UNIVERSITY OF TORONTO

ν_e CCQE/CC1π^+ Selection Studies

Trevor Towstego

ν_e CCQE/CC1π^+ Meeting

September 18, 2019

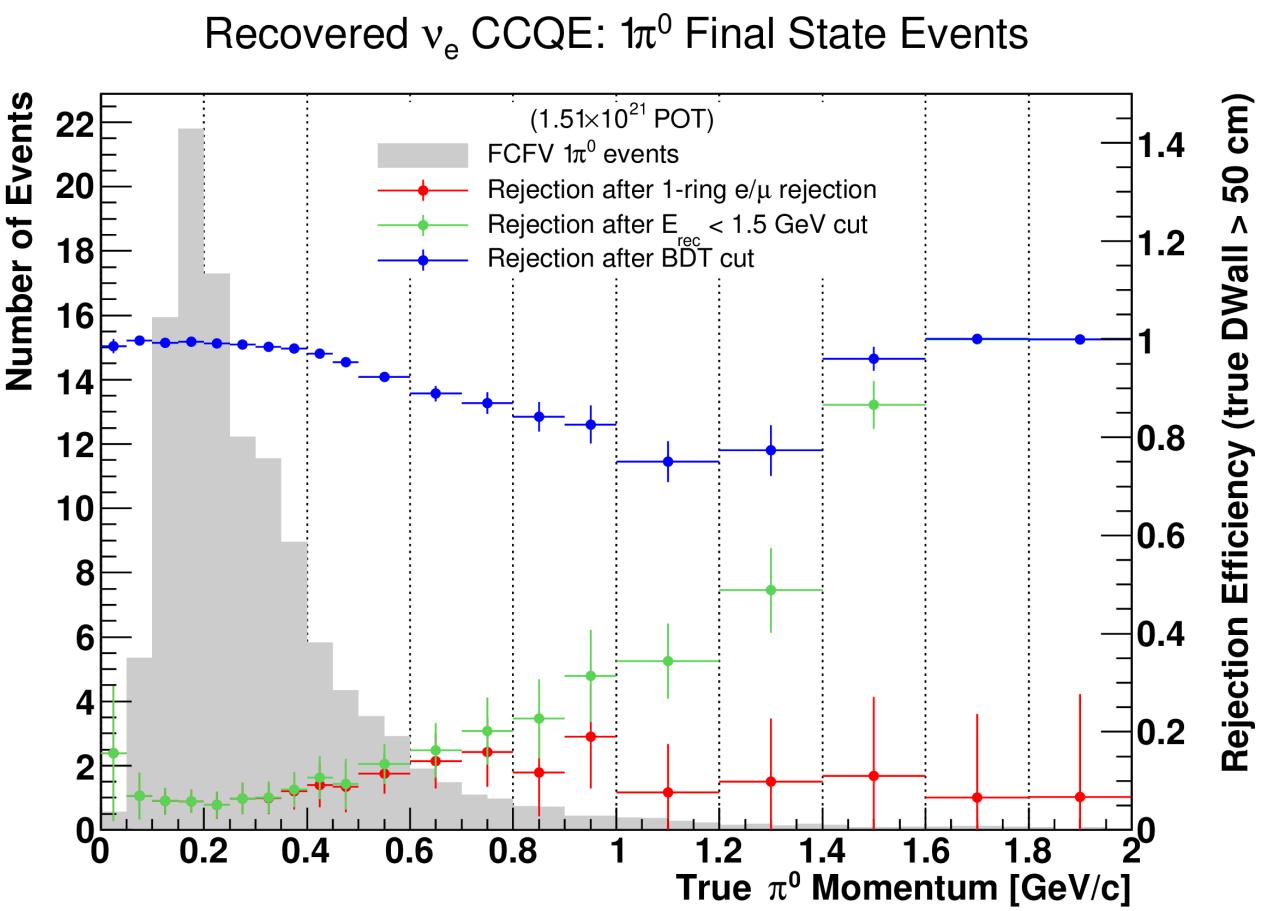
Systematics Checks

- Working on plotting selection efficiencies versus some potentially problematic variables
  - Recovered ν_e CCQE sample: Plot final state $1\pi^0$ rejection efficiency vs. true π^0 momentum
  - 2-ring ν_e CC$1\pi^{\pm}$ sample: Plot final state $1e1\pi^+$ selection efficiency vs. true π^+ and e momentum

ν_e CCQE Sample

$1\pi^0$ rejection vs. π^0 momentum

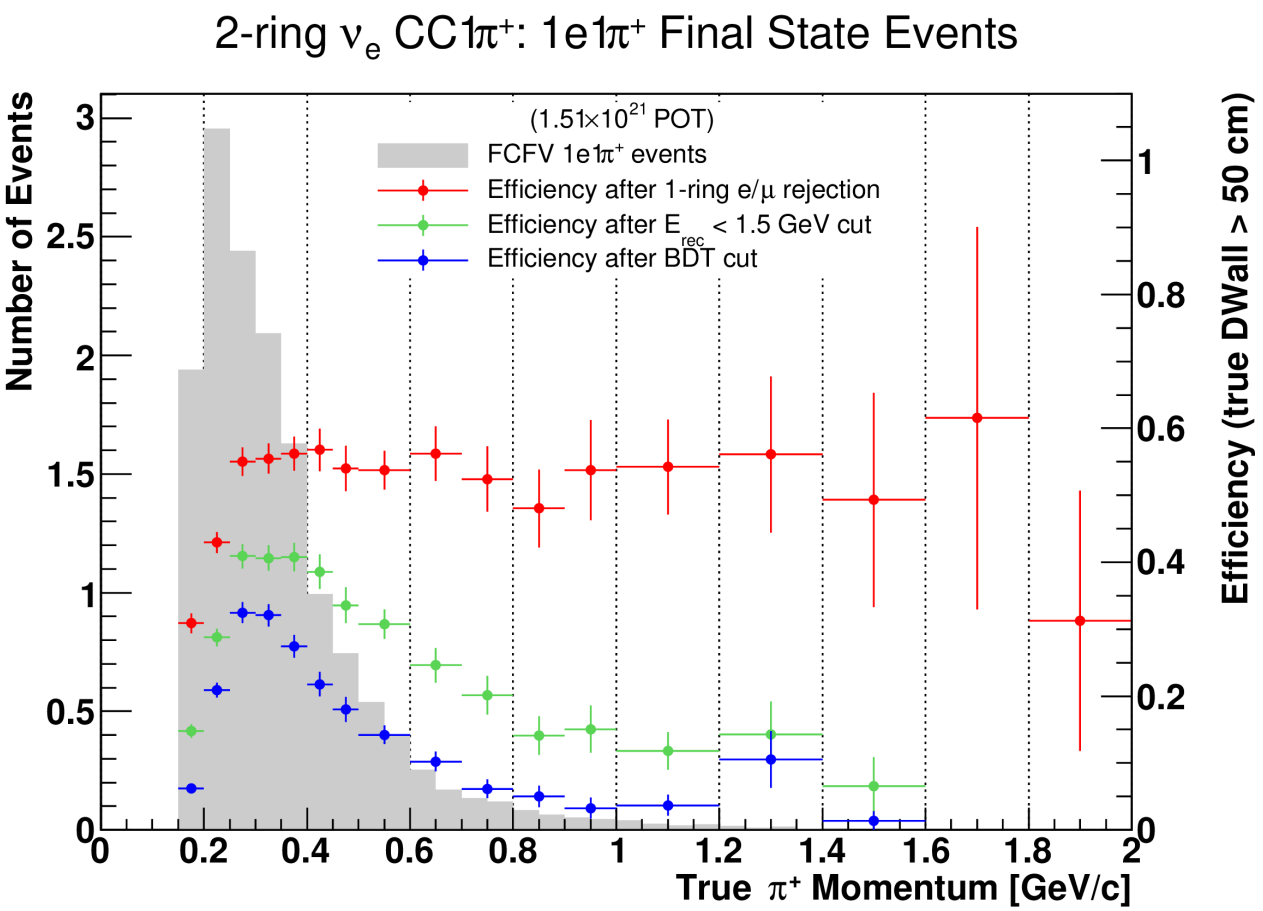
- Rejection is calculated relative to true $1\pi^0$ events in true FCFV
- Some π^0 momentum dependence is seen in final sample
  - Seems to be interplay between E_{rec} cut and BDT cut



