

$e+He3$ Full Simulations

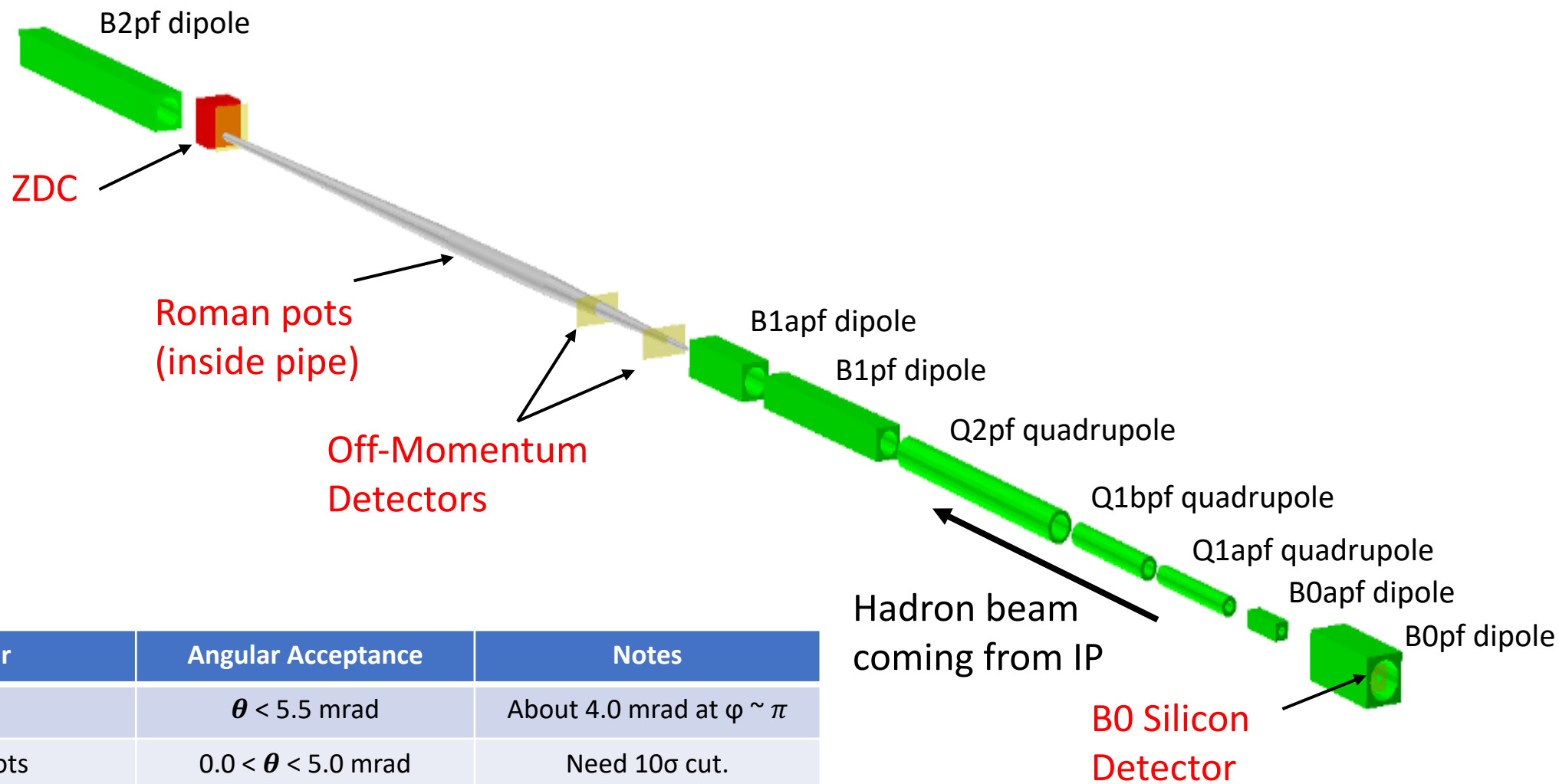
Alex Jentsch

9/28/2020

Preliminaries

- Study of $e+\text{He3}$ *proton spectator* tagging using 4 different MC samples at two energies:
 - BeAGLE DIS and Exclusive J/Psi – 5x41 GeV/n and 10x110 GeV/n
 - MC events from Ivica with 3-body breakup or short-range correlations – 5x41 GeV and 18x110 GeV/n
- No special event cuts. Just looking at the *proton* spectators in each event in the record.
 - No INC in the BeAGLE events.
- All detectors included.
- Small event samples for now (1k events) just to see what we get.
- Not showing neutrons here since their acceptance is simple and doesn't depend on the magnetic fields, etc.

IR & Detector Layout

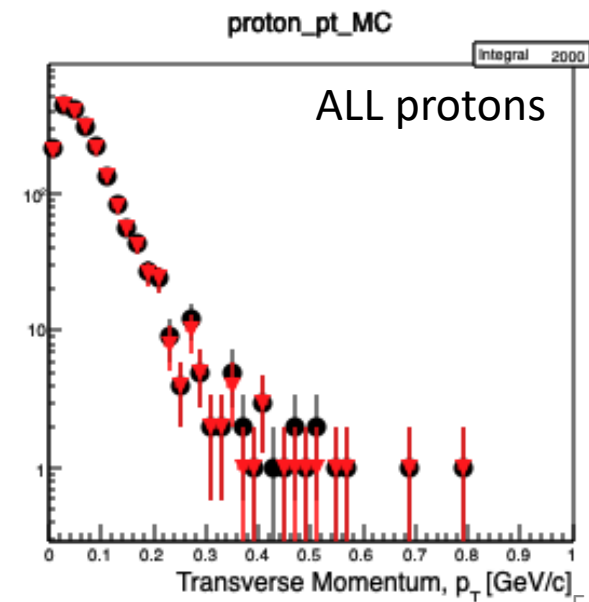
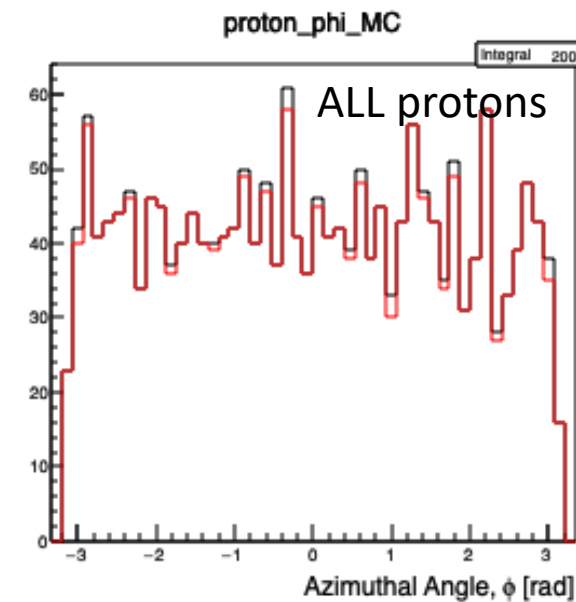
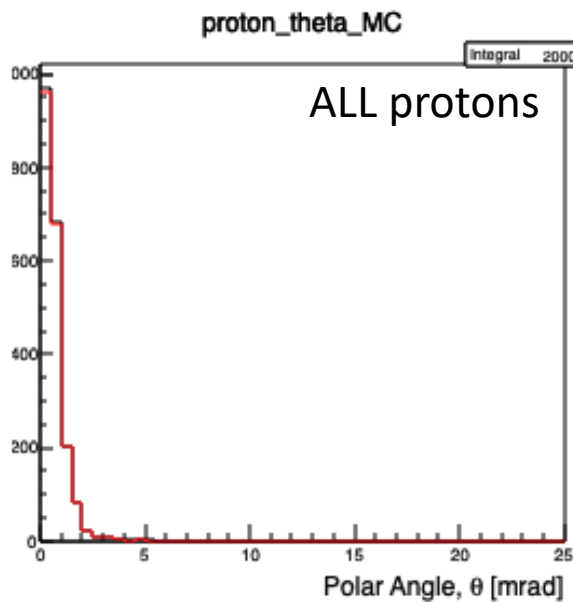
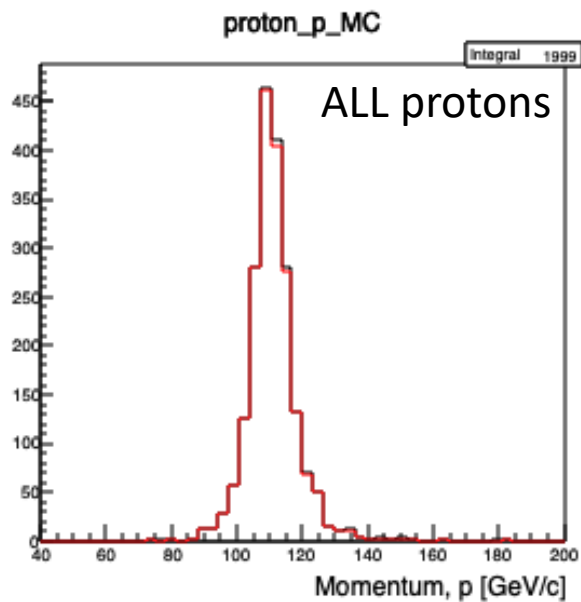
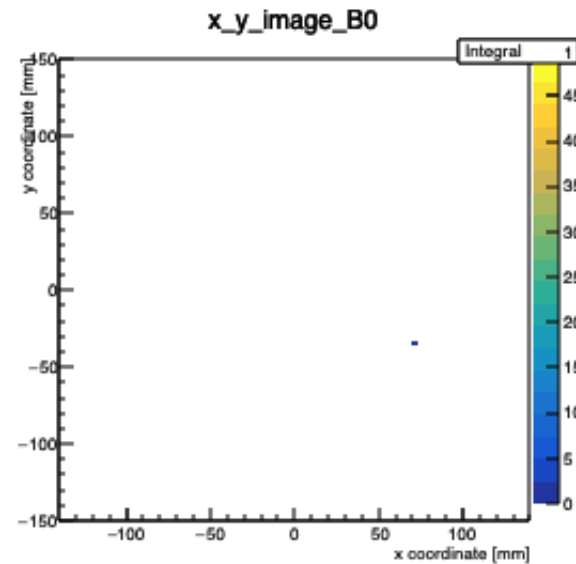
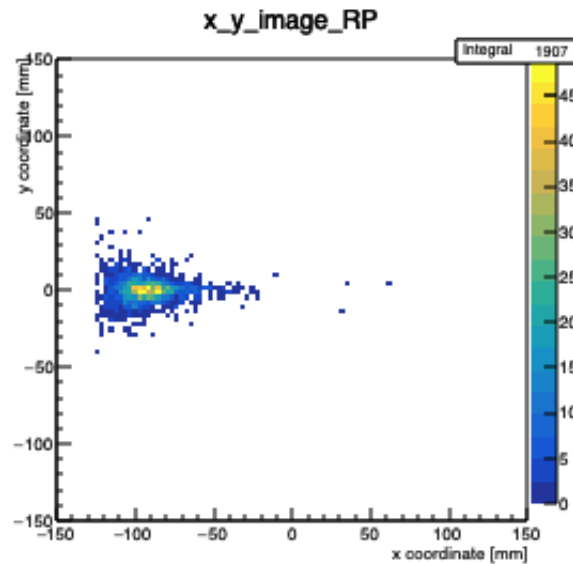
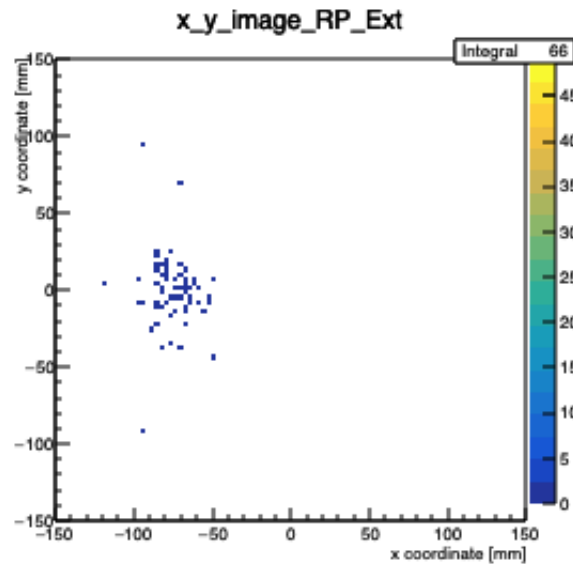


Detector	Angular Acceptance	Notes
ZDC	$\theta < 5.5$ mrad	About 4.0 mrad at $\varphi \sim \pi$
Roman Pots	$0.0 < \theta < 5.0$ mrad	Need 10σ cut.
Off-Momentum Detectors	$0.0 < \theta < 5.0$ mrad	Roughly $.4 < x_L < .6$
B0 Sensors	$5.5 < \theta < 13.0 - 20.0$ mrad	Still need to optimize.

