

# Brief summary of beam studies

Peter *et al.*, Sunday, August 18, 2003

## 1 Overview

From 14-Aug to 17-Aug we performed beam studies to

- Search for possible sources of the low stopping fraction and potentially wide range distribution observed during the test TPC run.
- Quantify the contribution of each beam element on scattering and range width.
- Gain information concerning the relative merits of various TPC target window choices.

The main set-up was (seen in muon direction)

name	description	dimensions	distance
PC	Peter collimator	2mm lead, 35mm hole	On beam window
Mu	Mu counter	0.5mm, 5x5 cm <sup>2</sup> scint	Directly behind
MuPC1	Wire chamber	100mu Mylar, ~3cm wide, 5x5 cm <sup>2</sup>	directly behind
CC	Cenap's collimator	5mm plastic, 40mm hole, simulates entrance TPC hole	8 cm from Mu
windows	100um Fe or 1 mm Be or 0.3 mm Mylar	Simulates TPC entrance window	8 cm from Mu
foils	X foils of 100 mu Mylar each	Add stopping mass	On SS
SS	Stop scintillator	5 mm, 13 (hor) x12(vert) cm <sup>2</sup>	Dist (variable) to CC

The standard experimental condition included PC, Mu, CC and SS, other elements optional at various conditions. For scattering studies the following distances were chosen

Dist (cm)		notation	
5	At mPC2 position	MuPC2	
15	At TPC entrance	TPC1	
30	At TPC center	TPC2	
45	At TPC exit	TPC3	

Two basic measurement were done

- Range measurement with SS at MuPC2 position, and possible some foils
- Scattering (and range) measurements with SS at various distances.

The basic signal for both measurements was  $(\mu \cdot SS)/\mu$ , i.e. the fraction of the mu rate seen by the coincidence mu and SS(to exclude Michel electrons).

For several addition measurements (SS only, beam tuning, collimator tuning and corrections) we refer to the e-log entries. Note also that not all measurements are reliable and consistent, because the CC alignment was not stable.

Some photos of the set-up are given below.