ν_e CC1π^+ Sample

1e1π^+ efficiency vs. π^+ momentum

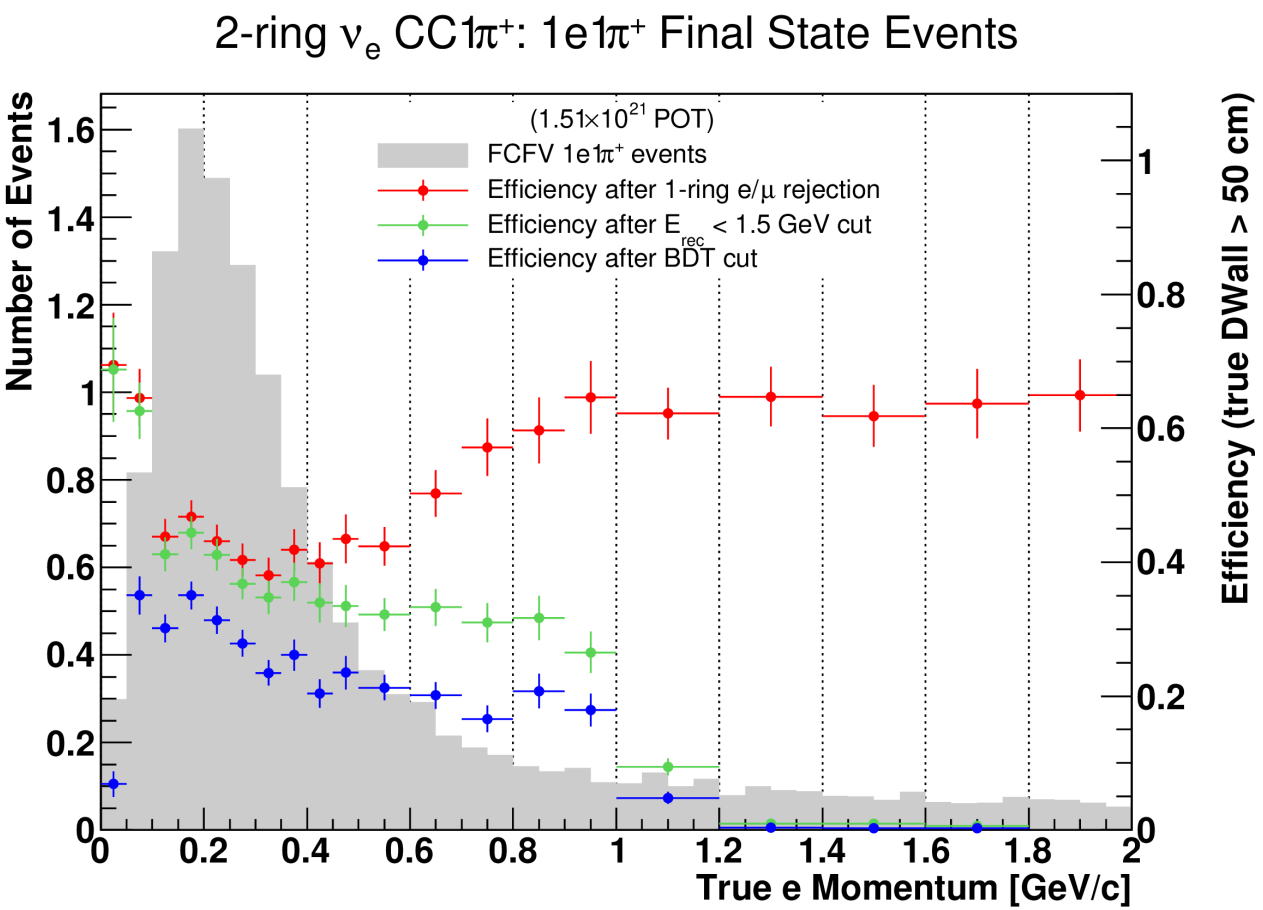
- Efficiency is calculated relative to true 1e1π^+ events in true FCFV
- Significant π^+ momentum dependence is seen in final sample
  - Seems to be primarily due to E_{rec} cut, not BDT cut



ν_e CC1π^+ Sample

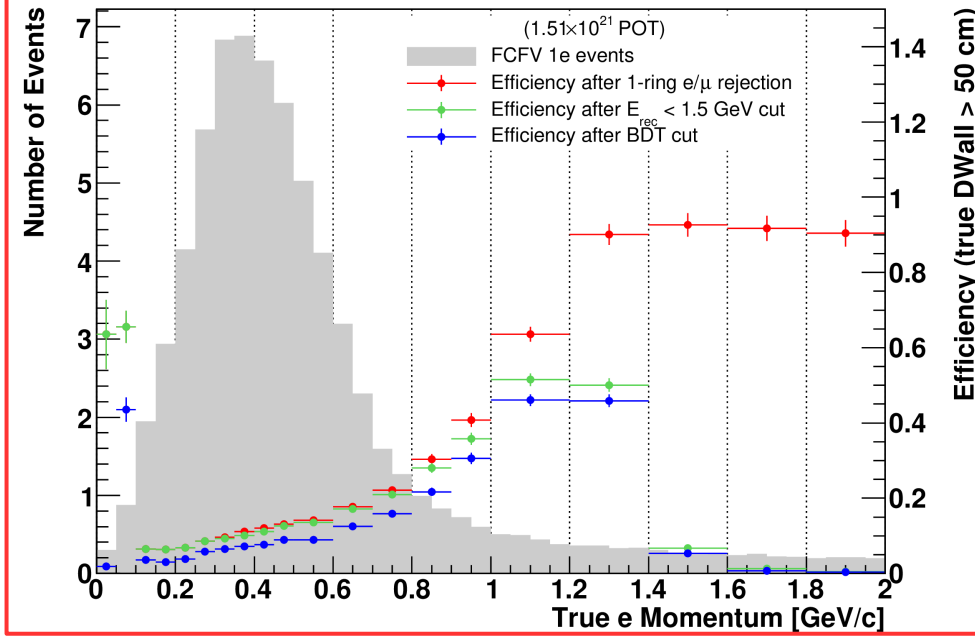
1e1π^+ efficiency vs. e momentum

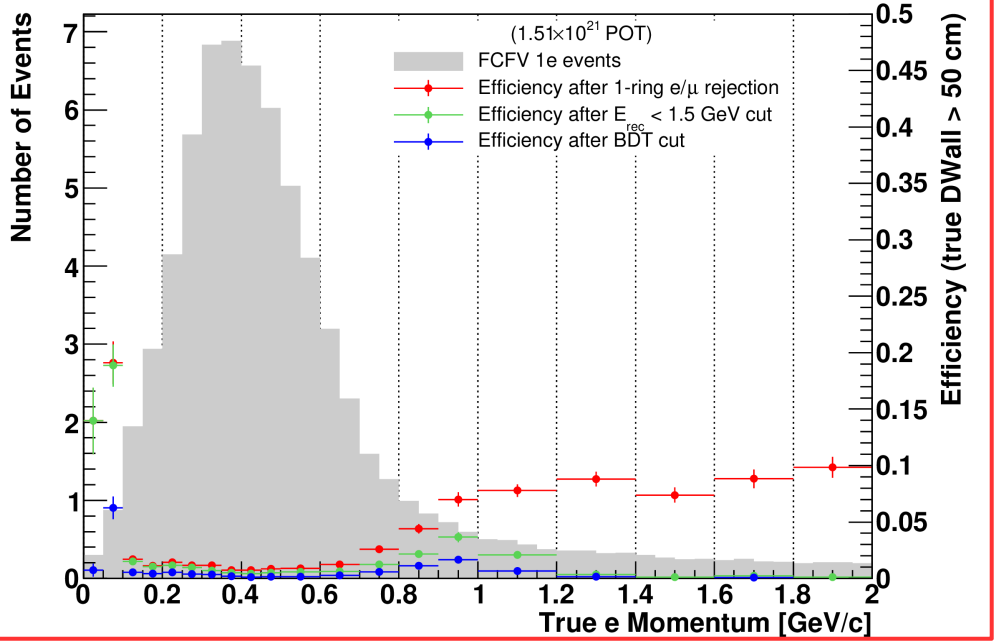
- Efficiency is calculated relative to true 1e1π^+ events in true FCFV
- Some e momentum dependence is observed in final sample
  - Large dependence after 1-ring e/μ rejection
    - Due to existing 1-ring ν_e CC1π^+ sample?
  - Less dependence seen after BDT cut

