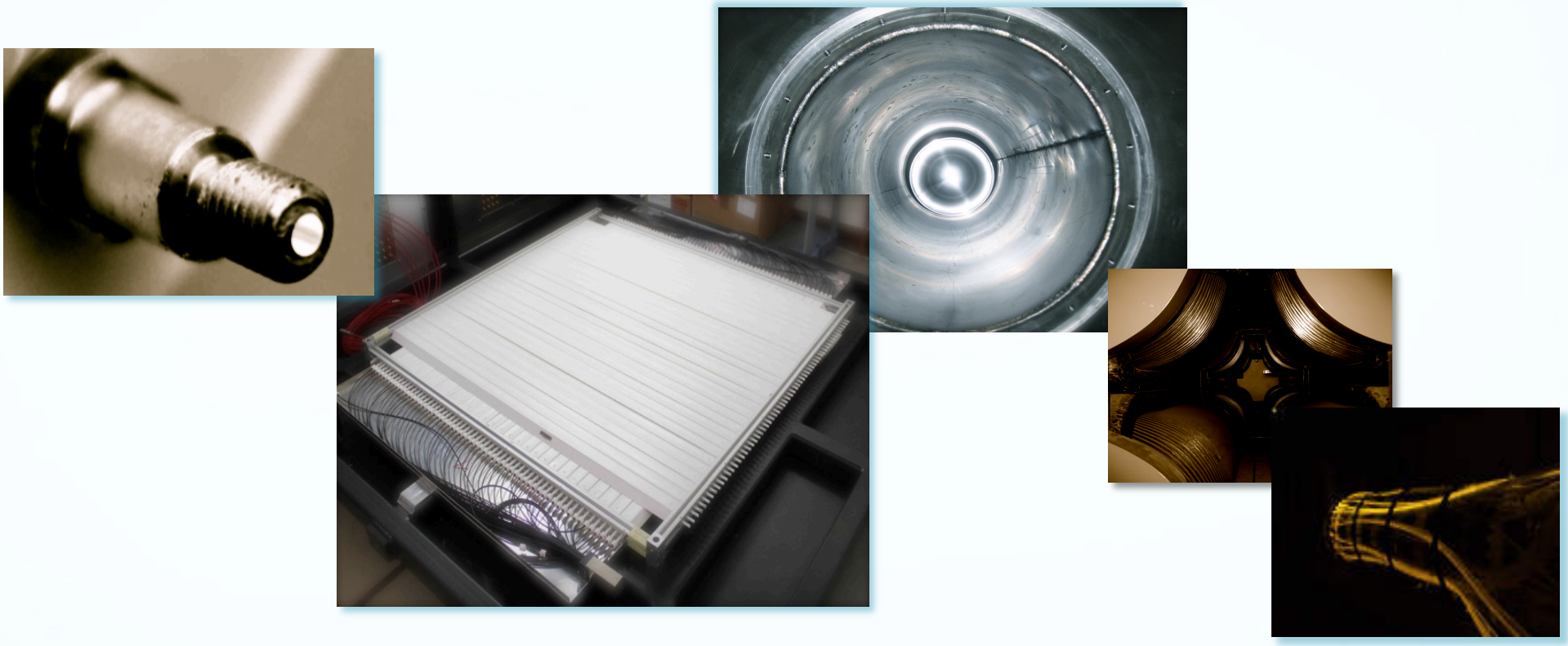


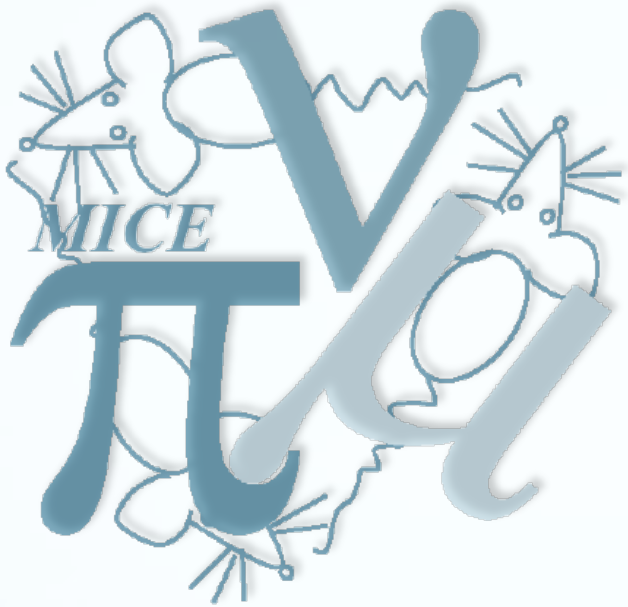
Measurement of Transfer Matrix

By Sophie Charlotte Middleton

Imperial College London

MICE Collaboration Meeting 43 – RAL - 29/10/2015

Outline



- Calculating the Transfer Matrix from data using least Squares Fitting

Motivations & Method

- Matrix elements in MC & Data
- How well does the method work?

Analysis

Conclusions

- What needs to be improved?

Introduction

Motivations & Method

Transfer Matrix

* With knowledge of the upstream tracker co-ords and downstream co-ords we can work backwards to find the transfer matrix:

$$x^d = M_{00} + M_{01}x^u + M_{02}Px^u + M_{03}y^u + M_{04}Py^u, \quad (1)$$

$$Px^d = M_{10} + M_{11}x^u + M_{12}px^u + M_{13}y^u + M_{14}Py^u, \quad (2)$$

$$y^d = M_{20} + M_{21}x^u + M_{22}px^u + M_{23}y^u + M_{24}Py^u \quad (3)$$

$$Py^d = M_{30} + M_{31}x^u + M_{32}px^u + M_{33}y^u + M_{34}Py^u \quad (4)$$

* Use linear least squares fit

Linear Least Squares

* Take a set of n data points (x_i, y_i) then

$$y_i = \Sigma_i a_i f_i(x_j) \quad \text{or} \quad y_i = a_0 + a_1 x_i$$

* The residual for the ith point is then defined as the difference in the y_i and $f(x_i)$:

$$r_i = (y_i - f(x_i)) = y_i - (a_0 + a_1 x_i)$$

$$S = \Sigma_i r_i^2 = \Sigma_i [y_i - (a_0 + a_1 x_i)]^2 = \Sigma_i (y_i - \Sigma_j a_j f_j(x_i))^2$$

* Aim is to minimize the sum of the squares (S) of these residuals such that:

$$\frac{\partial S}{\partial a_0} = -2\Sigma_i^n [y_i - (a_0 + a_1 x_i)] = 0$$

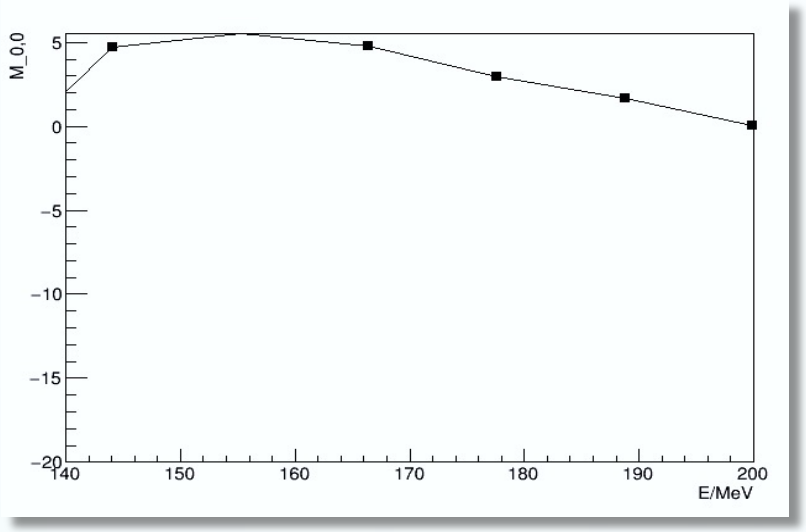
$$\frac{\partial S}{\partial a_1} = -2\Sigma_i^n [y_i - (a_0 + a_1 x_i)] x_i = 0$$