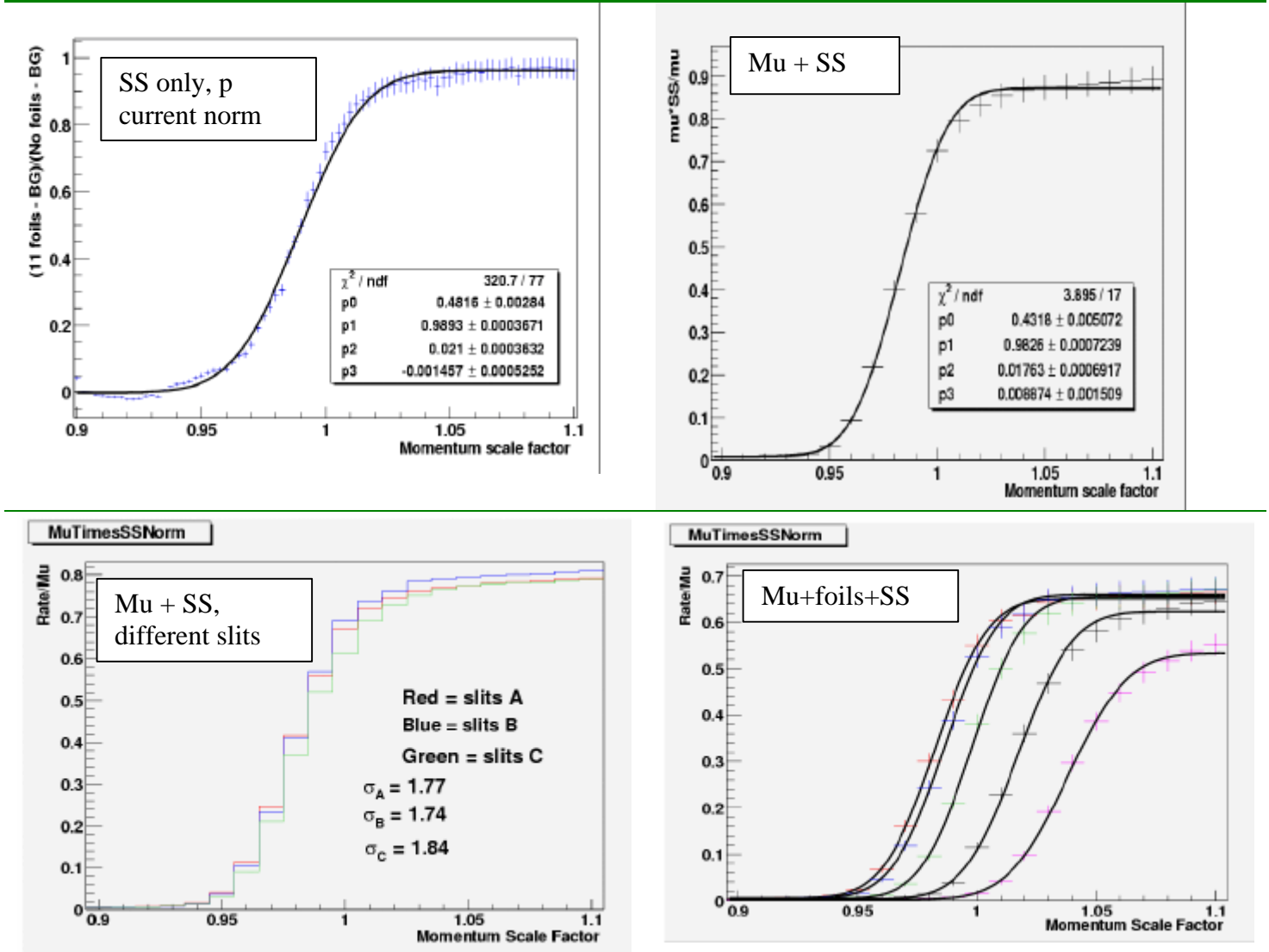


## 2 Results

For access to the numerical results as root files refer to the e-log entries.

### 2.1 Range measurements

The following figure presents the main results, further results are given in section 2.2 for SS in MuPC2 position.