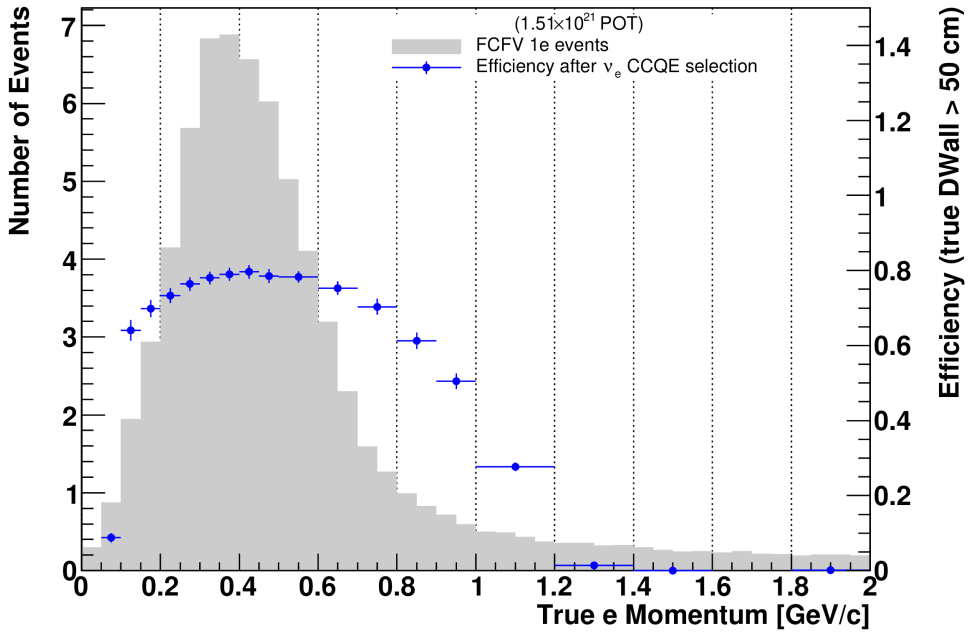


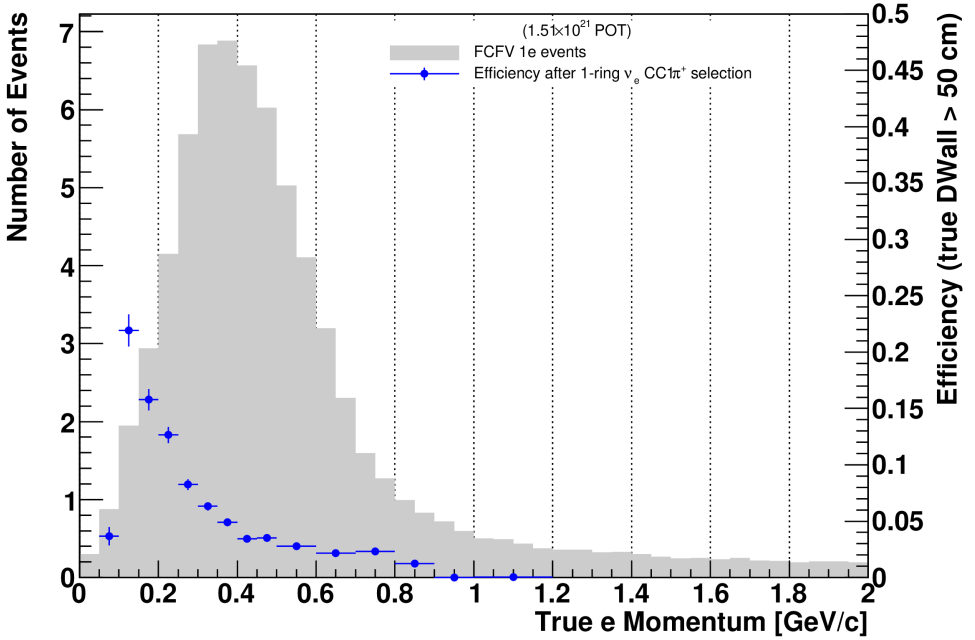
Comments from T2K-SK Meeting

- Mike:
  - Interested in seeing efficiency of other samples
  - i.e. figure out where true 1e and 1e1π^+ events end up
    - plot similar efficiency distributions for other ν_e samples
    - also plot sum of efficiencies from theses samples


Recovered ν_e CCQE: 1e Final State Events
(1.51×10^21 POT)
FCFV 1e events
Efficiency after 1-ring e/μ rejection
Efficiency after E_{rec} < 1.5 GeV cut
Efficiency after BDT cut
Number of Events
Efficiency (true DWall > 50 cm)
True e Momentum [GeV/c]

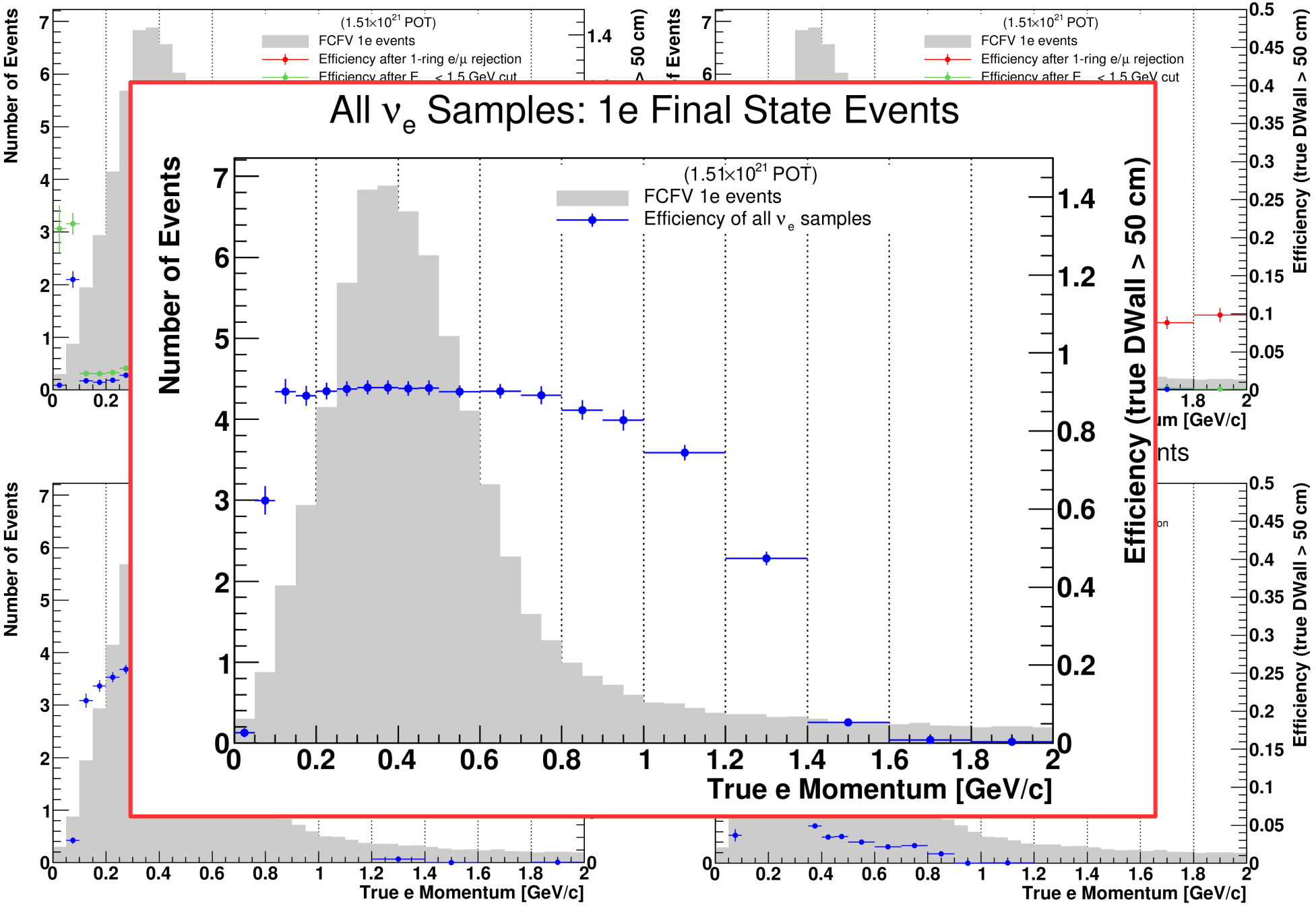

2-ring ν_e CC1π^+: 1e Final State Events
(1.51×10^21 POT)
FCFV 1e events
Efficiency after 1-ring e/μ rejection
Efficiency after E_{rec} < 1.5 GeV cut
Efficiency after BDT cut
Number of Events
Efficiency (true DWall > 50 cm)
True e Momentum [GeV/c]

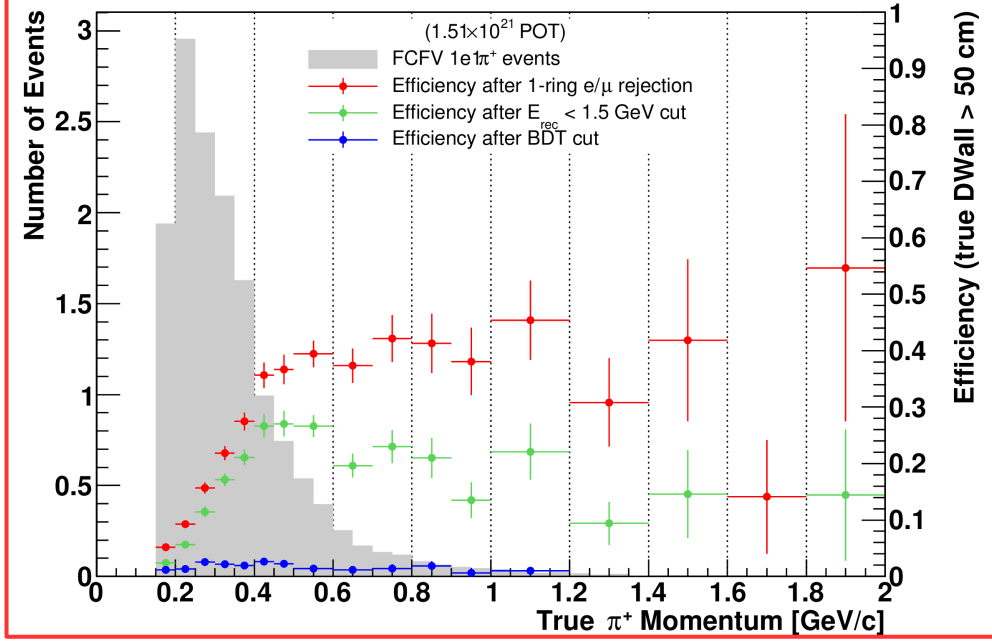

ν_e CCQE: 1e Final State Events
(1.51×10^21 POT)
FCFV 1e events
Efficiency after ν_e CCQE selection
Number of Events
Efficiency (true DWall > 50 cm)
True e Momentum [GeV/c]