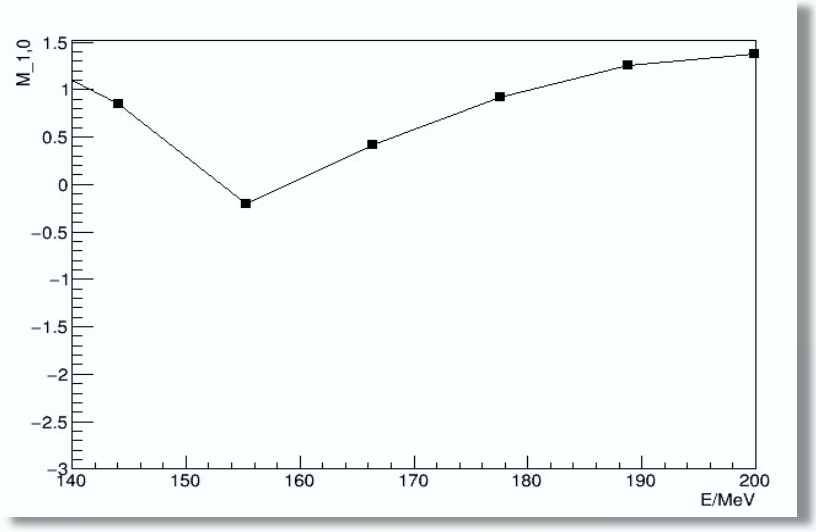
Analysis & Results

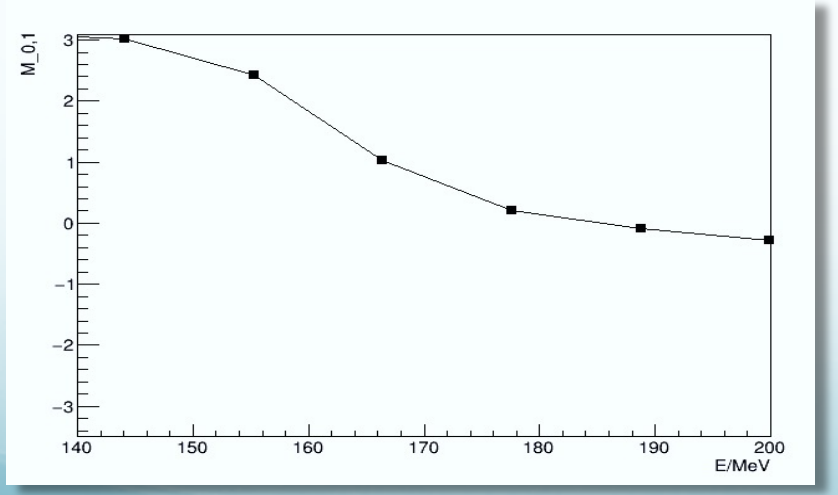
Plots & Discussions

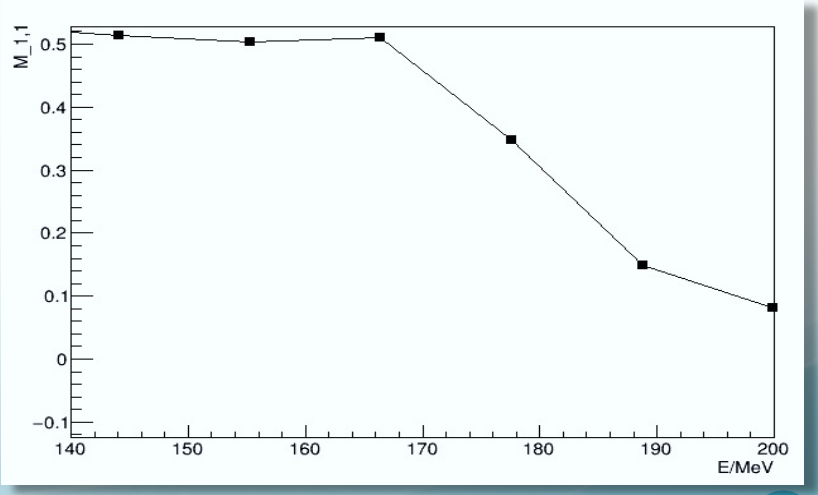
Results : MC Truth

* For MC the elements are plotted as a function of energy:



