MINERvA Test Beam Experiment
T-977

Aaron Higuera
Universidad de Guanajuato

New Perspectives 2012, Fermilab USA

Outline

MINERvA Experiment E-938.

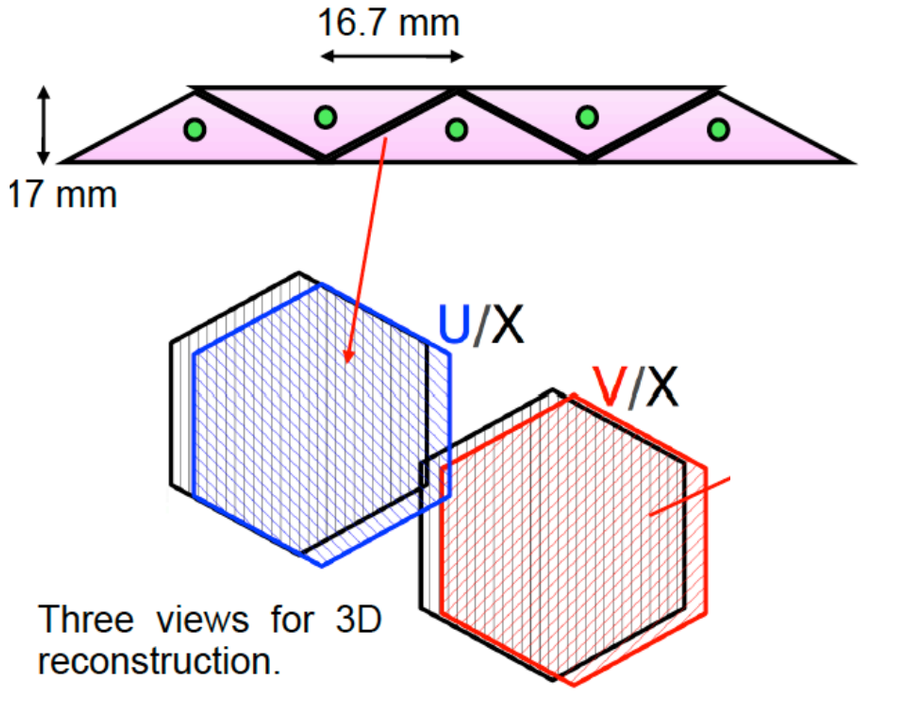
MINERvA Test Beam Experiment T-977.

- Fermilab Test Beam Facility.
- MINERvA Test Beam Motivation.
- MINERvA Test Beam Set Up.
- MINERvA Test Beam Status Analysis.

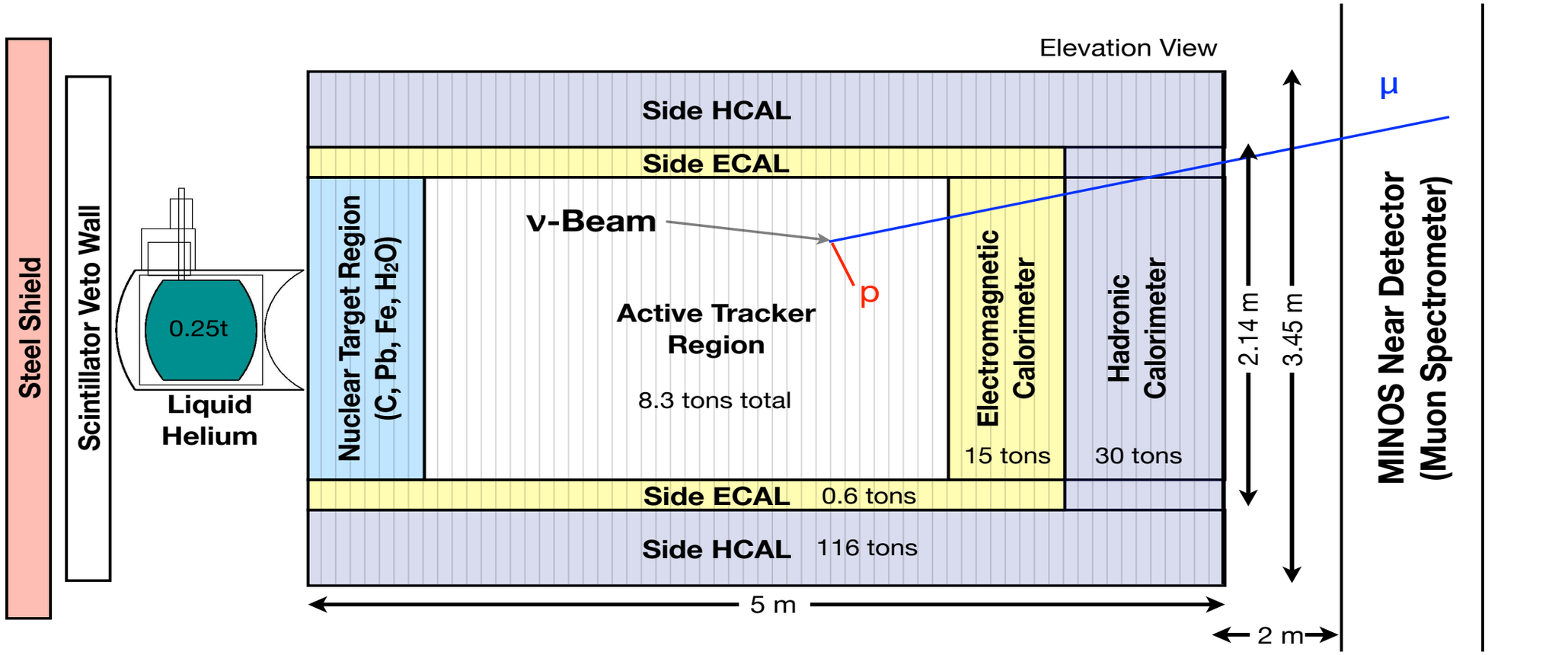
MINERvA

MINERvA is a neutrino scattering experiment in the NuMI beamline at Fermilab.

Designed to measure neutrino cross sections, final states, nuclear effects and A-dependence on a variety of targets in the few-GeV region.



Three views for 3D reconstruction.



