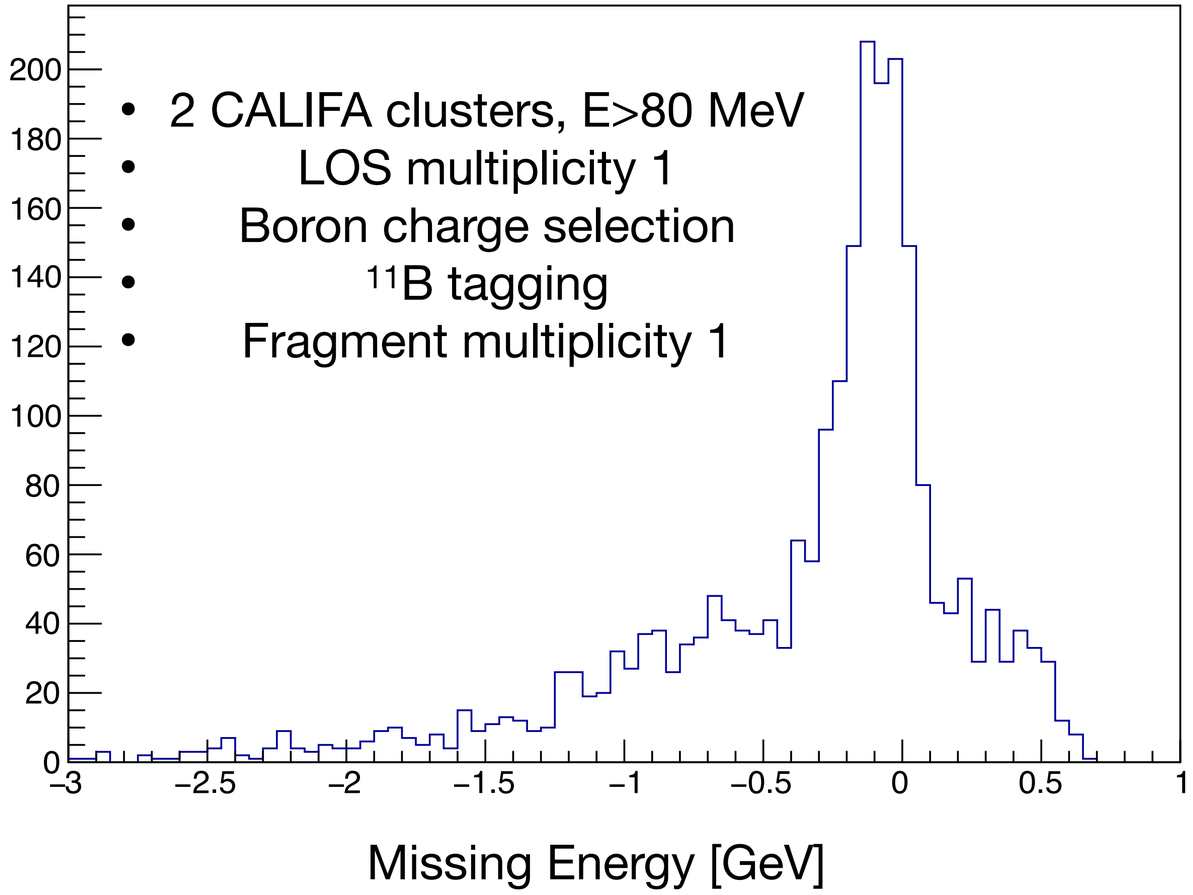
pp Opening Angle [Degree]