$$x_L = \frac{p_{z,nucleon}}{p_{z,beam}}$$

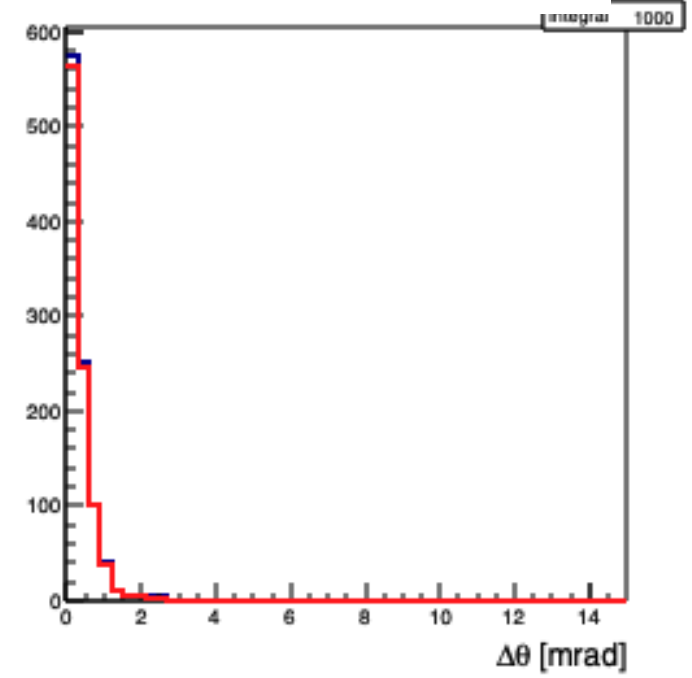
BeAGLE 10x110 GeV/n DIS

BeAGLE 10x110 results – spectator protons – DIS

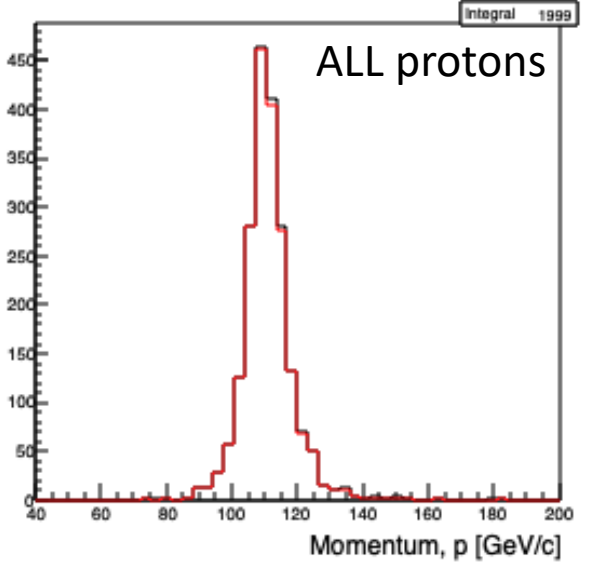


BeAGLE 10x110 results – spectator protons – DIS

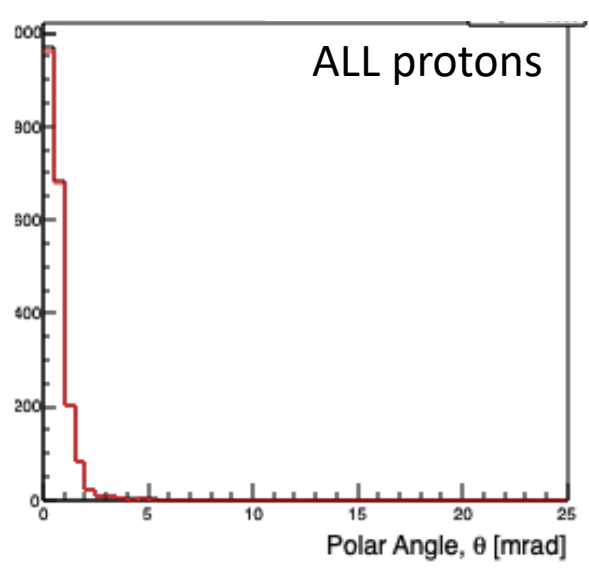
Double-tagged protons



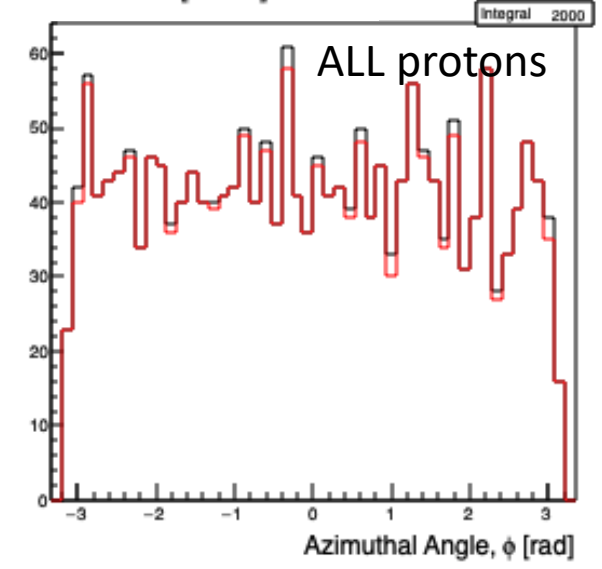
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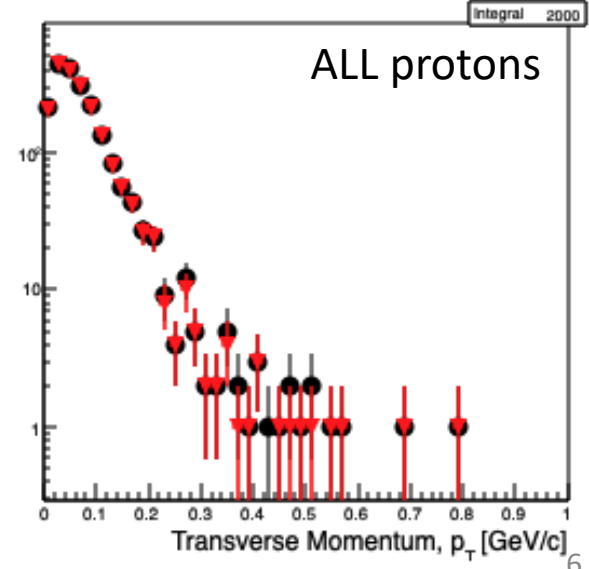
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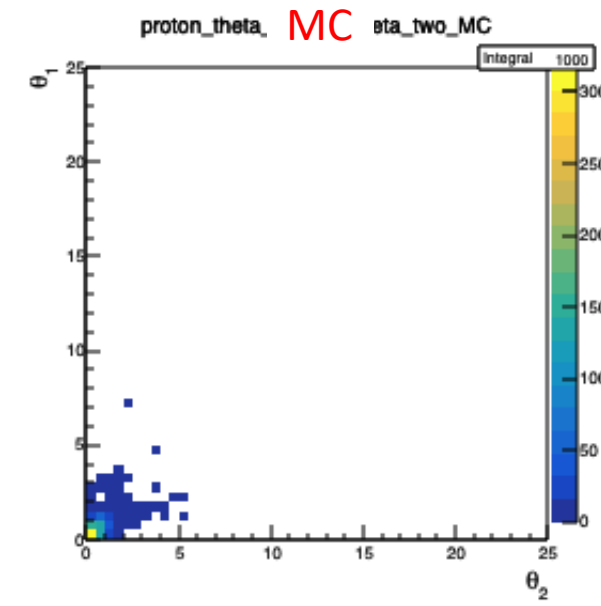
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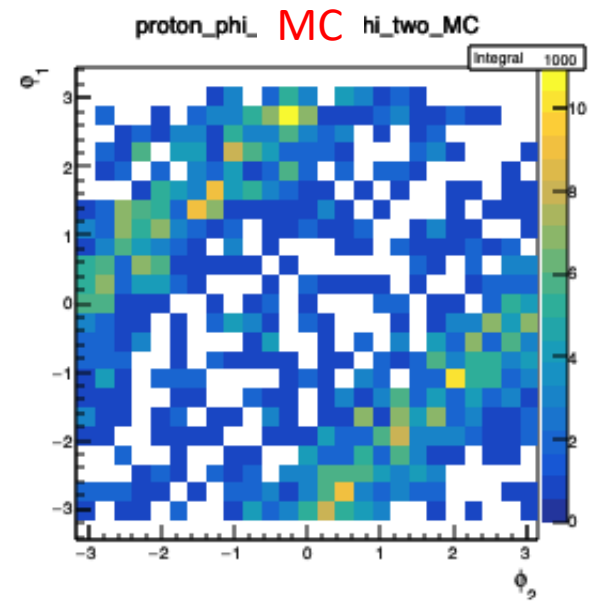
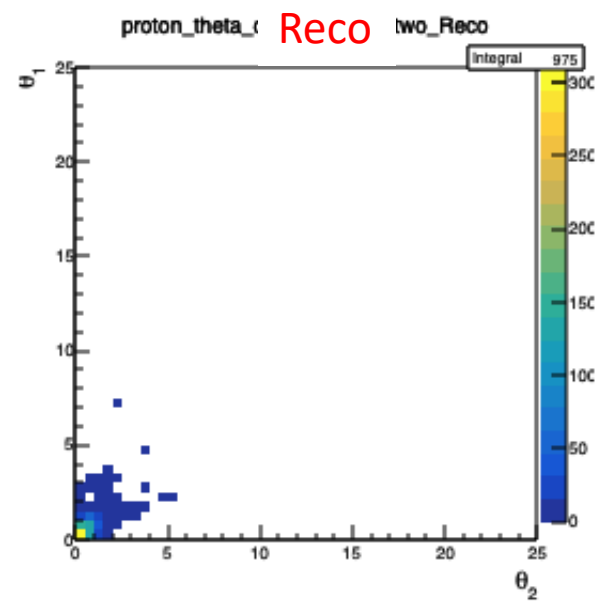
proton_pt_MC



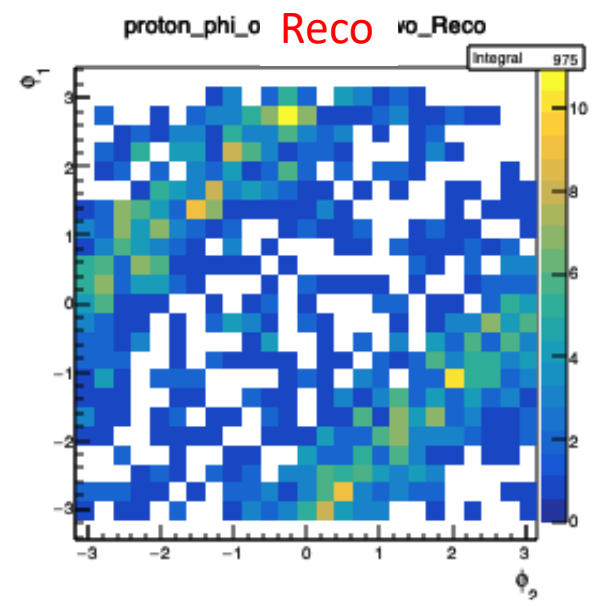
BeAGLE 10x110 results – spectator protons – DIS



Proton 1 theta vs. proton 2 theta

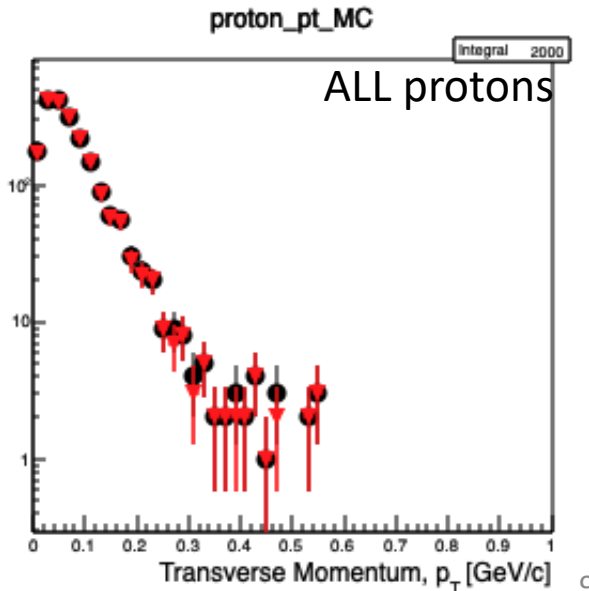
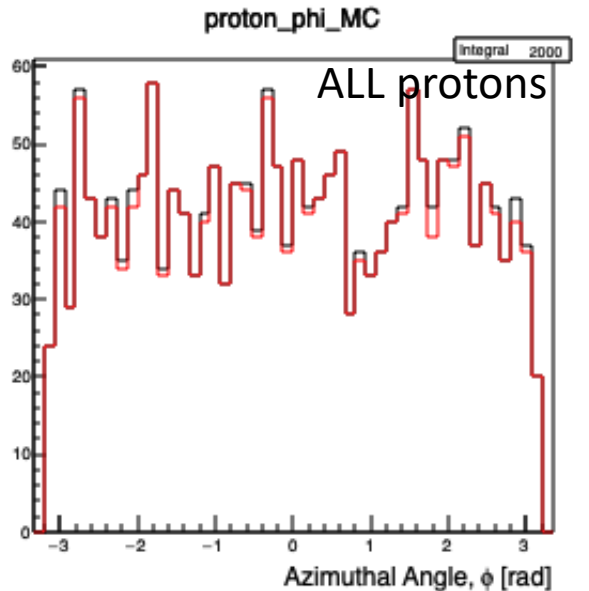
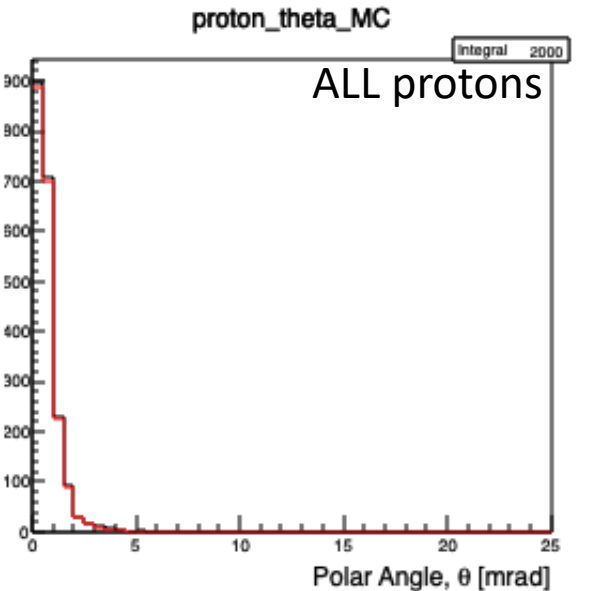
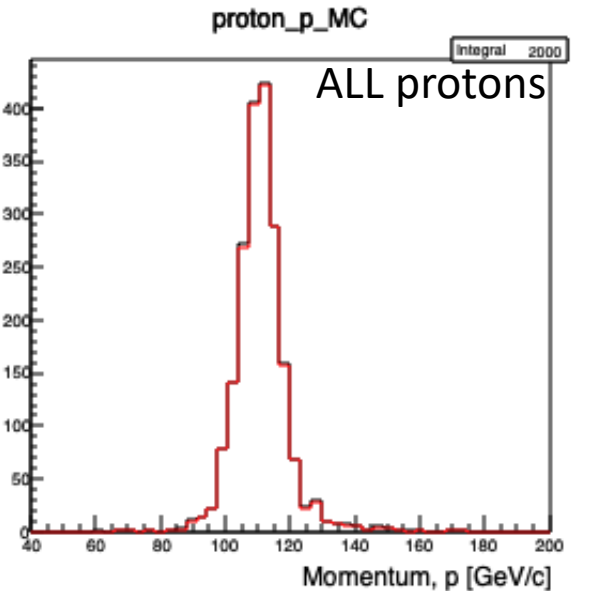
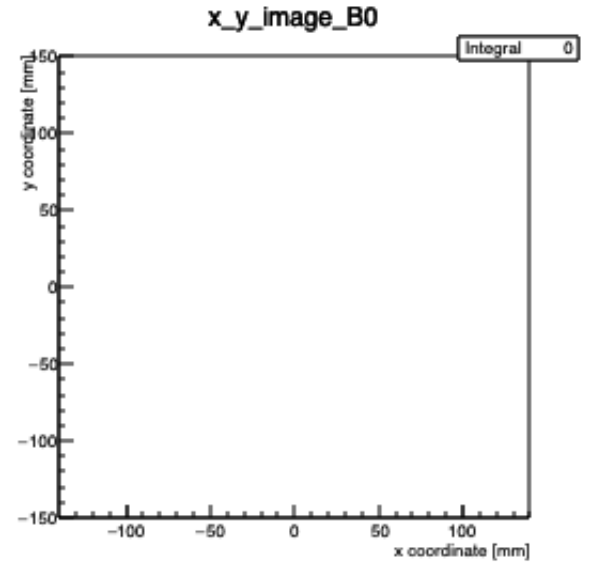
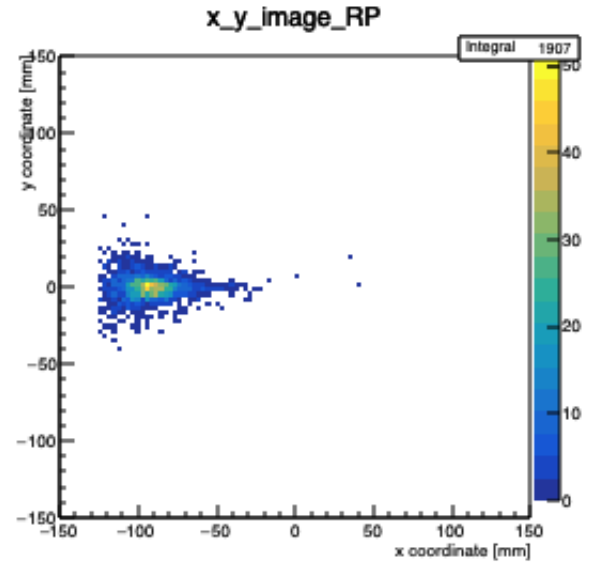
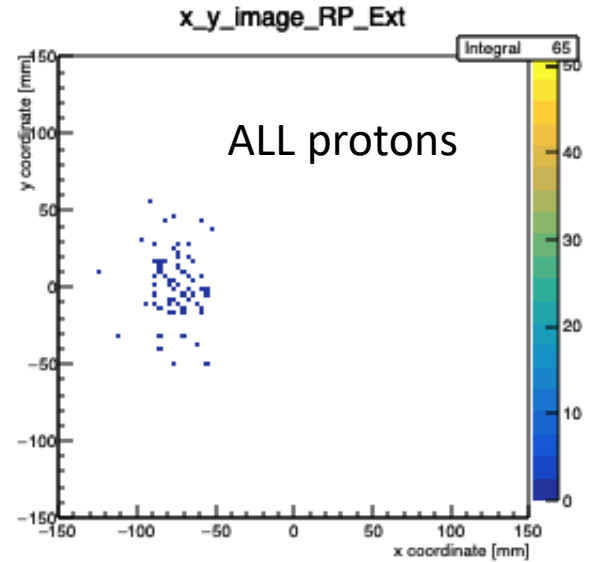