NuMI Beamline

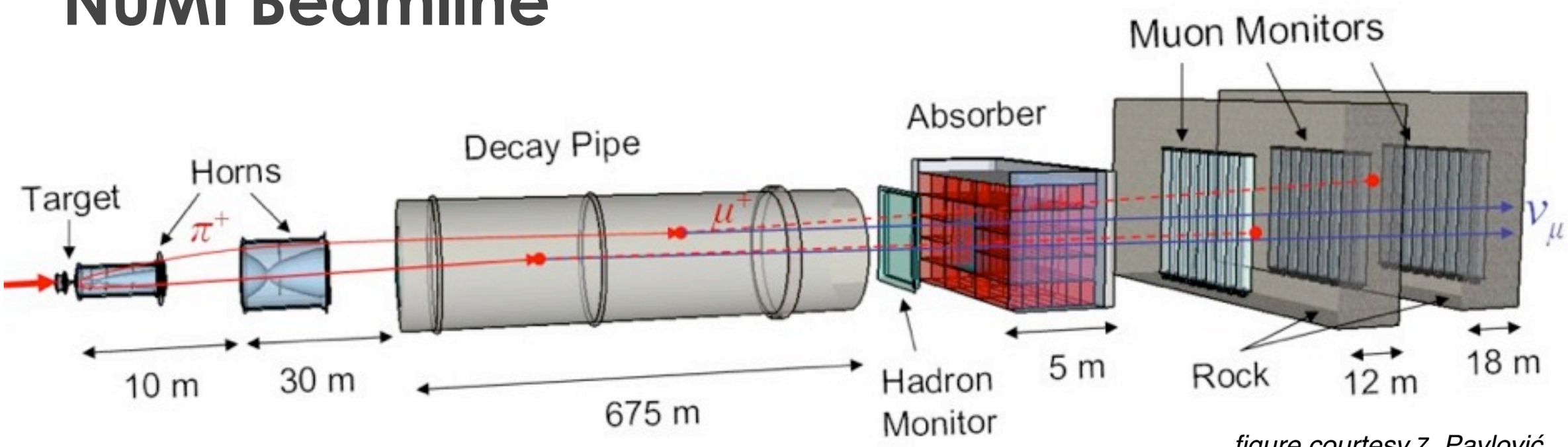
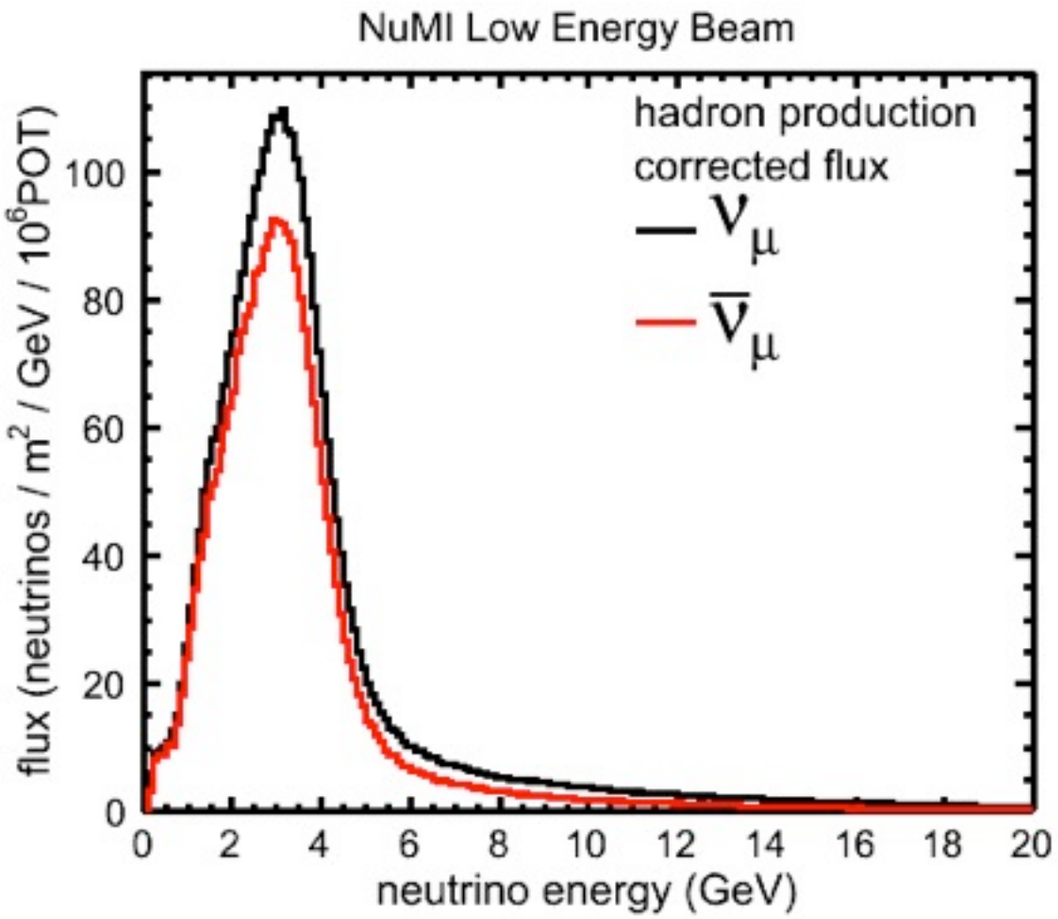


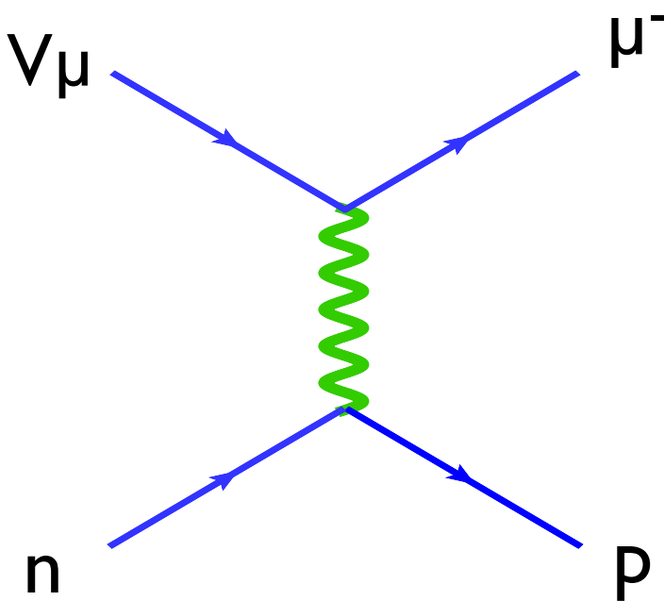
figure courtesy Z. Pavlović



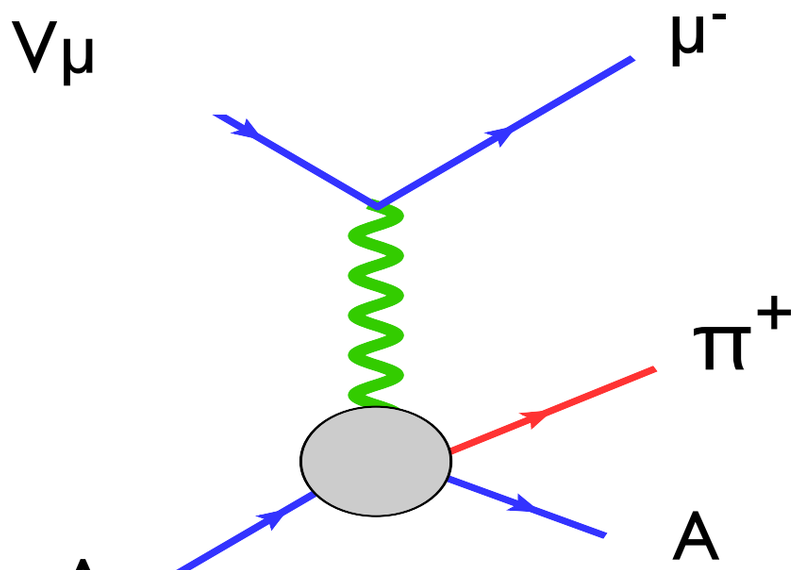
GEANT4 based simulation of the NuMI beamline.

G4 9.4.p02
QGSP physics list

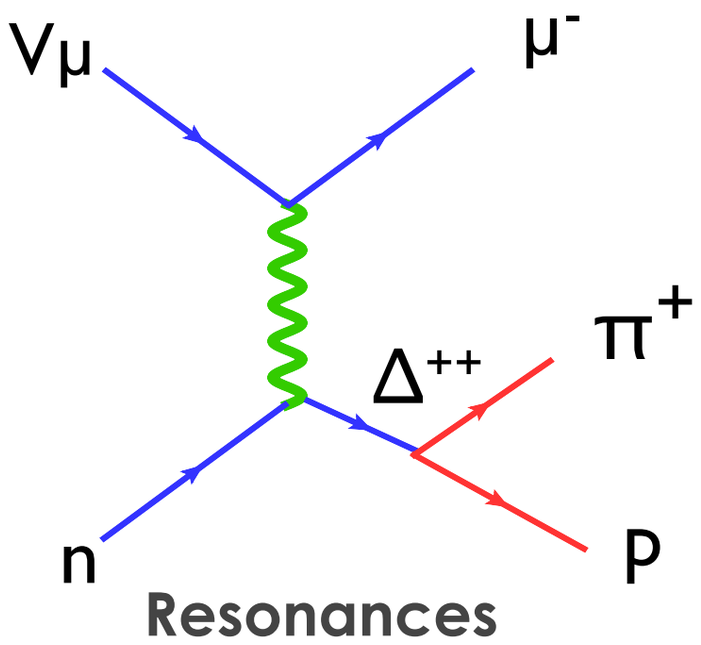
MINERvA Physics Program (Exclusive Channels)