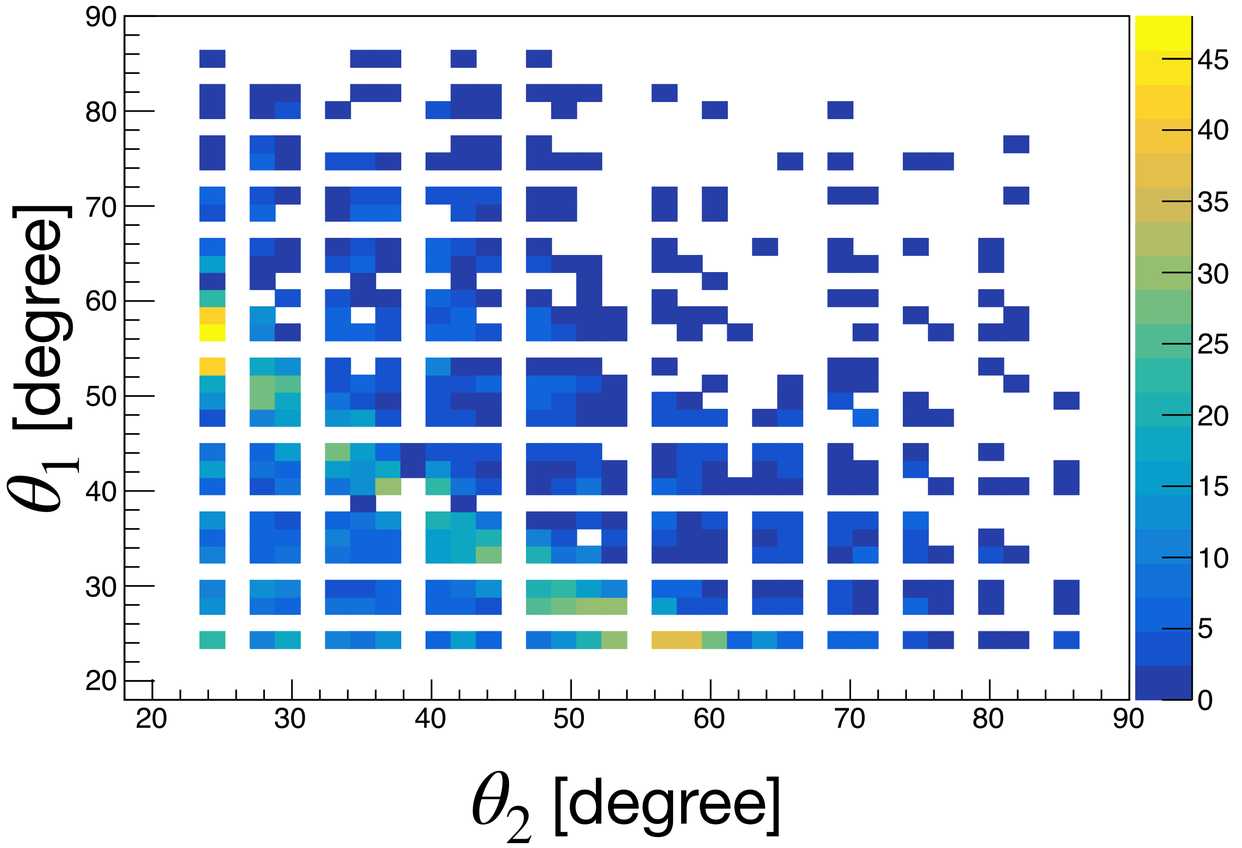
Missing Momentum [GeV]