Proton 1 phi vs. proton 2 phi



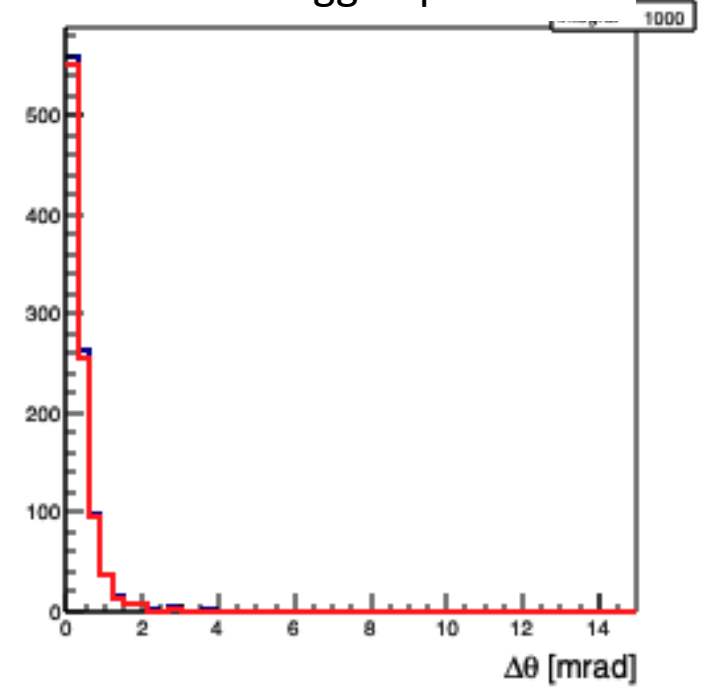
BeAGLE 10x110 GeV/n J/Psi

BeAGLE 10x110 results – spectator protons – J/Psi

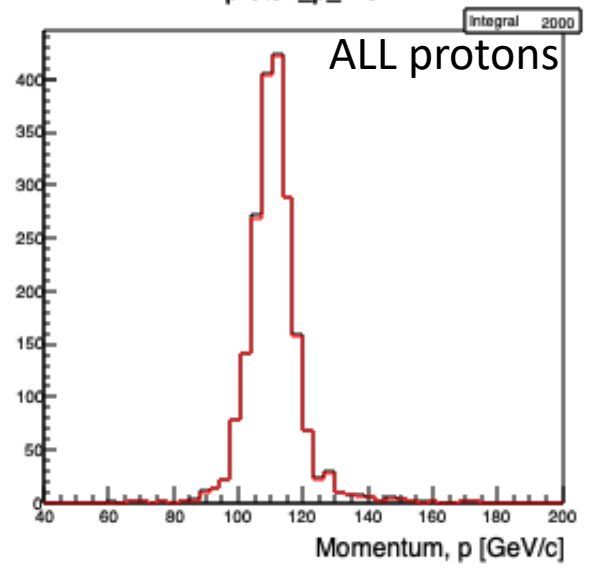


BeAGLE 10x110 results – spectator protons – J/Psi

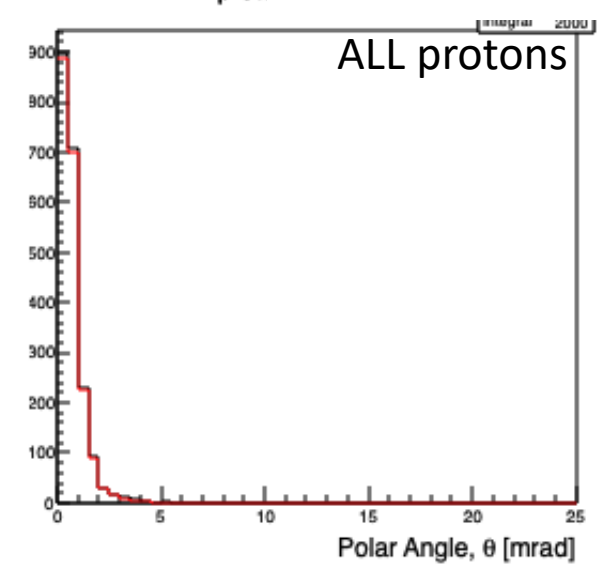
Double-tagged protons



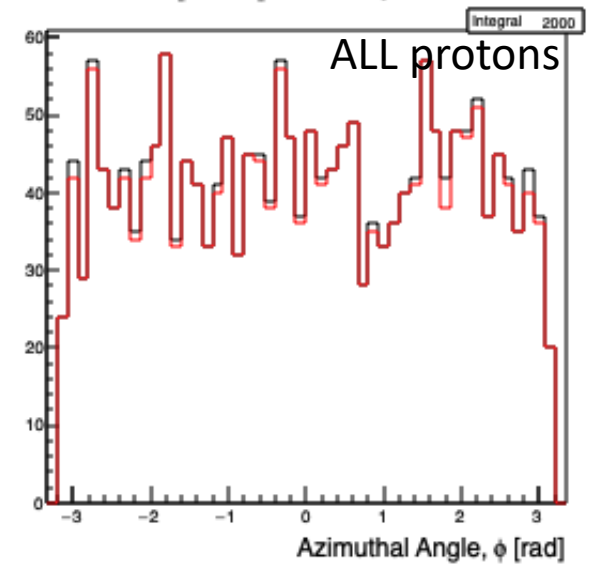
proton_p_MC



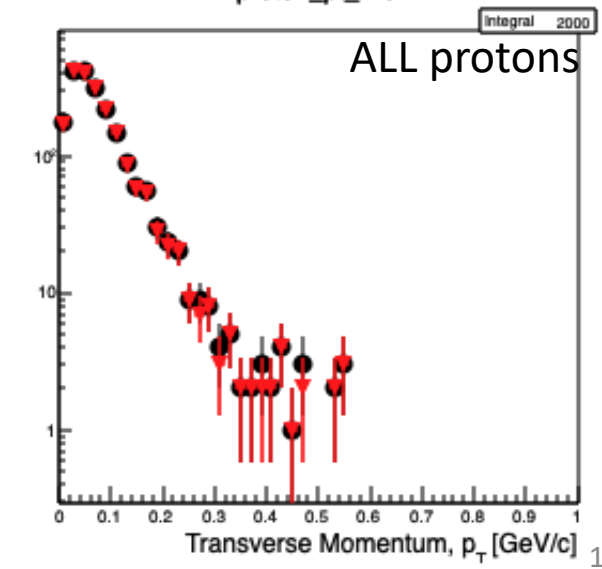
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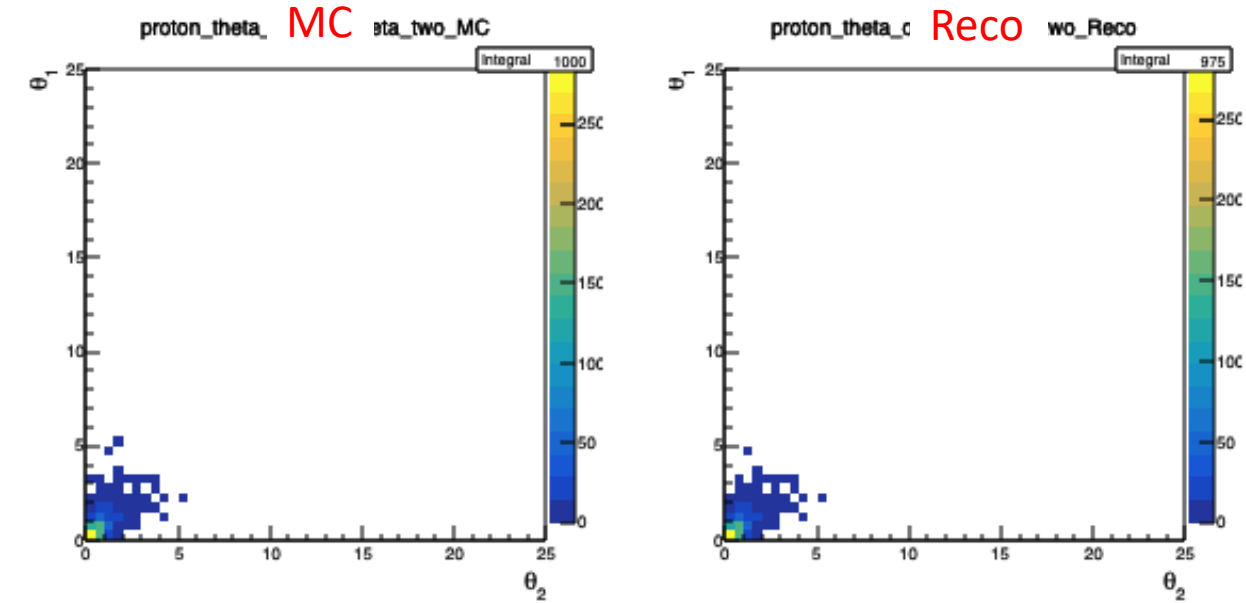
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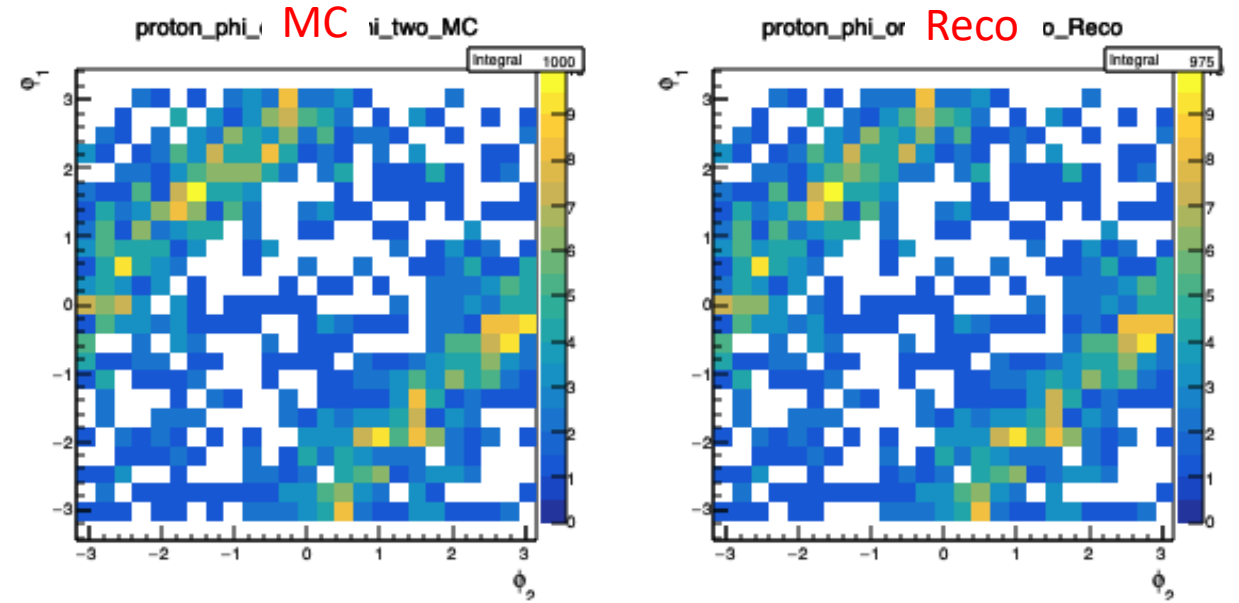
proton_pt_MC