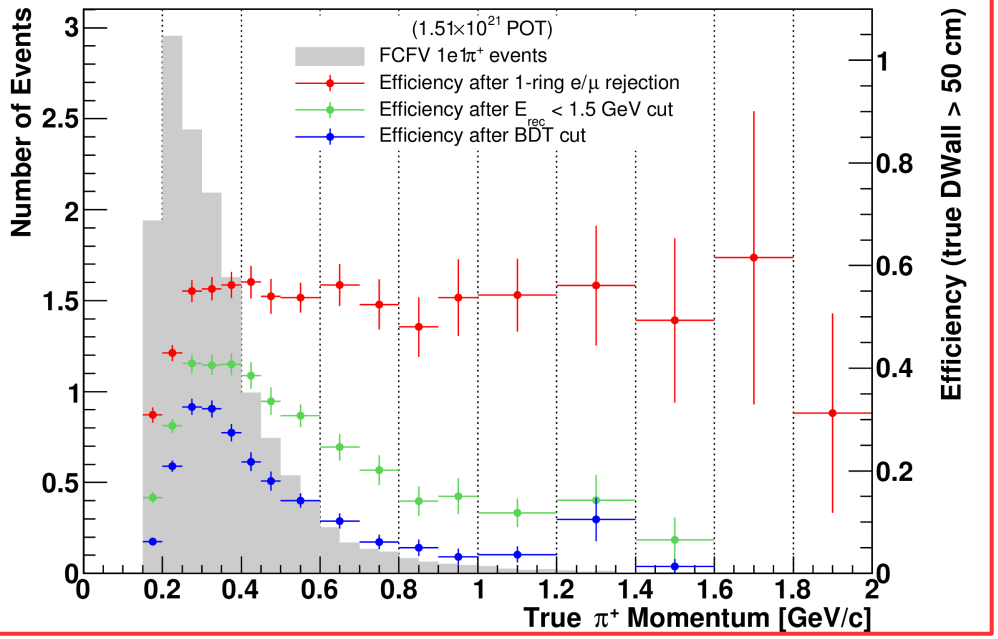

1-ring ν_e CC1π^+: 1e Final State Events
(1.51×10^21 POT)
FCFV 1e events
Efficiency after 1-ring ν_e CC1π^+ selection
Number of Events
Efficiency (true DWall > 50 cm)
True e Momentum [GeV/c]

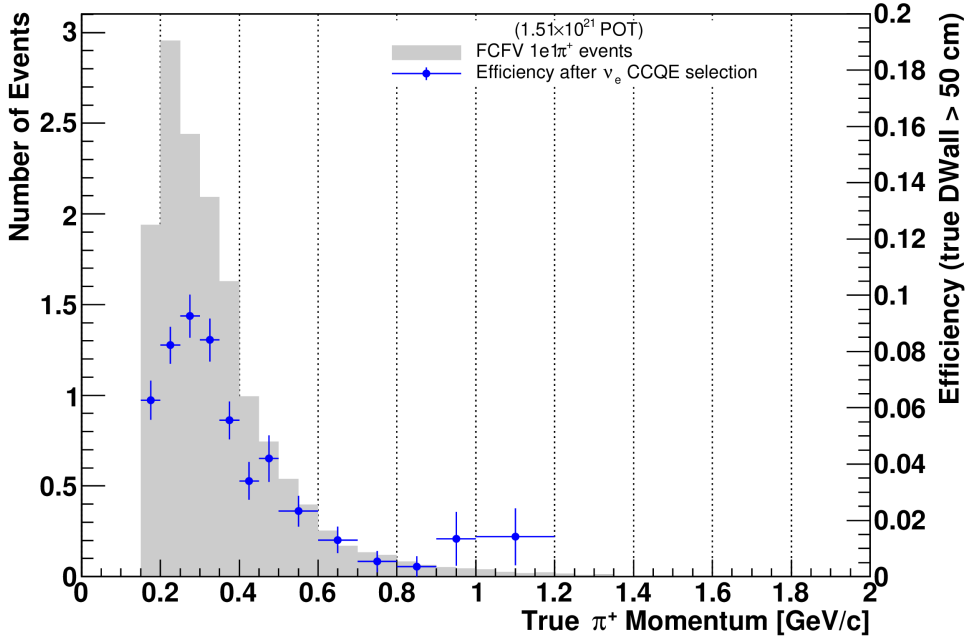
Recovered ν_e CCQE: 1e Final State Events

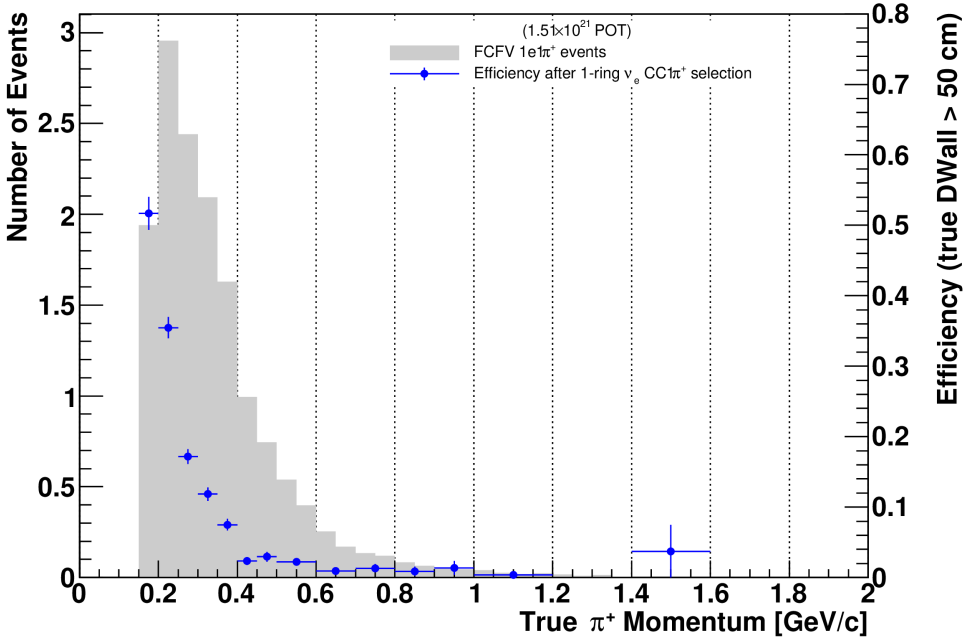
2-ring ν_e CC1π^+: 1e Final State Events