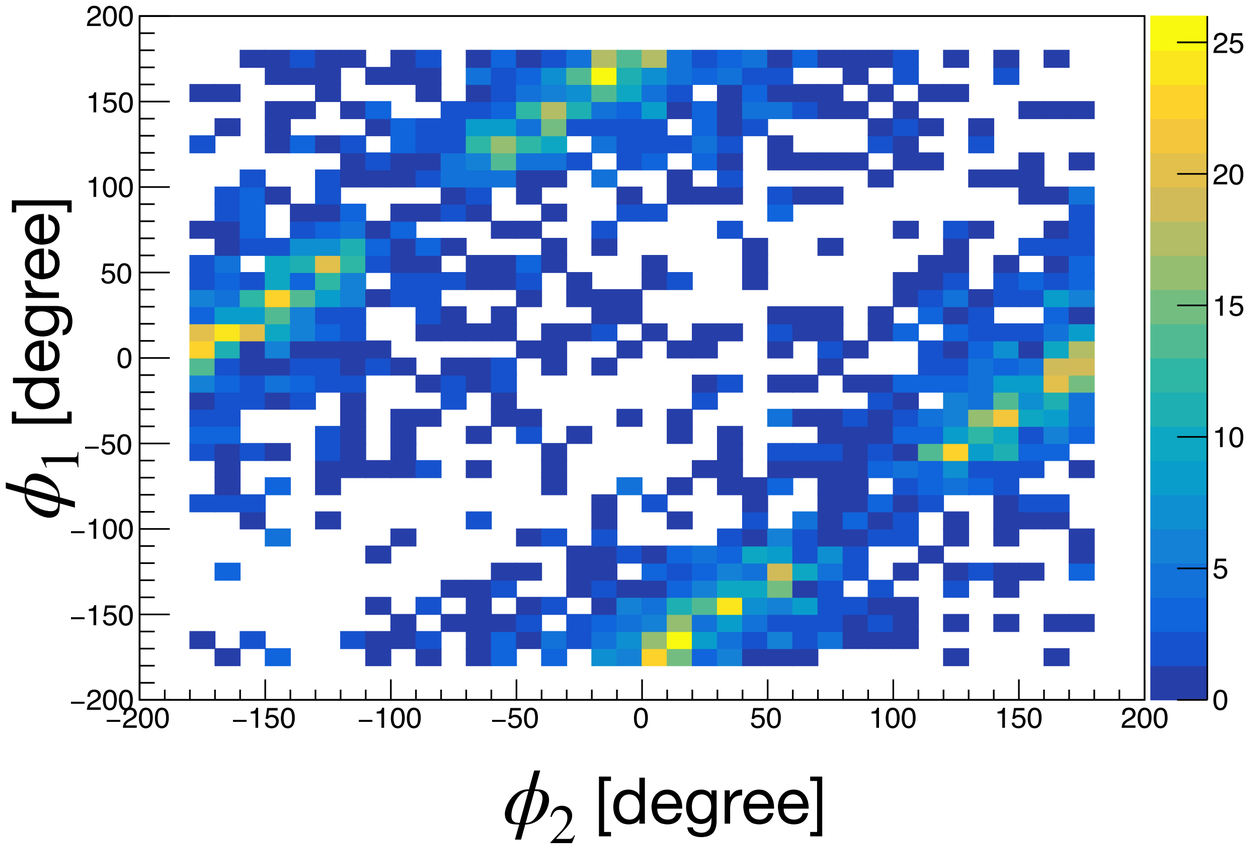
^{11}B tagging


140
120
100
80
60
40
20
0
−1
−0.5
0
0.5
1
1.5
2
2.5
3
Missing Mass Squared [GeV²]


• 2 CALIFA clusters, E>80 MeV
• LOS multiplicity 1
• Boron charge selection
• ^{11}B tagging
• Fragment multiplicity 1
200
180
160
140
120
100
80
60
40
20
0
−3
−2.5
−2
−1.5
−1
−0.5
0
0.5
1
Missing Energy [GeV]