BeAGLE 10x110 results – spectator protons – J/Psi



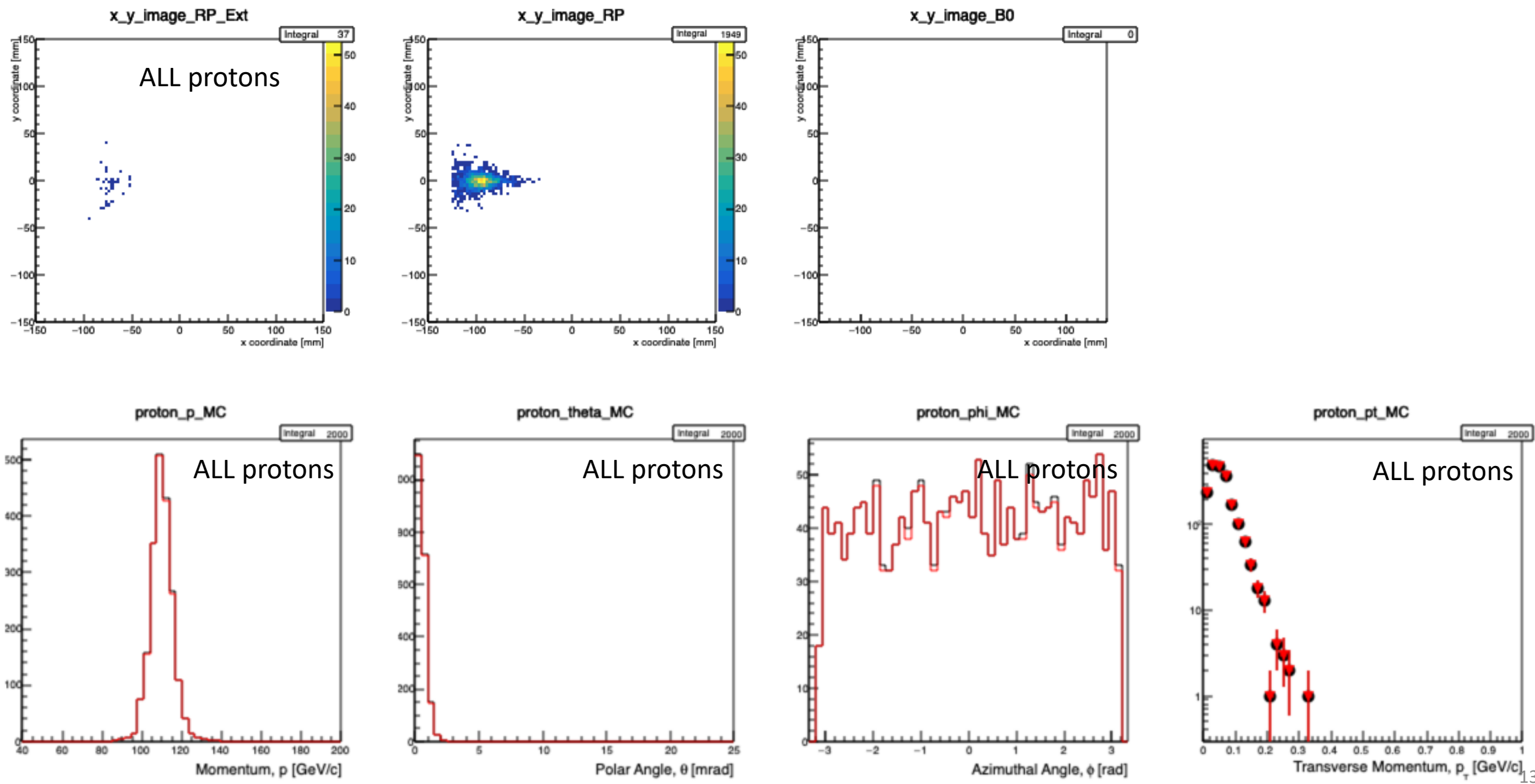
Proton 1 theta vs. proton 2 theta



Proton 1 phi vs. proton 2 phi

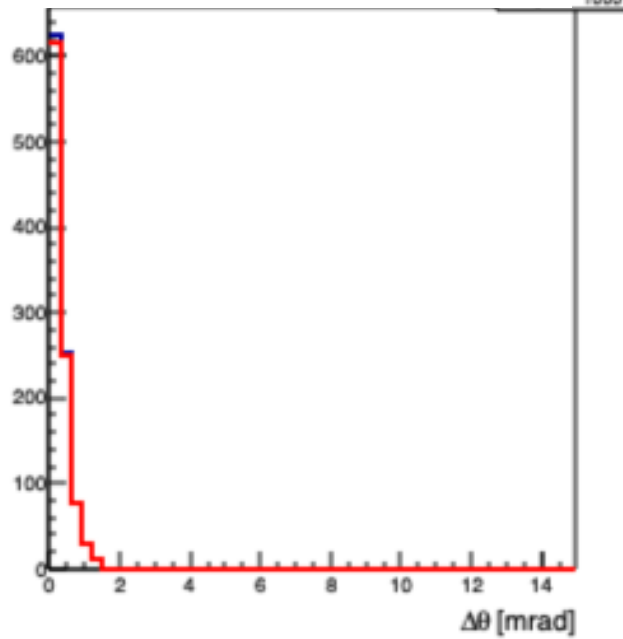
Ivica 18x110 GeV/n 3BBU

Ivica 18x110 results – spectator protons – 3BBU



Ivica 18x110 results – spectator protons – 3BBU

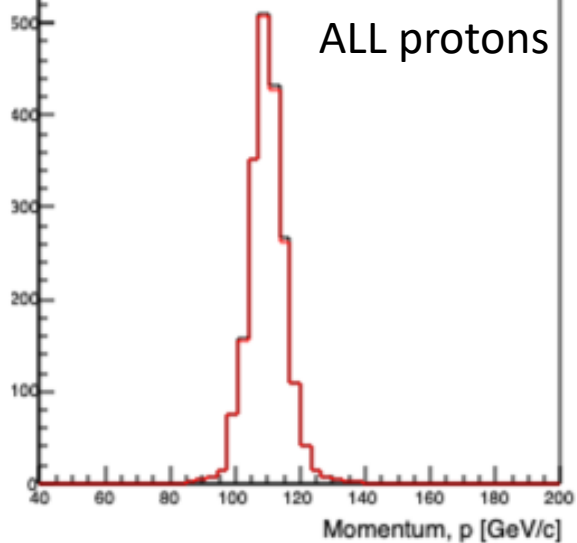
Double-tagged protons



proton_p_MC

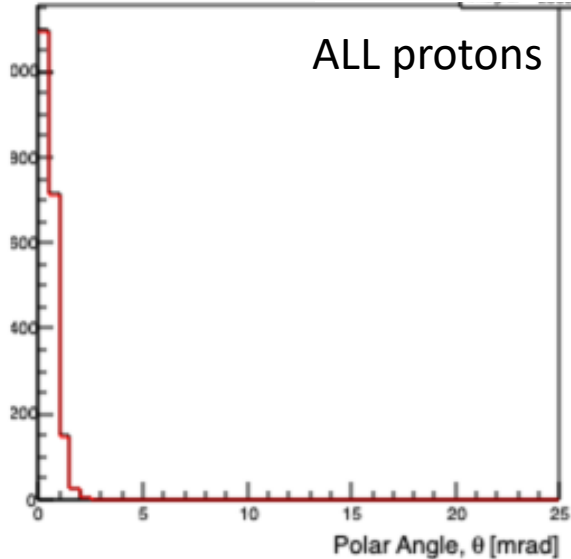
Integral 2000

ALL protons



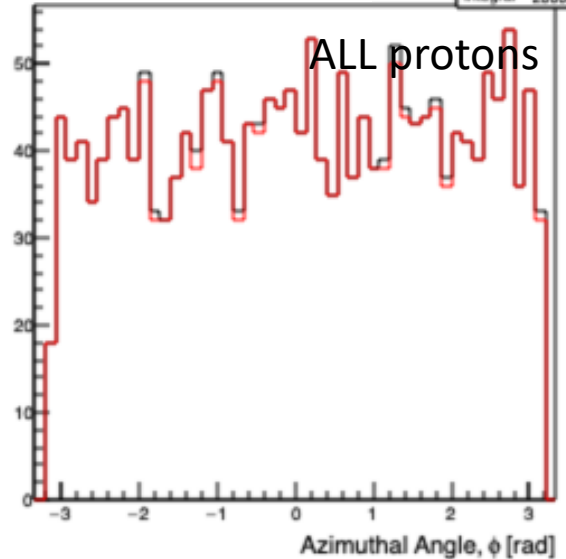
proton_theta

ALL protons



Integral 2000

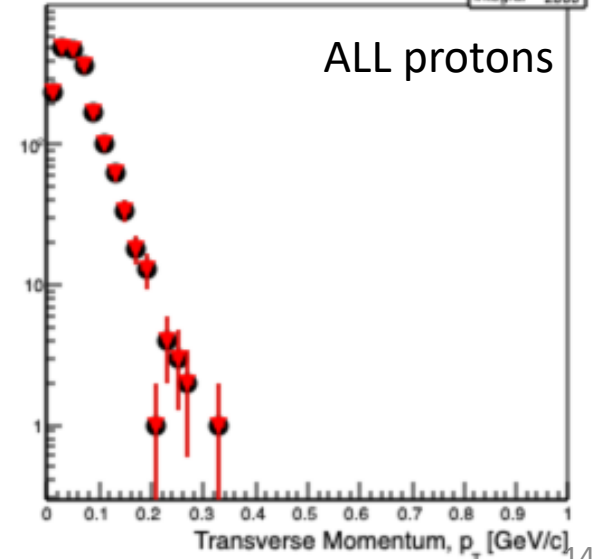
ALL protons



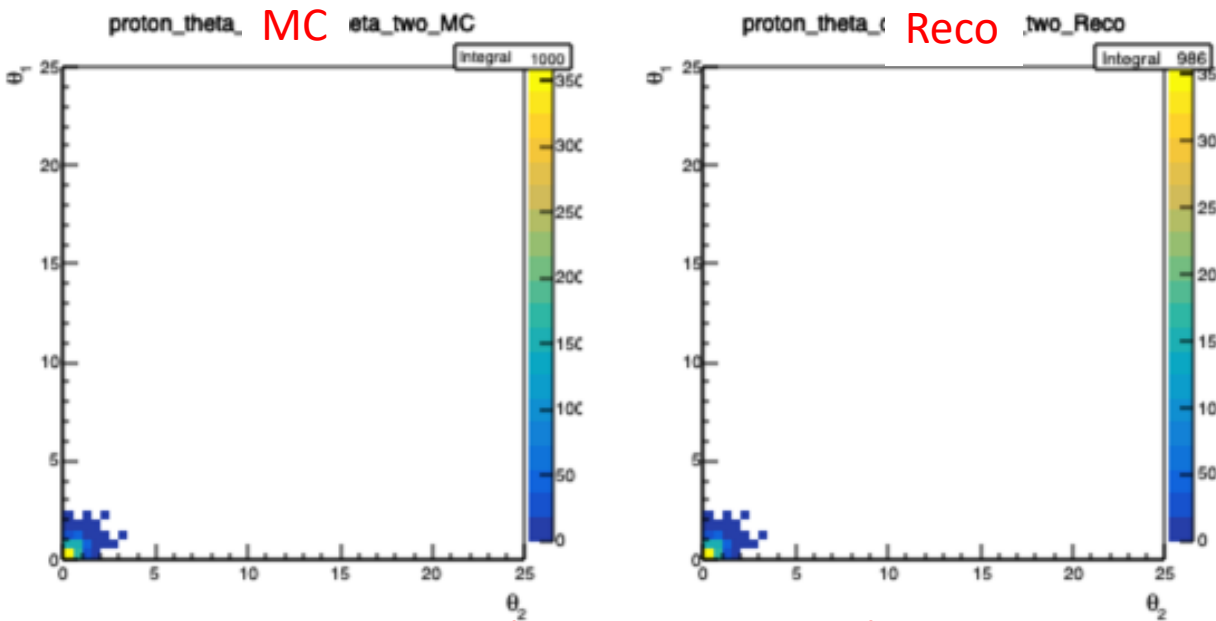
proton_pt_MC

Integral 2000

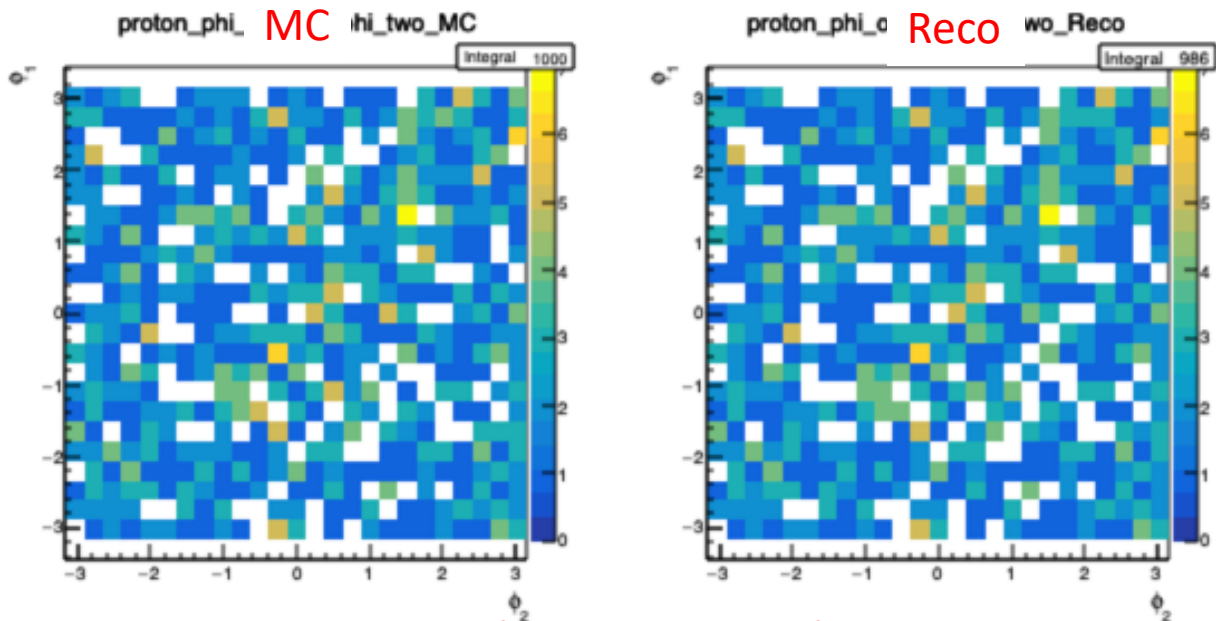
ALL protons



Ivica 18x110 results – spectator protons – 3BBU



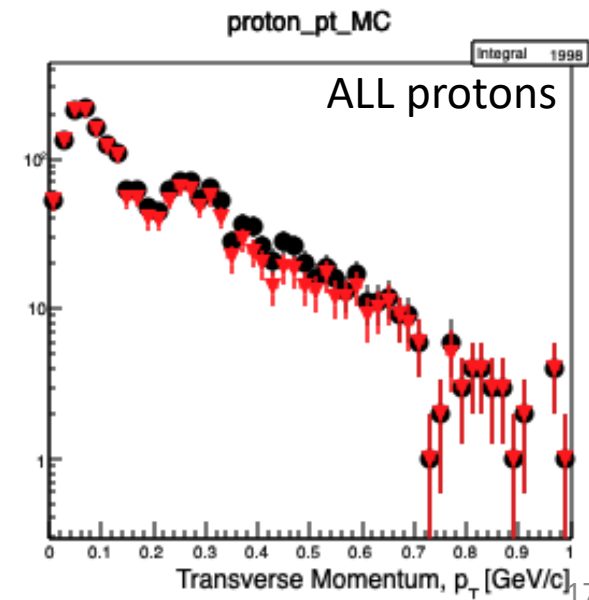
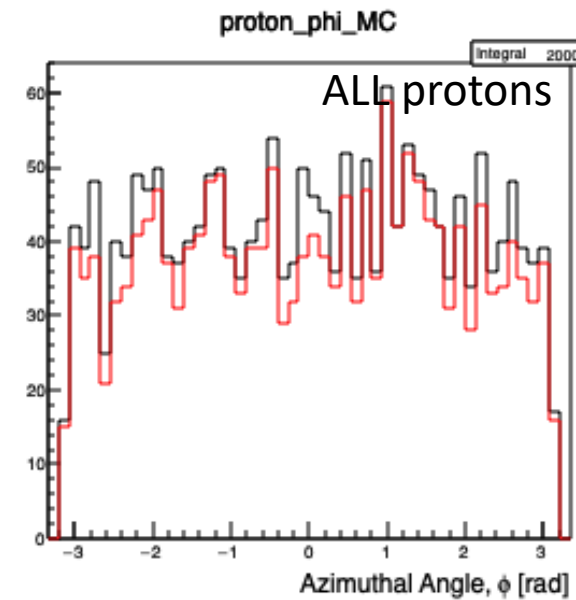
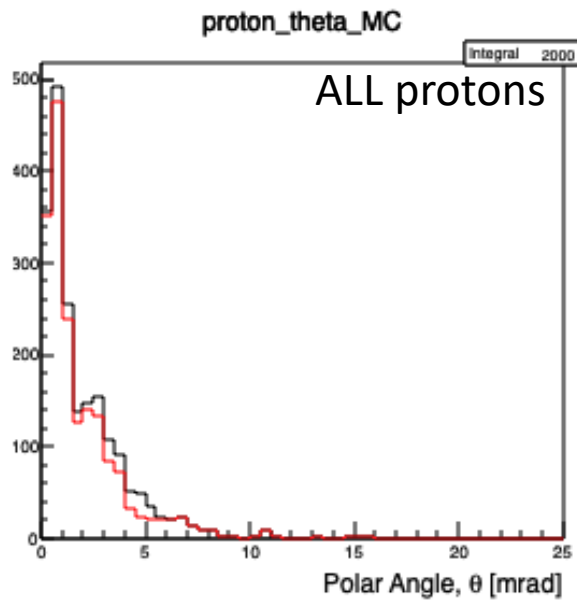
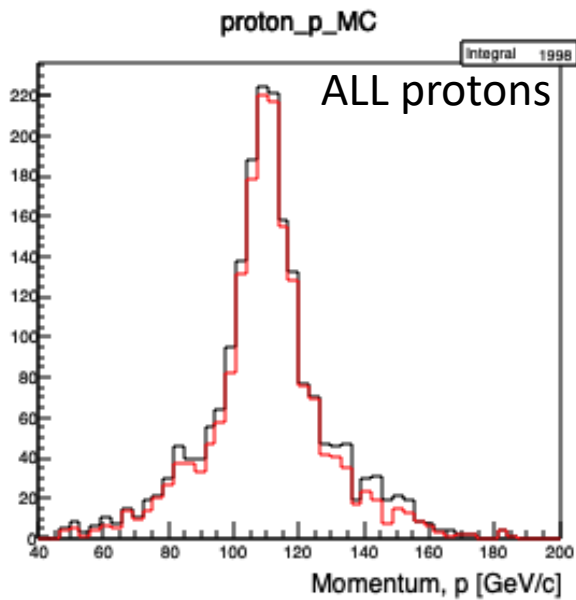
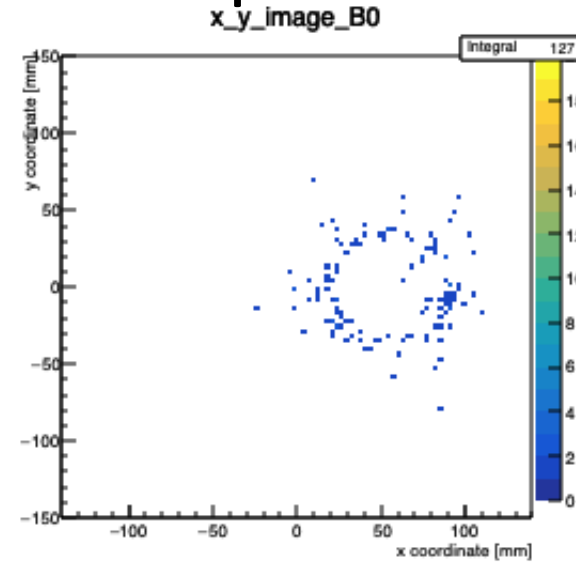
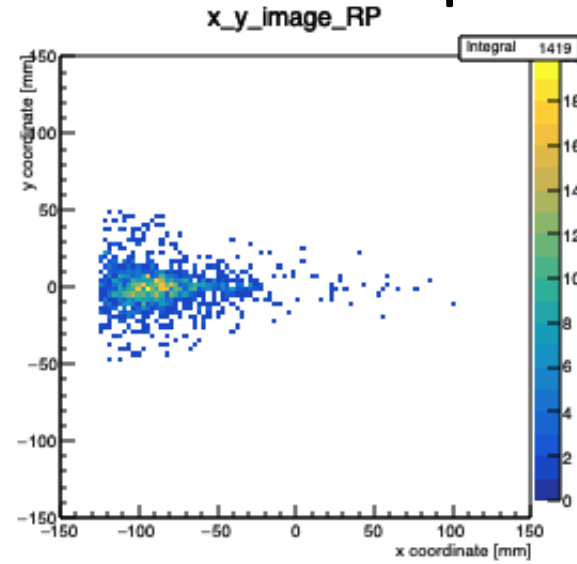
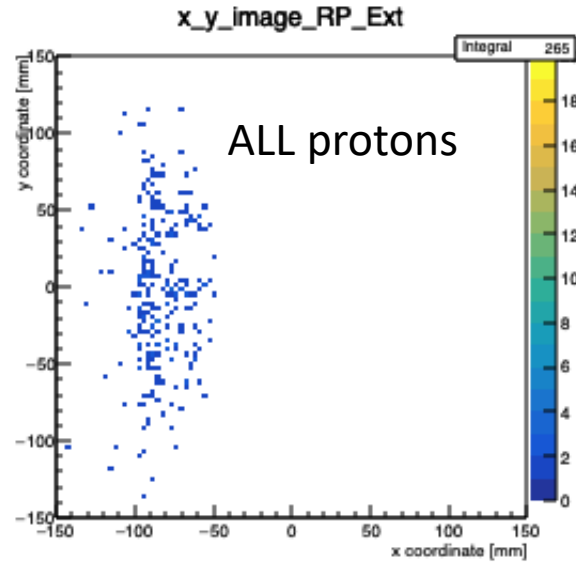
Proton 1 theta vs. proton 2 theta



Proton 1 phi vs. proton 2 phi

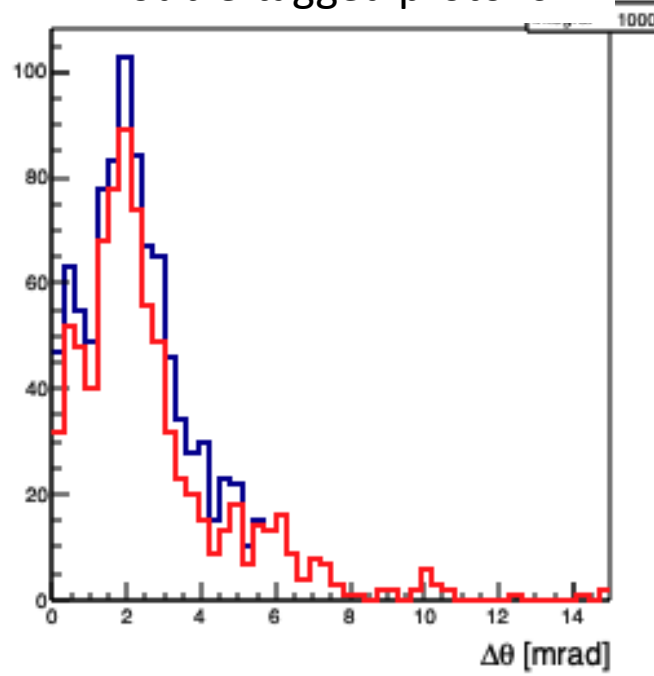
Ivica 18x110 GeV/n SRC

Ivica 18x110 results – spectator protons – SRC

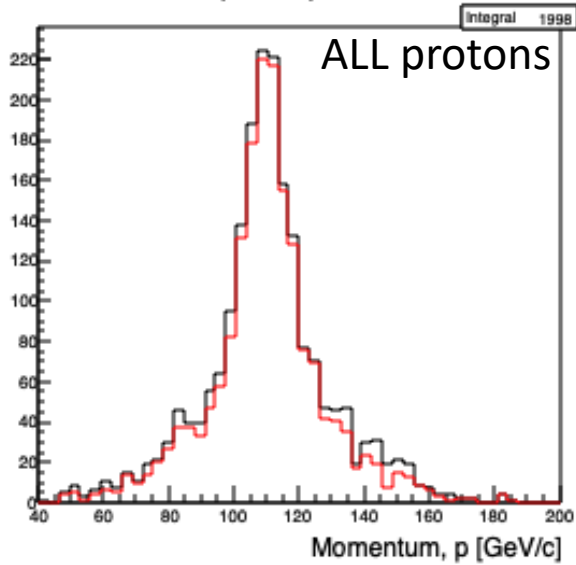


Ivica 18x110 results – spectator protons – SRC

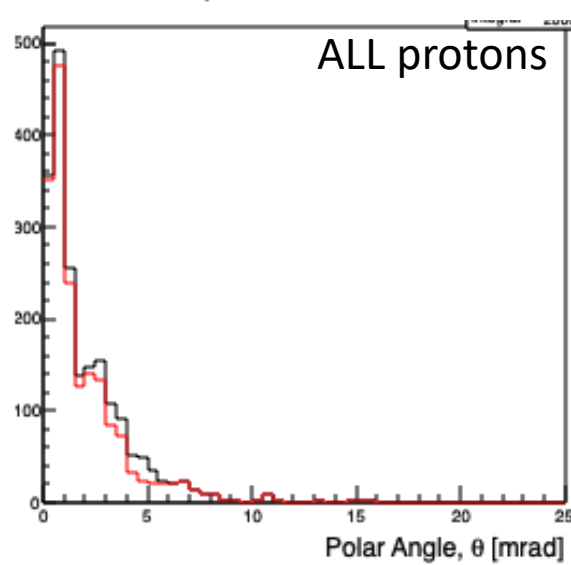
Double-tagged protons



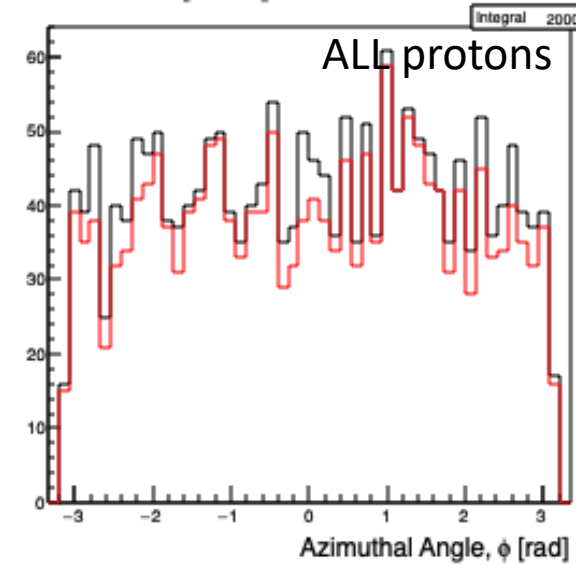
proton_p_MC



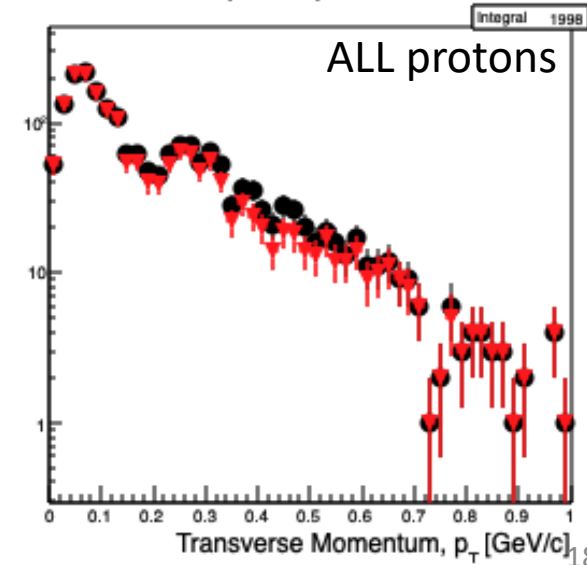
protor



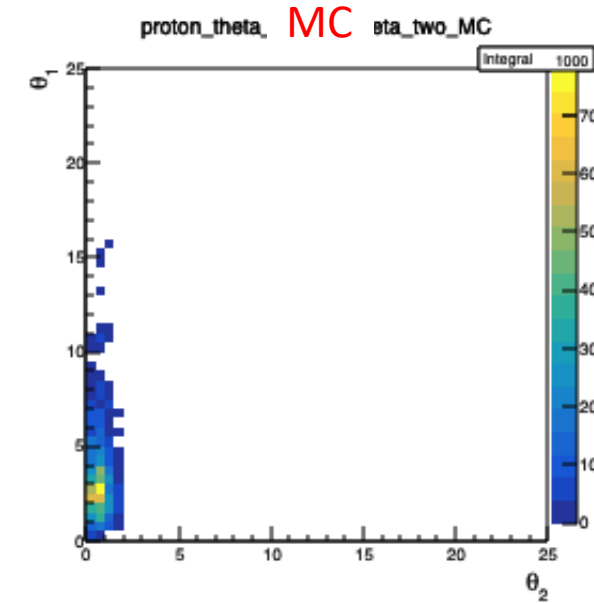
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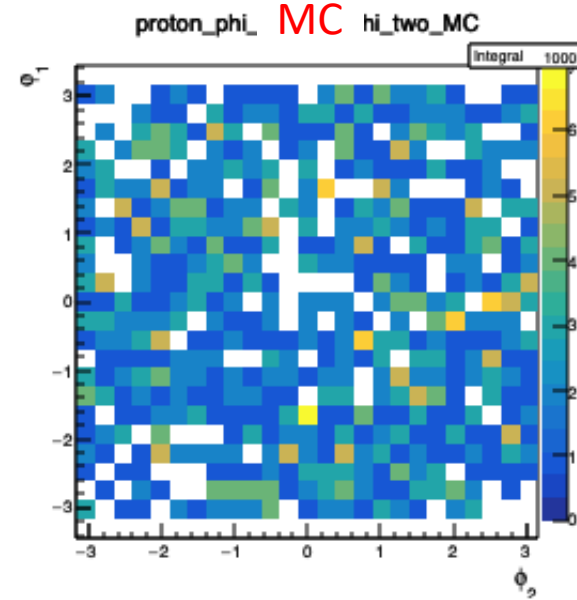
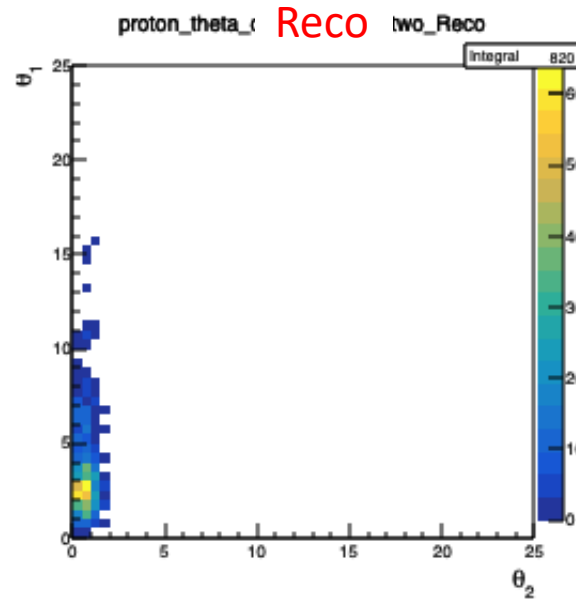
proton_pt_MC