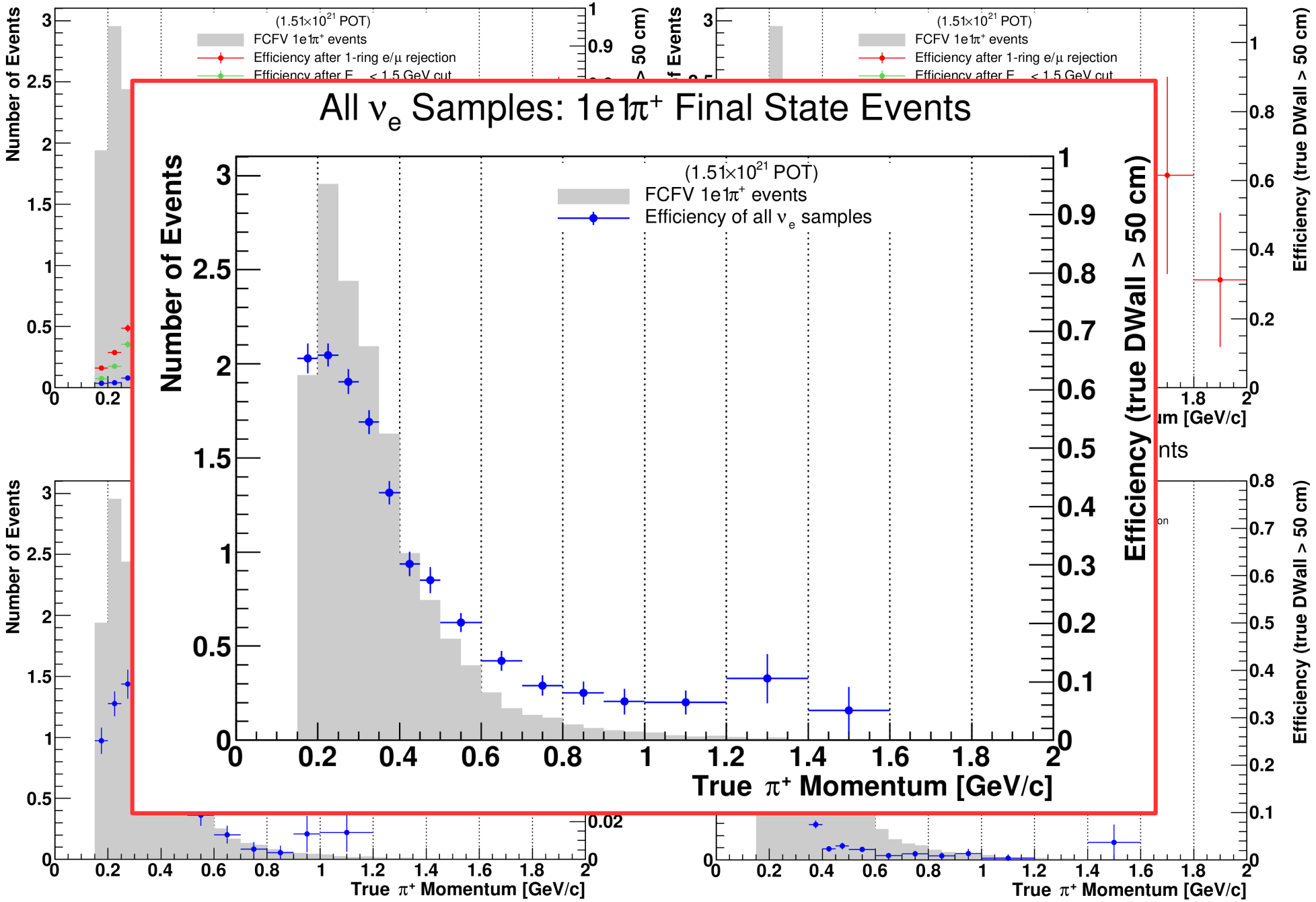


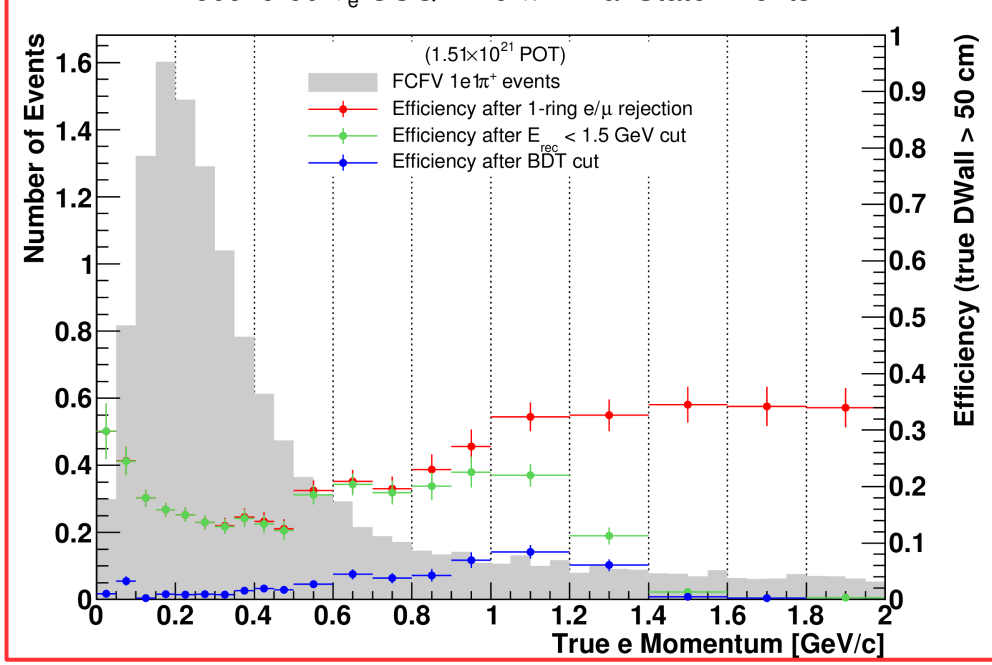

Recovered ν_e CCQE: 1e1π⁺ Final State Events
(1.51×10²¹ POT)
FCFV 1e1π⁺ events
Efficiency after 1-ring e/μ rejection
Efficiency after E_{rec} < 1.5 GeV cut
Efficiency after BDT cut
Number of Events
Efficiency (true DWall > 50 cm)
True π⁺ Momentum [GeV/c]


2-ring ν_e CC1π⁺: 1e1π⁺ Final State Events
(1.51×10²¹ POT)
FCFV 1e1π⁺ events
Efficiency after 1-ring e/μ rejection
Efficiency after E_{rec} < 1.5 GeV cut
Efficiency after BDT cut
Number of Events
Efficiency (true DWall > 50 cm)
True π⁺ Momentum [GeV/c]


ν_e CCQE: 1e1π⁺ Final State Events
(1.51×10²¹ POT)
FCFV 1e1π⁺ events
Efficiency after ν_e CCQE selection
Number of Events
Efficiency (true DWall > 50 cm)
True π⁺ Momentum [GeV/c]


1-ring ν_e CC1π⁺: 1e1π⁺ Final State Events
(1.51×10²¹ POT)
FCFV 1e1π⁺ events
Efficiency after 1-ring ν_e CC1π⁺ selection
Number of Events
Efficiency (true DWall > 50 cm)
True π⁺ Momentum [GeV/c]