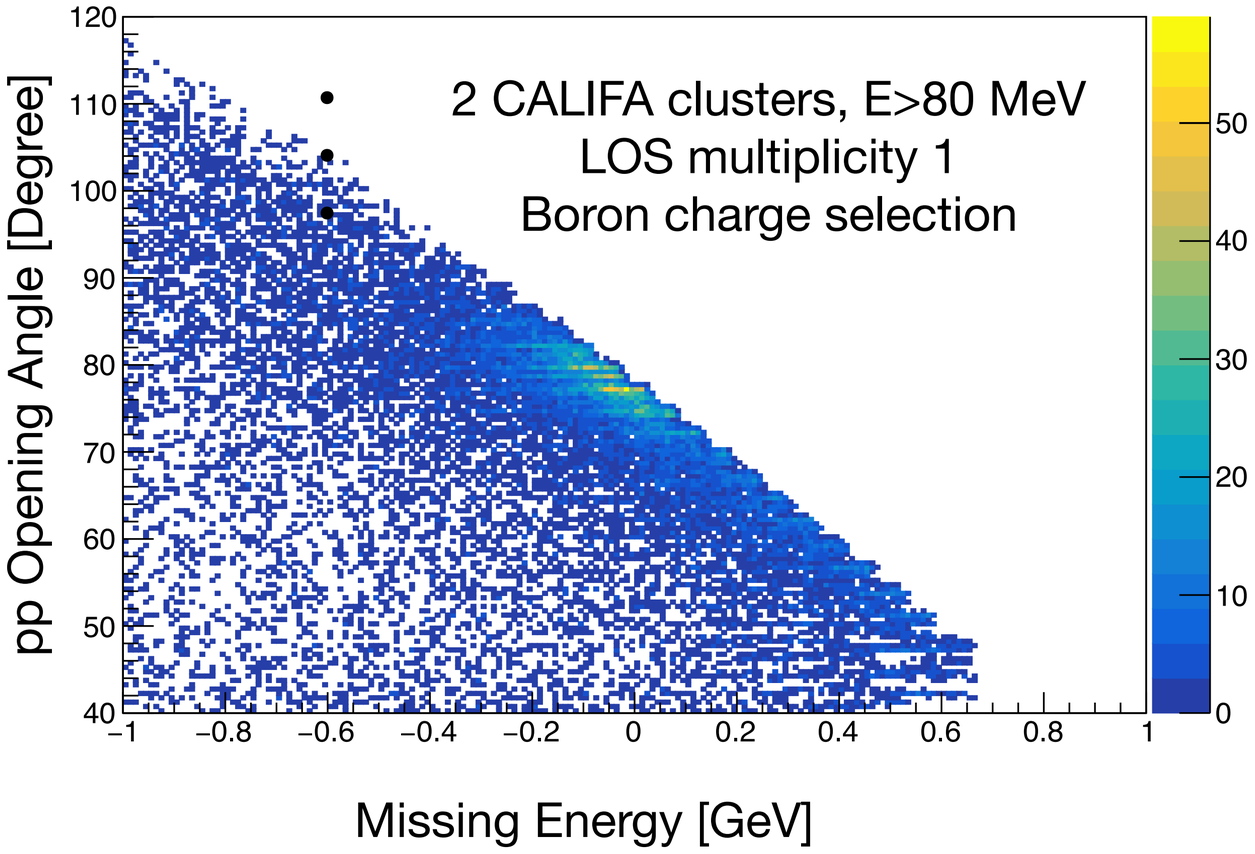
^{11}B tagging

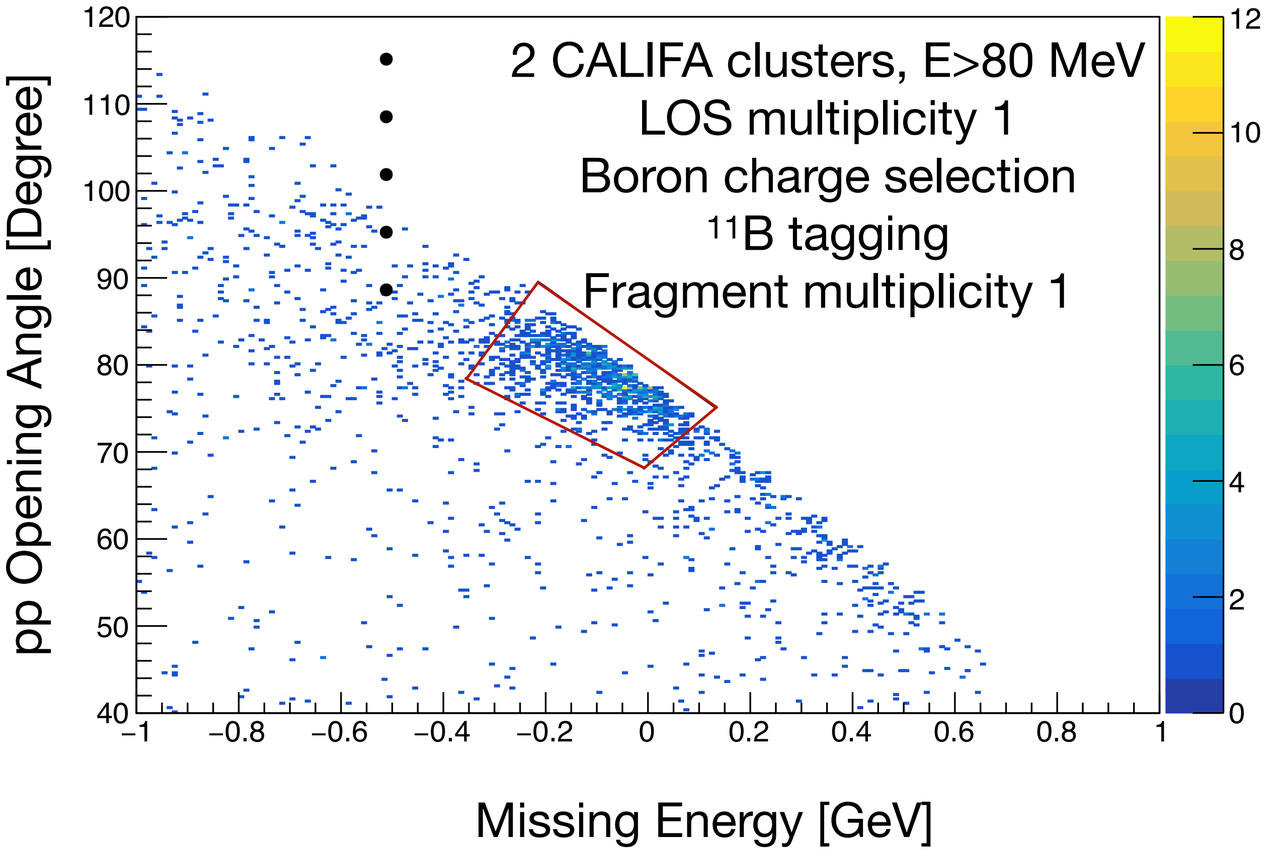




