E906 Geant4 Simulation for Background Rates

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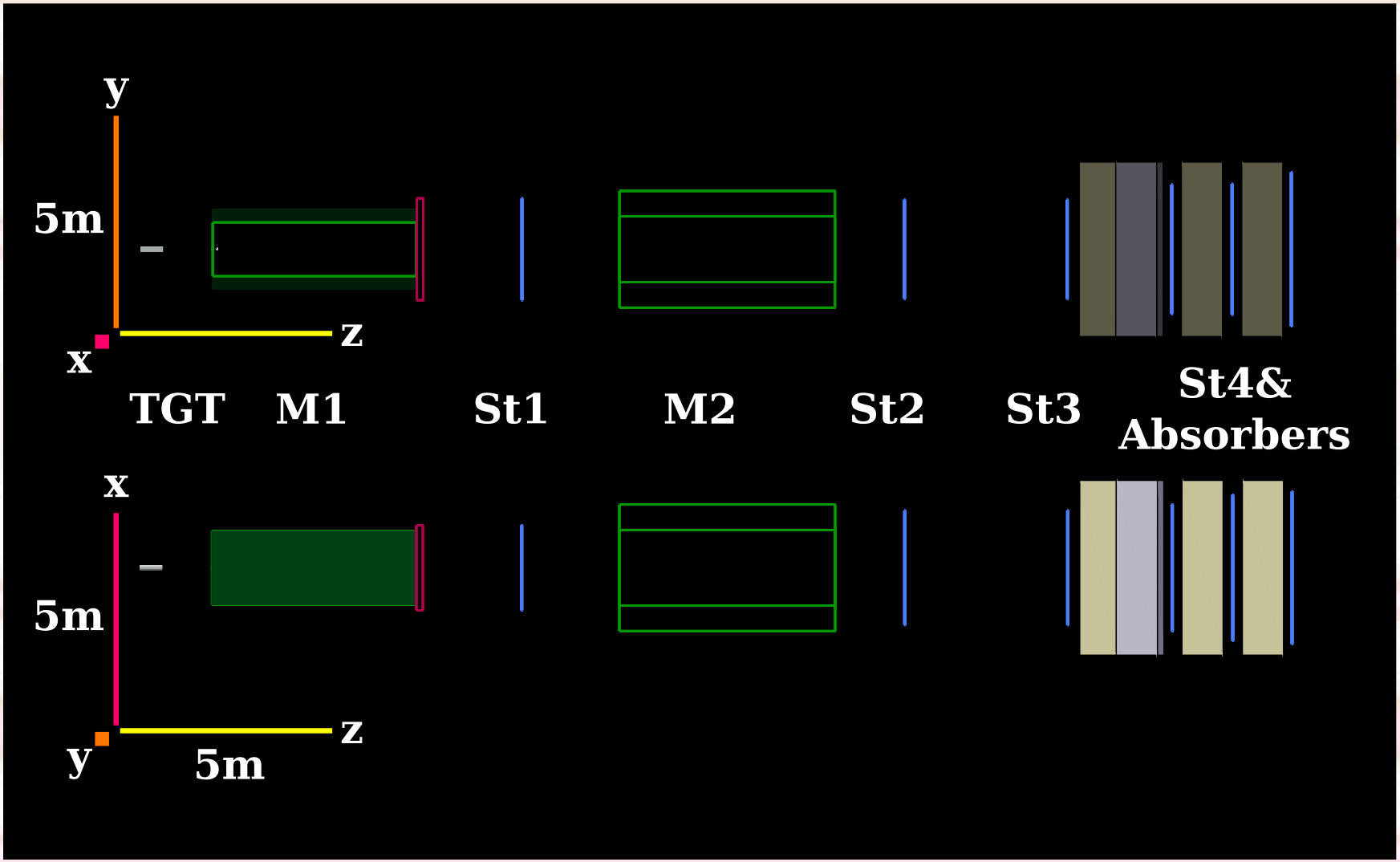
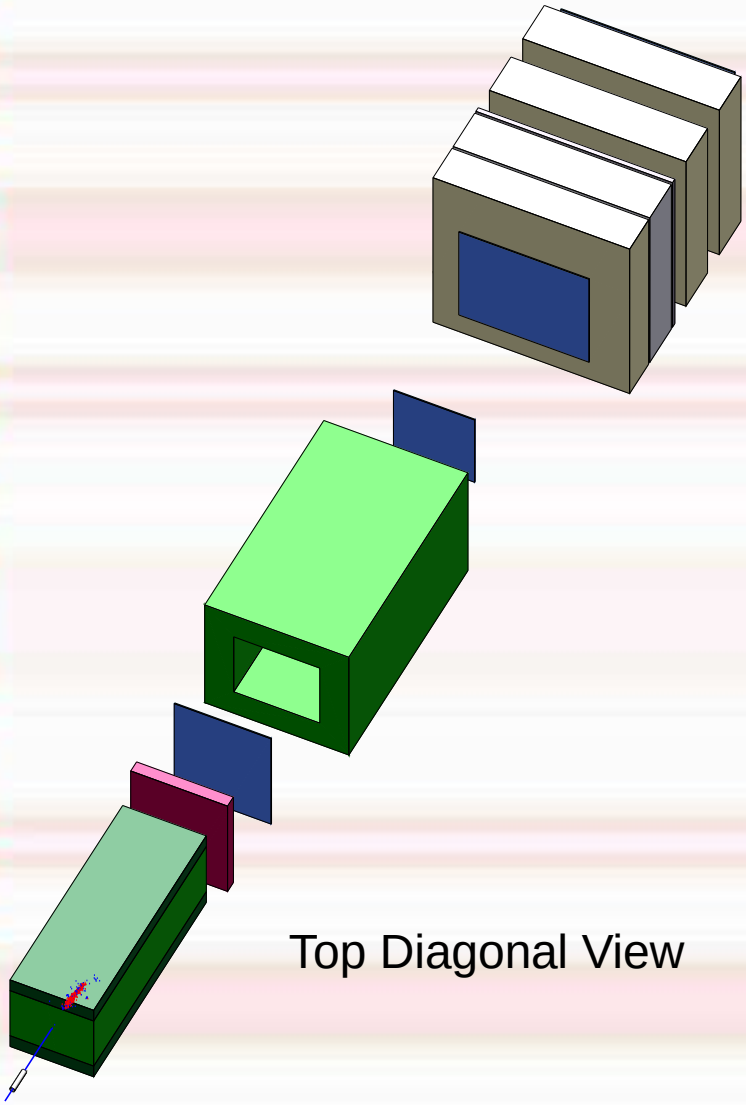
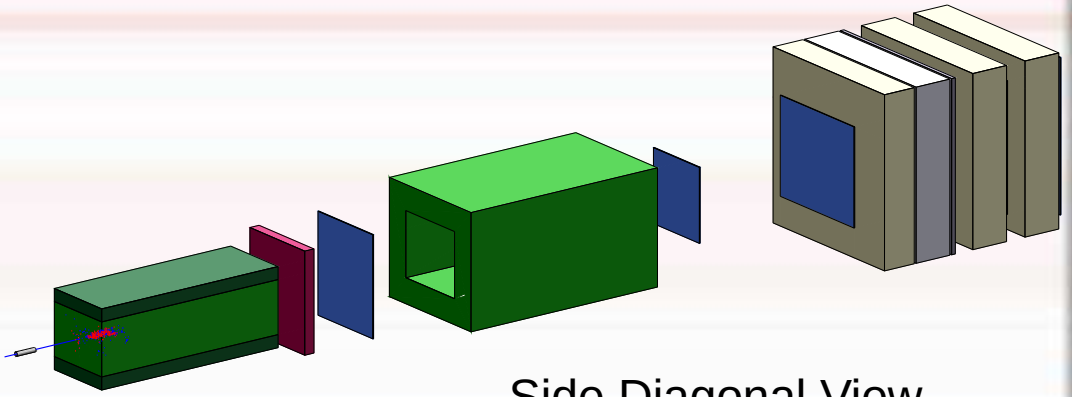
Y-Z and X-Z Views of the Geant4 Simulation