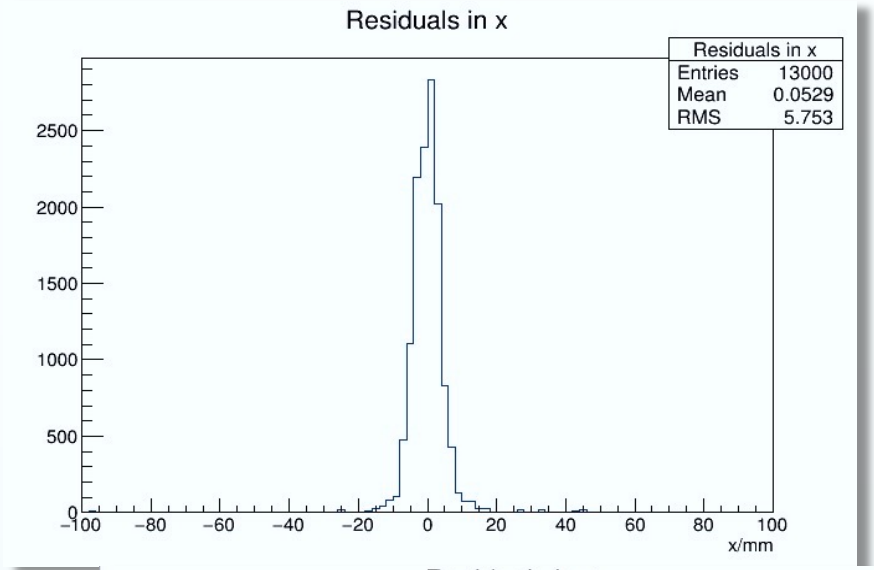


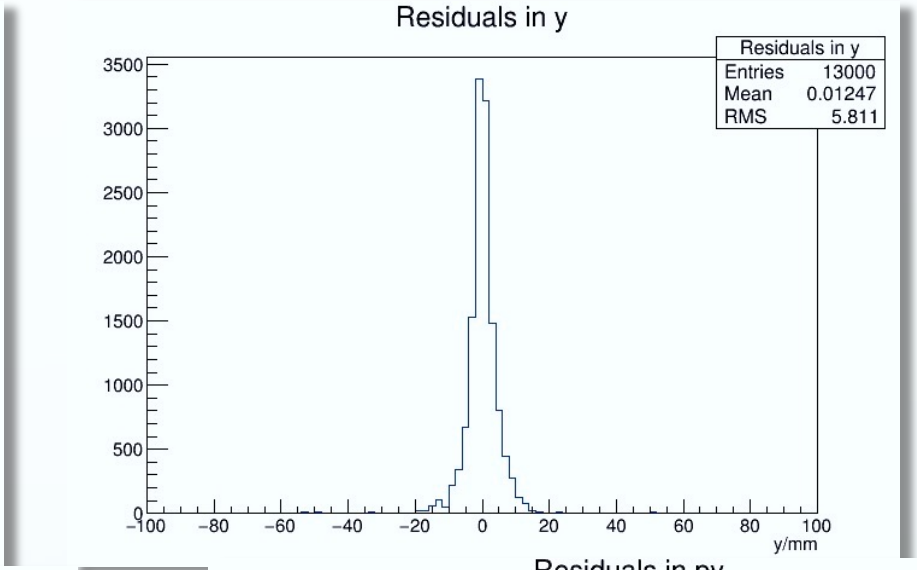


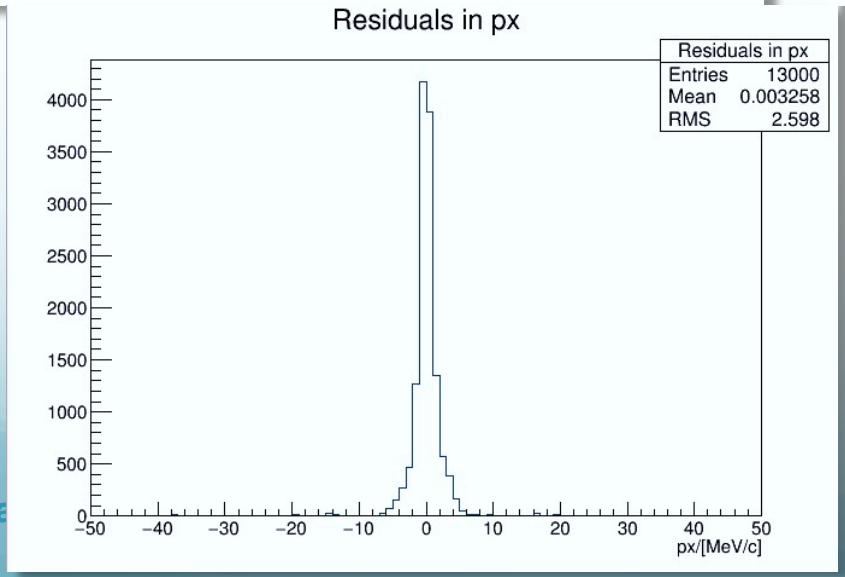


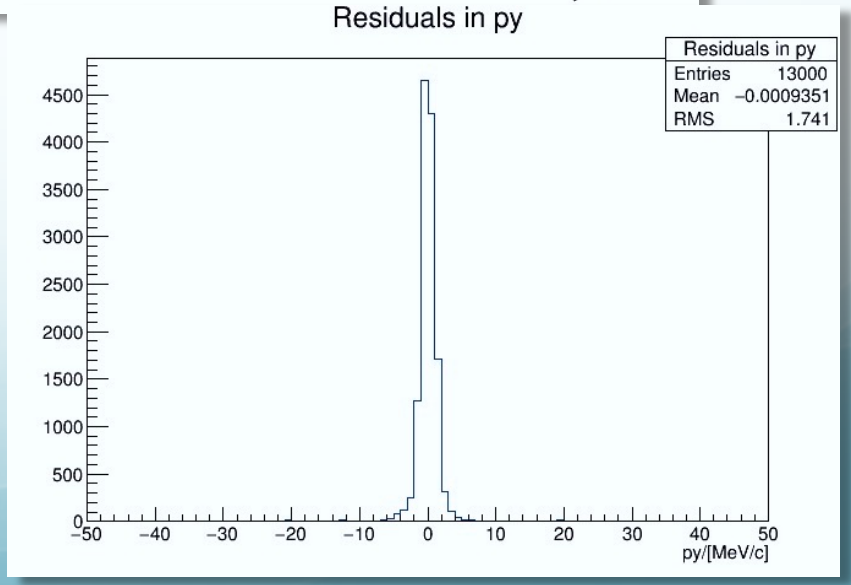
Residuals: MC Truth

The Residuals are the difference in the real downstream data and that projected from the equations on slide 5