Opening Angle v. Missing Energy

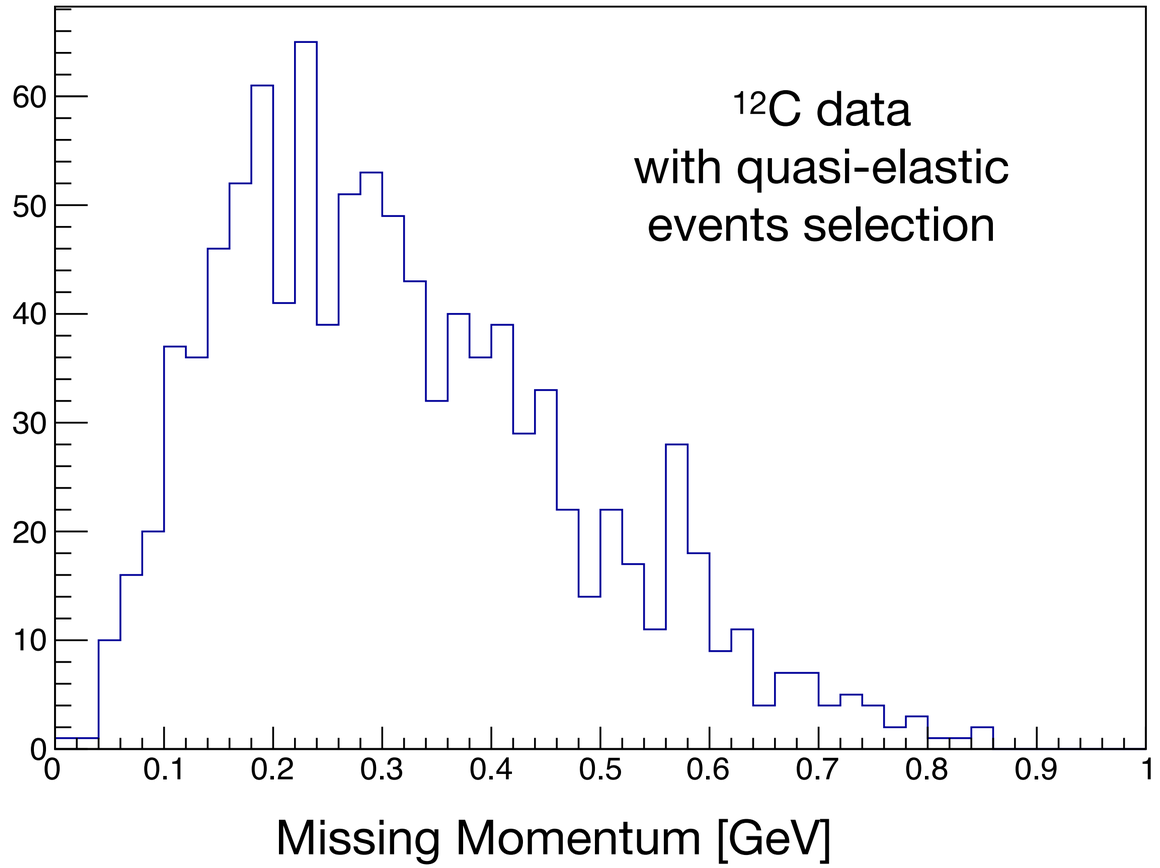
Using 2D correlations to identify quasi-elastic events