Quasi-Elastic



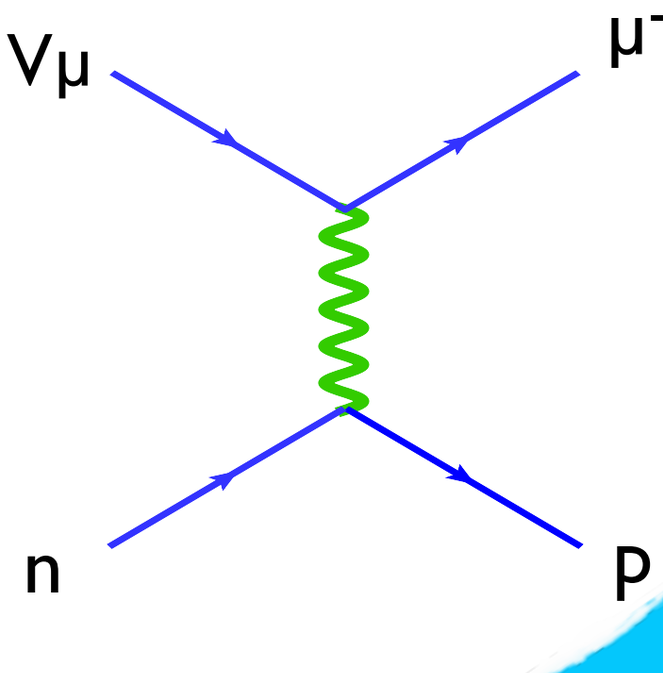
Coherent



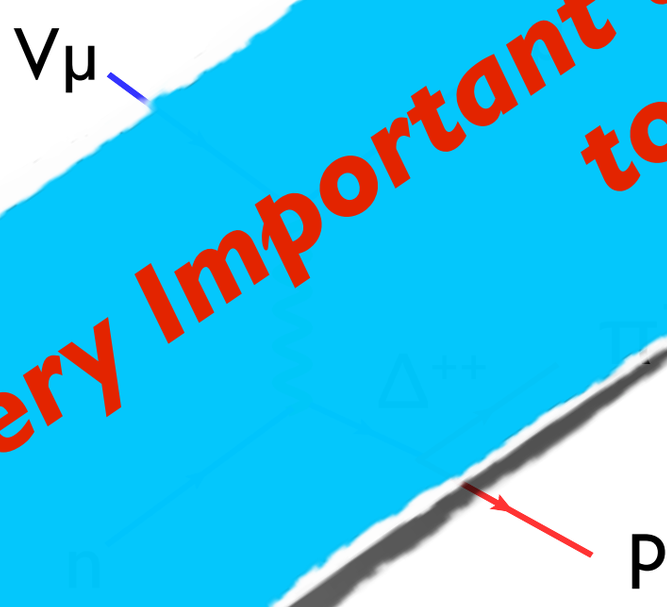
Resonances

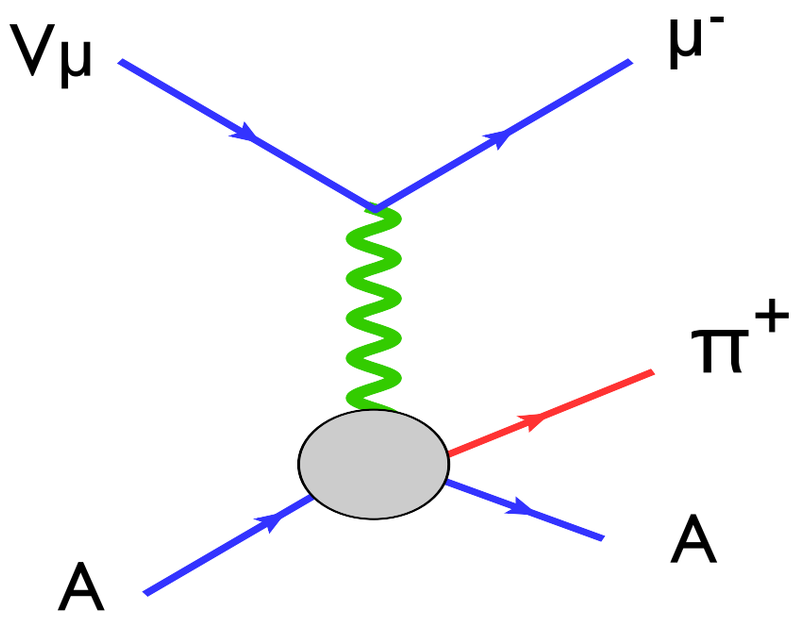
Leptons
Protons & Pions

MINERvA Physics Program (Exclusive Channels)



Very Important to Know the Detector Response to Pions and Protons



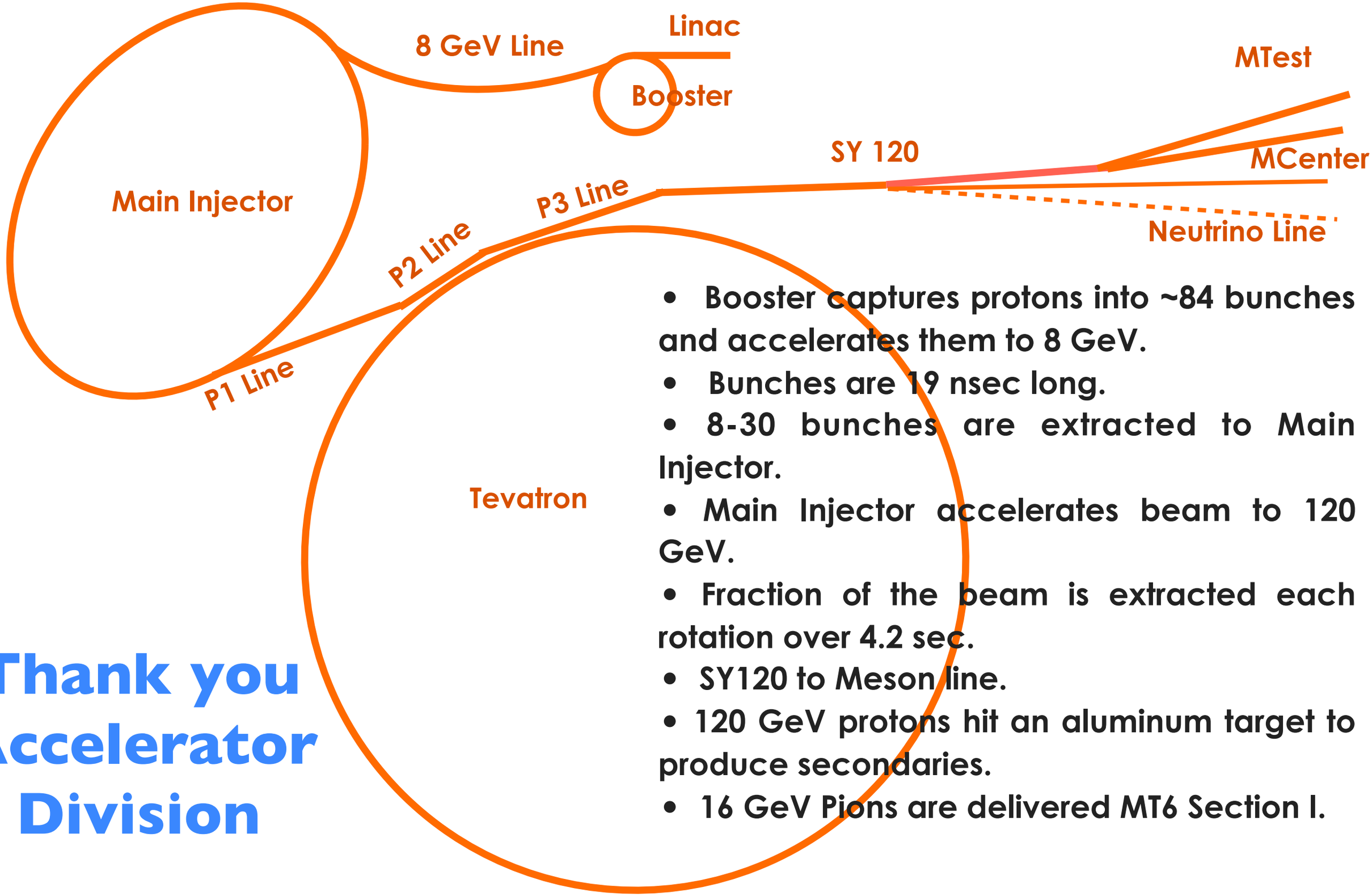


MINERvA Test Beam Experiment

The MINERvA collaboration planned, designed, constructed and commissioned the MINERvA Test Beam experiment at Fermilab Test Beam Facility.

To Provide hadronic response in the MINERvA Main Detector.