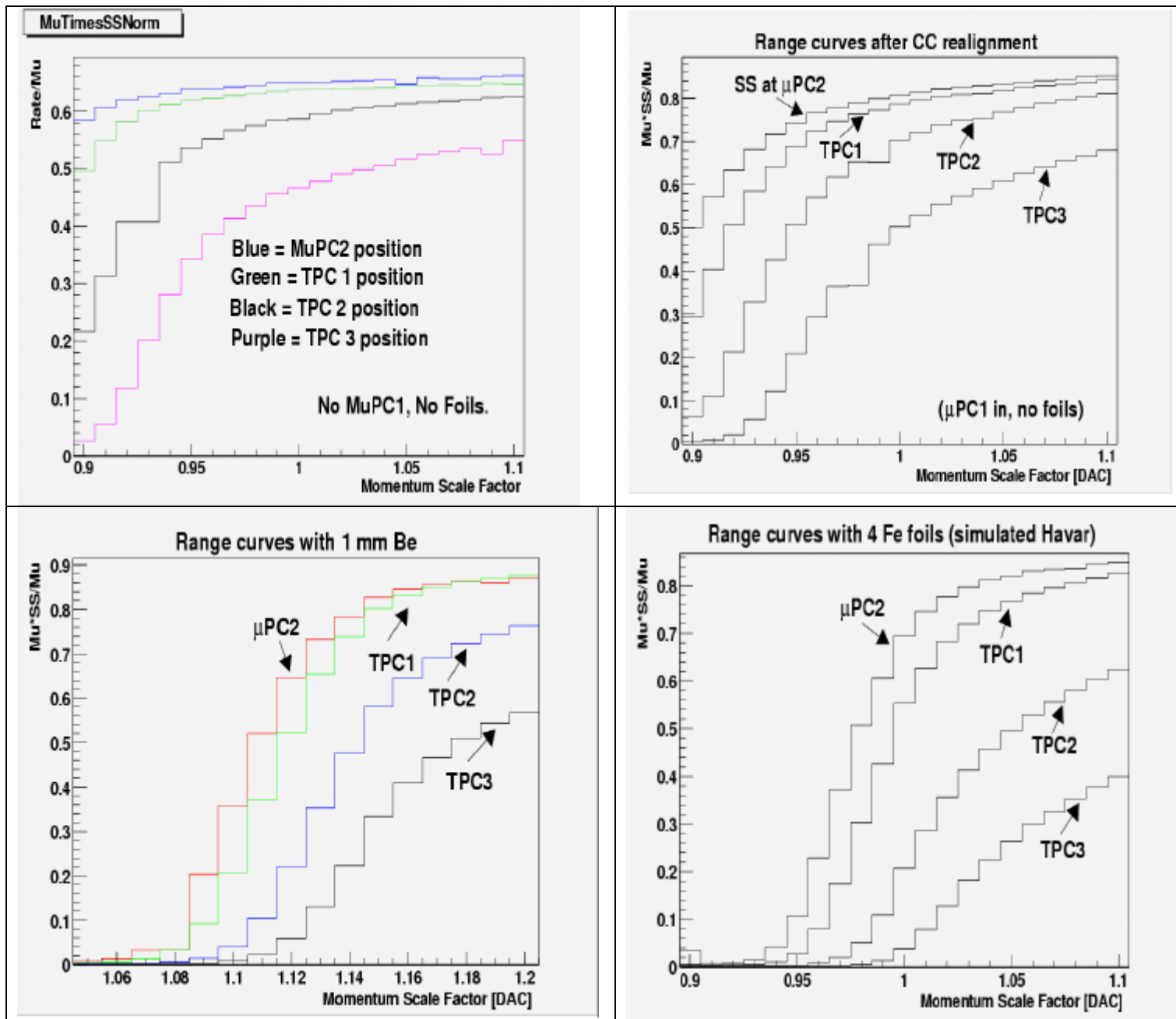


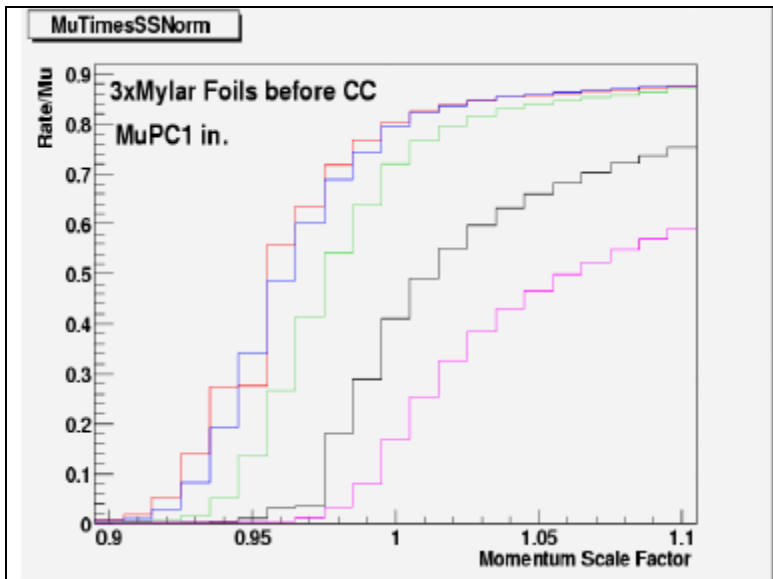
The fitted sigmas of the range distribution (resulting from an Erf fit) are collected in the table. Given are momentum corresponding to range center and the sigma of the momentum distribution (all given as scale factors of the nominal 34MeV/c tune). Probably the results have errors of 5% (estimated from fit consistency, fit errors are rather <1%).

configuration	Central momentum (%)	Sigma (%)
11foil+SS	98.6	1.82
Mu+6foil+SS, slit A, B, C	97.9	1.76, 1.74, 1.84
Mu+mPC1+6(7)foil+SS	100	2.02 (1.92)
Mu+mPC1+Fe+SS	97.4	2.10
Mu+mPC1+Be+SS	110	1.9