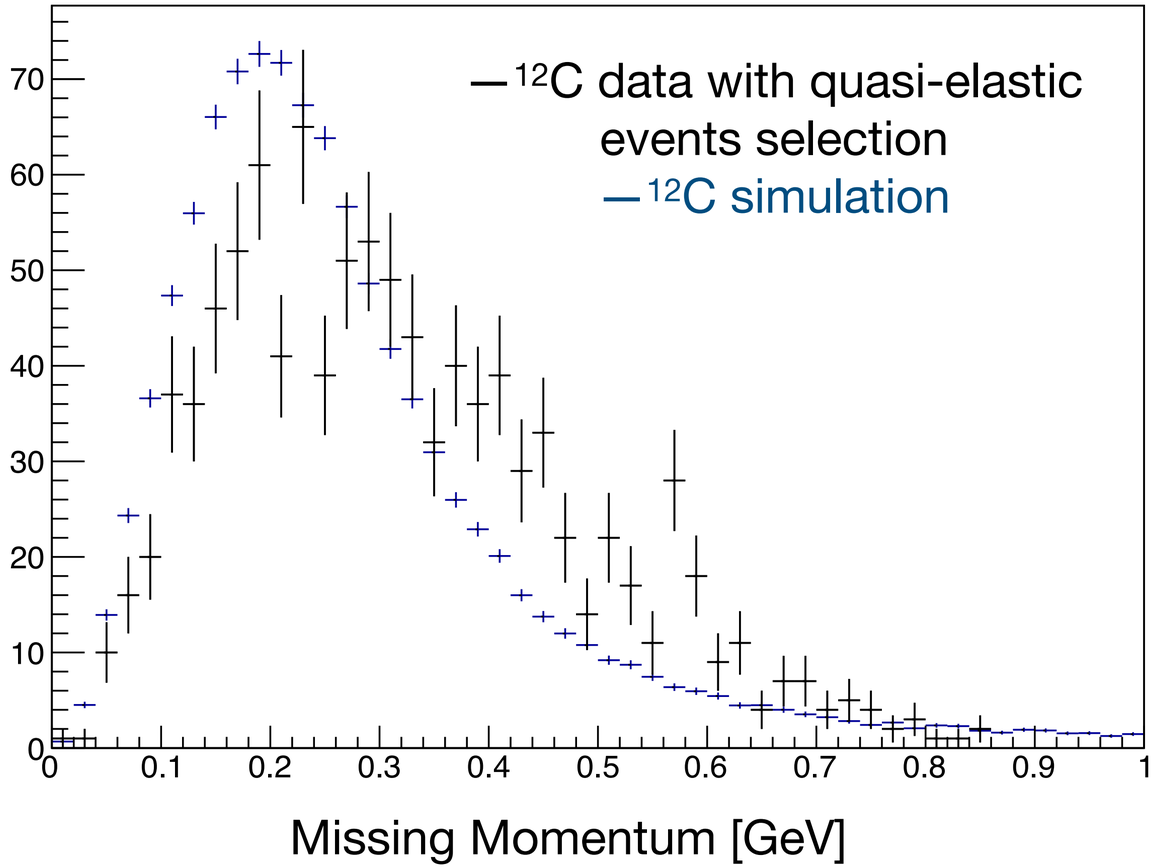




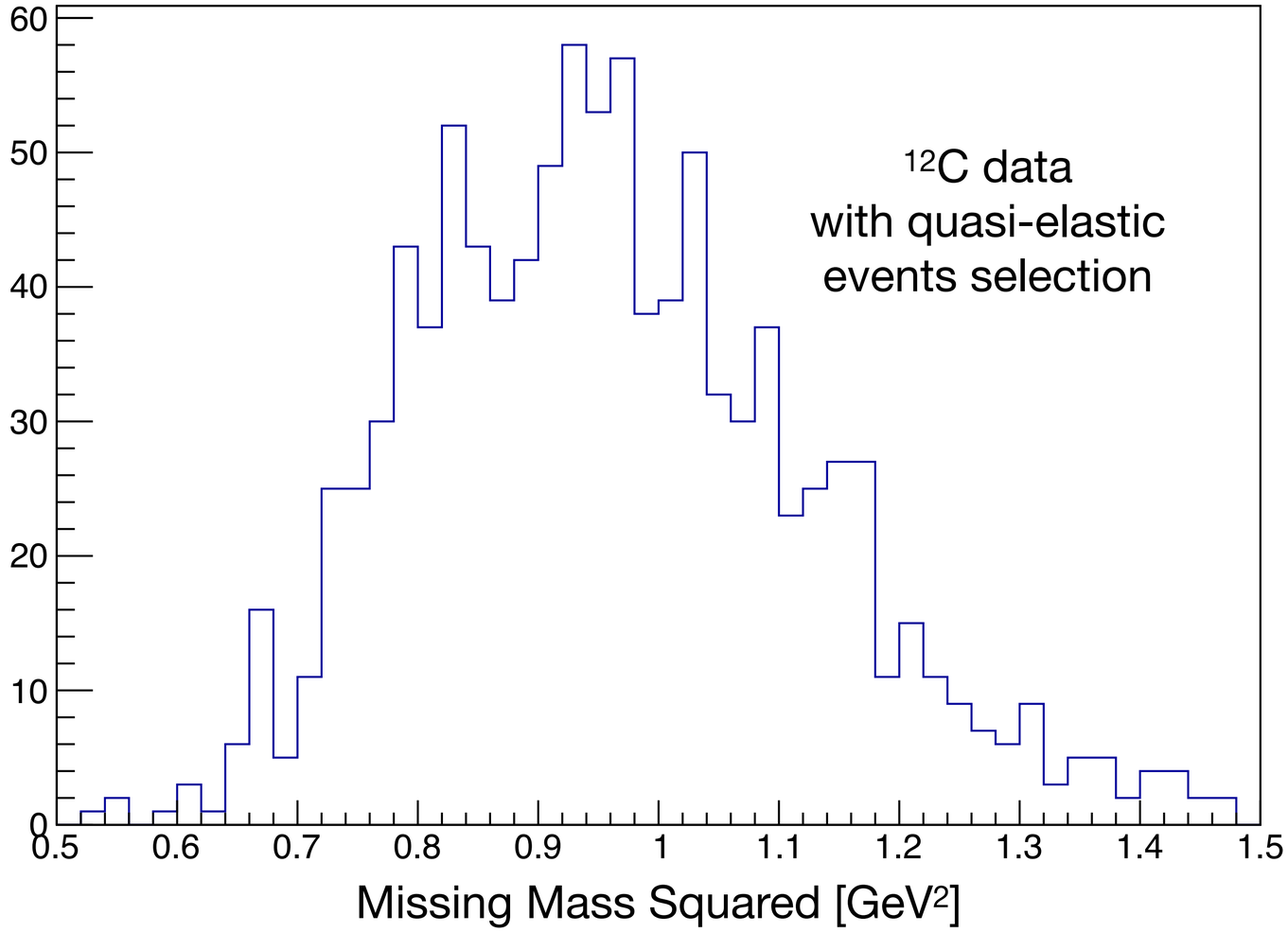
Quasi-elastic events selection

Kinematic distribution in data and simulation





Quasi-elastic events selection



Conclusions and future-work

- Quasi-elastic events identification using missing mass method: fragment tagging suppresses inelastic scattering and FSI
- Analysis of reference channel $^{12}C(p,2p)^{11}B$ kinematics
  - Check detector calibration with reference channel kinematics
  - Simulation data comparison
- SRC identification