Diagonal Views of the Geant4 Simulation



Top Diagonal View

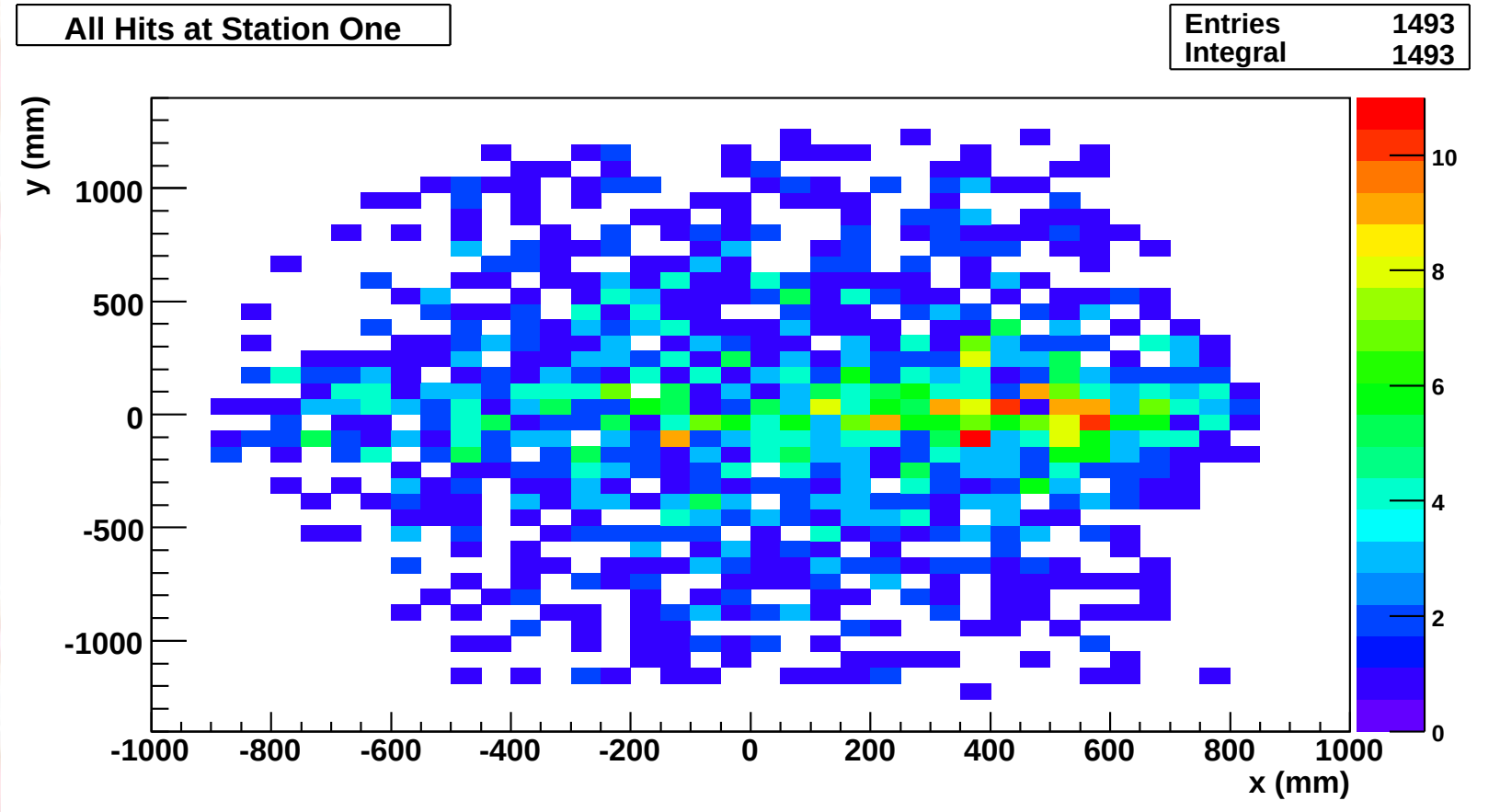


Side Diagonal View

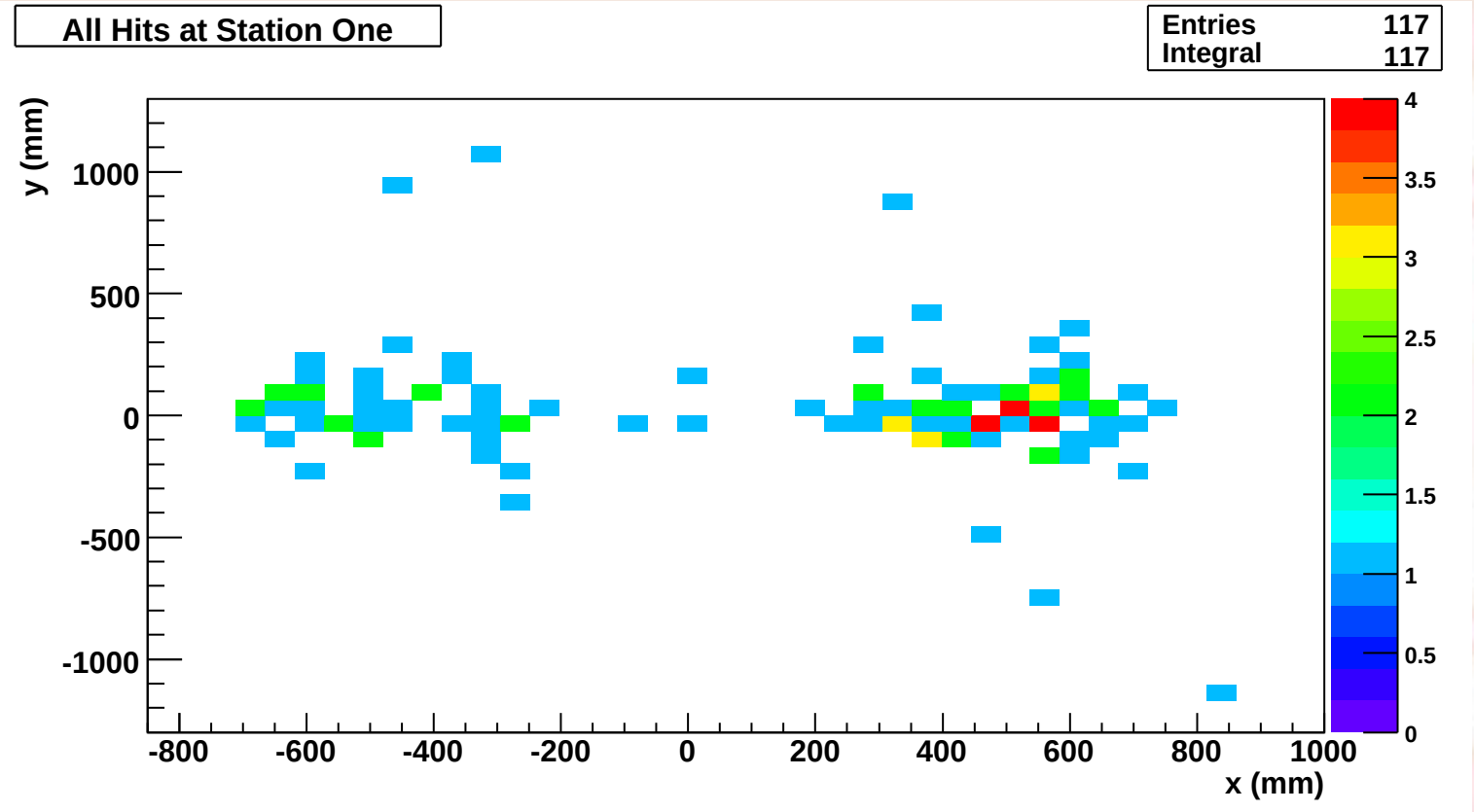
Length of the Magnet

- Two length possibilities:
  126” (3.2 m) and 189” (4.8 m)
- Simulations of 2 million protons at 120 GeV
- Simple magnetic field, uniform throughout the magnet
- Comparison of charged particles that hit station one

SHORT MAGNET: Charged Particles



LONG MAGNET: Charged Particles



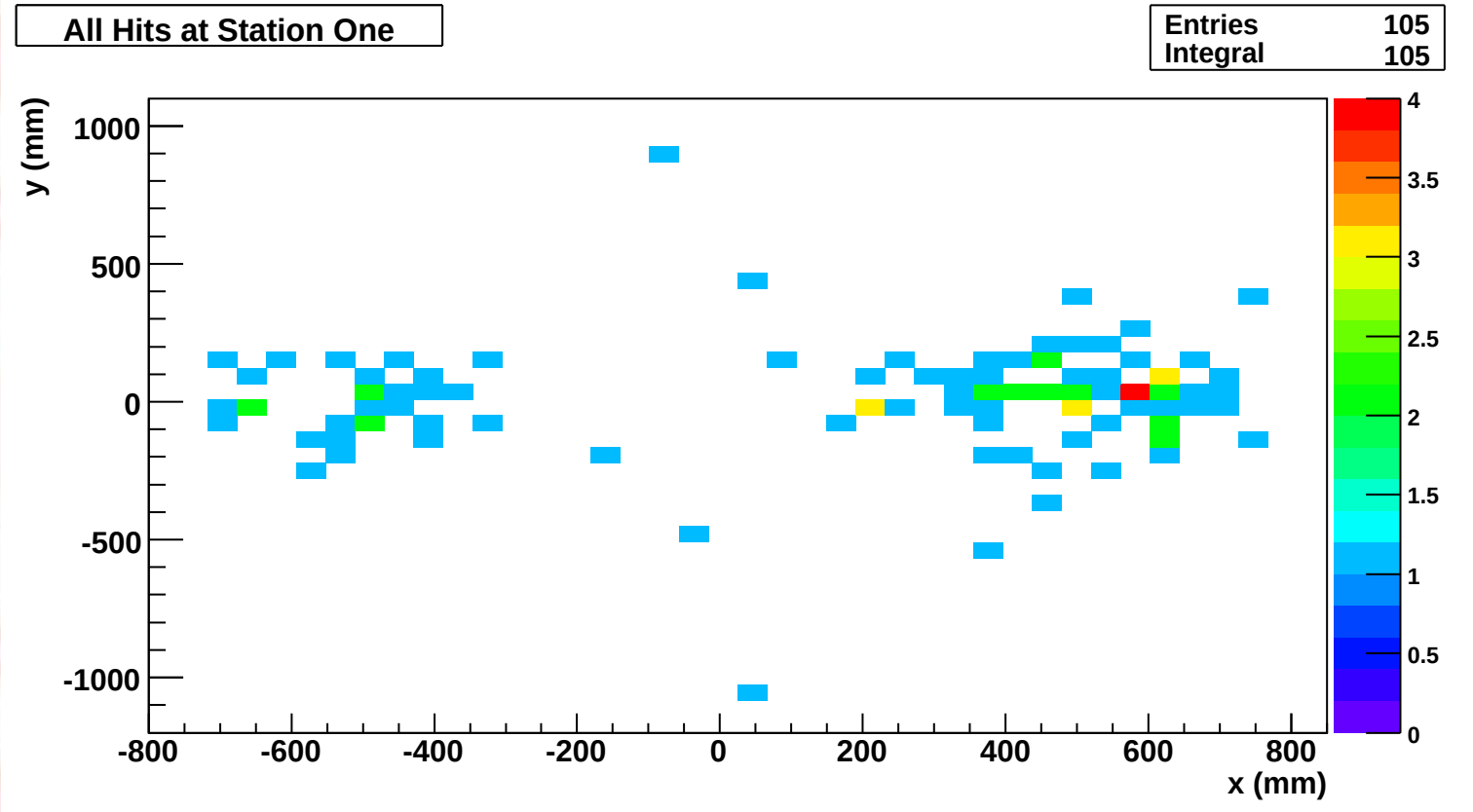
Comparing station one rates, out of 2 million protons: 126 inches vs. 189 inches