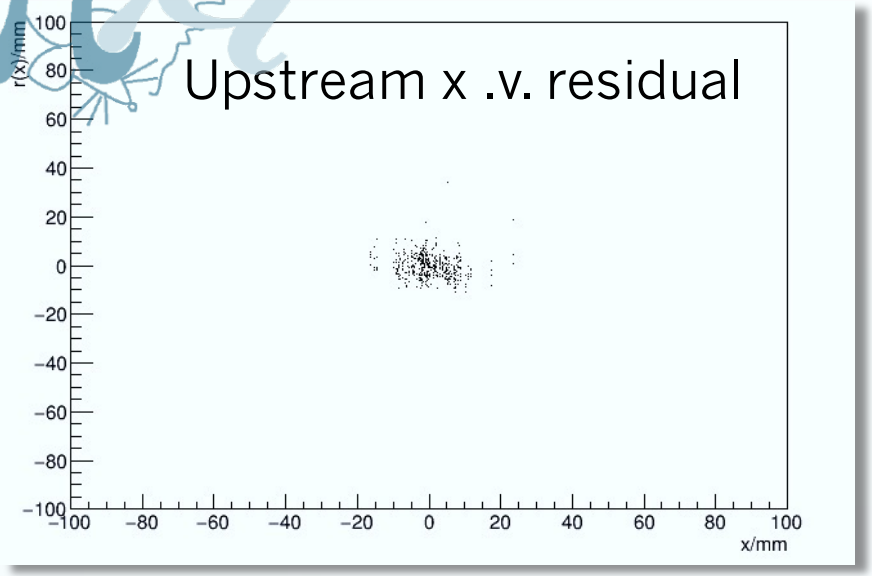


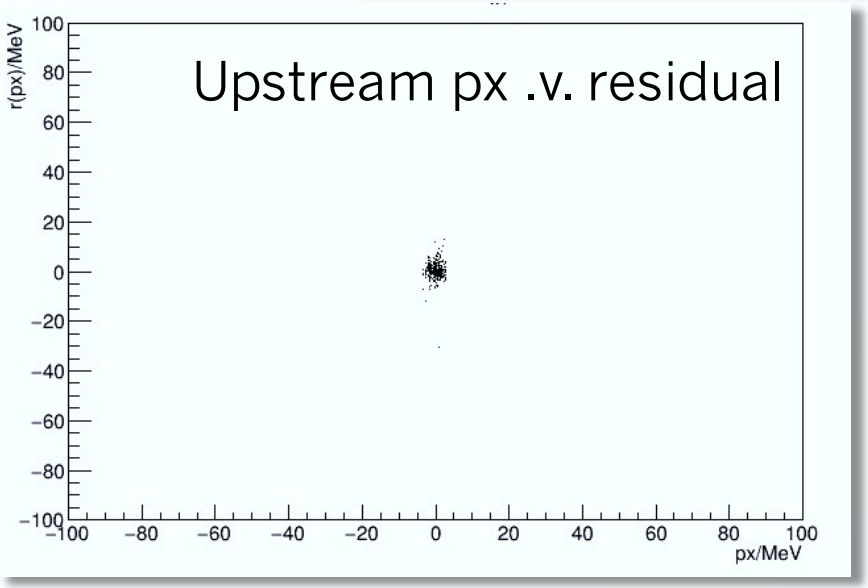


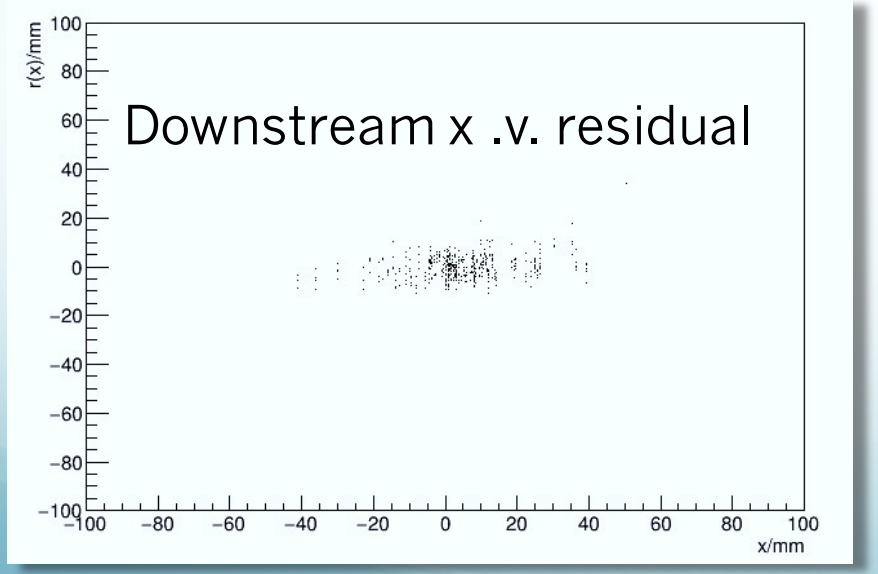


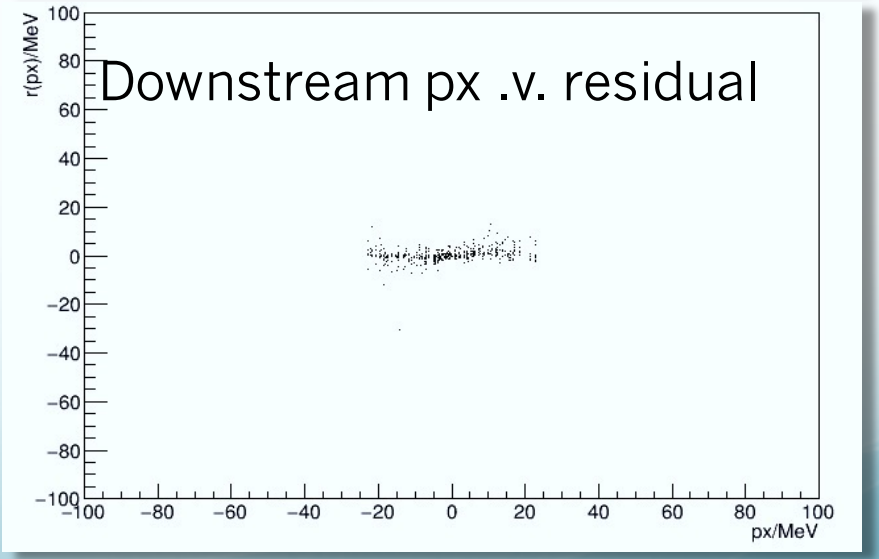


Results : MC Truth

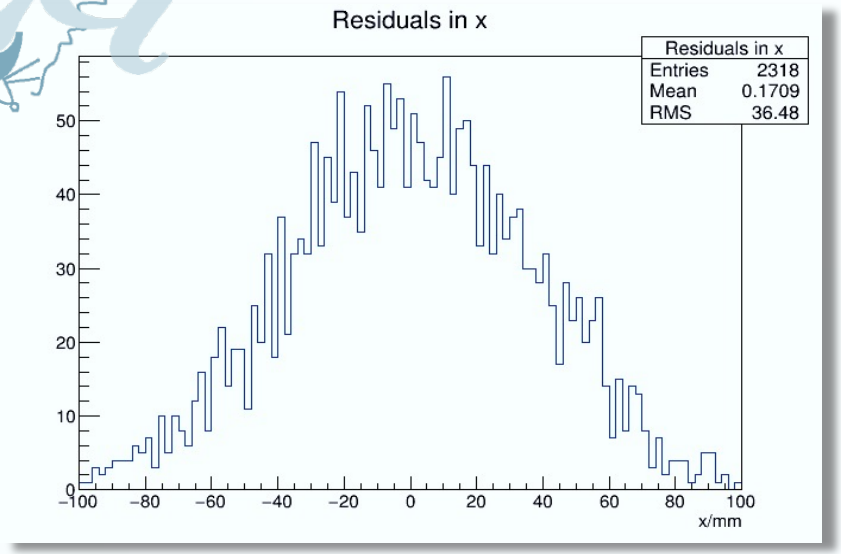


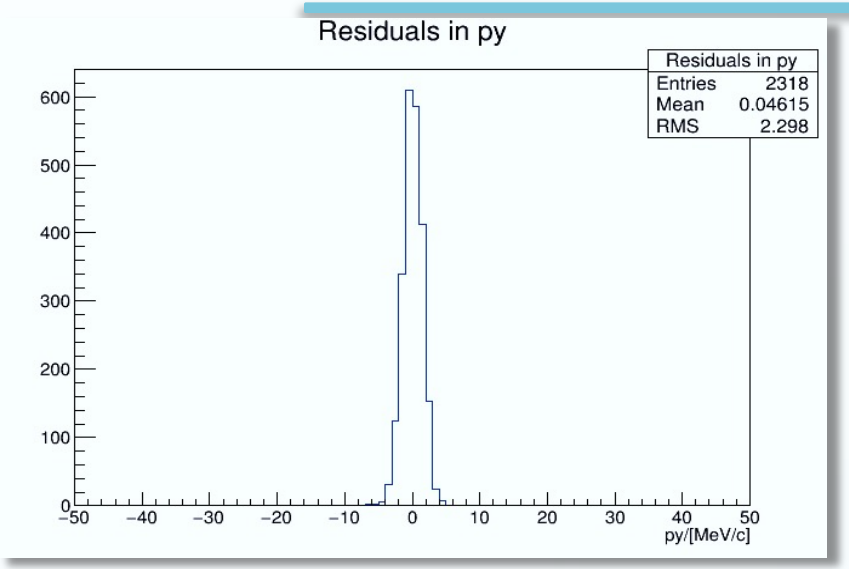