Backup Slides

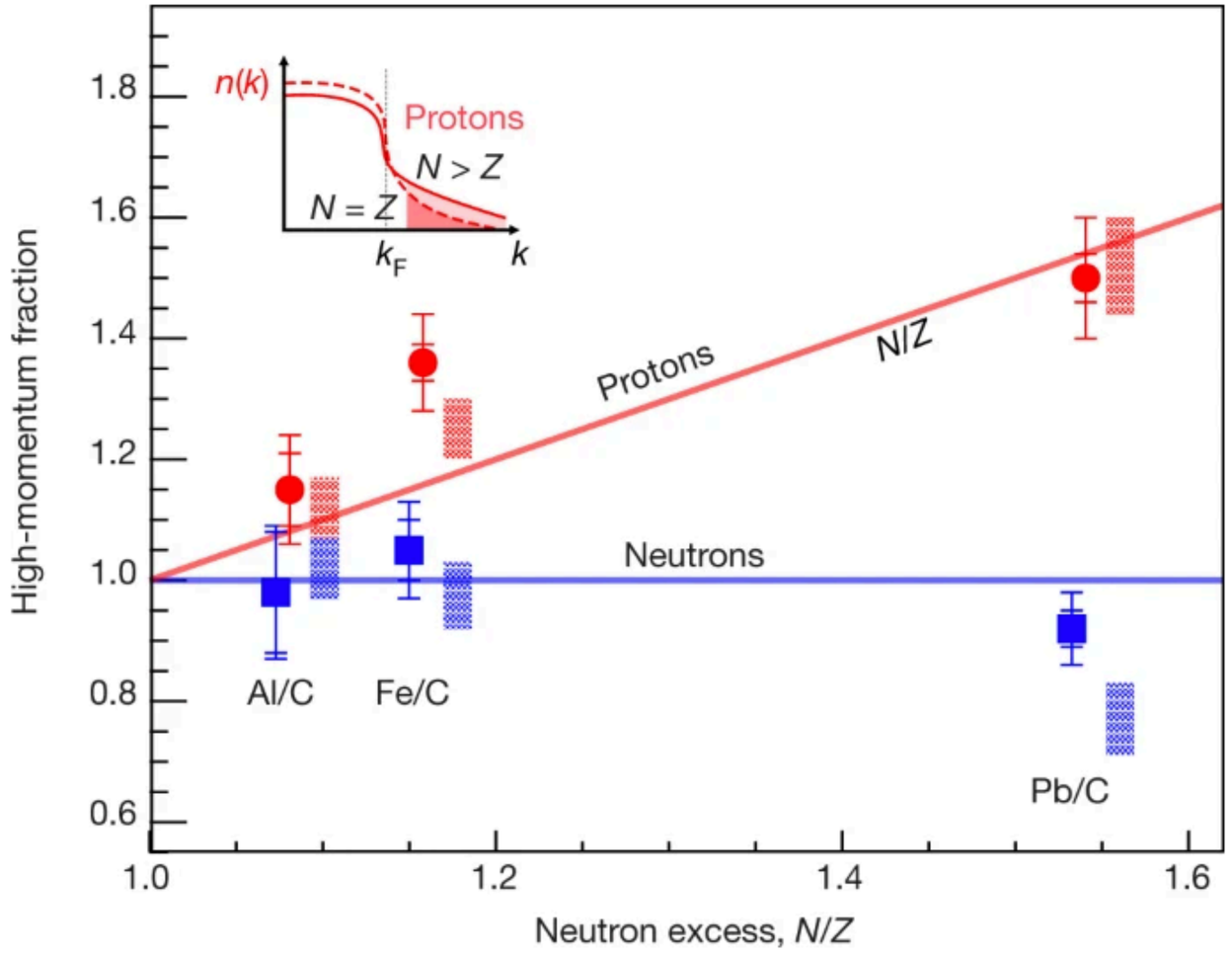
Outline

- ^{12}C data with ^{11}B tagging
- Quasi-elastic events selection
- $p_{\mathrm{miss}} = p_3 + p_4 - p_{\mathrm{tg}}$ in ^{12}C rest frame
- p_3, p_4: kinetic energy and angle of protons from CALIFA analysis
- $E_{\mathrm{miss}} = m_N - p_{\mathrm{miss}}\,.\,E$

SRC study for neutron-rich nuclei

Limitations of this study:

- Inverse kinematics is the only way to study nuclei with asymmetry > 1.5
- Results might be mass-dependent



M. Duer et al. (CLAS), Nature 2018.

p2p selection

Kinetic distribution after initial selection