	All Hits	Muons	Electrons
126 in.	1493	416	321
189 in.	117	106	7

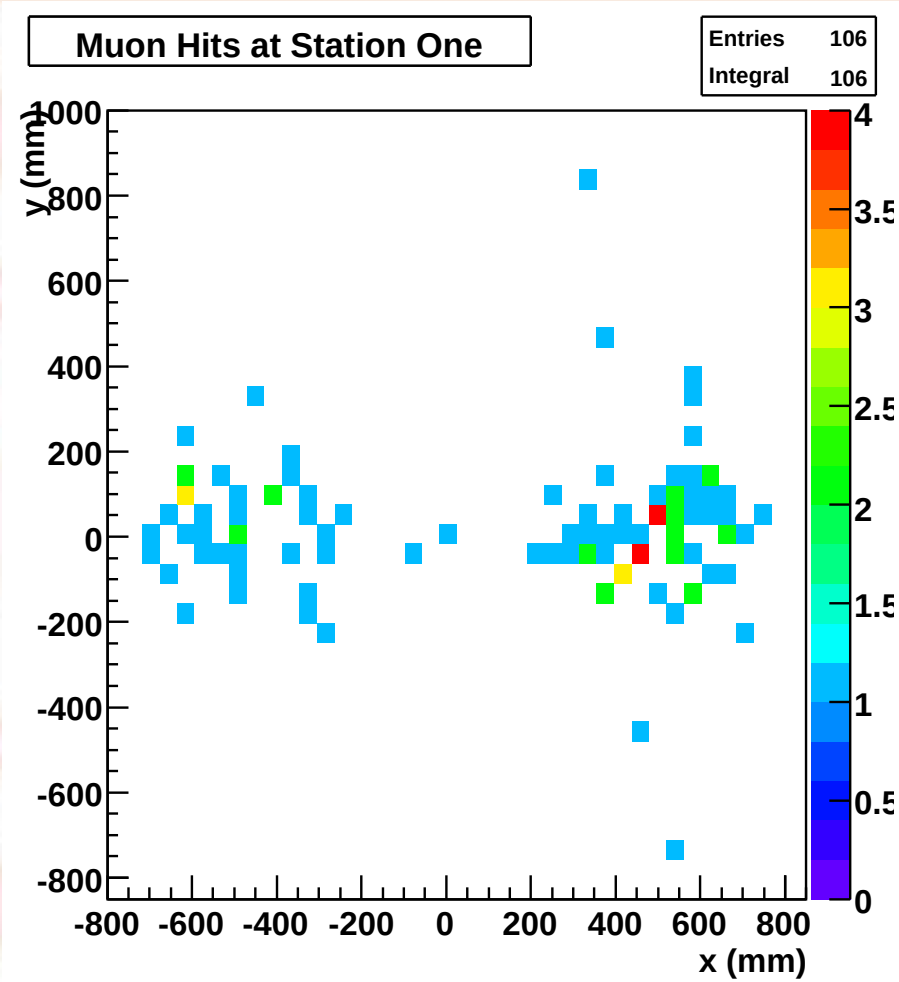
Copper Insert

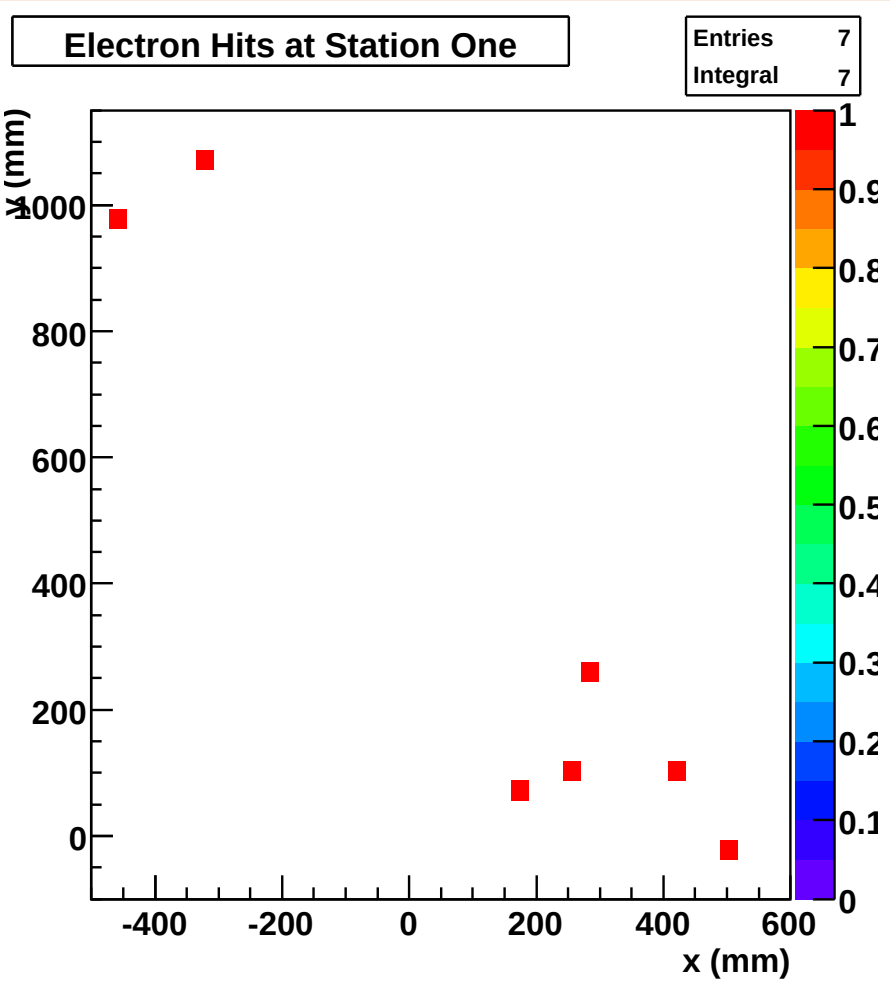
- 2 feet (0.61 m) length of copper inside of the magnet
- Comparison of simulations with and without the copper
- Both runs using the 189”/4.8m long magnet

LONG MAGNET WITH COPPER INSERT: Charged Particles

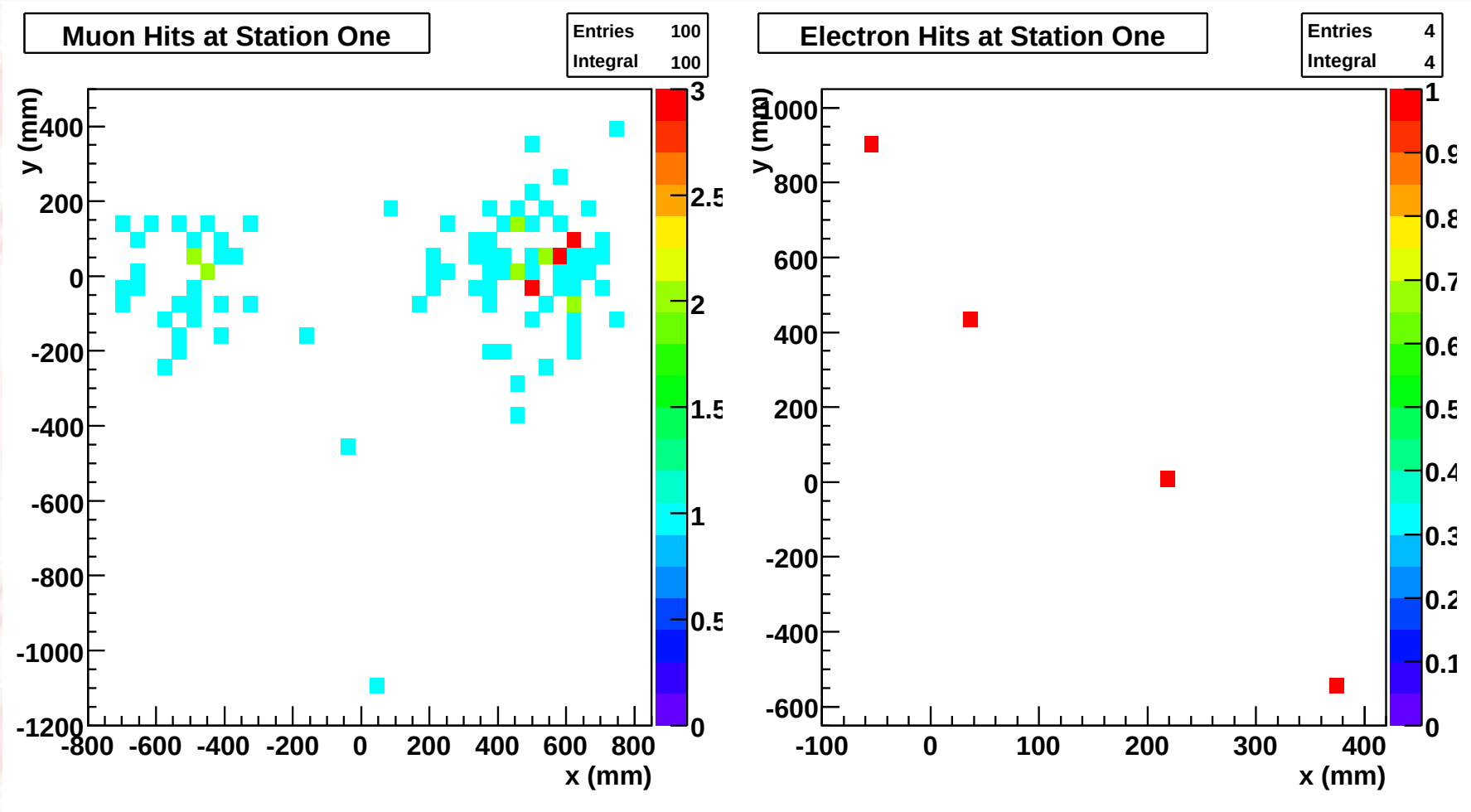


Muon and Electron Hits at Station One: Using Long Magnet with no Copper Insert





Muon and Electron Hits at Station One: Using Long Magnet with Copper Insert



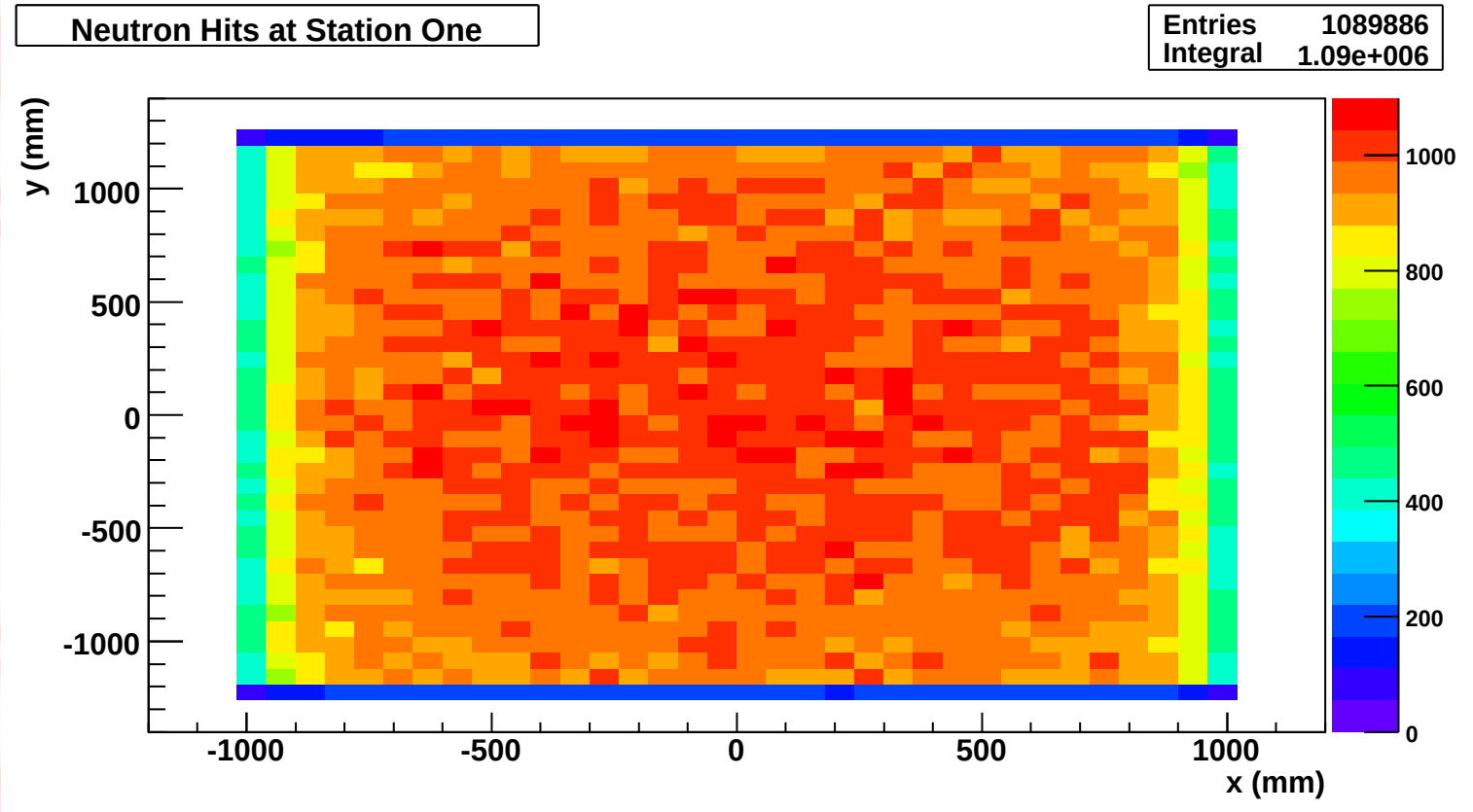
Comparing station one rates, out of 2 million protons: with vs. without copper