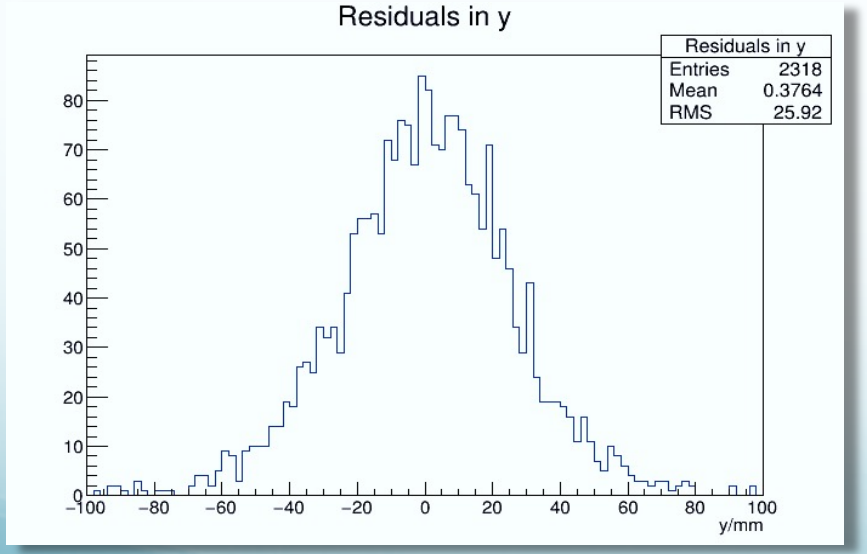


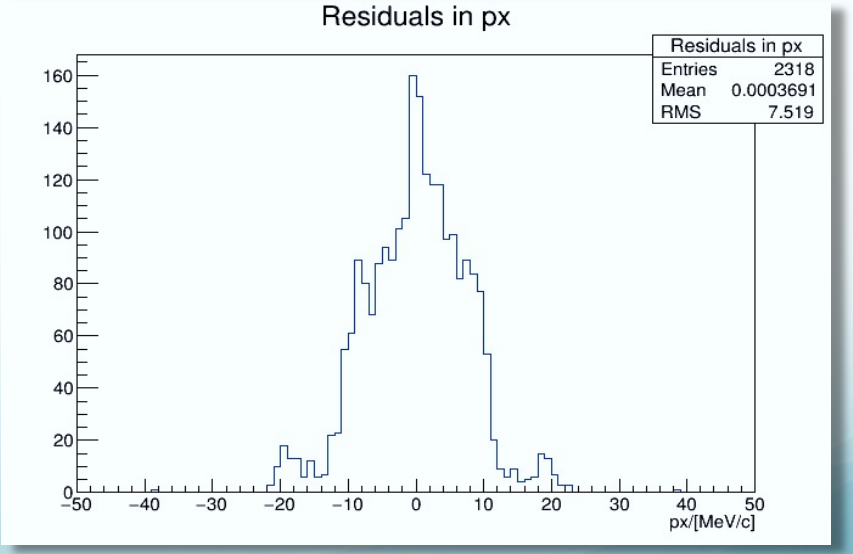


Residuals: MC Recon

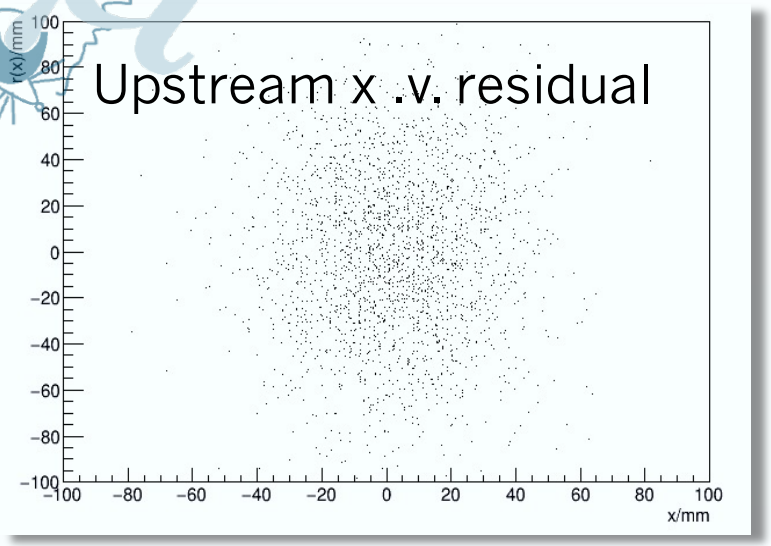


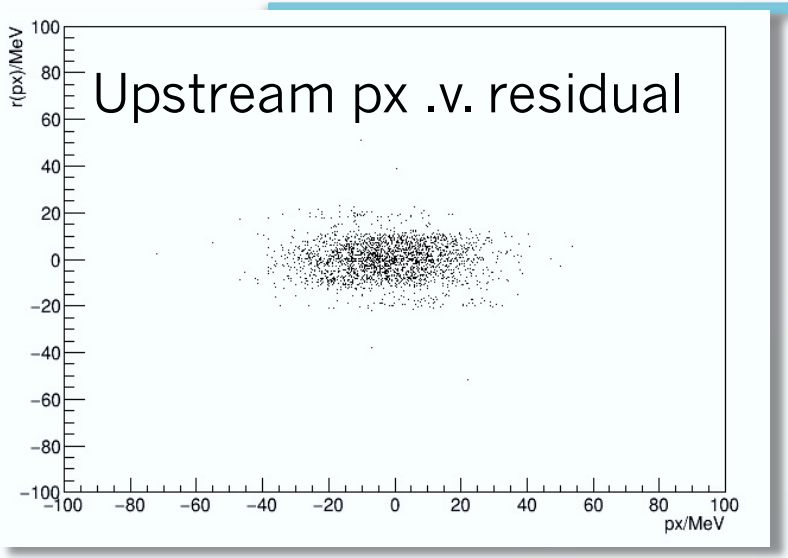


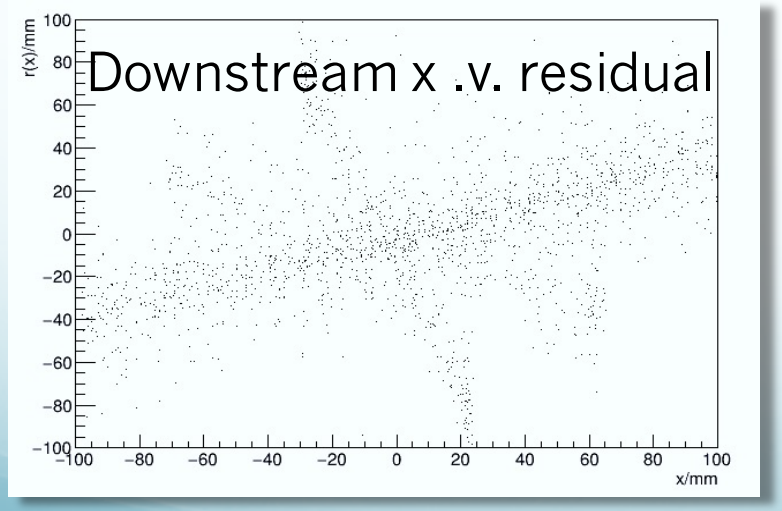


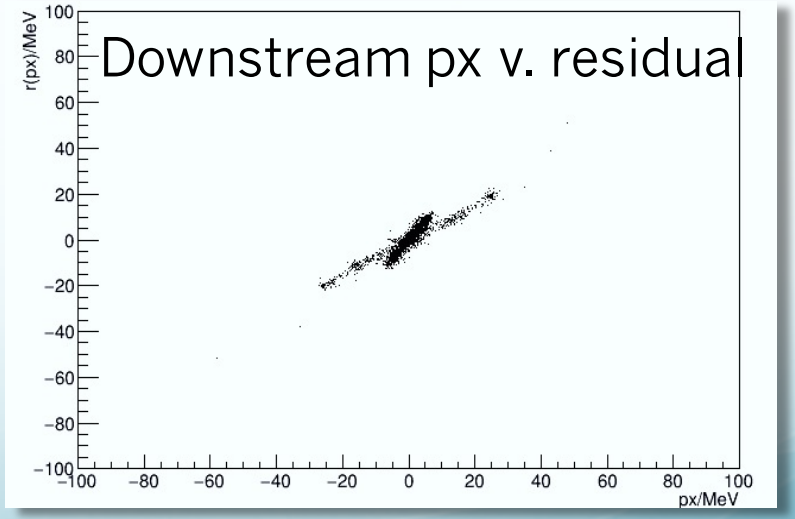