Test Beam Delivery

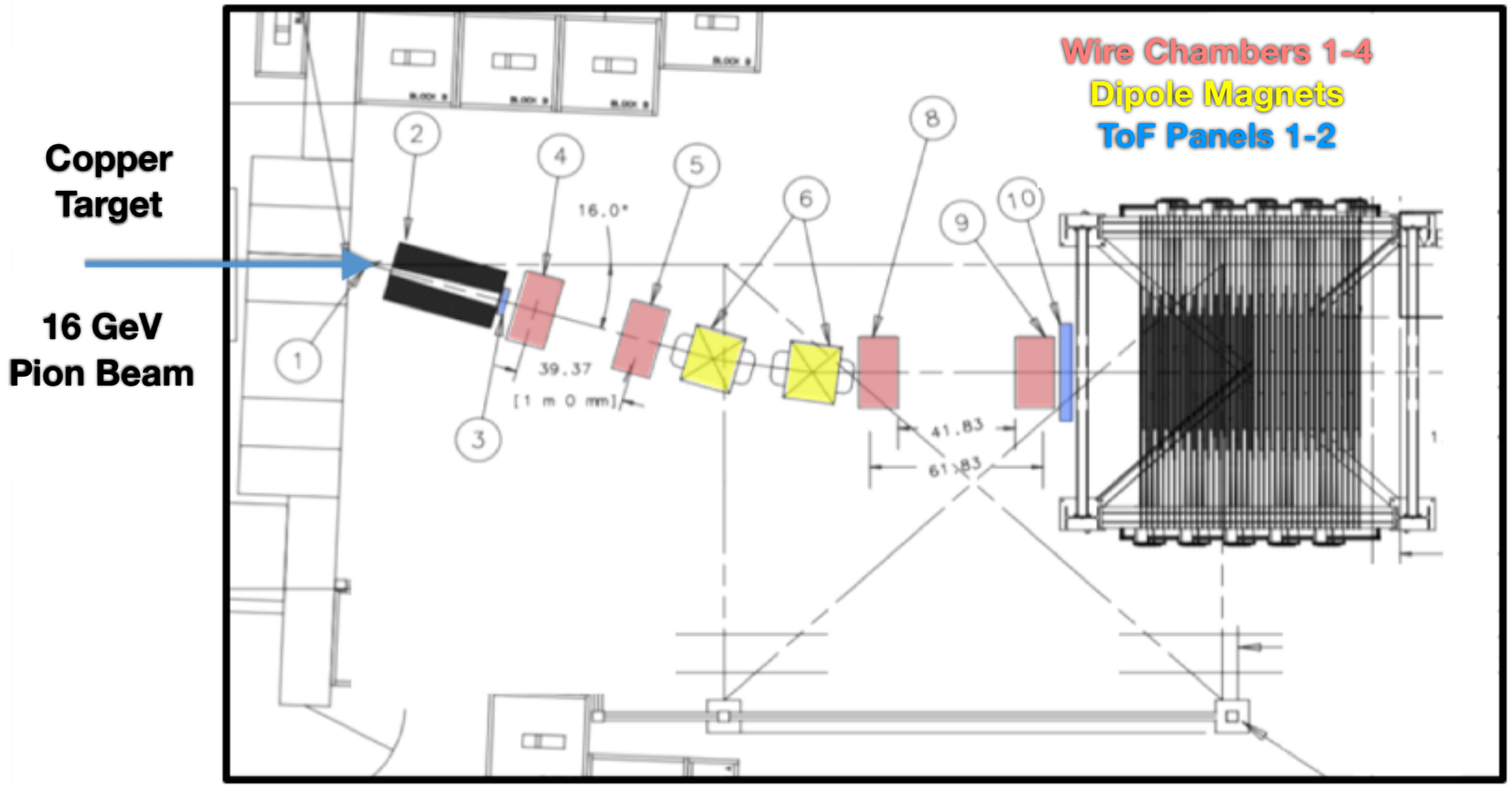


- Booster captures protons into ~84 bunches and accelerates them to 8 GeV.
- Bunches are 19 nsec long.
- 8-30 bunches are extracted to Main Injector.
- Main Injector accelerates beam to 120 GeV.
- Fraction of the beam is extracted each rotation over 4.2 sec.
- SY120 to Meson line.
- 120 GeV protons hit an aluminum target to produce secondaries.
- 16 GeV Pions are delivered MT6 Section I.

Thank you Accelerator Division

Tertiary Beam

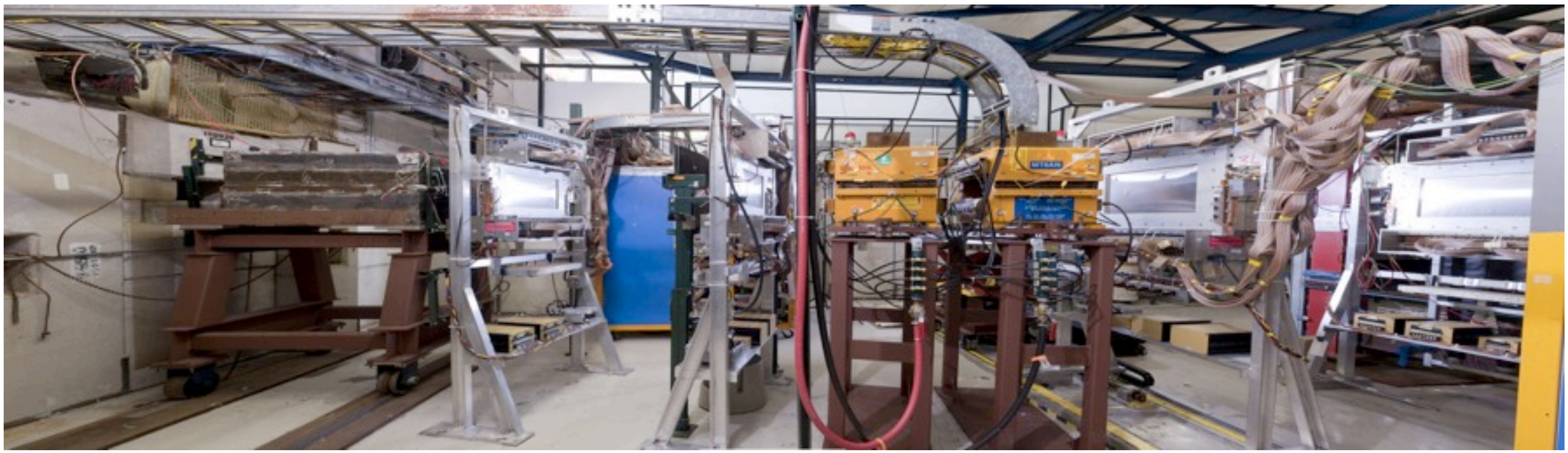
Thank you MTest staff



- Target (1).
- Collimator (2).
- Time of Flight System (3,10).
- Spectrometer (4,5,6,8,9).
- Test Beam Detector.