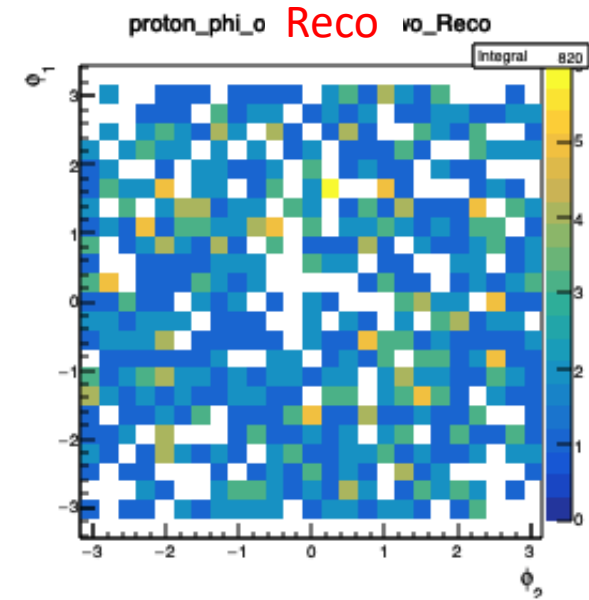
Ivica 18x110 results – spectator protons – SRC



Proton 1 theta vs. proton 2 theta

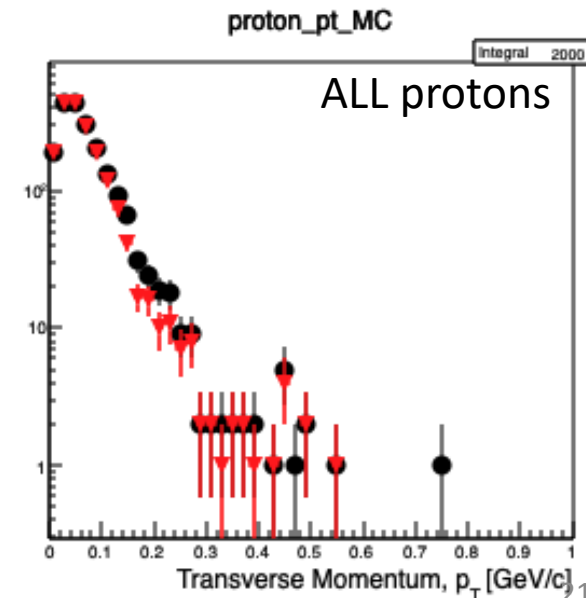
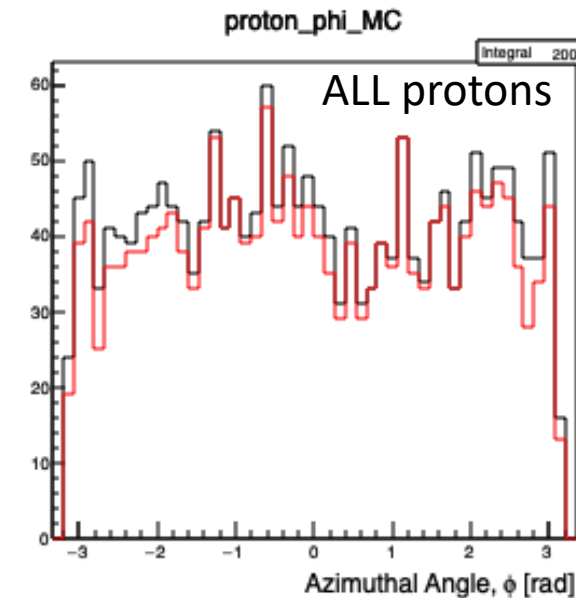
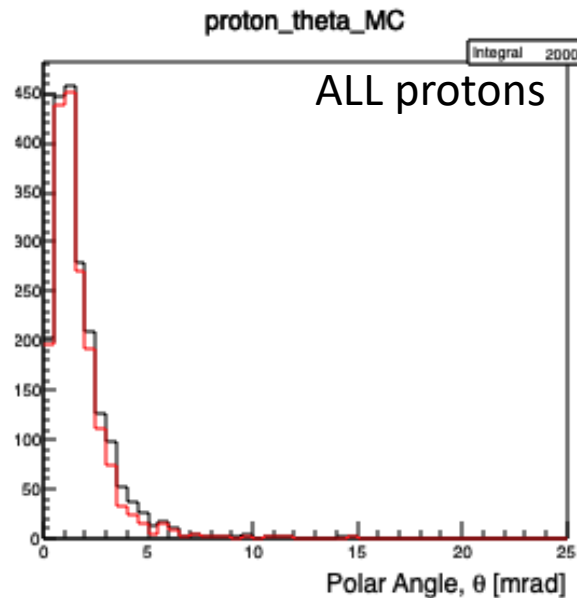
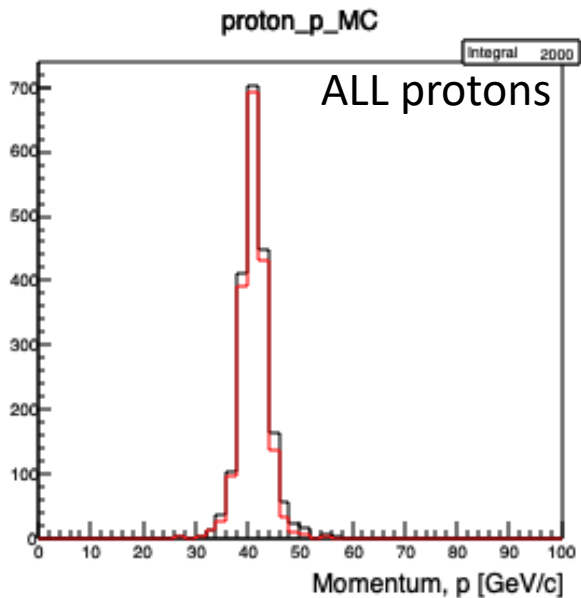
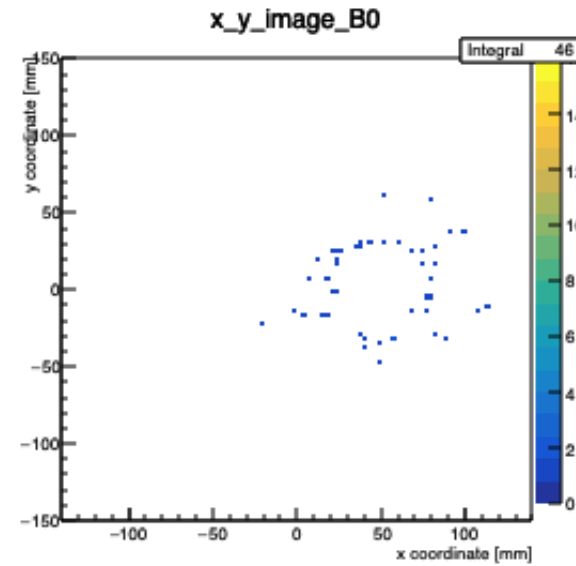
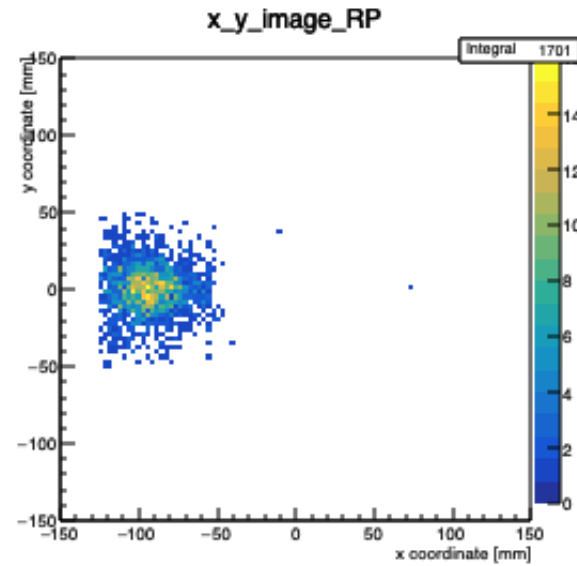
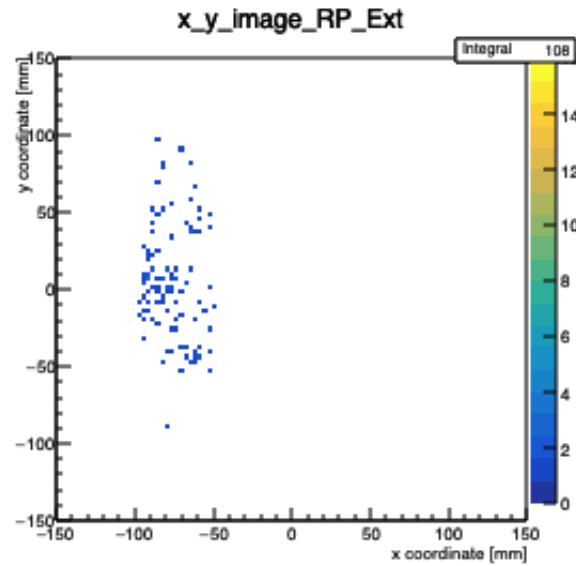


Proton 1 phi vs. proton 2 phi



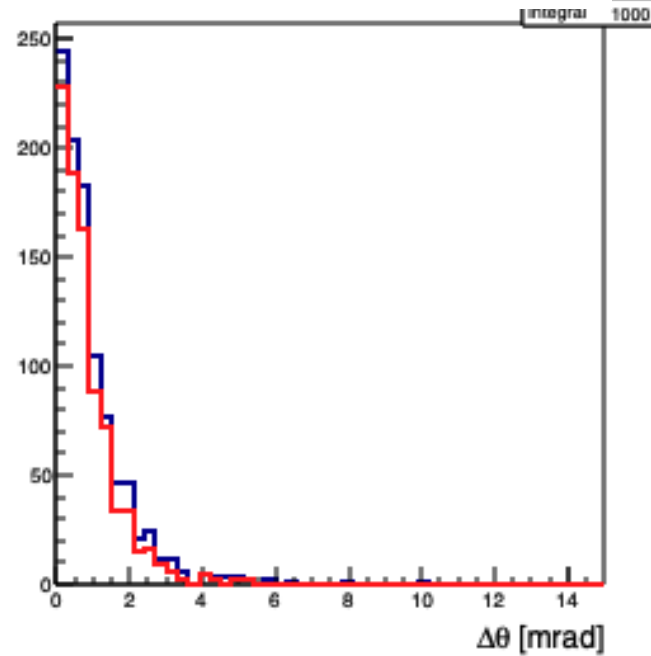
BeAGLE 5x41 GeV/n DIS

BeAGLE 5x41 results – spectator protons – DIS



BeAGLE 5x41 results – spectator protons – DIS

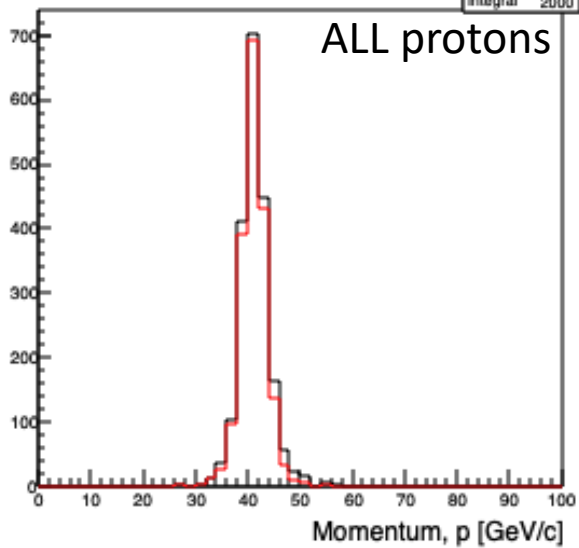
Double-tagged protons



proton_p_MC

integral 2000

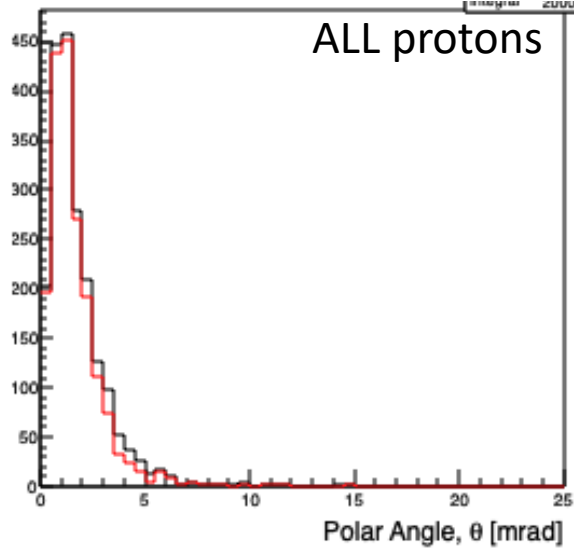
ALL protons



prot

integral 2000

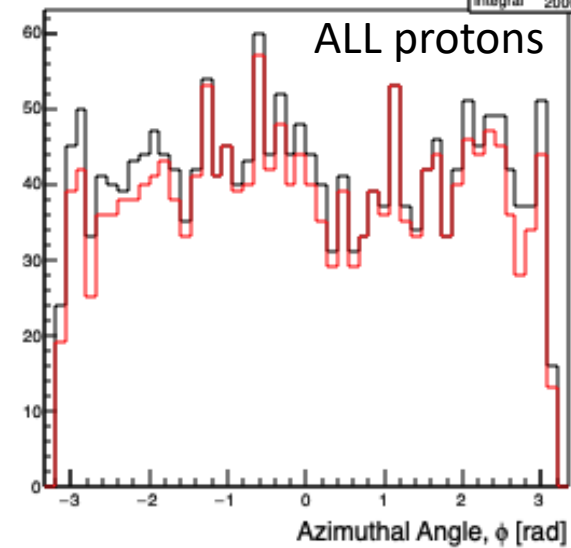
ALL protons



_MC

integral 2000

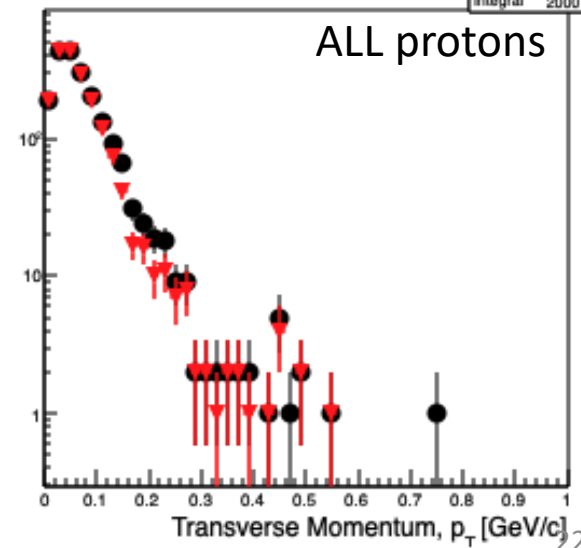
ALL protons



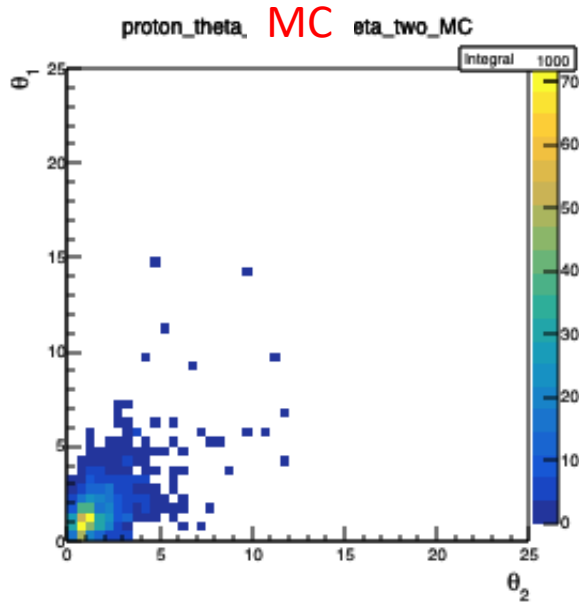
proton_pt_MC

integral 2000

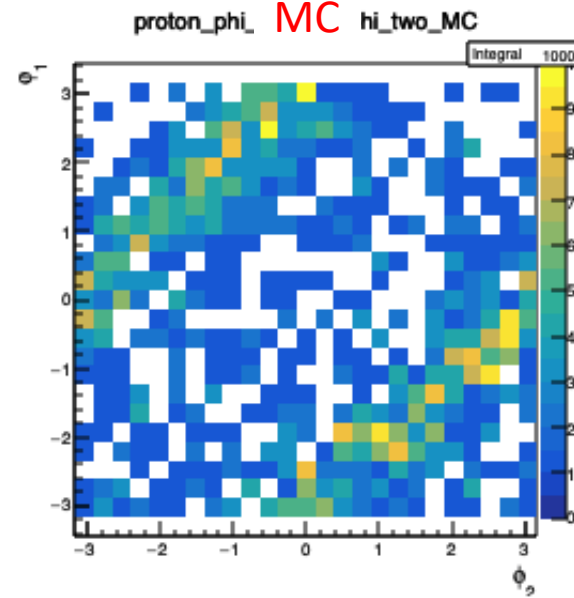
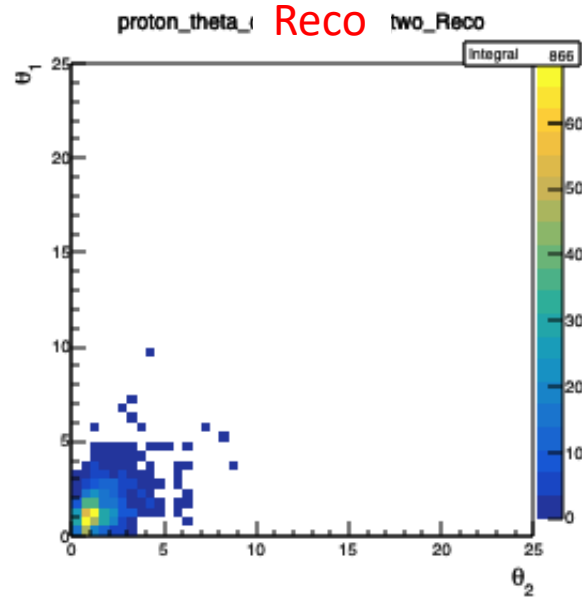
ALL protons



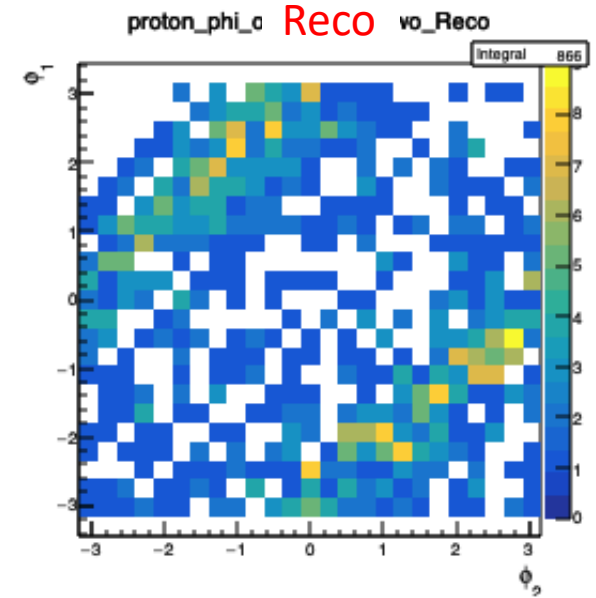
BeAGLE 5x41 results – spectator protons – DIS