Results: MC Recon



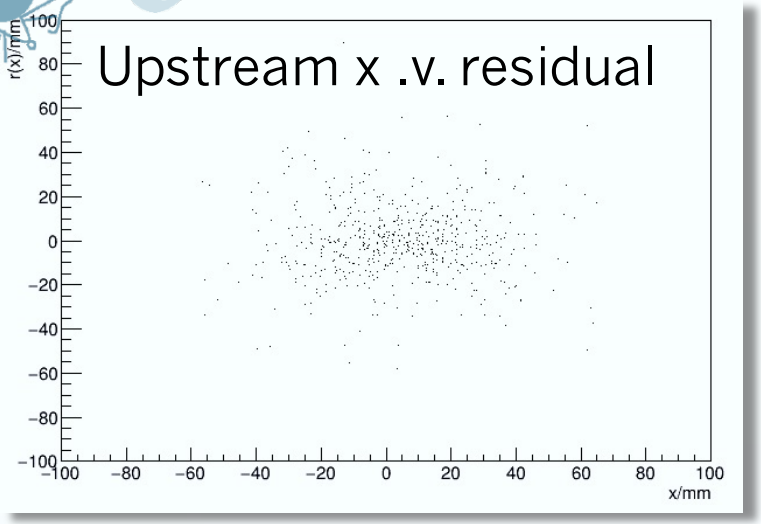


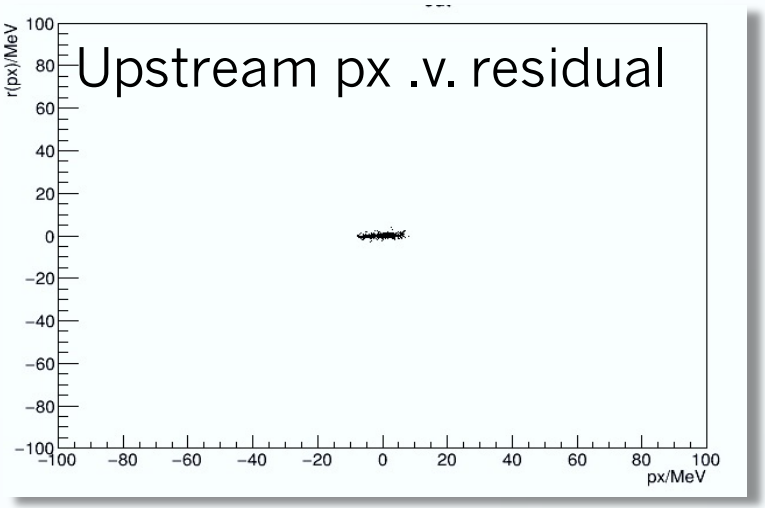


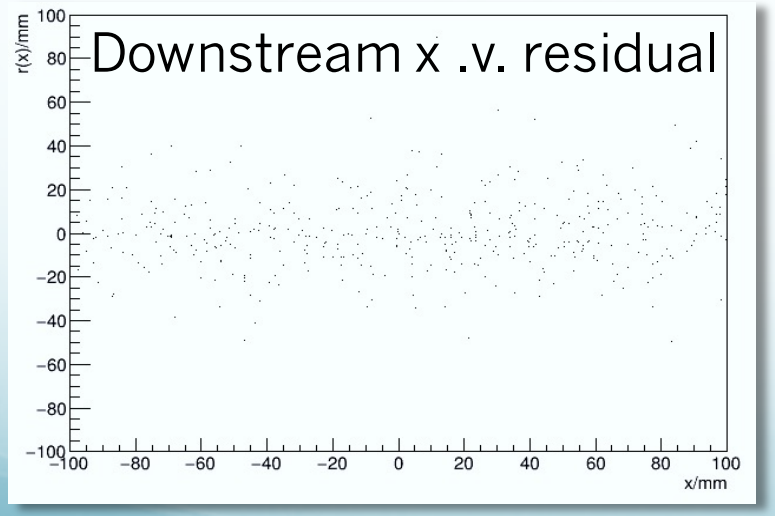


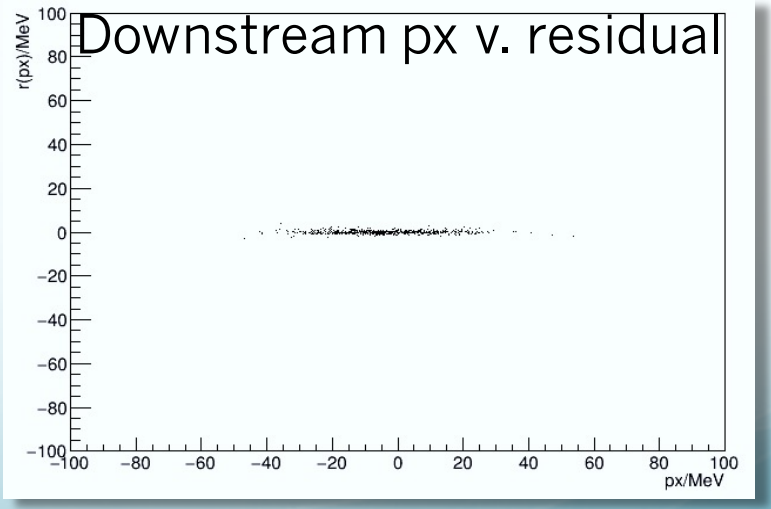
MC Recon: P Value Cut

* I added a P-Values cut at P > 0.5 …. the results look better…..