Recovered ν_e CCQE: 1e1π^+ Final State Events
2-ring ν_e CC1π^+: 1e1π^+ Final State Events
All ν_e Samples: 1e1π^+ Final State Events
(1.51×10^{21} POT)
FCFV 1e1π^+ events
Efficiency of all ν_e samples
Efficiency after 1-ring e/μ rejection
Number of Events
Efficiency (true DWall > 50 cm)
True π^+ Momentum [GeV/c]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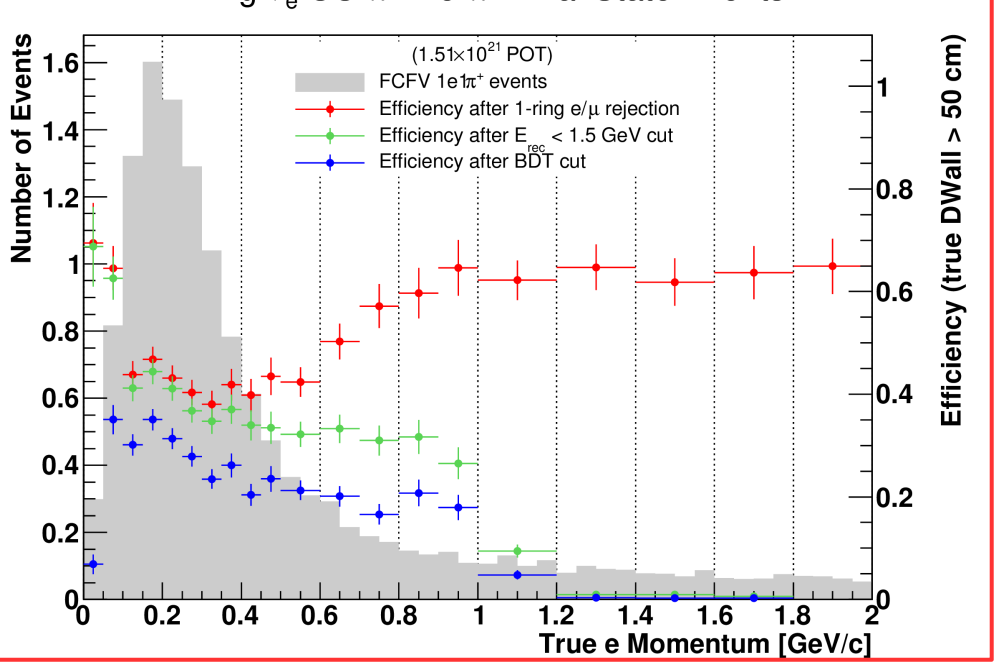
Efficiency after BDT cut
Number of Events
Efficiency (true DWall > 50 cm)
True e Momentum [GeV/c]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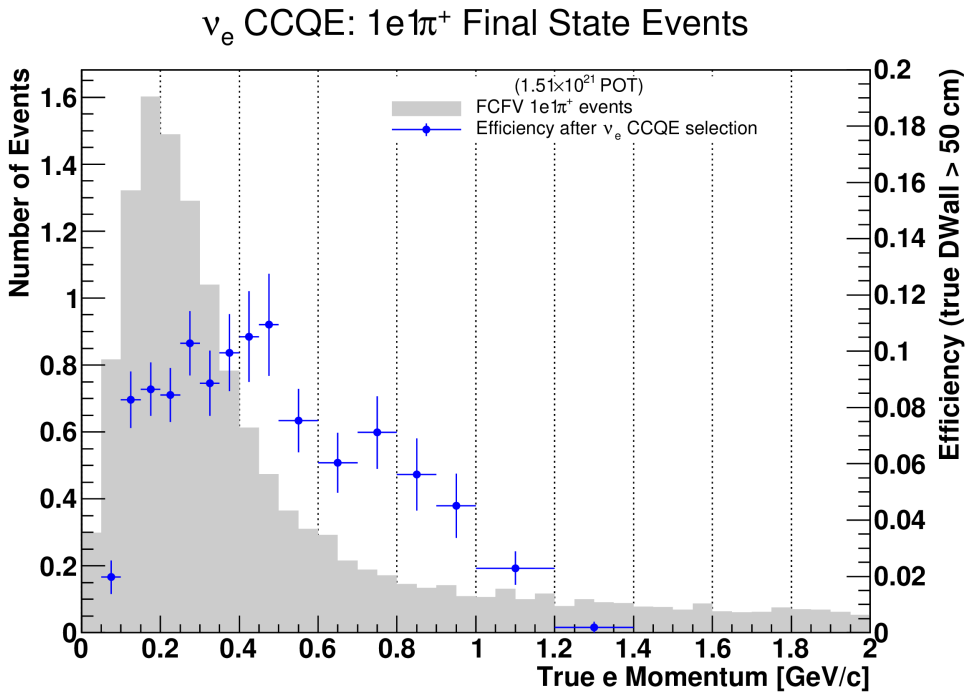
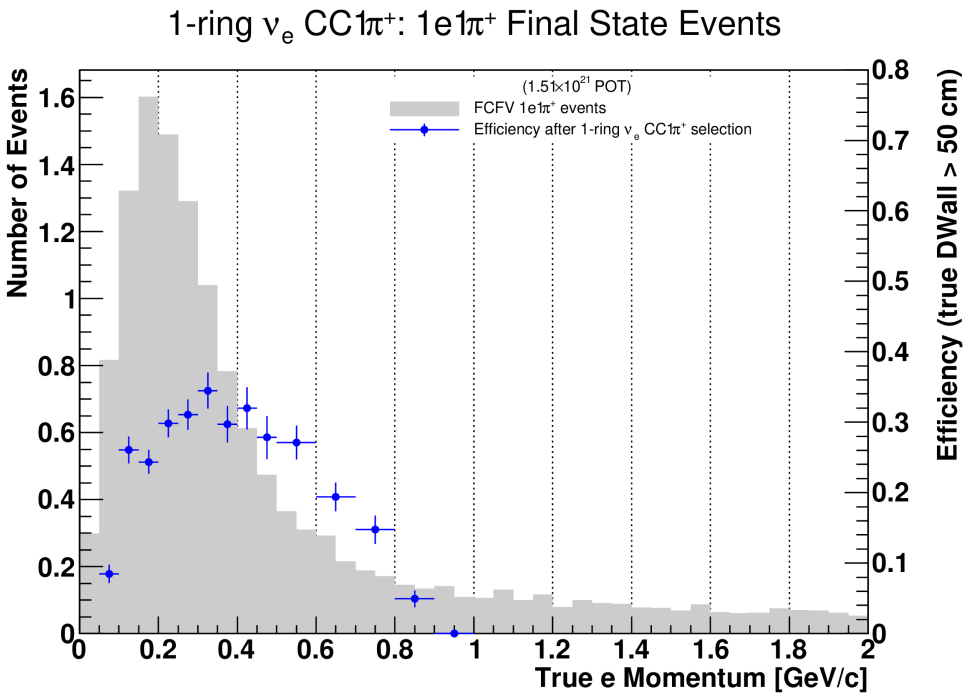
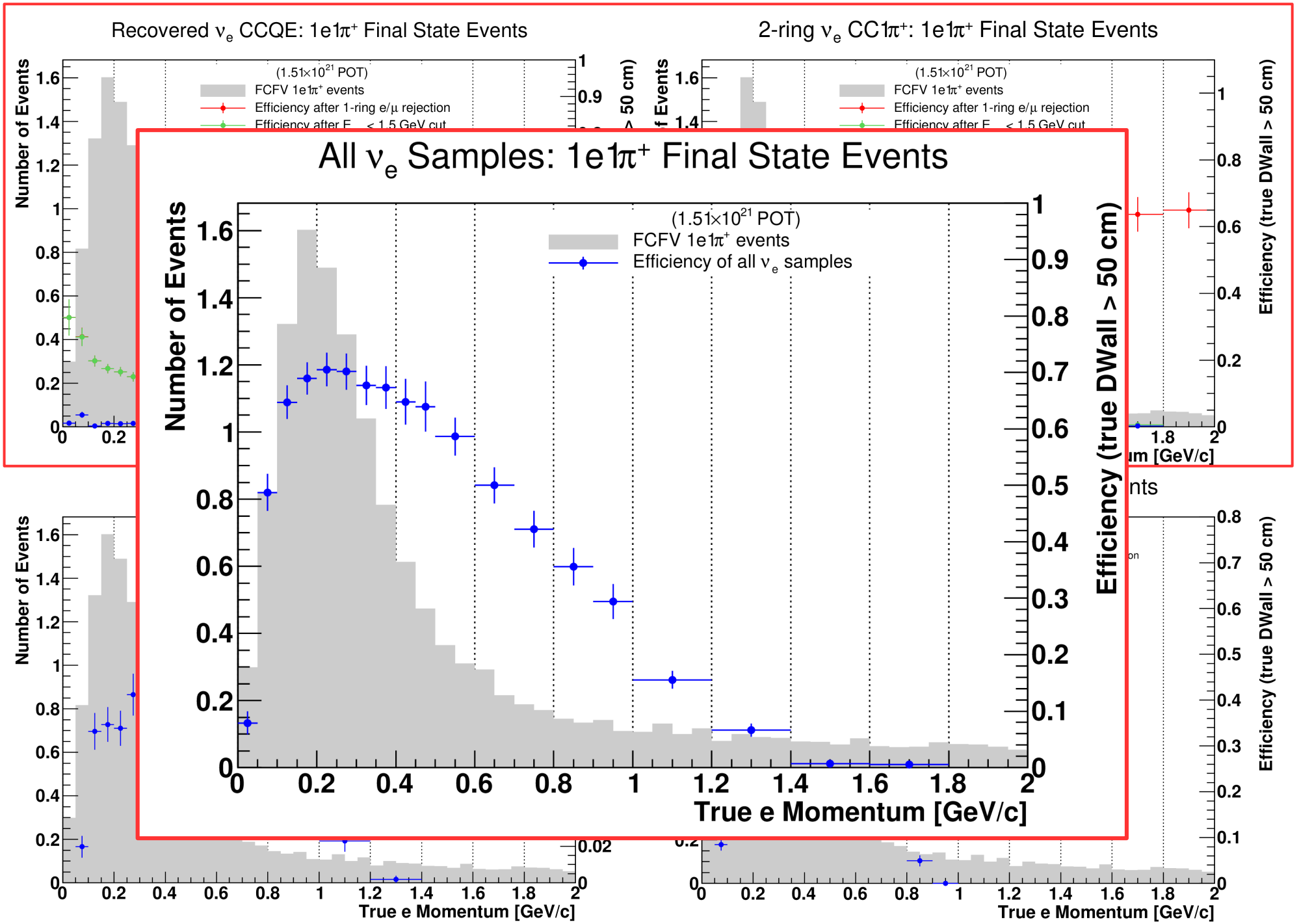

ν_e CCQE: 1e1π⁺ Final State Events
(1.51×10²¹ POT)
FCFV 1e1π⁺ events
Efficiency after ν_e CCQE selection
Number of Events
Efficiency (true DWall > 50 cm)
True e Momentum [GeV/c]


1-ring ν_e CC1π⁺: 1e1π⁺ Final State Events
(1.51×10²¹ POT)
FCFV 1e1π⁺ events
Efficiency after 1-ring ν_e CC1π⁺ selection
Number of Events
Efficiency (true DWall > 50 cm)
True e Momentum [GeV/c]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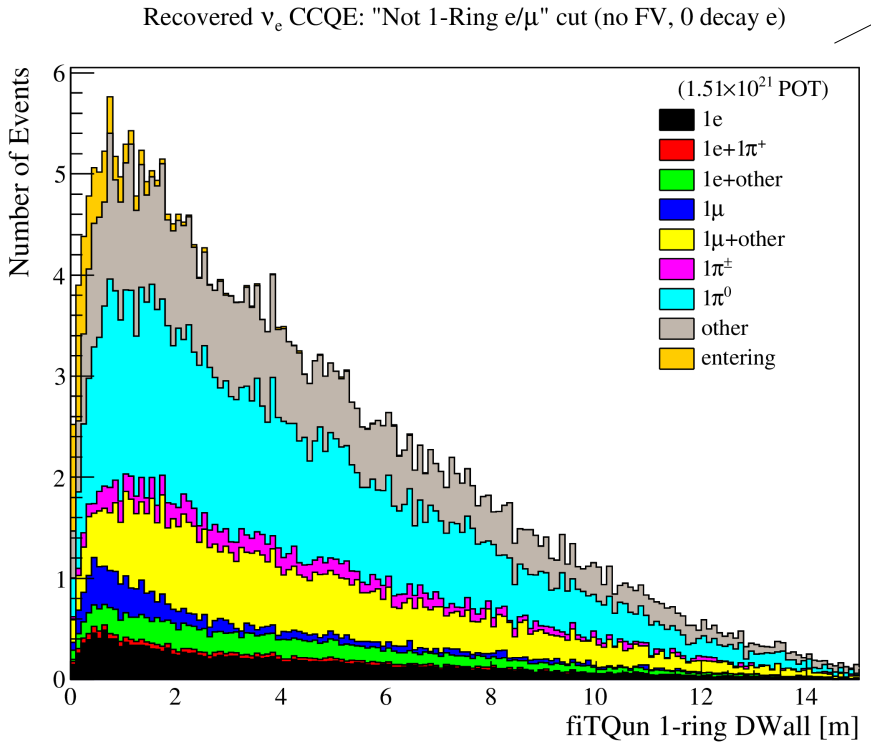
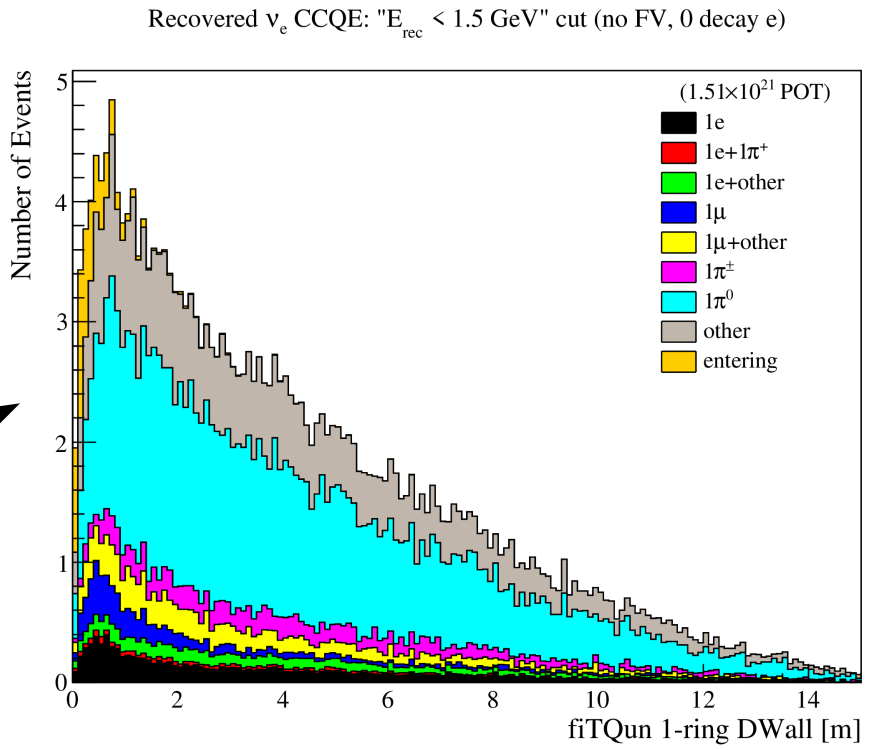
2-ring ν_e CC1π⁺: 1e1π⁺ Final State Events
All ν_e Samples: 1e1π⁺ Final State Events
(1.51×10²¹ POT)
FCFV 1e1π⁺ events
Efficiency after 1-ring e/μ rejection
Efficiency of all ν_e samples
Number of Events
Efficiency (true DWall > 50 cm)
True e Momentum [GeV/c]