Tertiary beam 400-2000 MeV/c

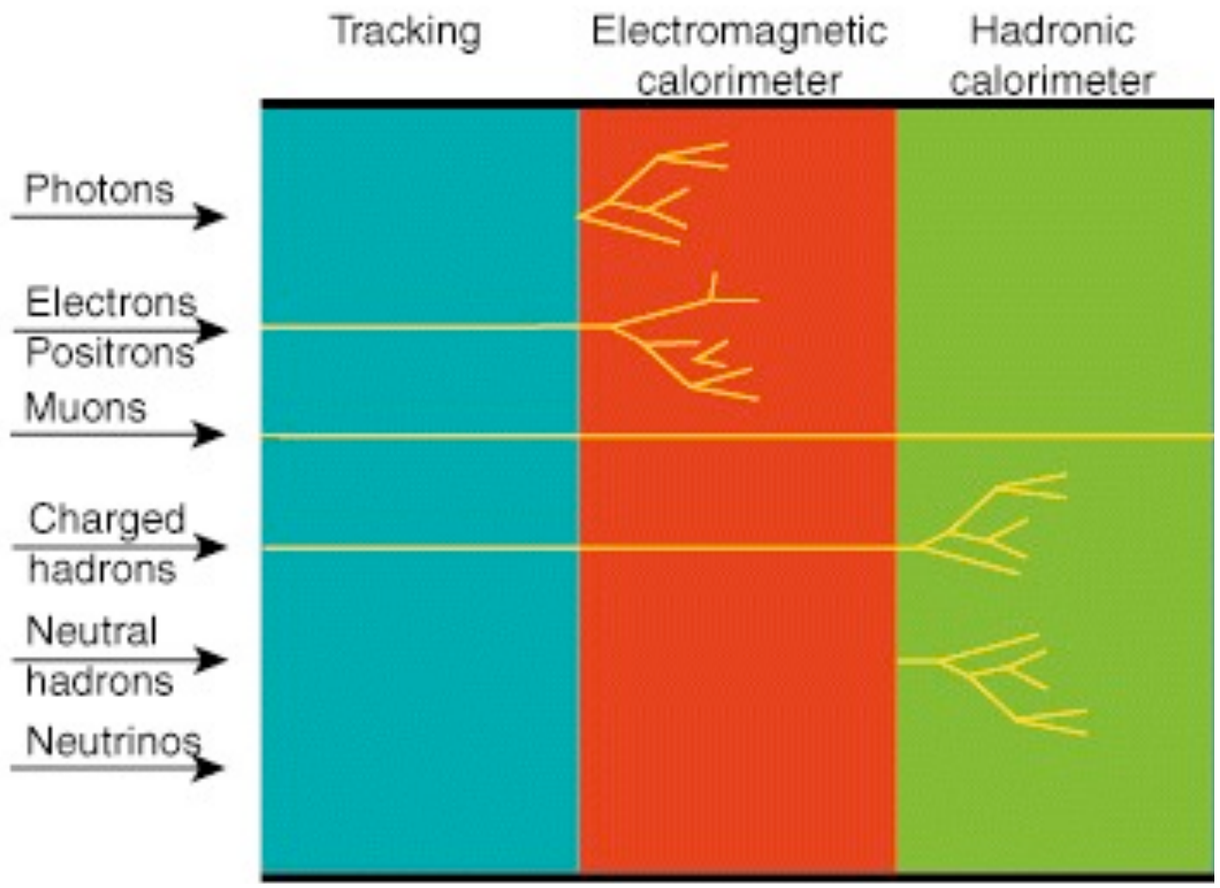
Tertiary Beam and Test Beam Detector



- Test Beam detector is a replica of inner full MINERvA detector 1.07 X 1.07 m.
- Reconfigurable construction.
- 20 Tracker+ 20 ECal planes.
- 20 ECal + 20 HCal planes.
- Simulation base on GEANT4 (QGS-Bert hadron physics list)

Calorimetry

The energy of particles, be them electrically charged or neutral, is measured by having them interact with matter until they totally exhaust their kinetic energy.

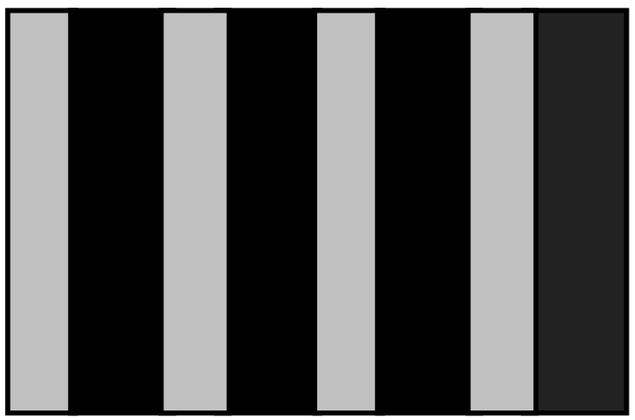


Test Beam Detector

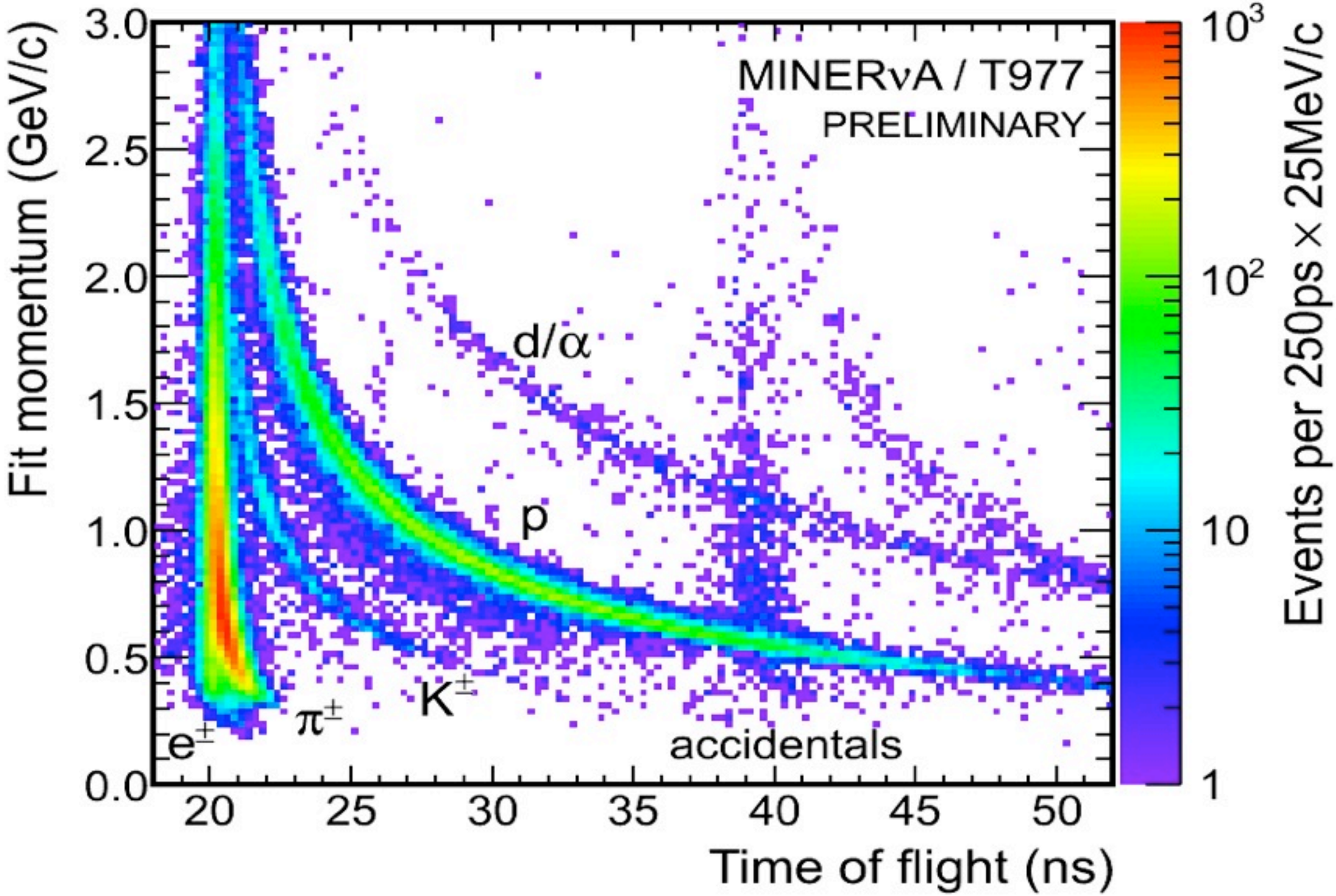
- 1.7 cm of Scintillator.
- 2.03 cm of Pb.
- 2.594 cm of Fe.