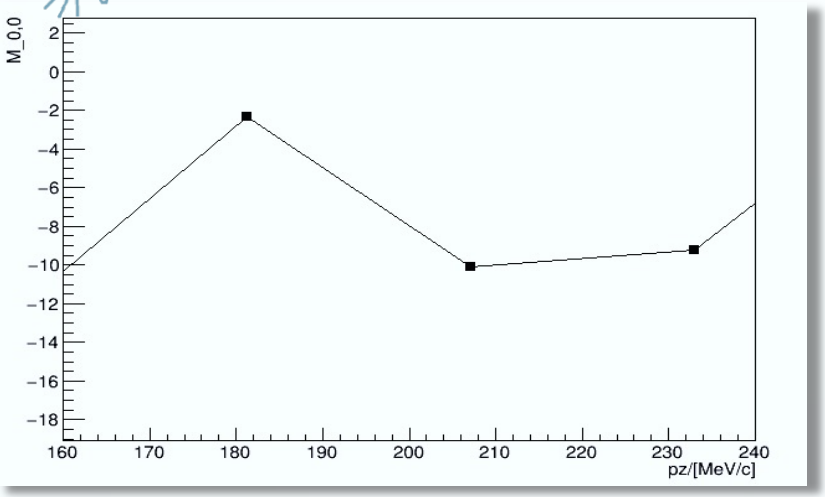


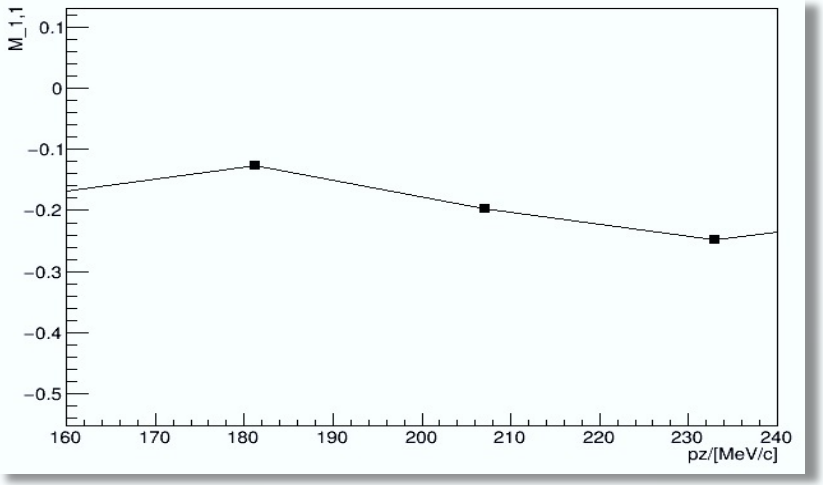
Analysis & Results

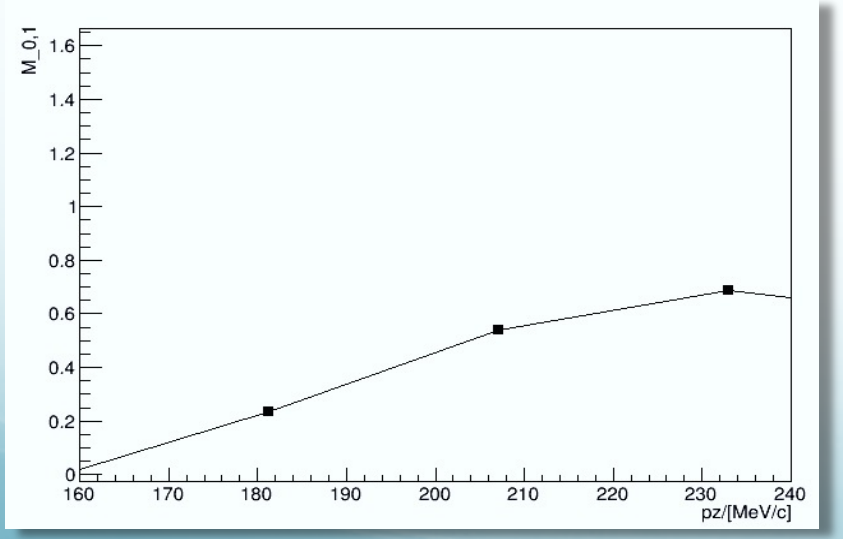
Data Analysis

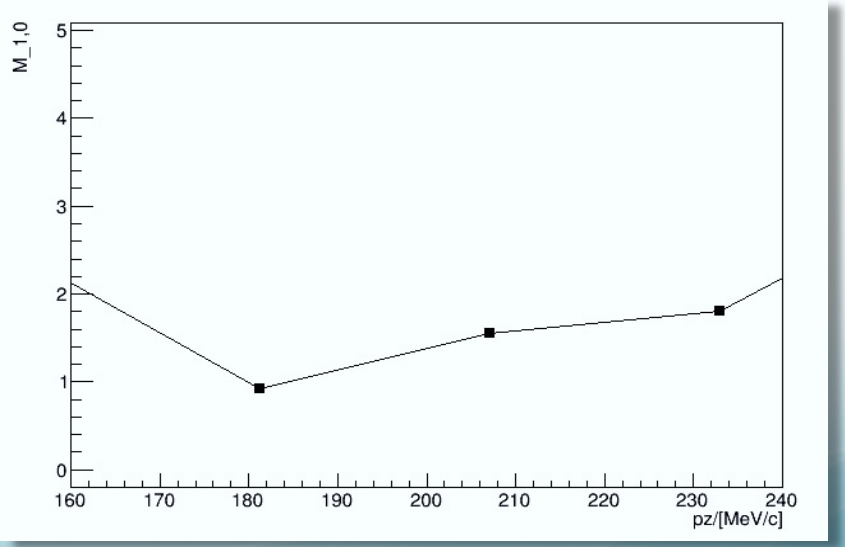
Results : Data

For data set 07475 the the matrix elements have been plotted as functions of pz.