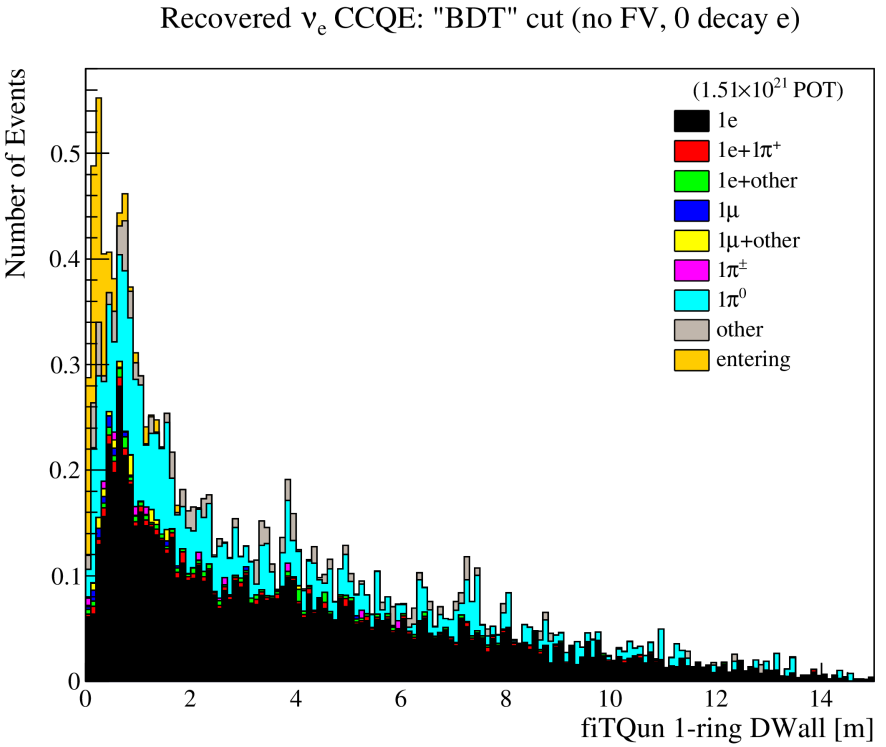
Fiducial Volume Studies

- Plot DWall distribution including entering backgrounds
- Plot reconstructed energy residuals vs. DWall
  - look for reconstructed energy bias at low DWall
- Plot reconstructed energy residuals vs. ToWall
  - look for reconstructed energy bias at low ToWall

Recovered ν_e CCQE: DWall

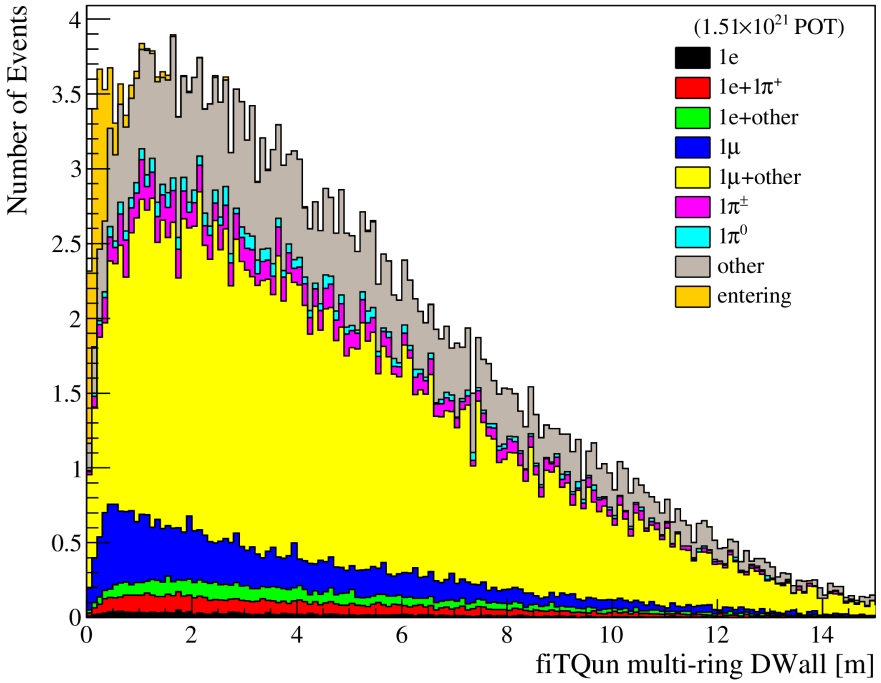


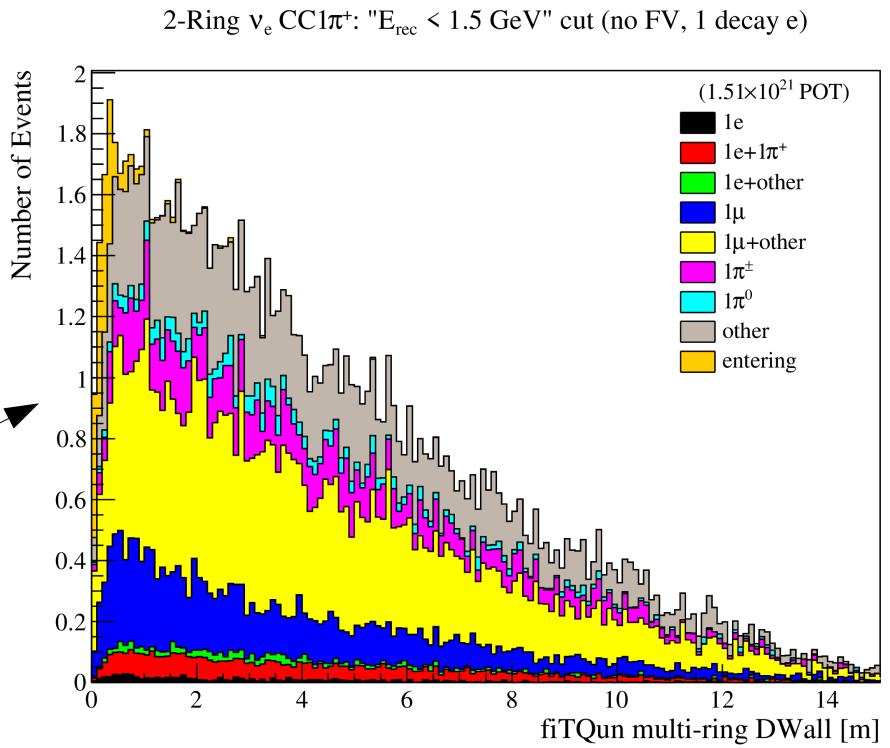


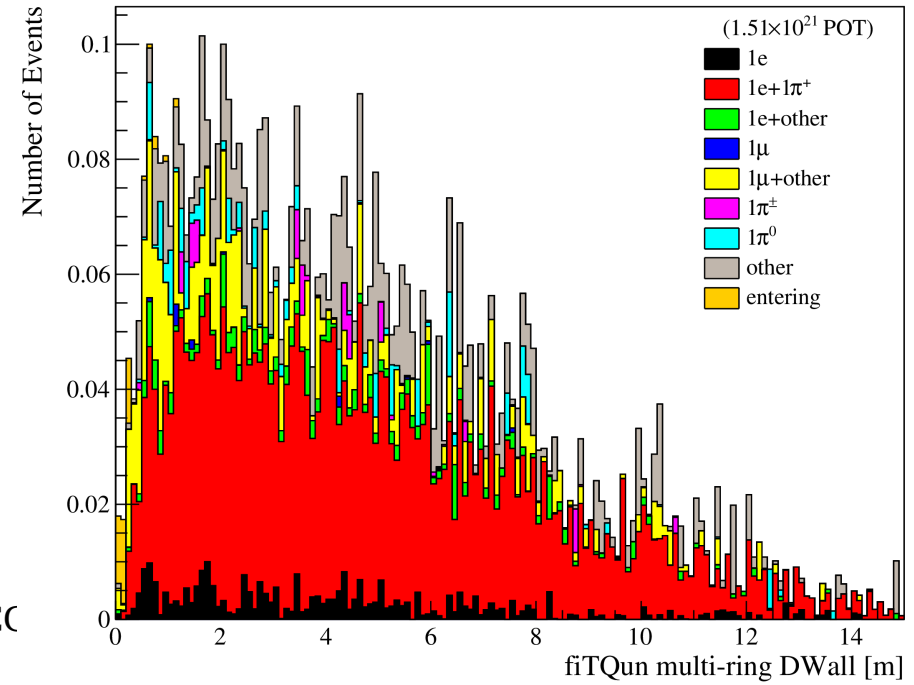


- Perhaps a cut at DWall > 80 cm?
- Will make plots of % reduction in entering backgrounds vs. wall cut