	All Hits	Muons	Electrons
No Cu	117	106	7
With Cu	105	100	4

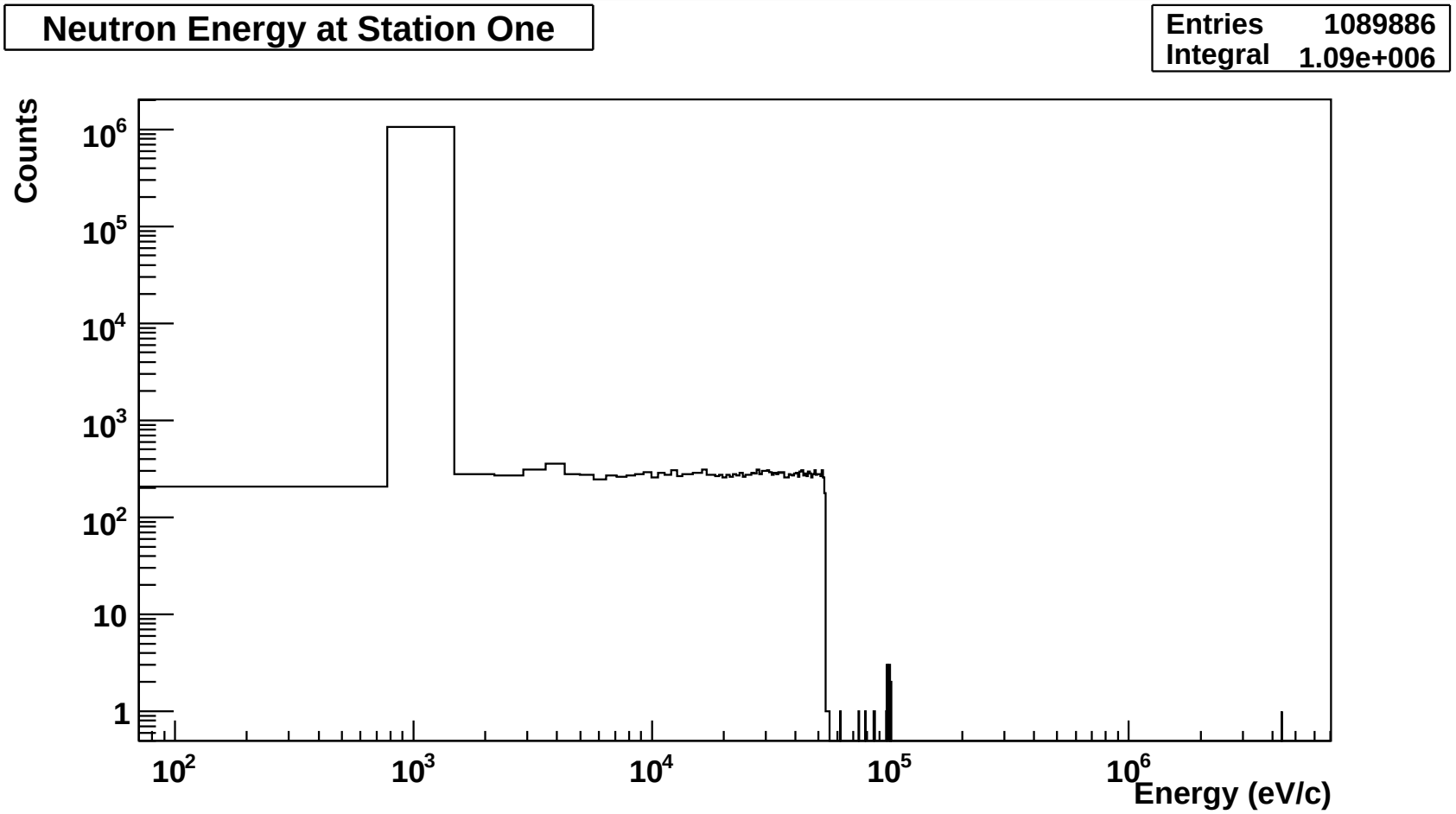
Neutrons and Borated Polyethylene

- Long magnet without copper
- Comparison of neutron rates at station one
- One run with no borated polyethylene
- One run with 6 inch-thick (15 cm) borated polyethylene immediately after the first magnet