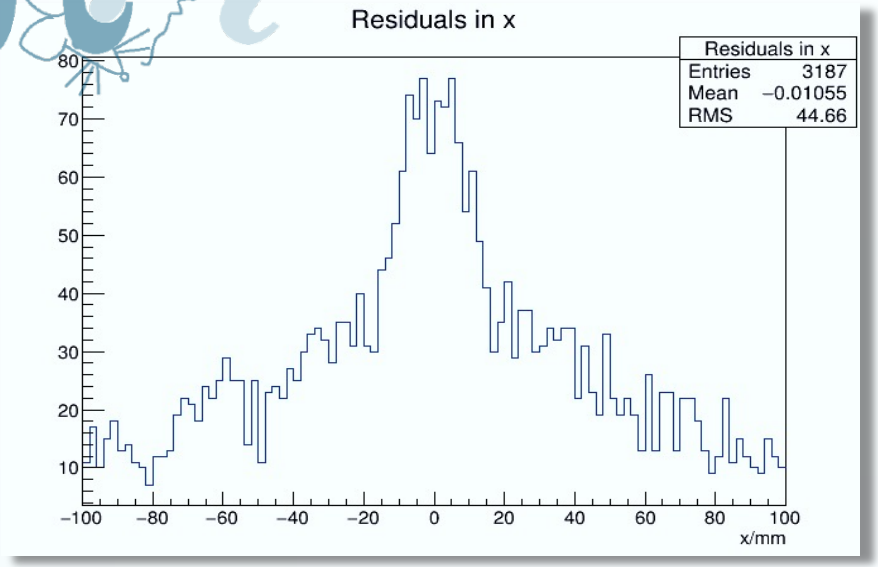


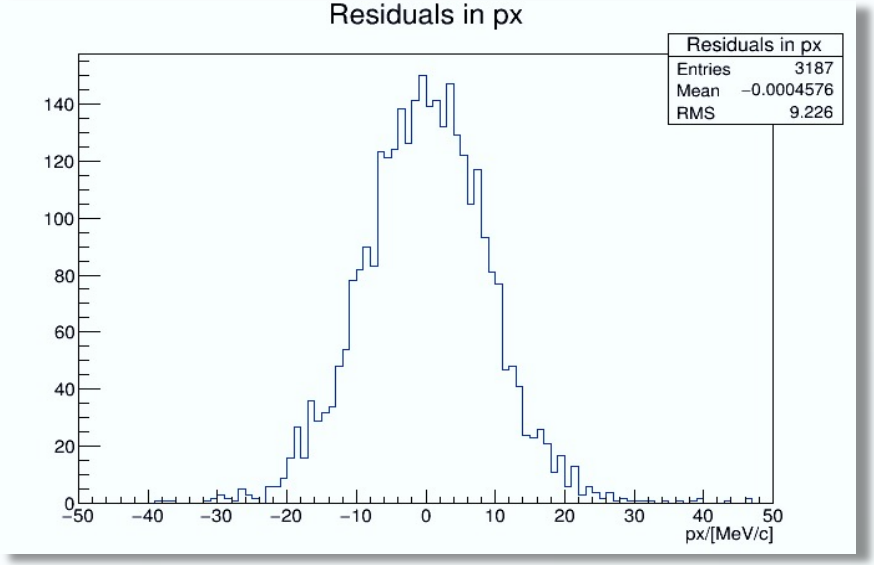


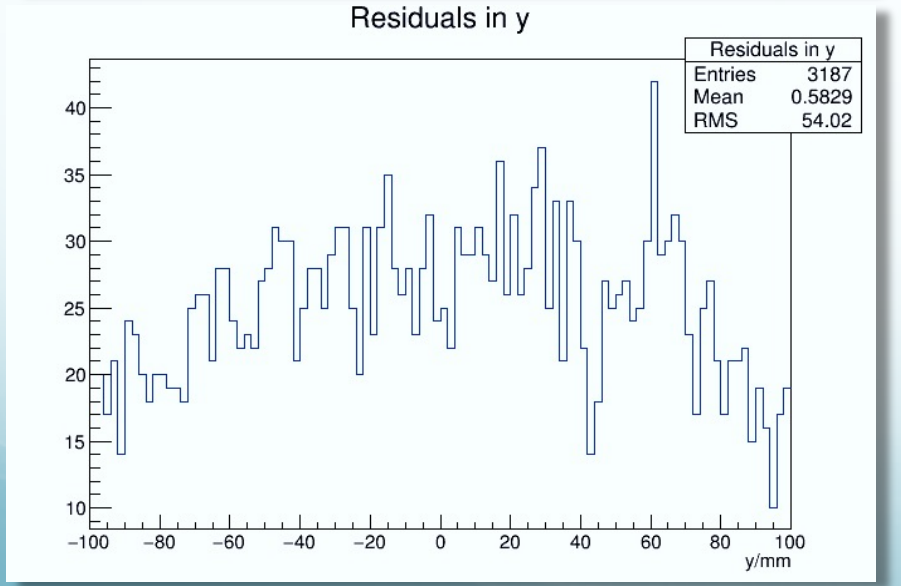


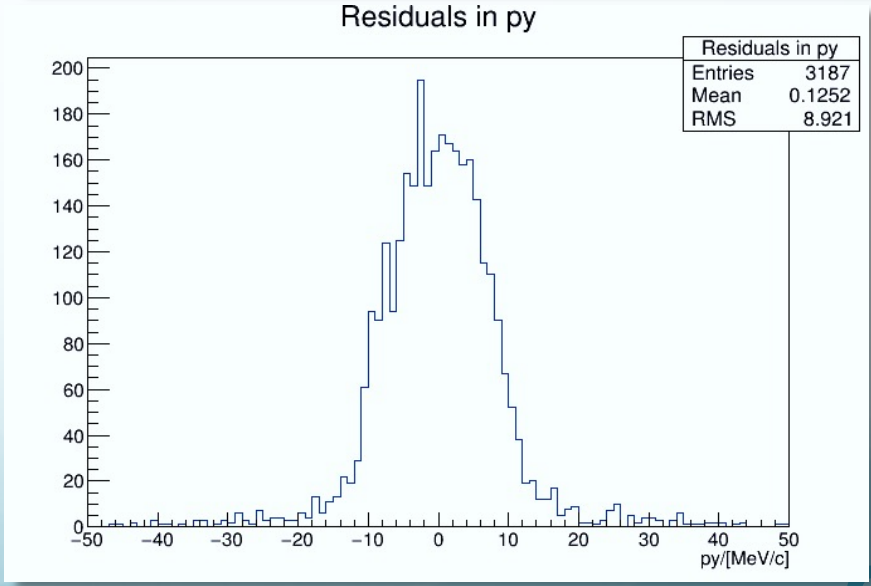


Residuals: Data



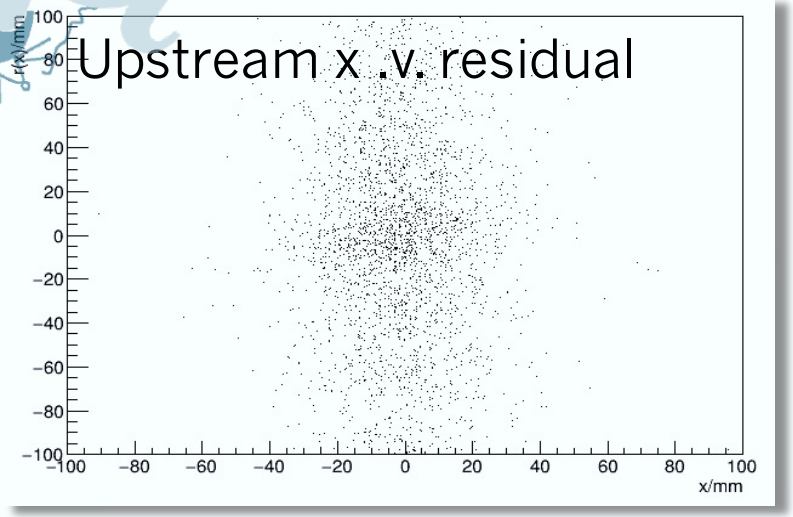


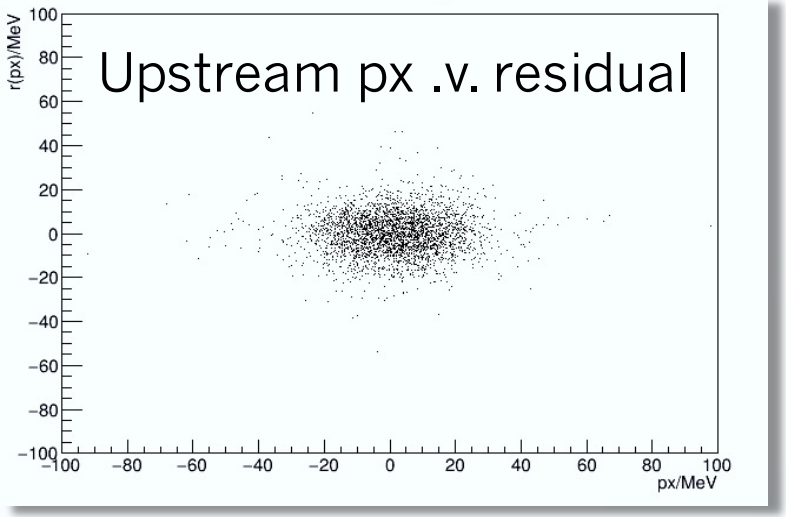


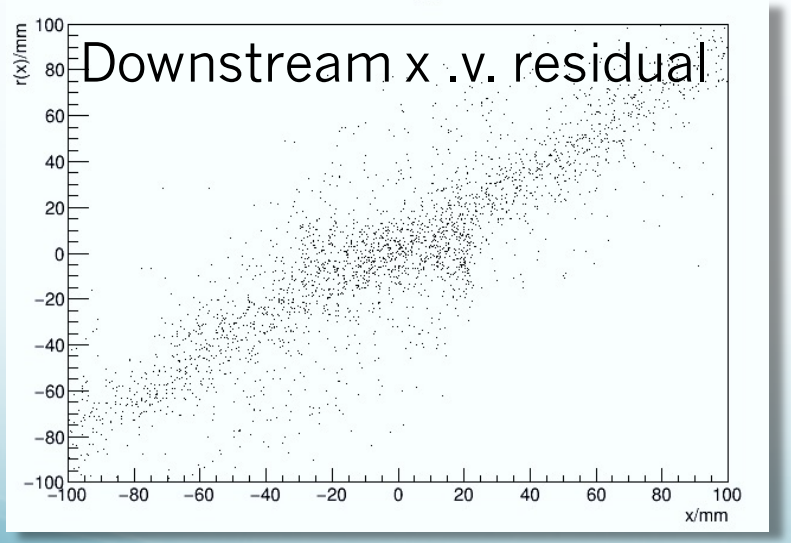


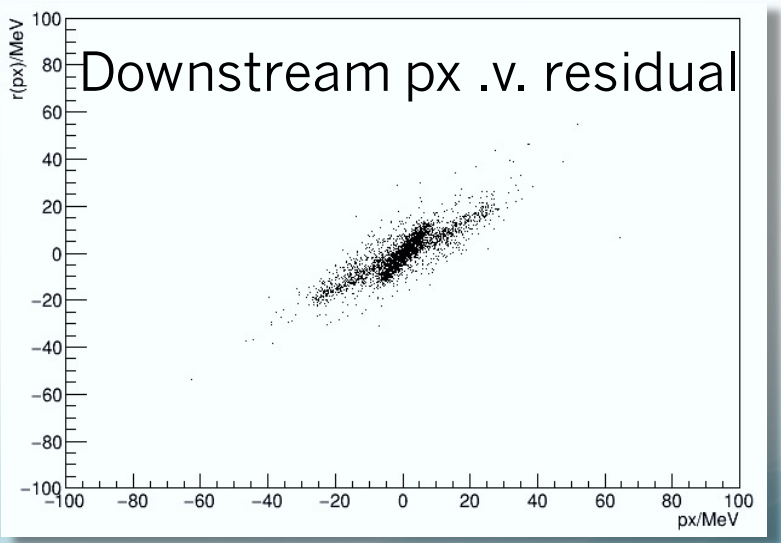
Results: Data

Some issues with tracker reconstruction (…maybe ?)









Conclusions

Summary & Future Plans

Summary

- Presented an measurement of the transfer matrix from tracker data using the least squares fitting method
- Residuals have acceptable RMS for MC truth
- MC recon and data are less nice….need to think why and fix!
- Matrix elements dont seem consistent with MC but need to quantify errors and use some higher stats-Work in progress here!

Thank You For Listening

Any Questions?