Active Calorimeter

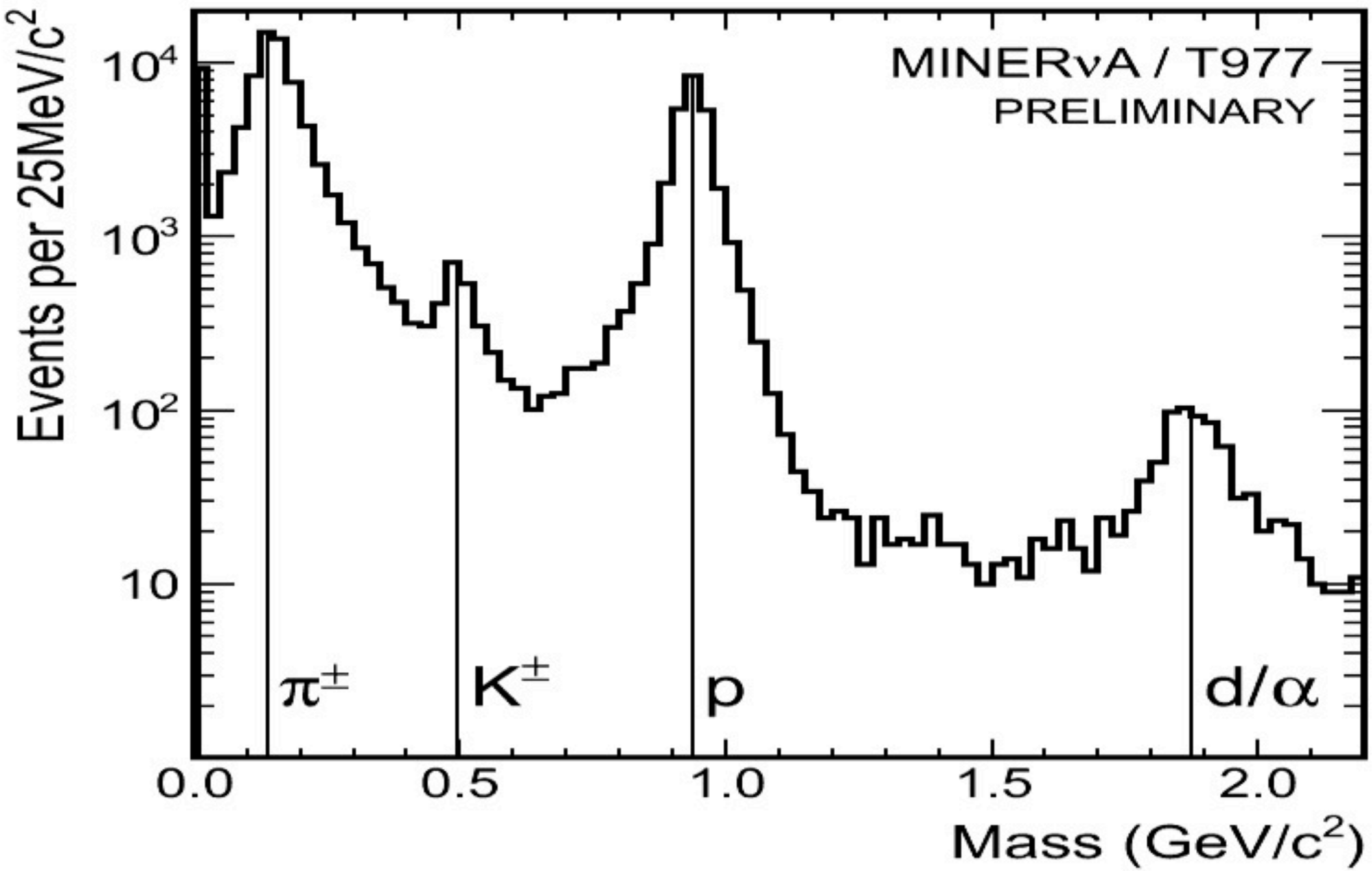
CH/Absorber/CH



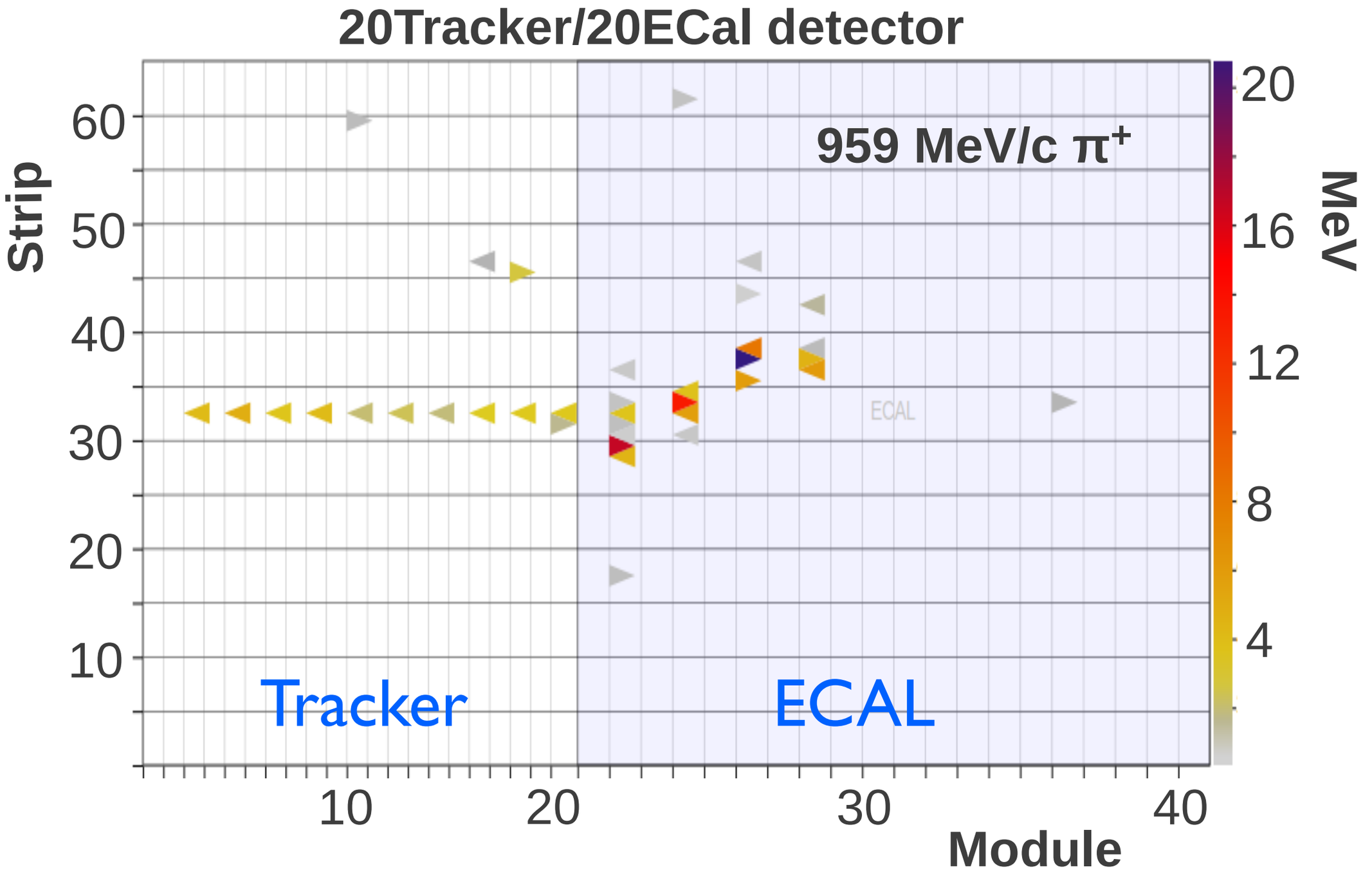
Tertiary Beam Component



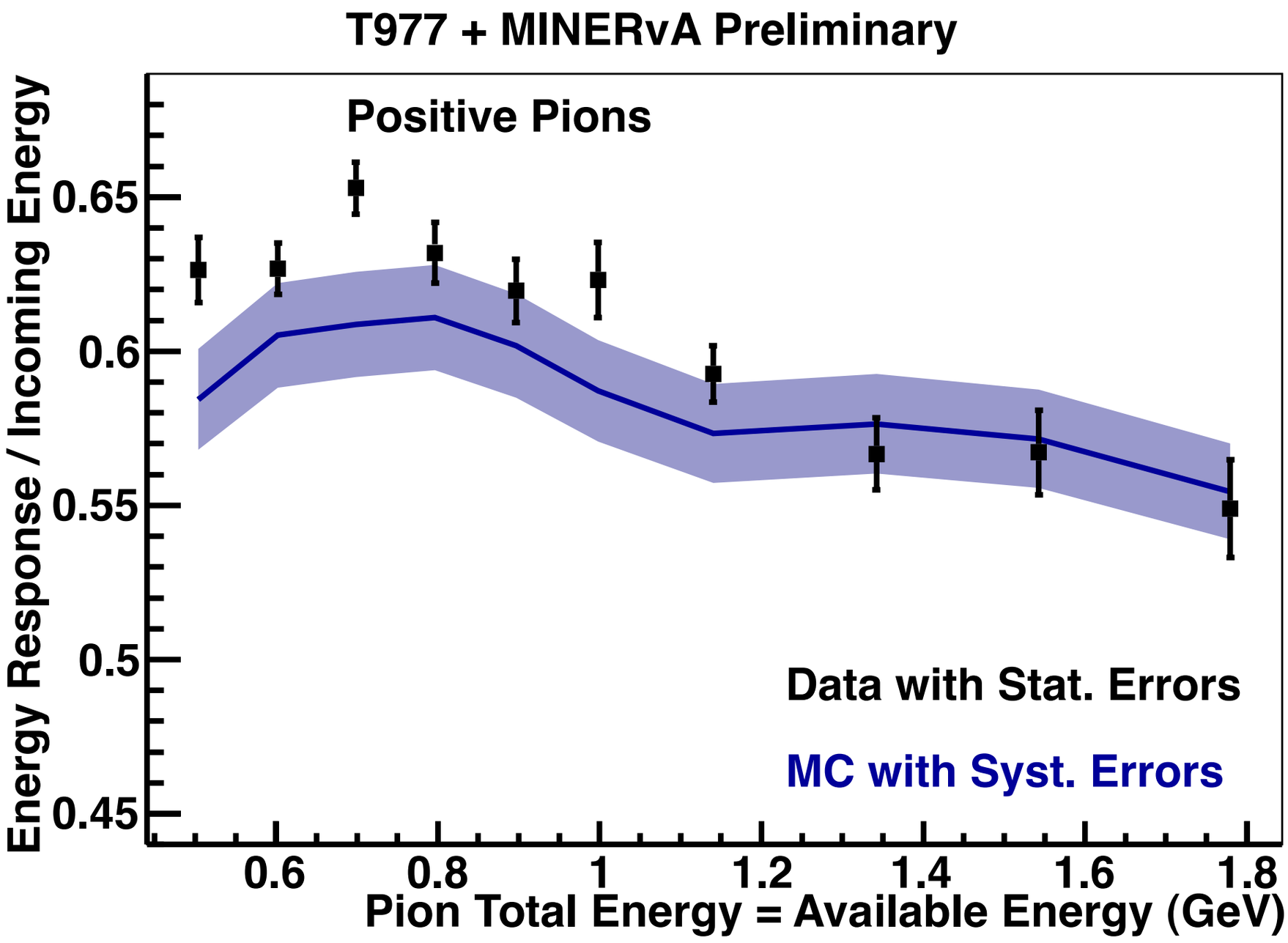
Tertiary Beam Component