2-Ring ν_e CC1π^+: DWall

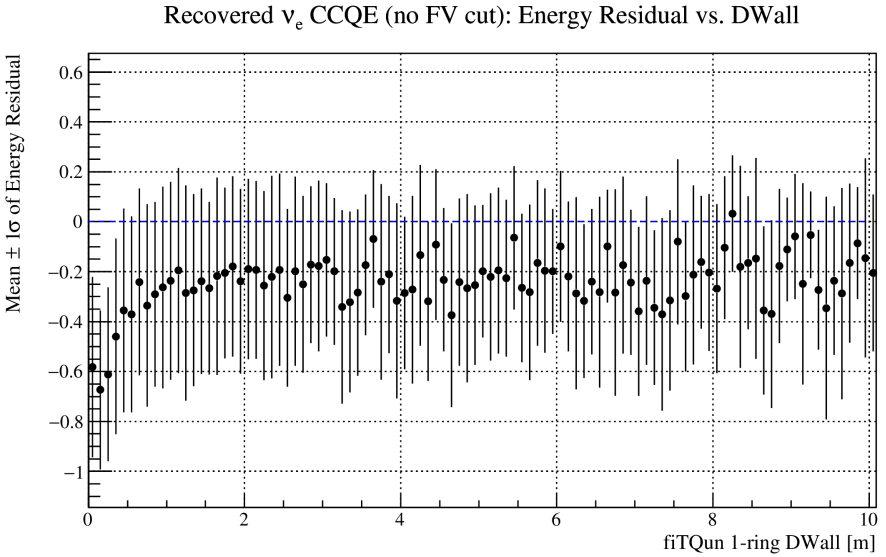


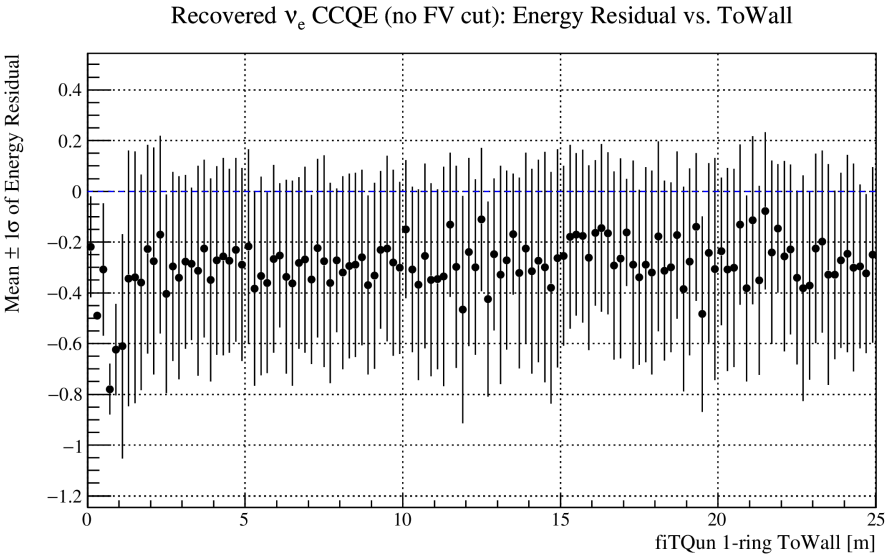




- Might be able to get away with DWall > 50 cm
- Will make plots of % reduction in entering backgrounds vs. wall cut

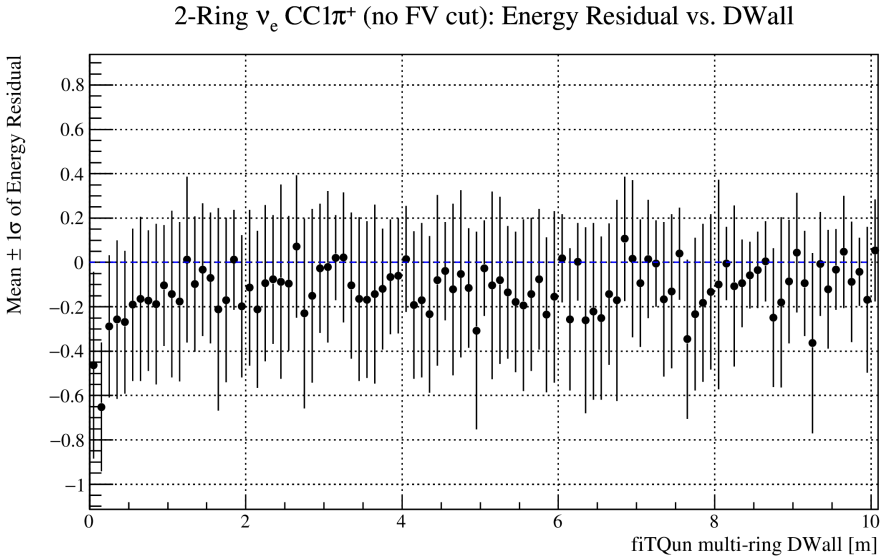
Recovered ν_e CCQE: Energy Residual

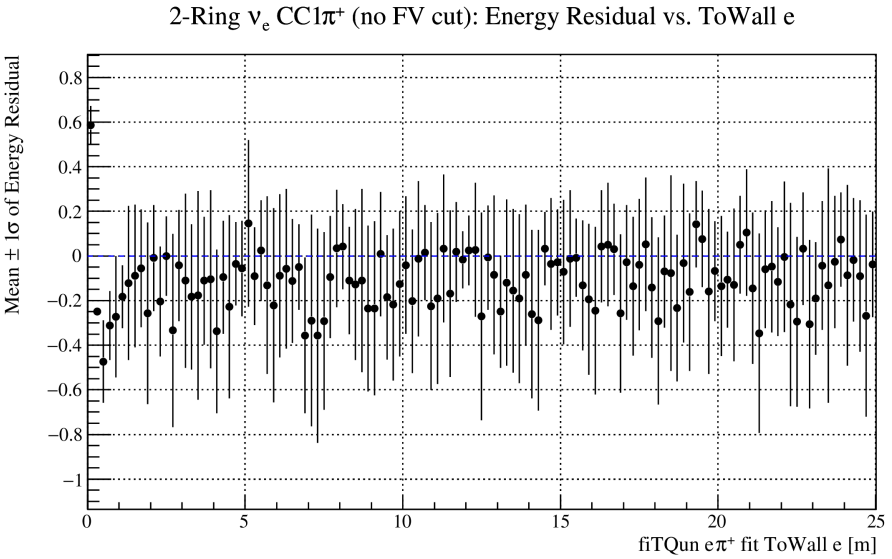


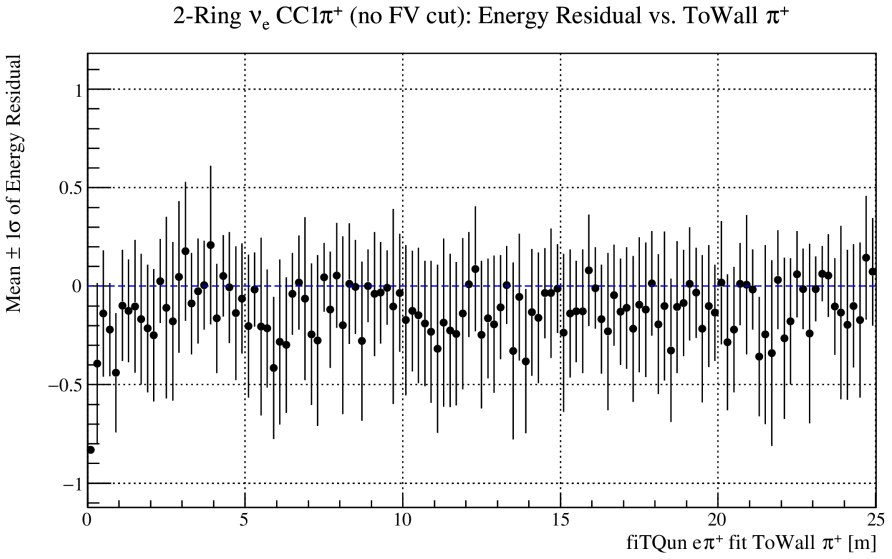


- Energy dependence at low DWall
  - A DWall > 80 cm cut seems reasonable
- May want to make ToWall cut around 100 – 150 cm

2-Ring ν_e CC1π^+: Energy Residual







- Energy dependence at low DWall
  - Again, can probably get away with cut at 50 cm
- ToWall cut around 100 cm for both rings may be reasonable

To Do

- Finalise efficiency studies
  - Plots of *relative* efficiency of BDT cut for each selection
    - Want to clearly plot momentum dependence of BDT cut on its own
- Finish fiducial volume studies
  - Study entering backgrounds loss for different DWall cuts
  - Decide on final DWall and ToWall cuts

Backup