Proton 1 theta vs. proton 2 theta

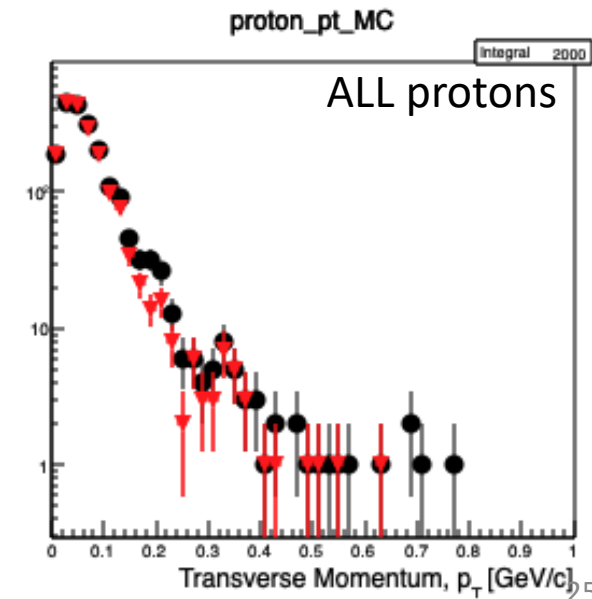
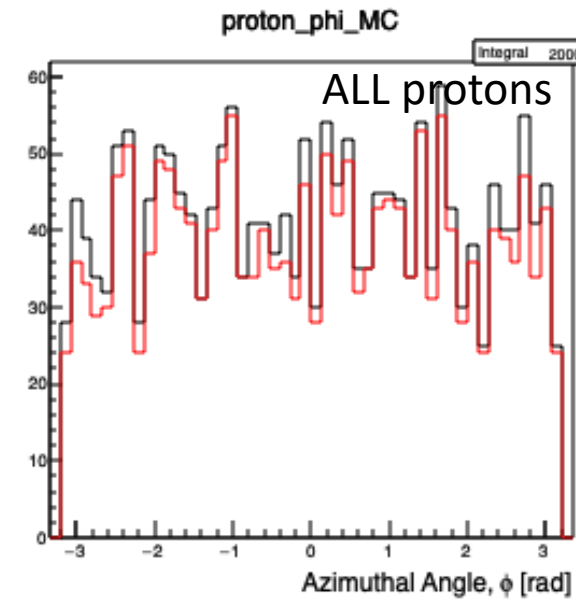
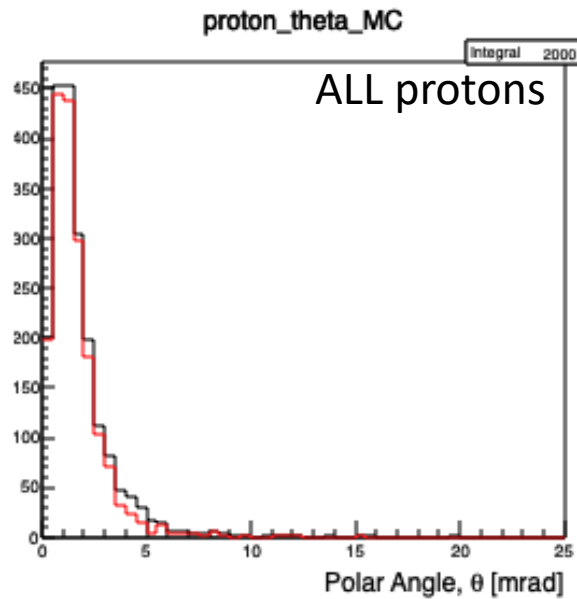
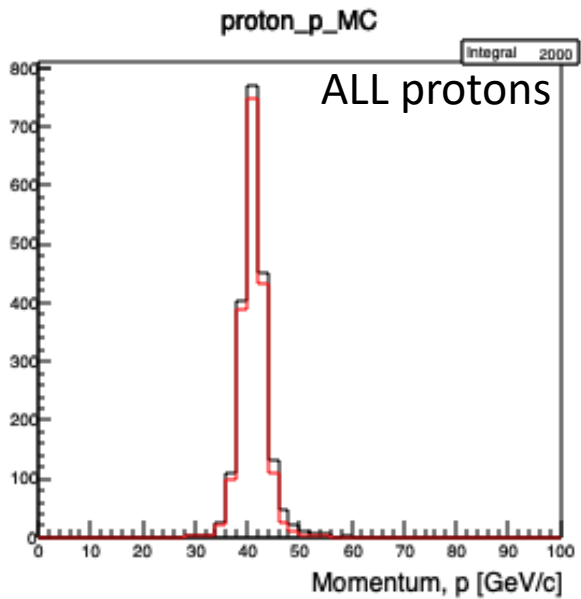
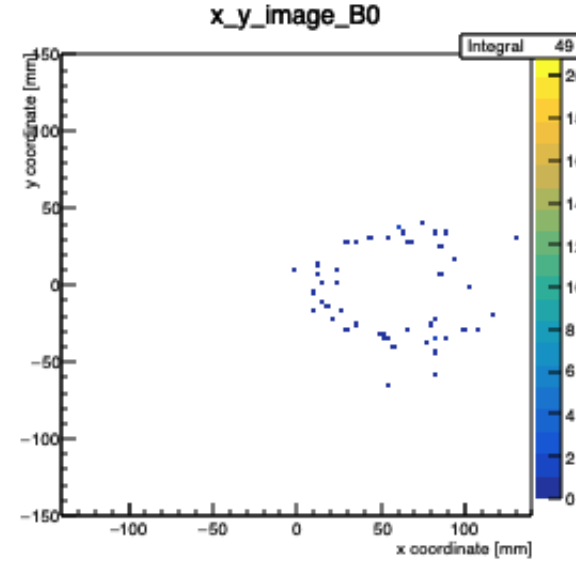
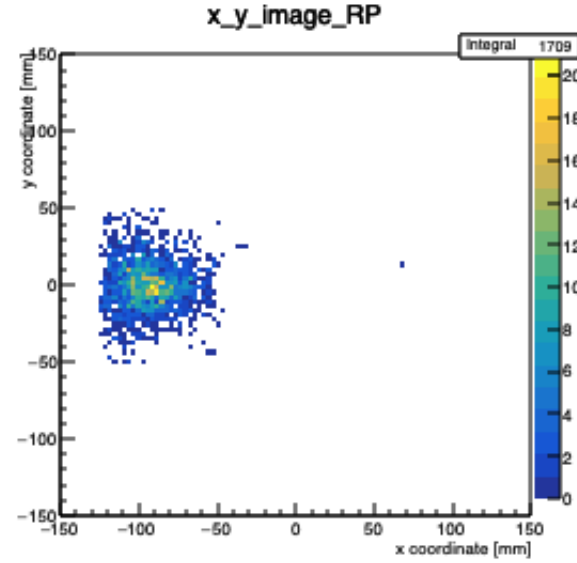
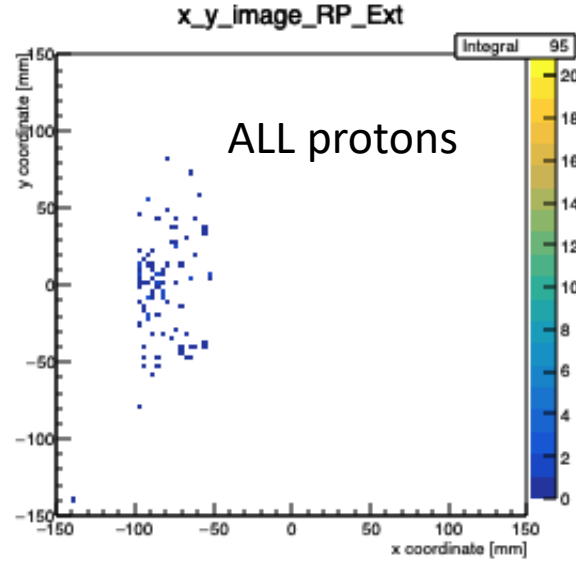