Event Display

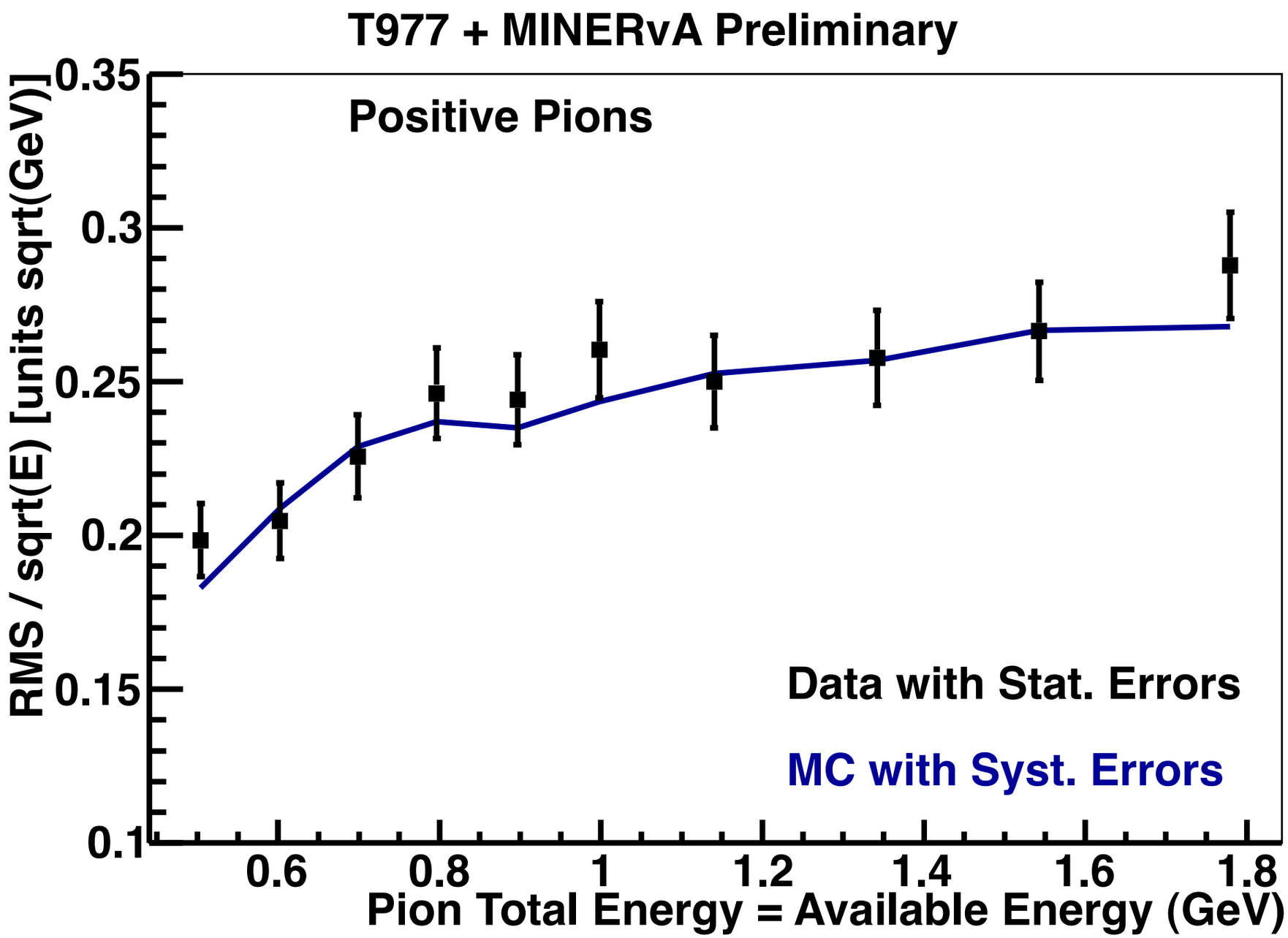


Current Analysis (Calorimetry)

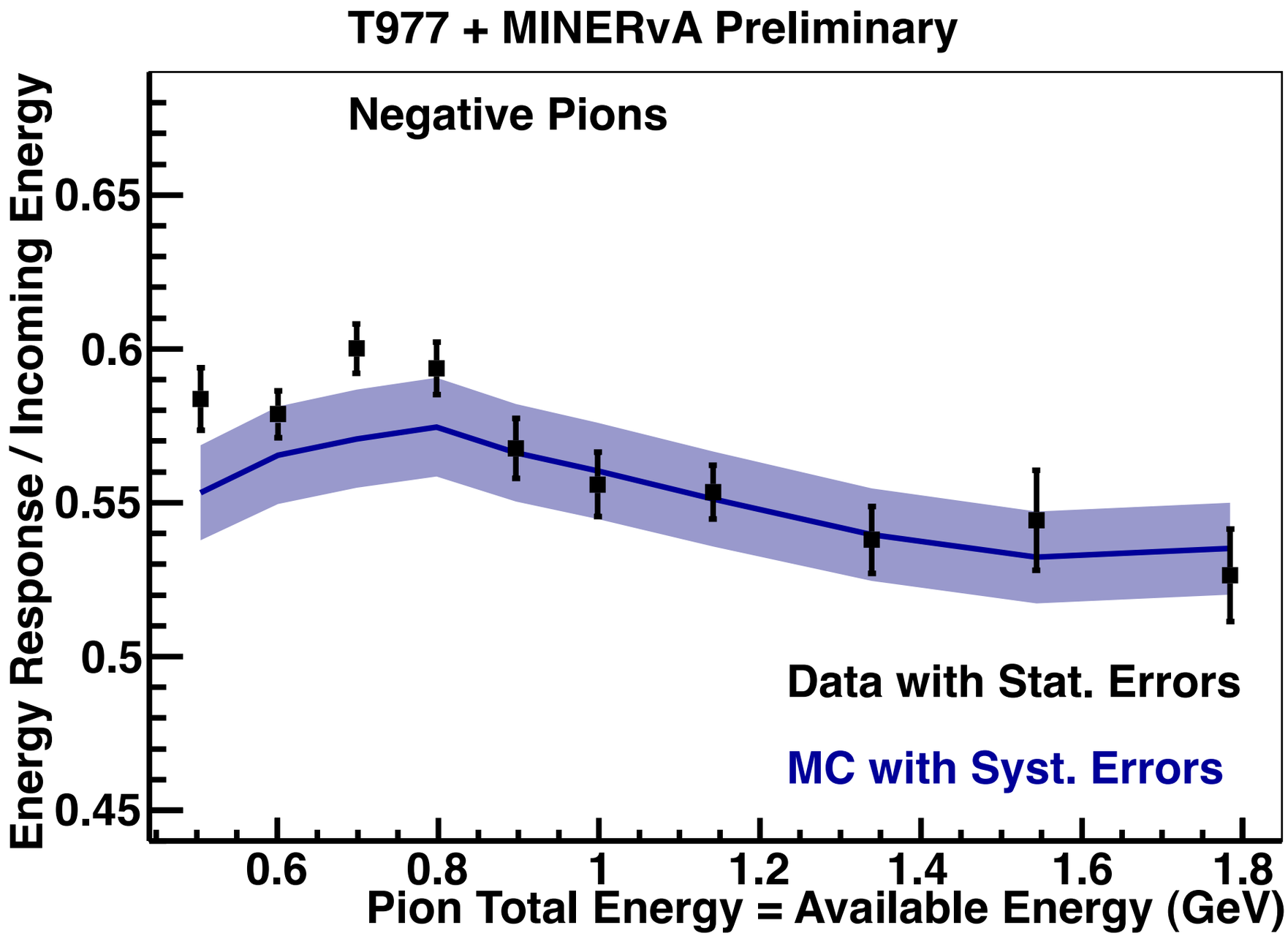


- 20 ECal + 20 HCal config.
- The energy response is corrected for the passive material.