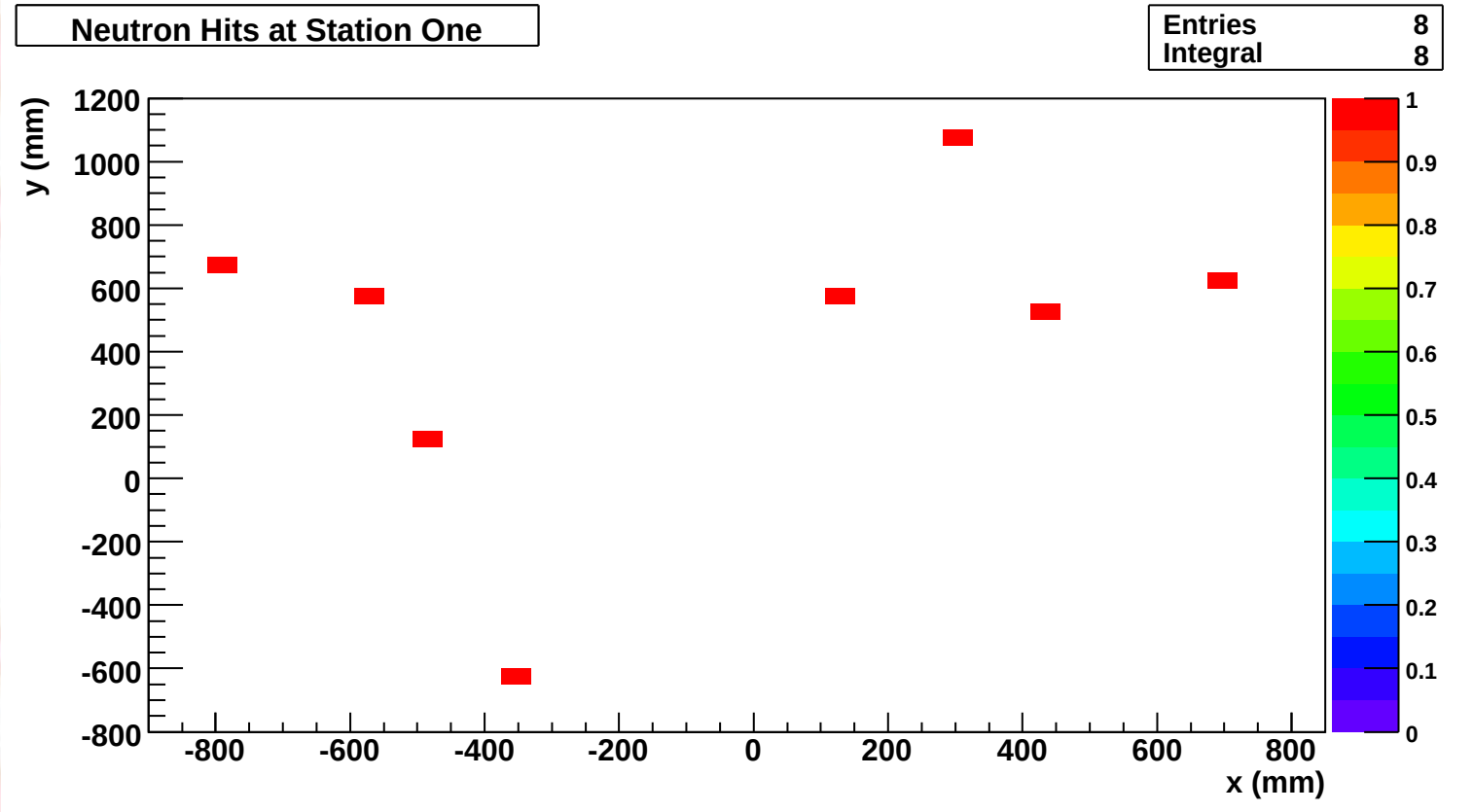
NO BORATED POLYETHYLENE



Neutron Energy Spectrum at Station One



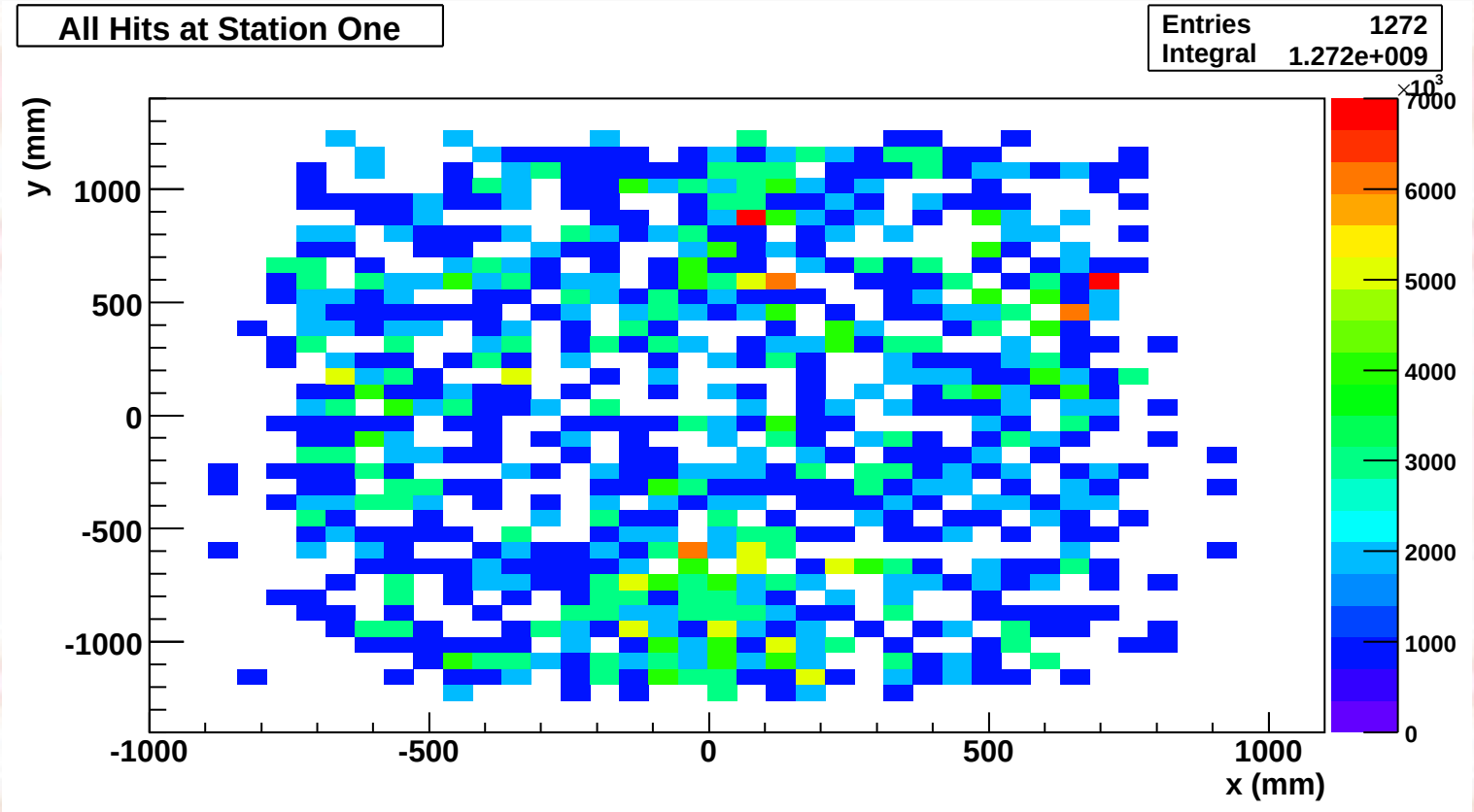
SIX INCHES OF BORATED POLYETHYLENE



3D Field Map

- Includes fringe fields
- Effects of fringe fields on previous results
- Comparison between simple field and new field map
- Results of simulations using fringe field without return yokes

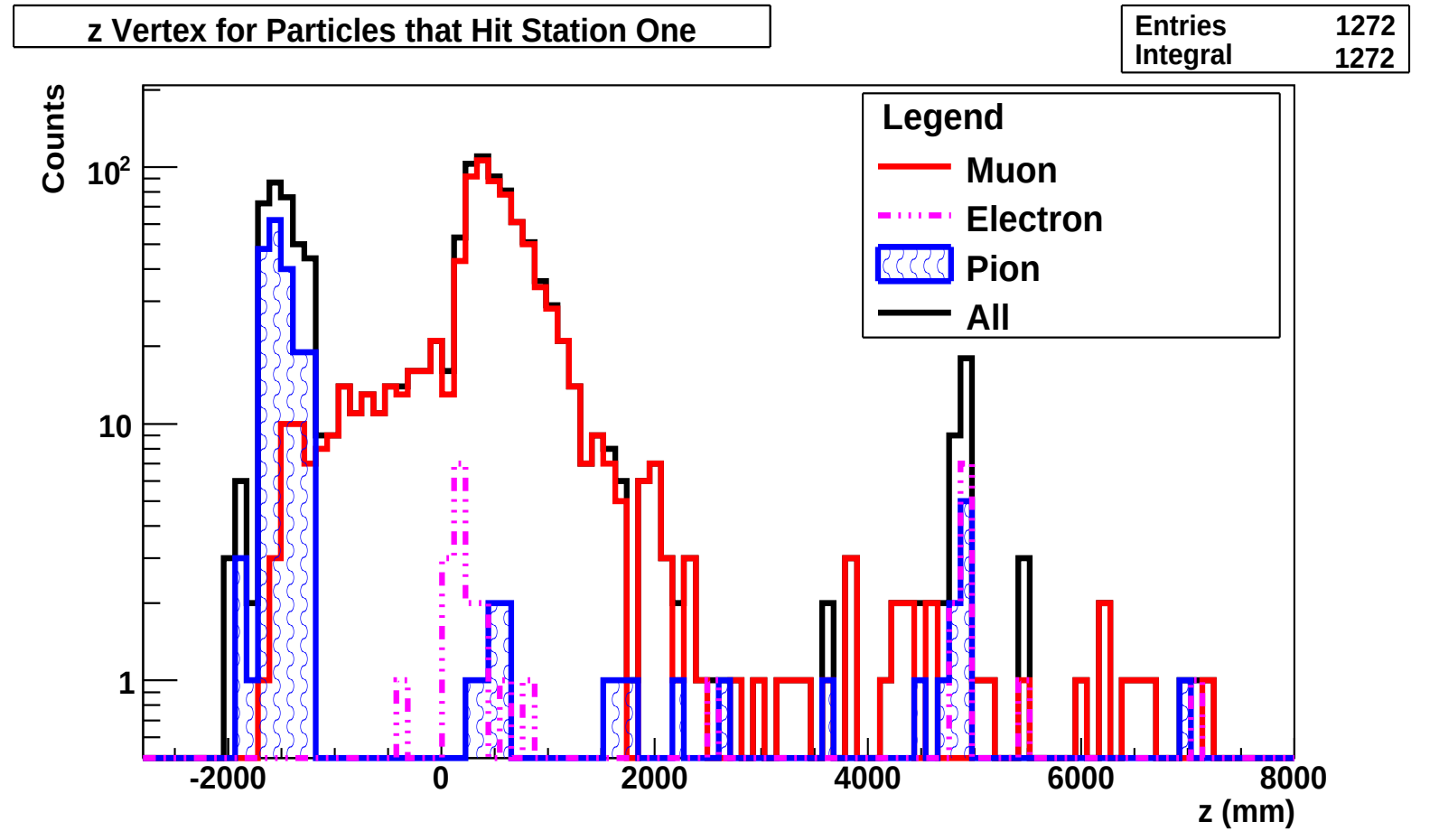
EFFECT OF FRINGE FIELD ON LONG MAGNET STATION ONE RATES



Station One Rates

	Muons	Electrons	Pions
simplified field	106	7	3
3D field map	880	29	214

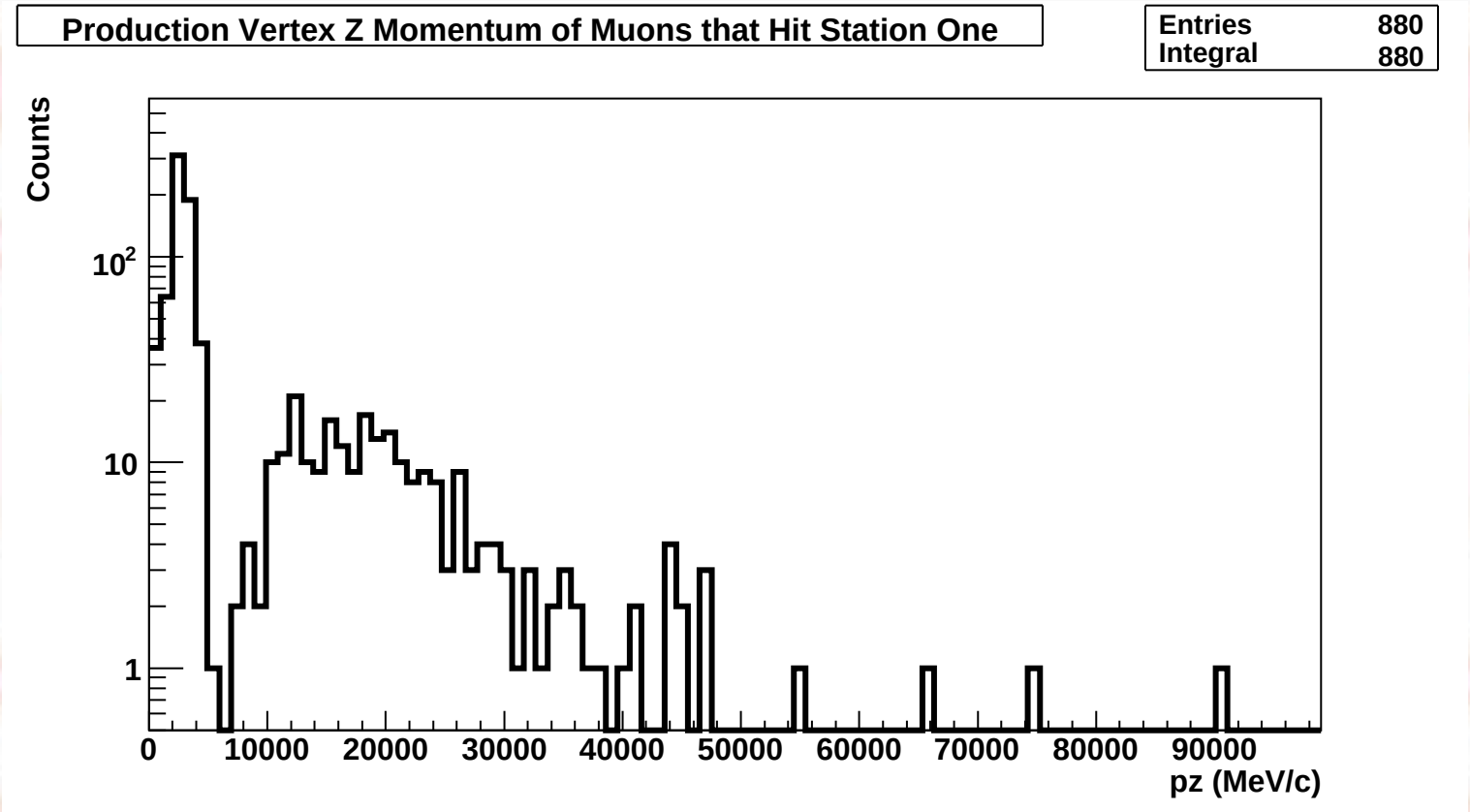
Z Vertex of Charged Particles that Hit Station One