Proton 1 phi vs. proton 2 phi



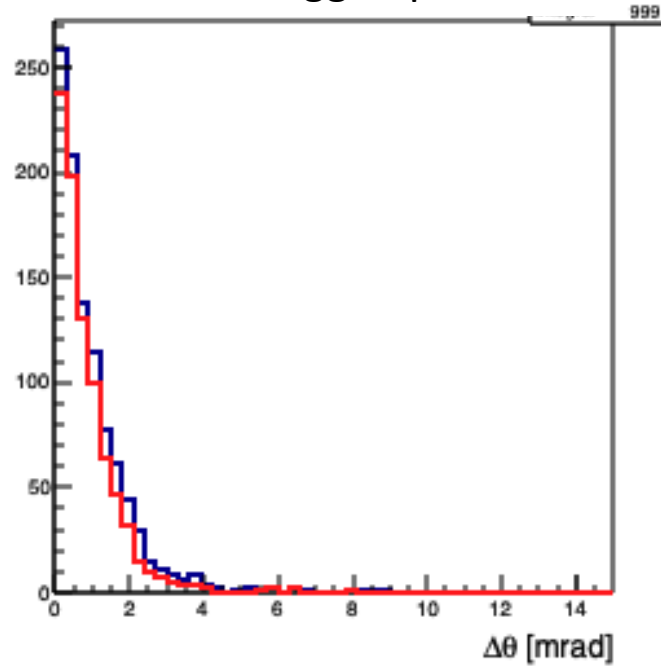
BeAGLE 5x41 GeV/n J/Psi

BeAGLE 5x41 results – spectator protons – J/Psi



BeAGLE 5x41 results – spectator protons – J/Psi

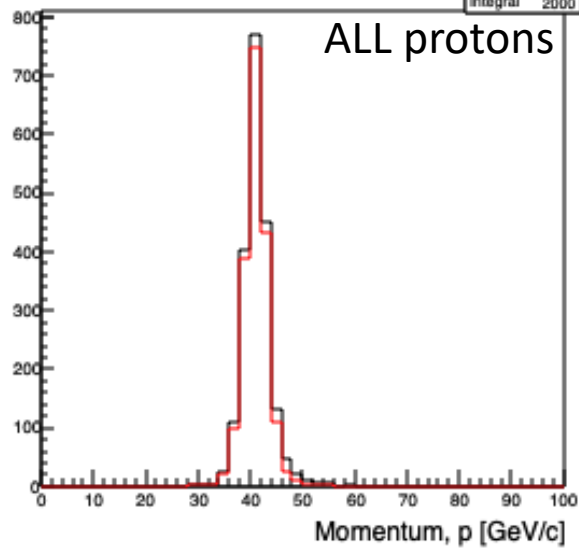
Double-tagged protons



proton_p_MC

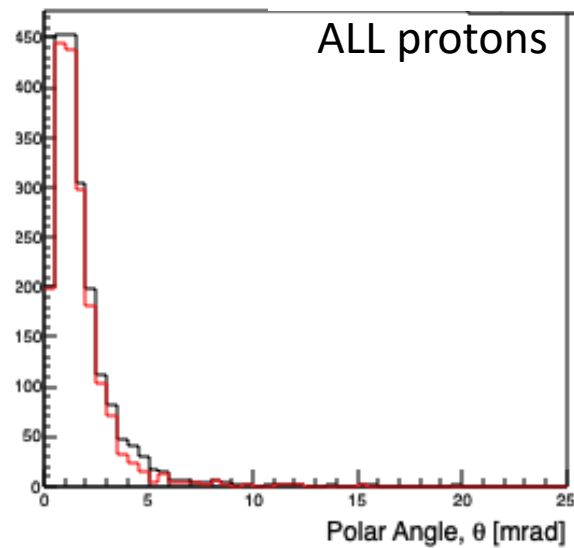
Integral 2000

ALL protons



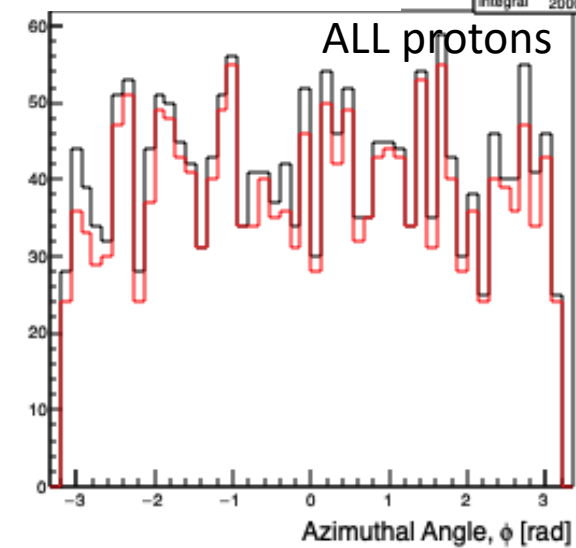
proton_theta

ALL protons



Integral 2000

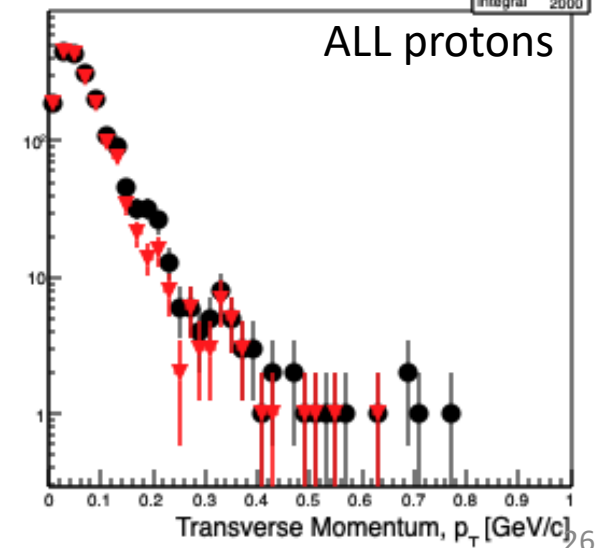
ALL protons



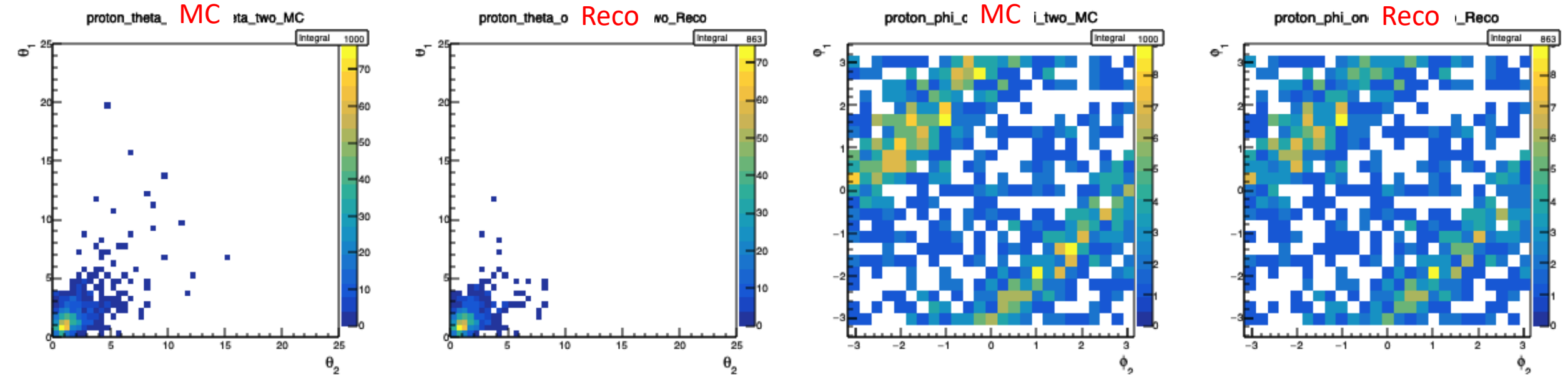
proton_pt_MC

Integral 2000

ALL protons



BeAGLE 5x41 results – spectator protons – J/Psi

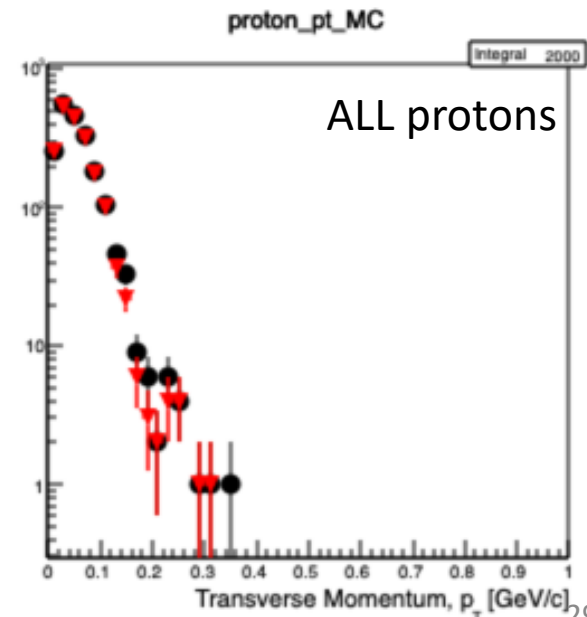
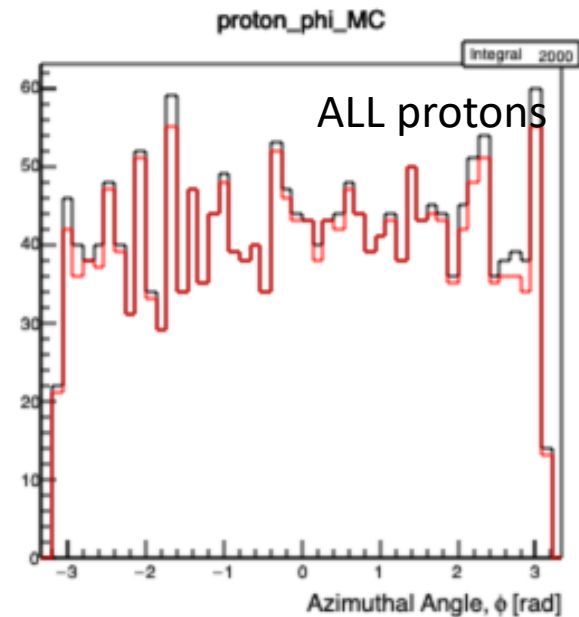
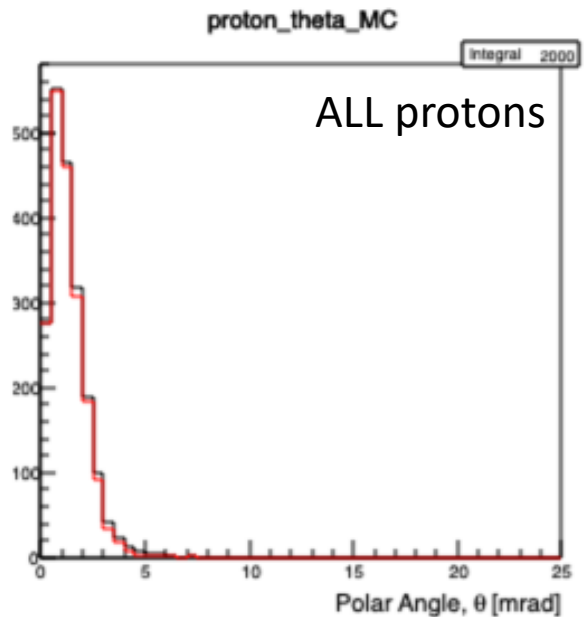
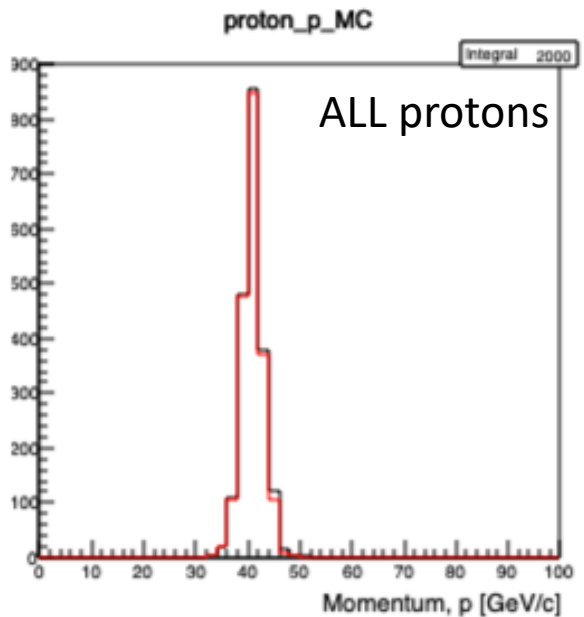
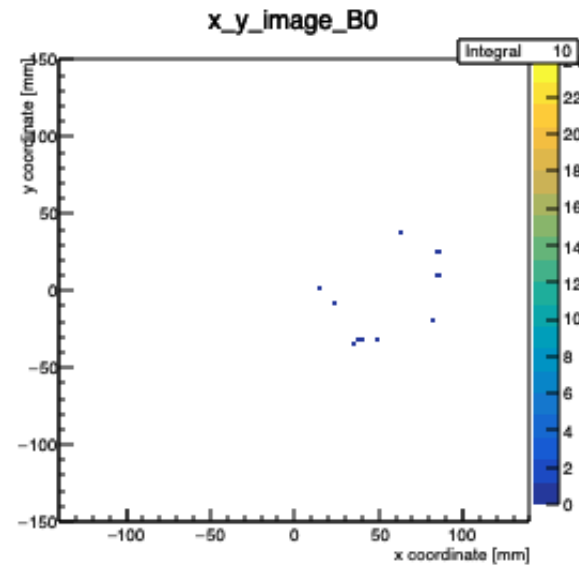
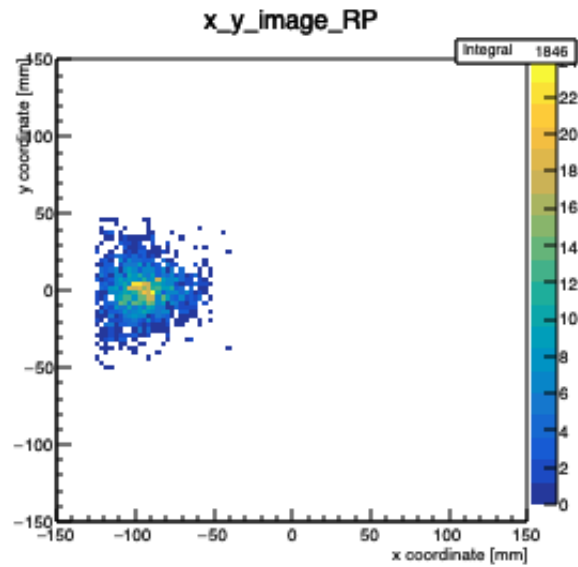
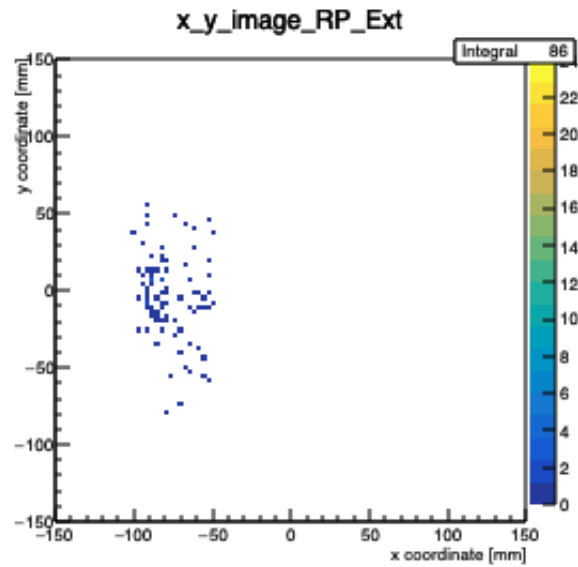