Current Analysis (Calorimetry)

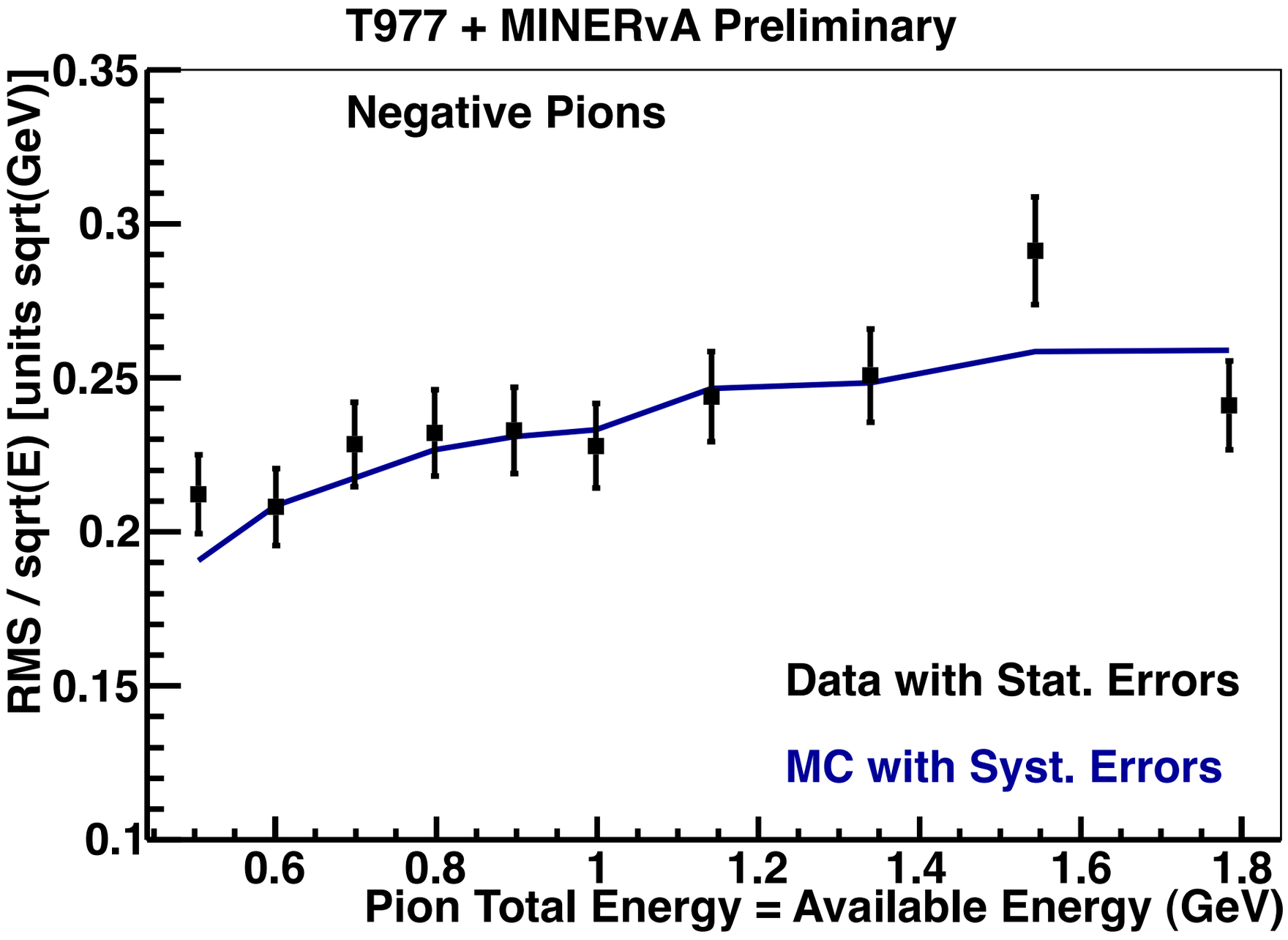


Current Analysis (Calorimetry)



- 20 ECal + 20 HCal config.
- The energy response is corrected for the passive material.

Current Analysis (Calorimetry)



Summary

The MINERvA collaboration planned, designed, constructed and commissioned the MINERvA Test Beam Experiment.

MINERvA Test Beam experiment provides hadronic response for the MINERvA Main detector.

Pion response is well modeled, agreement ~5 %.

More results on pions are coming.

Plus protons and small kaon sample.

Stay tuned for results soon!!!

The MINERvA Collaboration

G. Tzanakos
University of Athens

J. Cravens, M. Jerkins, S. Kopp, L. Loiacono, J. Ratchford, R. Stevens IV
University of Texas at Austin

D.A.M. Caicedo, C.M. Castromonte, H. da Motta, G. A. Fiorentini, J.L. Palomin
Centro Brasileiro de Pesquisas Fisicas

J. Grange, J. Mousseau, B. Osmanov, H. Ray
University of Florida

D. Boehnlein, R. DeMaat, N. Grossman, D. A. Harris, J. G. Morfn, J. Osta, R. B. Pahlka, P. Rubinov, D. W. Schmitz, F.D. Snider, R. Stefanski
Fermilab

J. Felix, A. Higuera, Z. Urrutia, G. Zavala
Universidad de Guanajuato

M.E. Christy, C. Keppel, P. Monagham, T. Walton, L. Y. Zhu
Hampton University

A. Butkevich, S.A. Kulagin
Inst. Nucl. Reas. Moscow

G. Niculescu, I. Niculescu
James Madison University

E. Maher
Mass. Col. Lib. Arts

L. Fields, B. Gobbi, L. Patrick, H. Schellman
Northwestern University

N. Tagg
Otterbein College

S. Boyd, I. Danko, S.A. Dytman, B. Eberly, Z. Isvan, D. Naples, V. Paolone
University of Pittsburgh

A. M. Gago, N. Ochoa, J.P. Velasquez
Pontificia Universidad Catolica del Peru

S. Avvakumov, A. Bodek, R. Bradford, H. Budd, J. Chvojka, M. Day, H. Lee, S. Manly, C. Marshall, K.S. McFarland, A. M. McGowan, A. Mislivec, J. Park, G. Perdue, J. Wolcott
University of Rochester

G. J. Kumbartzki, T. Le, R. D. Ransome, E. C. Schulte, B. G. Tice
Rutgers University

H. Gallagher, T. Kafka, W.A. Mann, W. P. Oliver
Tufts University

C. Simon, B. Ziemer
University of California at Irvine

R. Gran, M. Lanari
University of Minnesota at Duluth

M. Alania, A. Chamorro, K. Hurtado, C. J. Solano Salinas
Universidad Nacional de Ingeniera

W. K. Brooks, E. Carquin, G. Maggi, C. Pea, I.K. Potashnikova, F. Prokoshin
Universidad Tcnica Federico Santa Mara

L. Aliaga, J. Devan, M. Kordosky, J.K. Nelson, J. Walding, D. Zhang
College of William and Mary

Thank you for listening

Back-up Slides

If we know that a 100MeV/c transverse momentum kick caused a particle's trajectory to changed by angle, we can use trigonometry to get its total momentum.

$$p_{tot} = \frac{100\ \mathrm{MeV/c}}{\sin\theta}$$

Using a time of flight system we can get its velocity

$$\mathbf{p} = \frac{m\mathbf{v}}{\sqrt{1 - \frac{\mathbf{v}^2}{c^2}}}$$