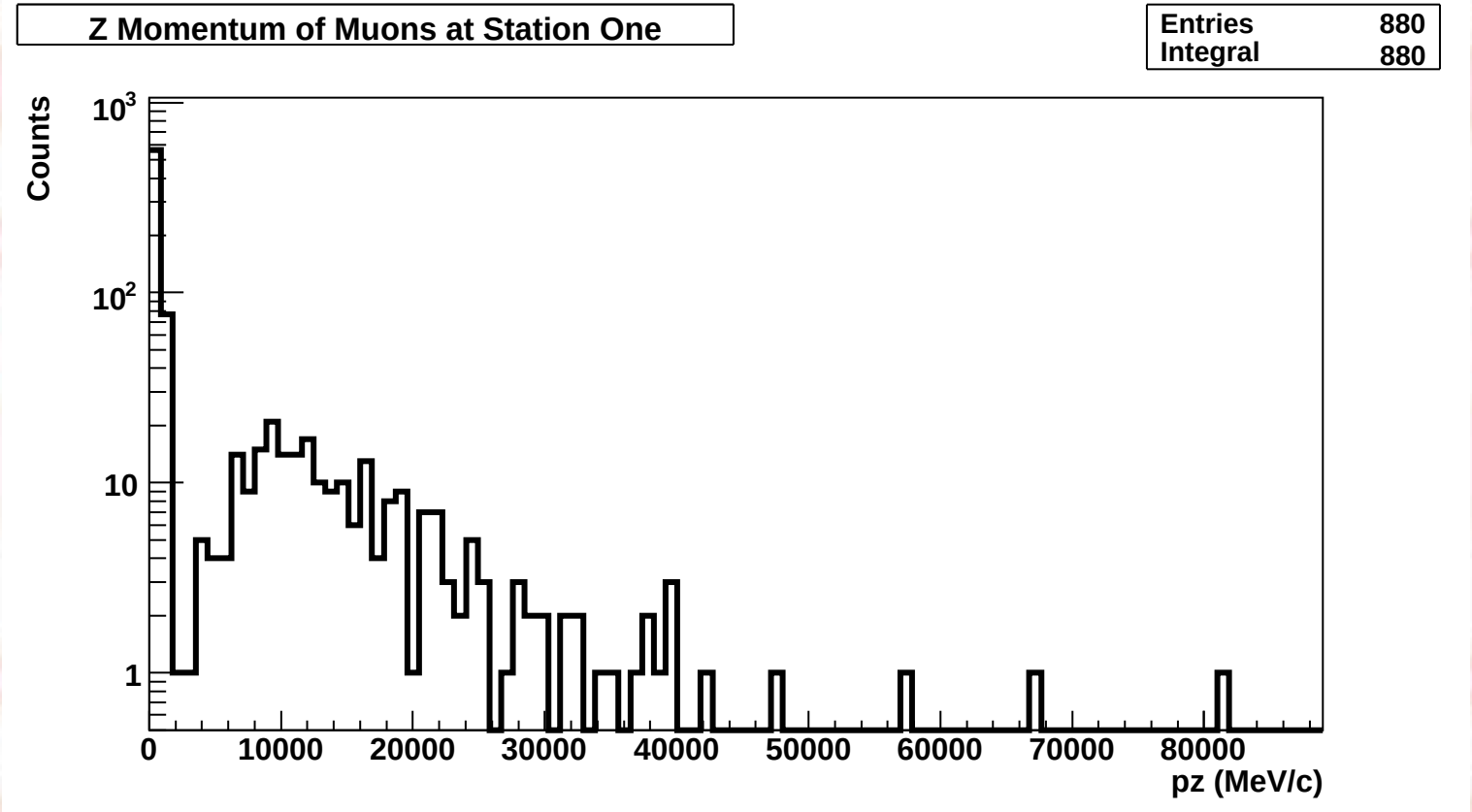
Reasons for Conspicuous Change

- Z momentum of Muons and Pions at the vertex and station one
- Difference between muon angle at the vertex using simplified field and the same angle using the new 3D field map

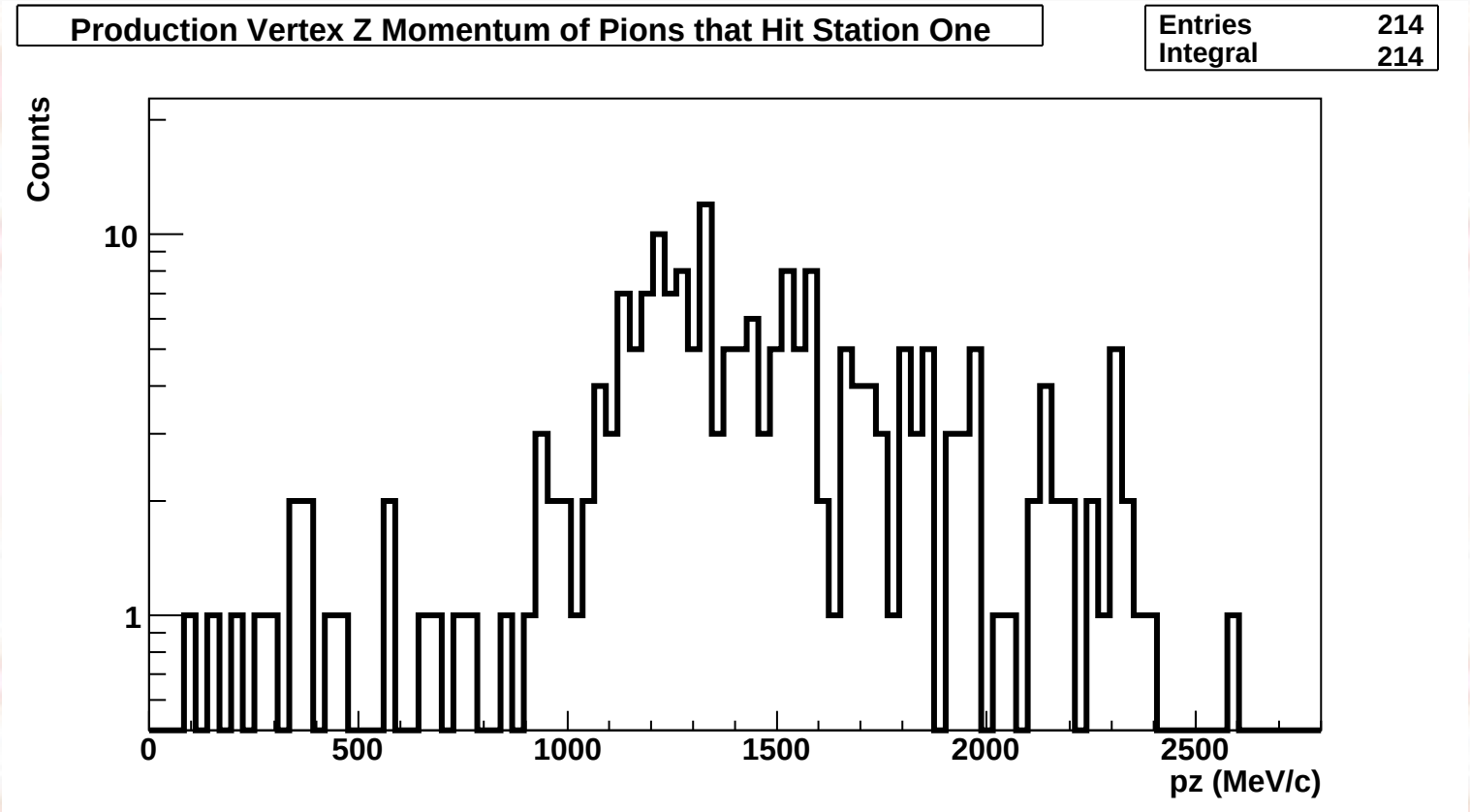
Z Momentum of Muon at Vertex: Using 3D Field Map



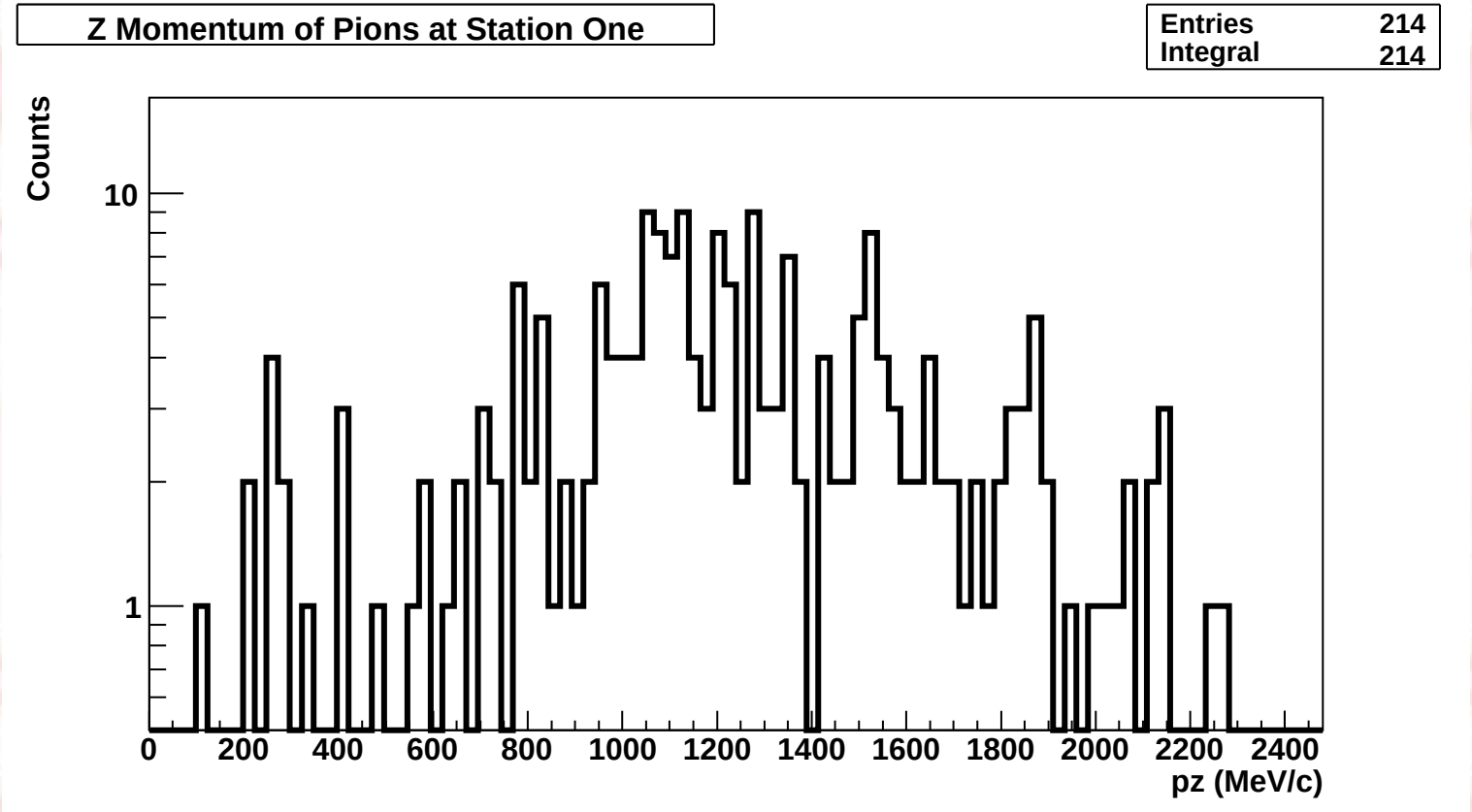
Z Momentum of Muons at Station One: Using 3D Field Map