Proton 1 theta vs. proton 2 theta

Proton 1 phi vs. proton 2 phi

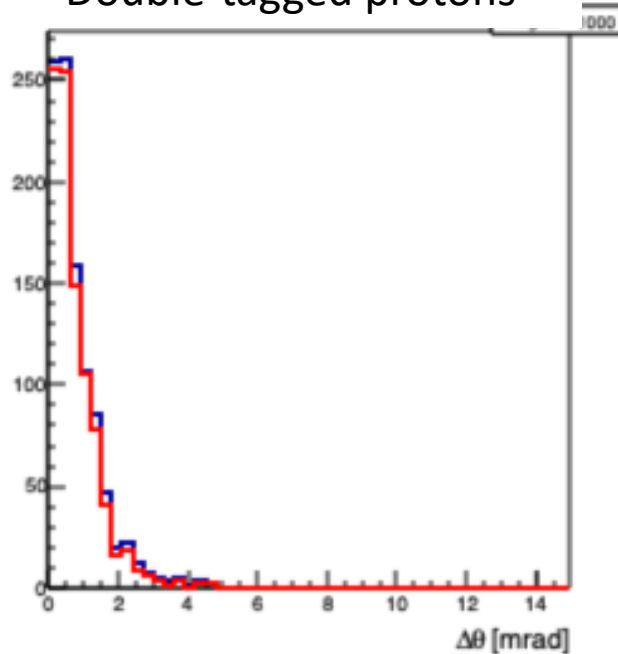
Ivica 5x41 GeV/n 3BBU

Ivica 5x41 results – spectator protons – 3BBU



Ivica 5x41 results – spectator protons – 3BBU

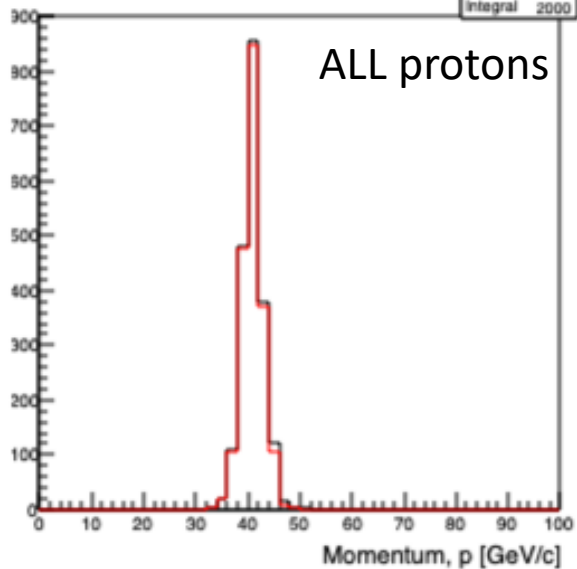
Double-tagged protons



proton_p_MC

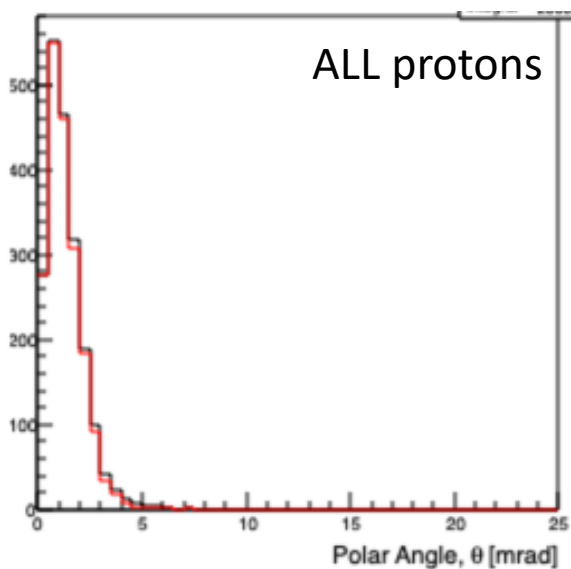
integral 2000

ALL protons



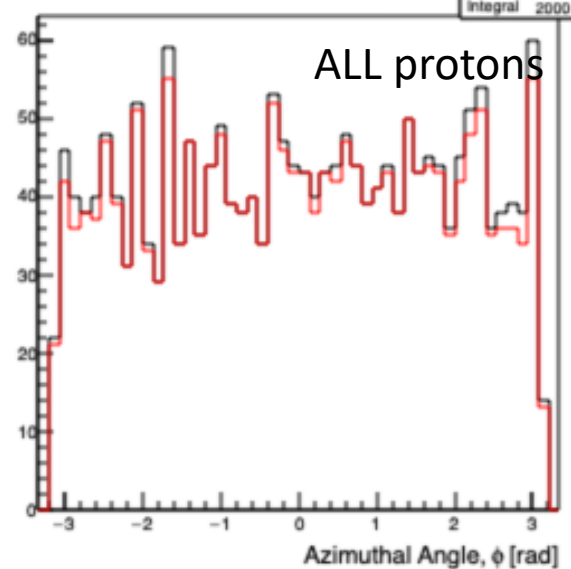
proton_thet

ALL protons



integral 2000

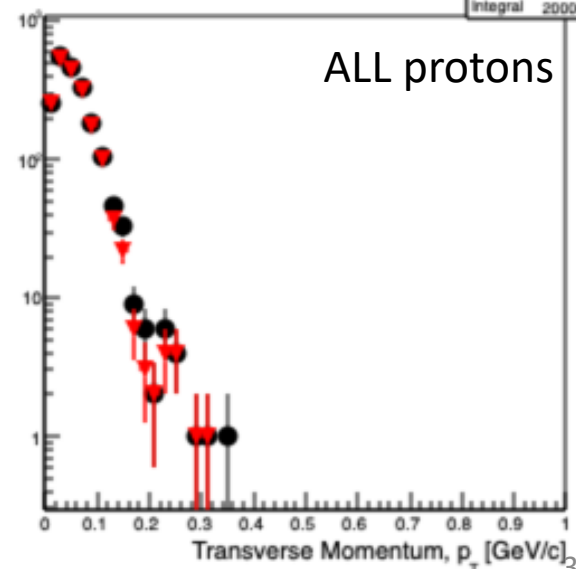
ALL protons



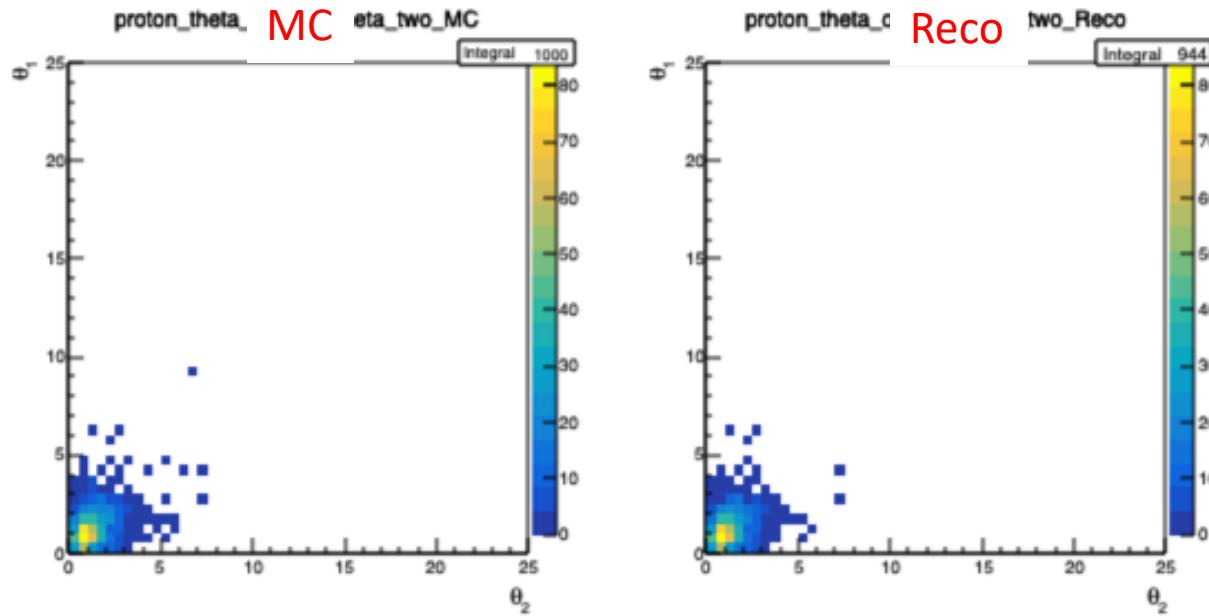
proton_pt_MC

integral 2000

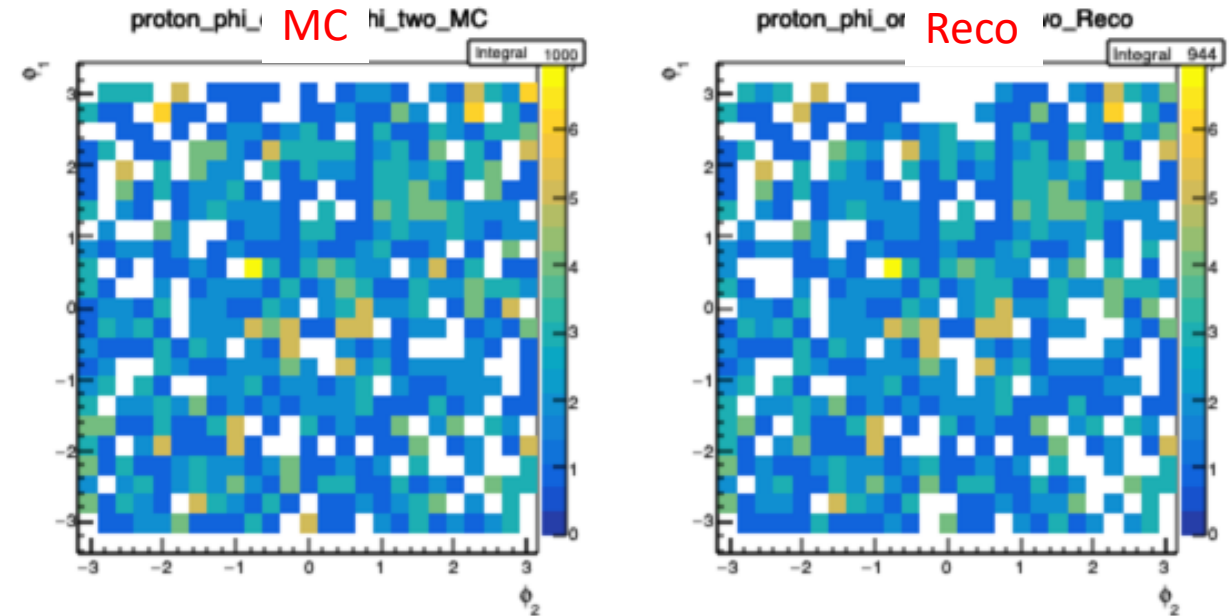
ALL protons



Ivica 5x41 results – spectator protons – 3BBU



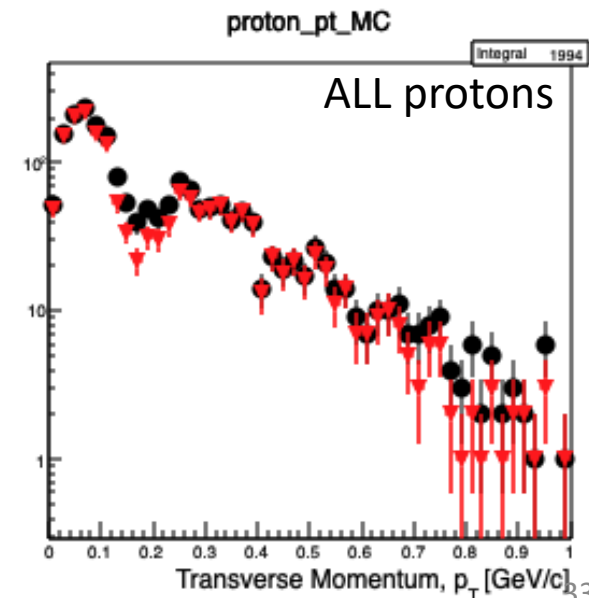
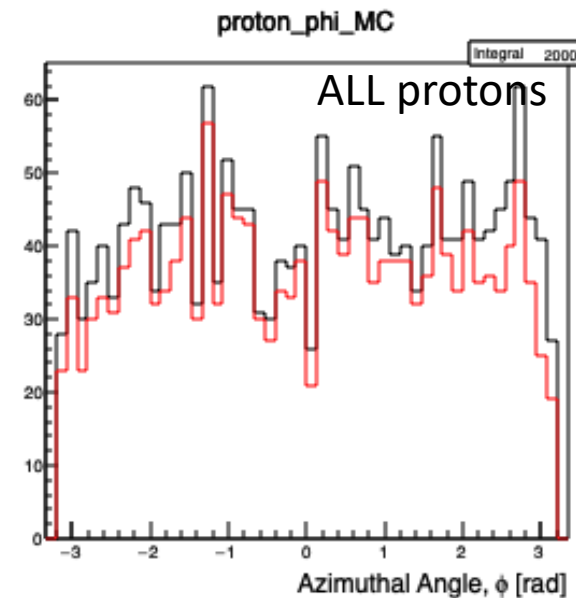
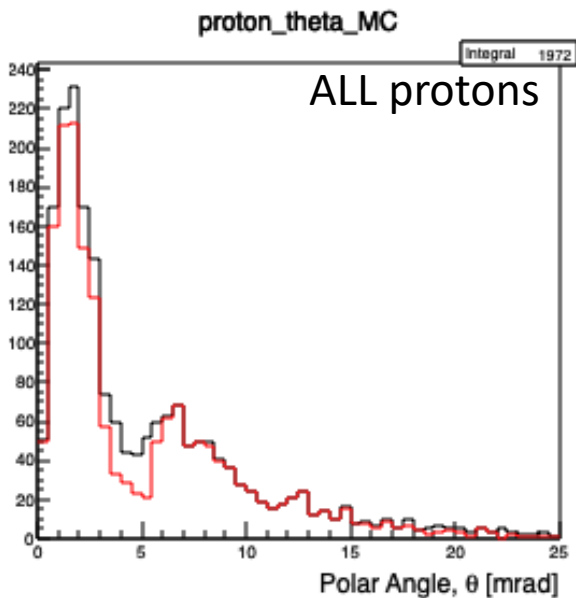
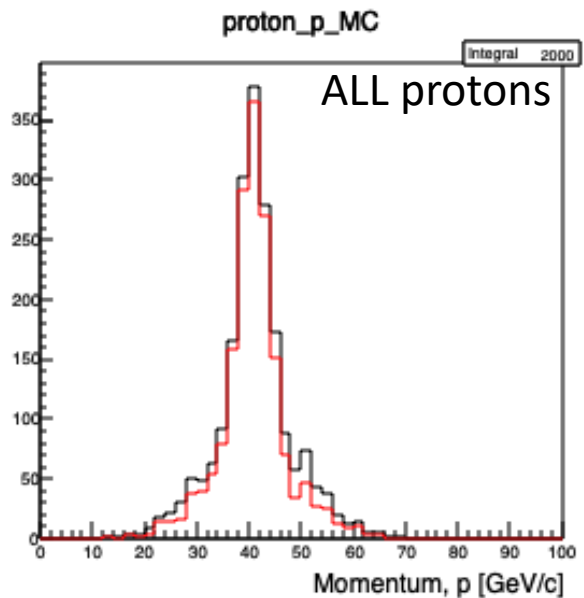
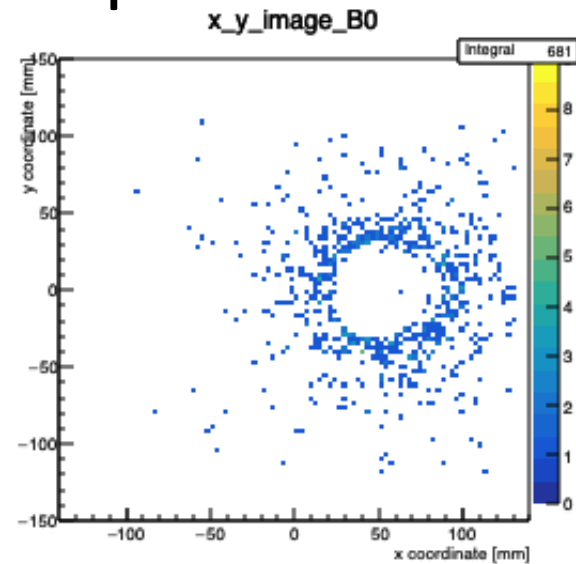
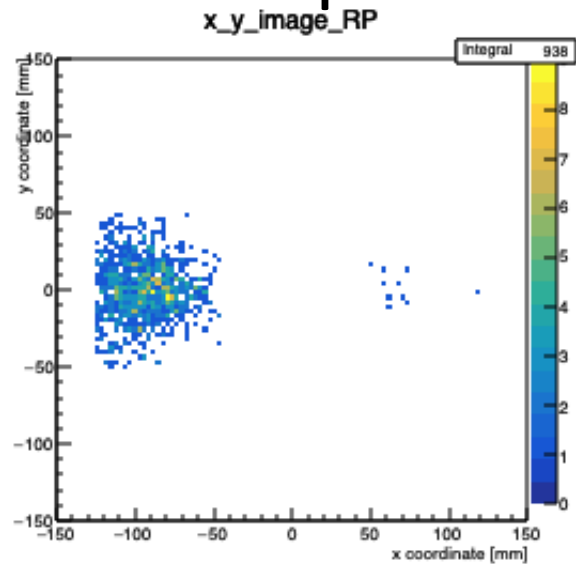
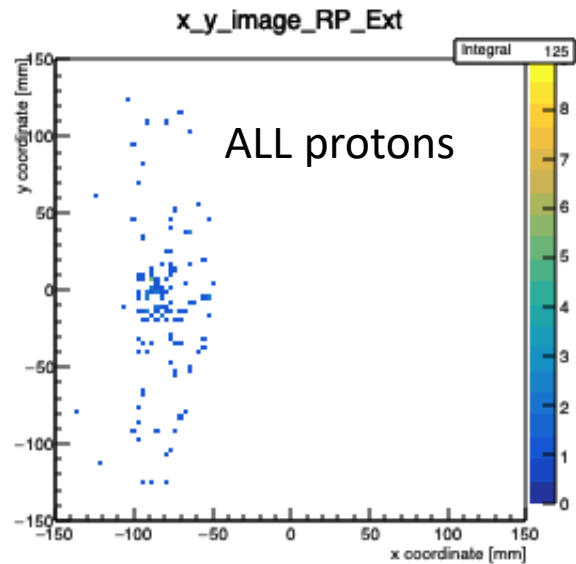
Proton 1 theta vs. proton 2 theta



Proton 1 phi vs. proton 2 phi

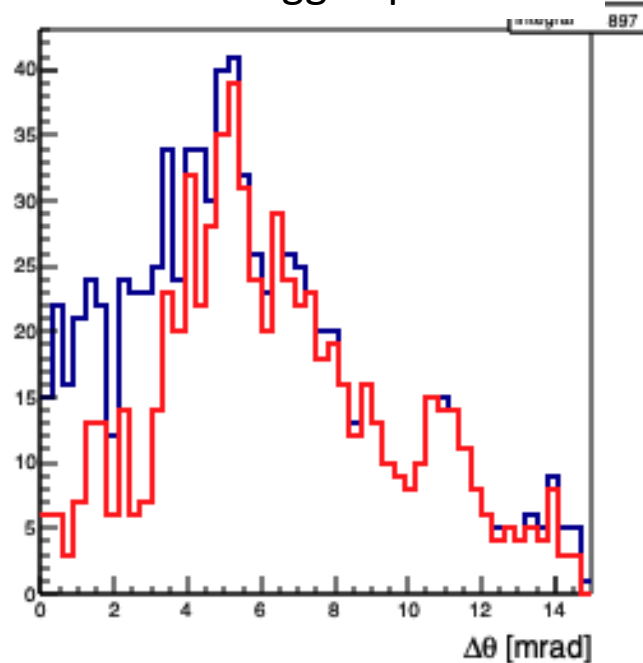
Ivica 5x41 GeV/n SRC

Ivica 5x41 results – spectator protons – SRC



Ivica 5x41 results – spectator protons – SRC

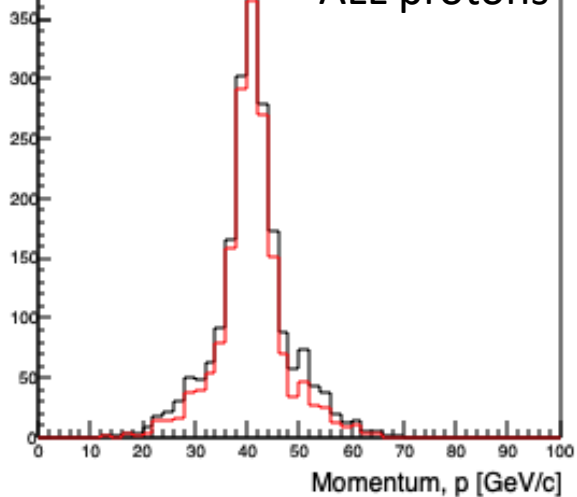
Double-tagged protons



proton_p_MC

integral 2000

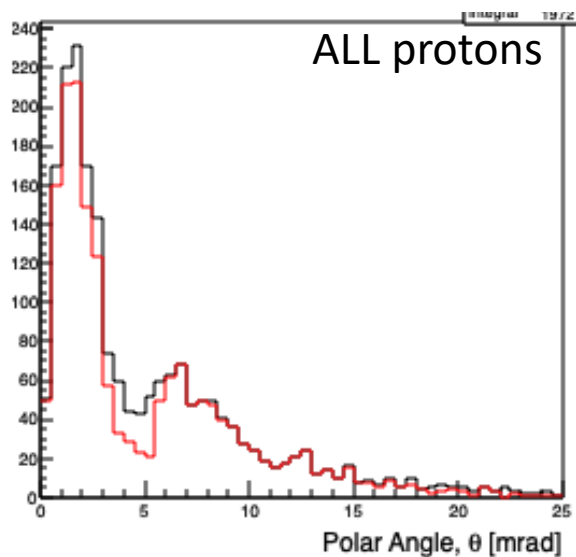
ALL protons



proton_t1

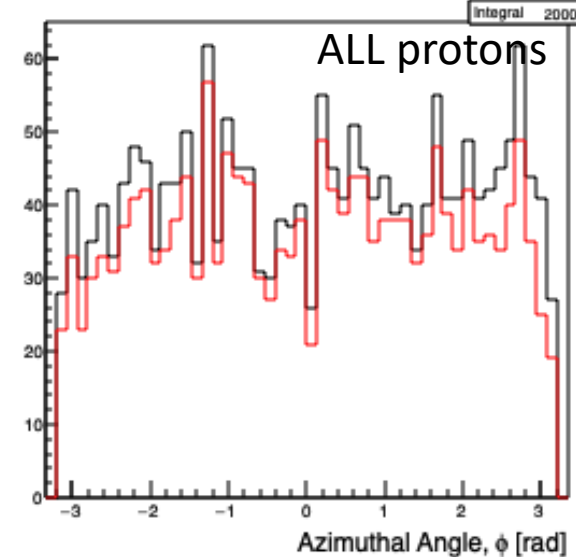
integral 1972

ALL protons



integral 2000

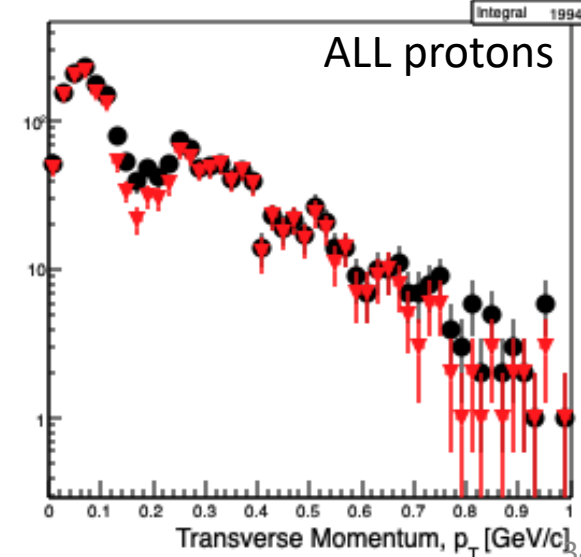
ALL protons



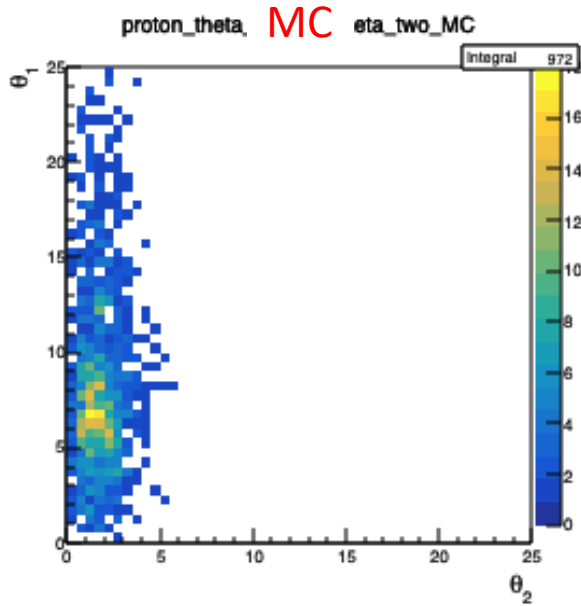
proton_pt_MC

integral 1994

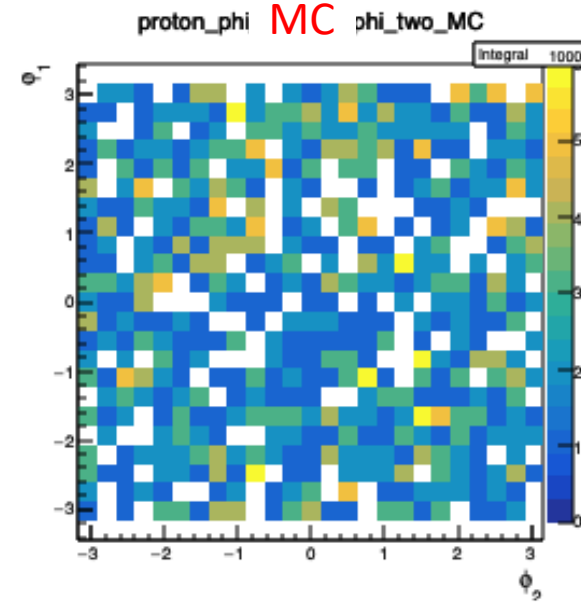
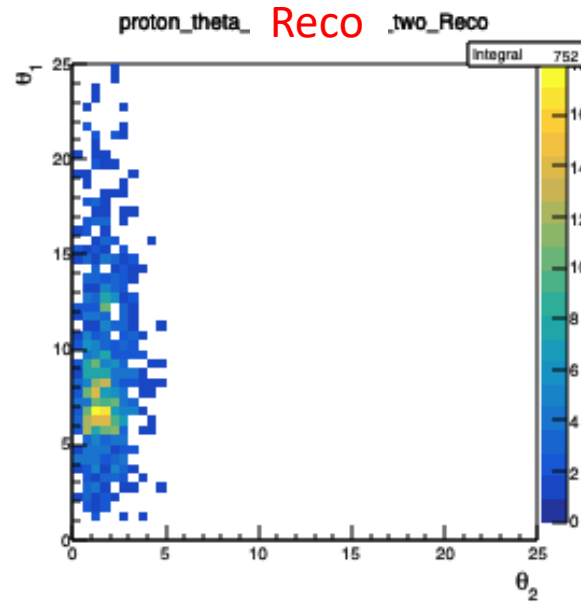
ALL protons



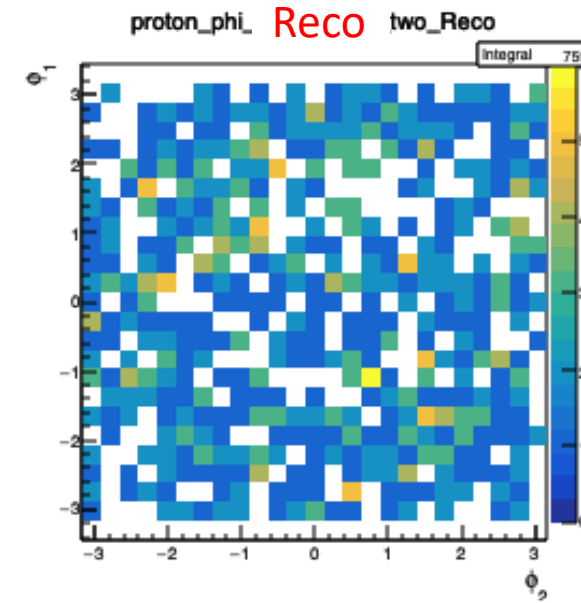
Ivica 5x41 results – spectator protons – SRC



Proton 1 theta vs. proton 2 theta



Proton 1 phi vs. proton 2 phi

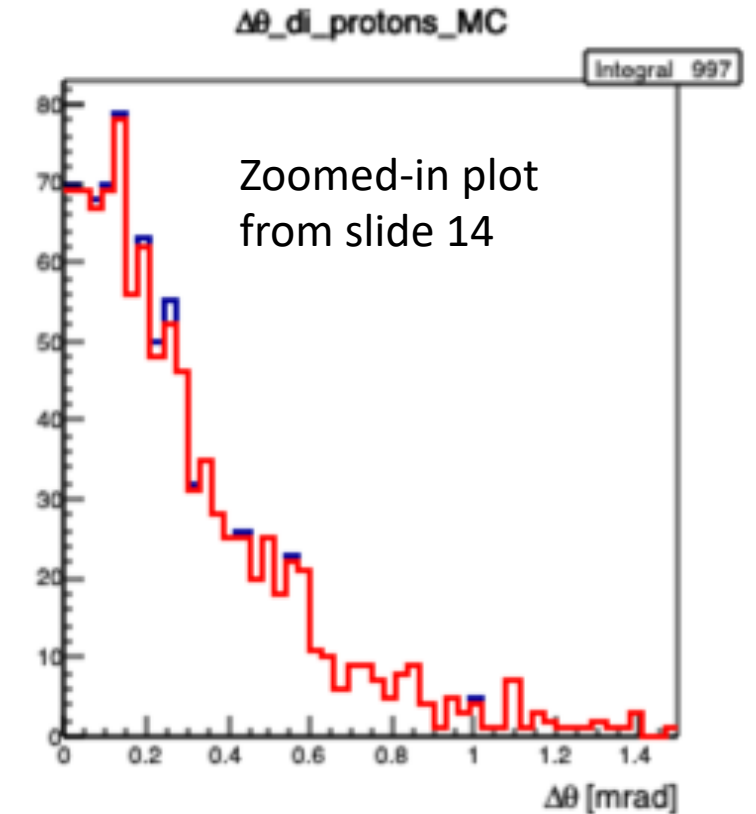
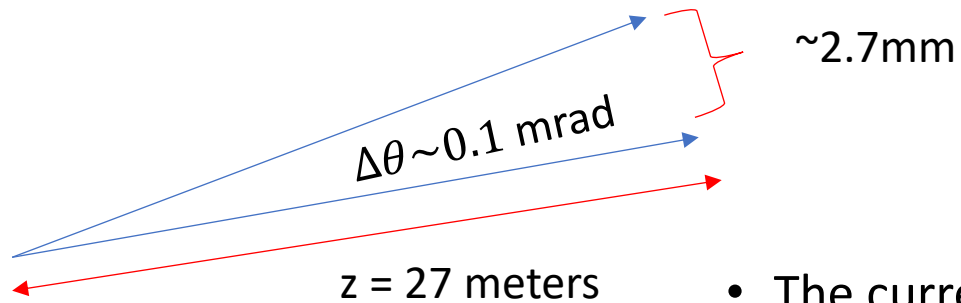


Conclusions

- The acceptance for spectator Double-tagged protons in He-3 breakup is quite good!
 - This acceptance will be dependent on the details of the RP layout especially.
 - Many of the hits are on the outer edge of the active area.
 - Further reinforces need for large sensors.
- Will need to re-run with updated optics files from the machine group. Will likely alter the acceptances, but not by a drastic amount.
- The angular separation can go quite low for some protons ($\Delta\theta \sim .1$ mrad).
 - For the distance between the IP and RP (27 meters), this is a spatial separation at the sensor of 2.7mm. For the LGADs with 500um pixels, this will not be a problem.

Quick note on the angular separation

- The angular separation in all but the SRC case for the spectator protons is peaked at small values (< 1 mrad).
- Looking at one case (3BBU 10x110 GeV) with a narrower range on $\Delta\theta$, the peak value is around $\Delta\theta \sim 0.1$ mrad.



- The currently proposed LGADs will have a pixel pitch of 500 μ m x 500 μ m, so this separation ensures they always fall on separate pixels.
- Will follow up with LGAD (eRD24) group either way to make sure.