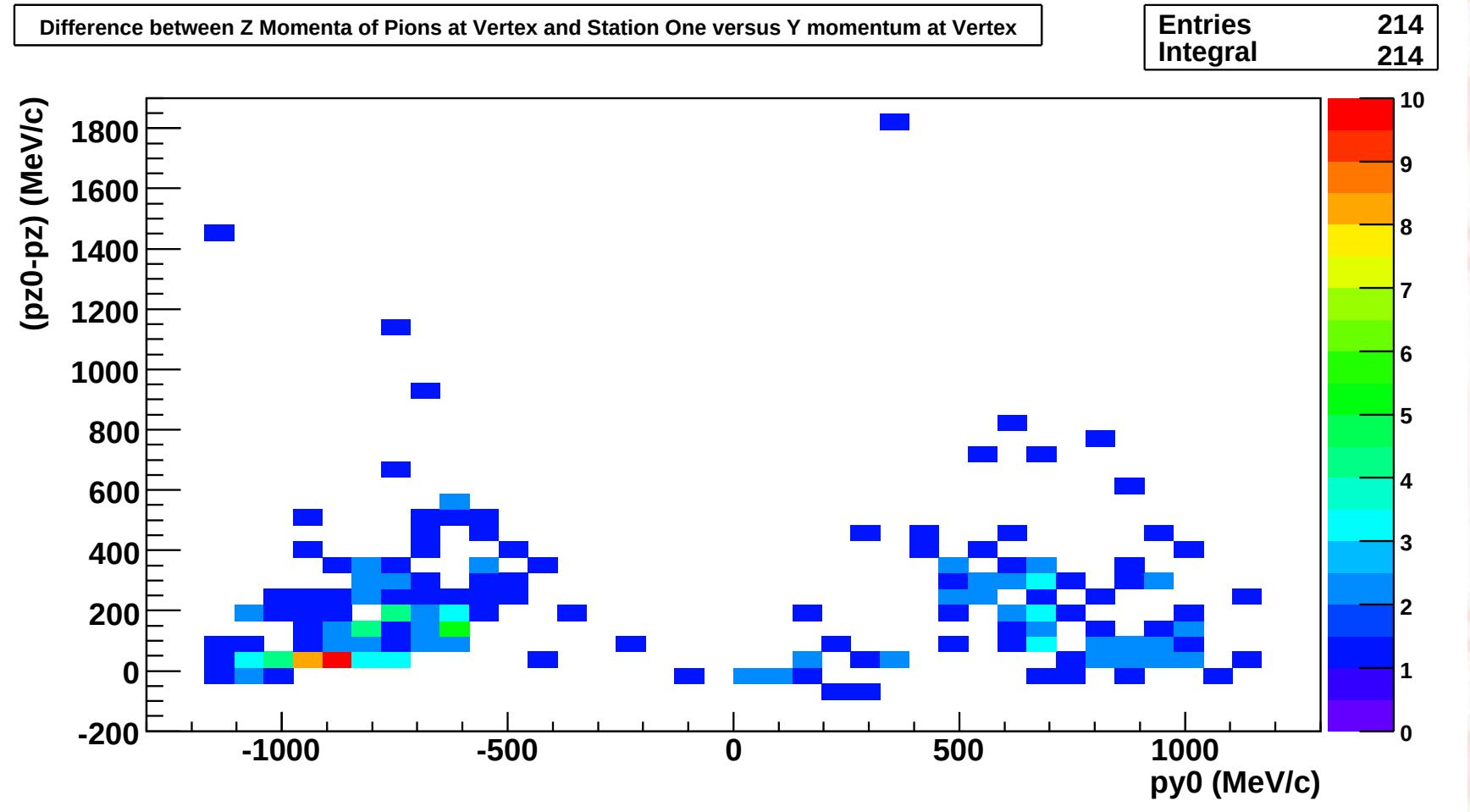
Z Momentum of Pions at Vertex: Using 3D Field Map



Z Momentum of Pions at Station One: Using 3D Field Map

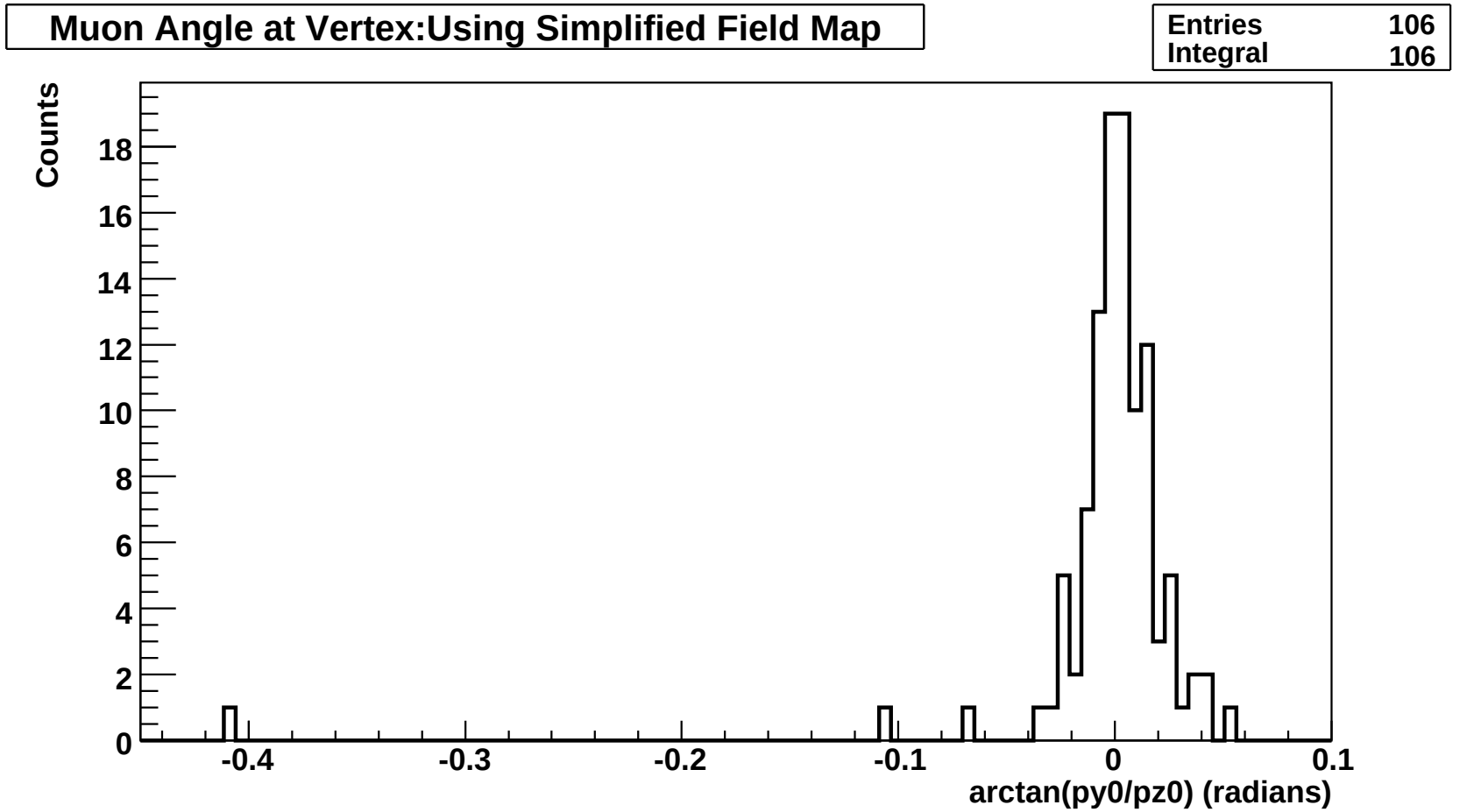


Difference between Z Momenta of Pions at Vertex and Station One versus Y Momentum at Vertex: Using 3D Field Map

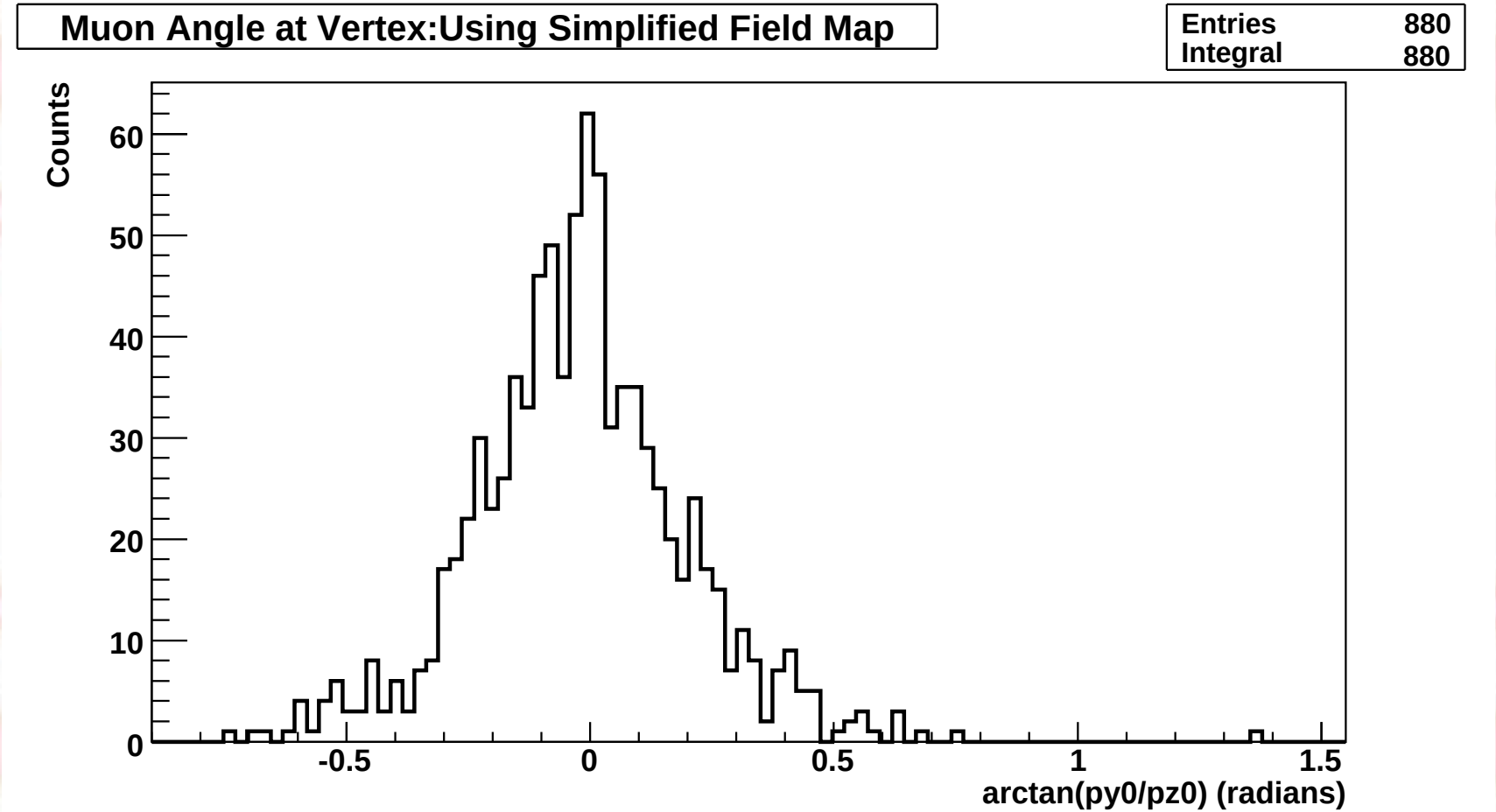


MORE OBSERVATIONS: BENDING ANGLE.....

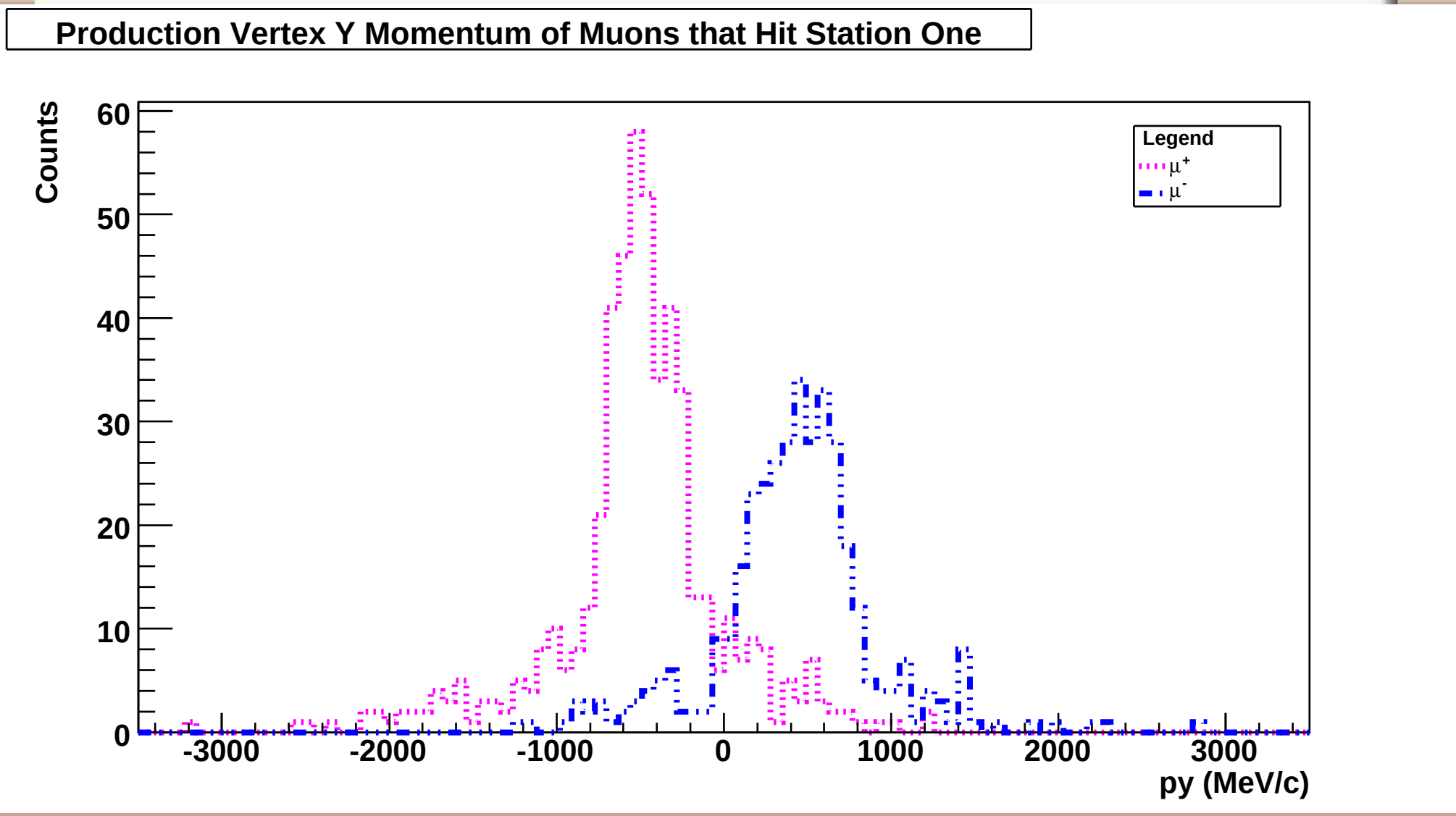
Muon Angle at Vertex: Using Simplified Field Map



Muon Angle at Vertex: Using 3D Field Map



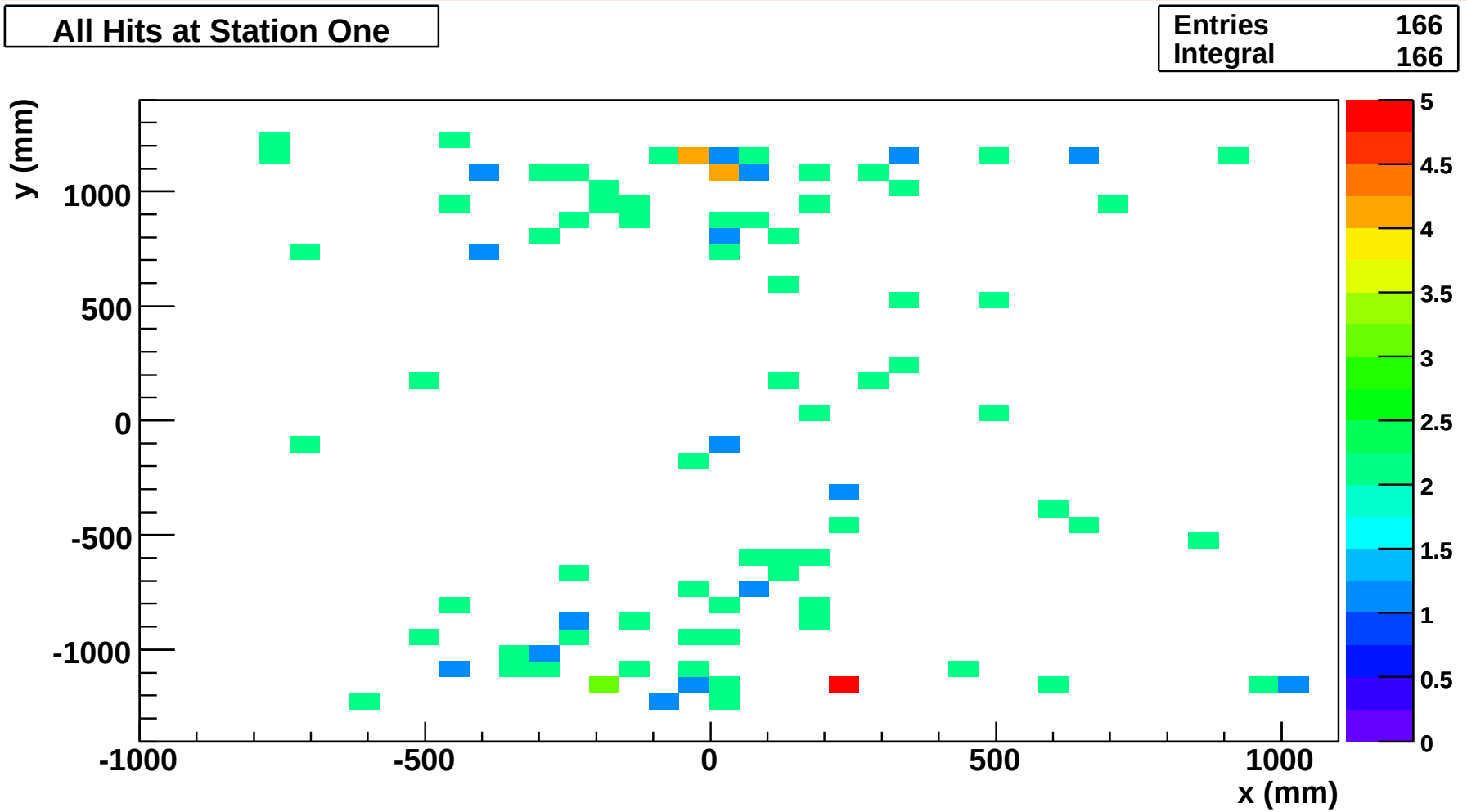
Y Momentum of Mu+ and Mu- at Vertex: Using 3D Field Map



INCLUDING RETURN YOKES IN THE SIMULATION

- Tremendously reduces the station one rates of all charged particles!
- This ratifies the importance of the return yokes in the simulation and experiment

All Hits with Return Yokes



Station One Rates

	Muons	Electrons	Pions
Simplified Field Map	106	7	3
3D Field Map	880	29	214
3D Field Map with Return Yokes	206	0	0

CONCLUSION

- Rates in shorter magnet are too high.
- The copper does not make an observable difference in the long magnet.
- Borated polyethylene works, but there is something wrong with the neutrons in our simulation.
- We have a great 3D field map!
- Now we need more specific geometry of re-turn yokes and coils.

Any Questions?

- We would be happy to work with other specific questions that you may have.
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- Marissa Walker: mbw05g@acu.edu

...AND THEY LIVED HAPPILY EVER AFTER...

The End.