## 2.2 Scattering (and range) measurements

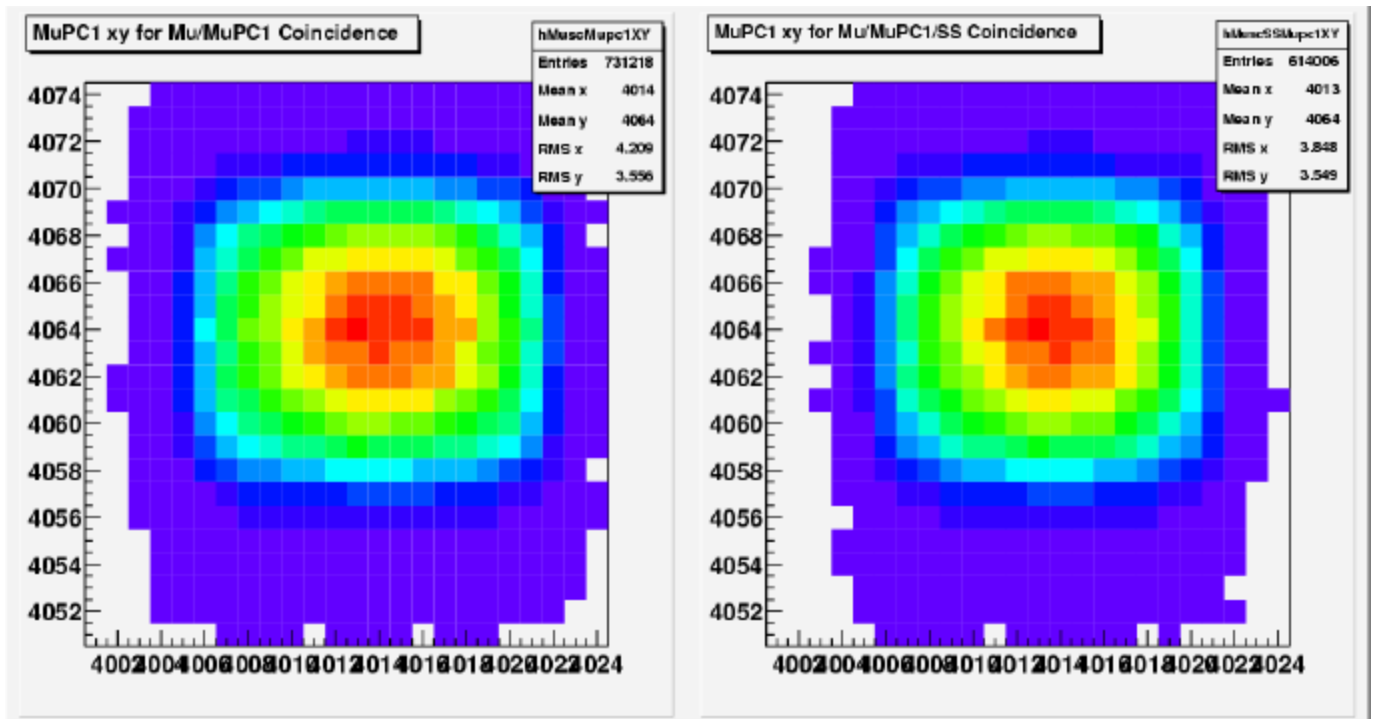
The following figure presents the main results.





### 2.3 MPC1 beam profile

The MPC1 beam profile was measured for two coincidence conditions. a) coincidence with mu counter (image of PC), b) coincidence with SS counter (effect of CC image). Momentum 34MeV/c.



### 2.4 Estimated beam divergence

At the muPC1 chamber the estimated muon beam divergences are approximately  $\sigma(x') = 30$  mrad,  $\sigma(y') = 60$  mrad (Claude's calculations).

## 3 Required Monte Carlo Simulation

In order to predict the expected muon stopping distribution for the present run and for future runs with different window choices Monte Carlo simulations are required.

The present data highly constrains the MC model, and thus should allow robust predictions.

For a MC simulation the phase space of the beam at the mPC1 position is required. The measured beam profile as well as Claude's  $x', y'$  predictions should define reasonable starting values. Then these initial condition can be tested with e.g. the mu+SS configuration, where scattering is small. Potentially the  $x', y'$  assumptions have to be slightly adjusted to describe the data.

The next step is the real description of the various window situations. As regards the absolute range one has to account for the dead layer in SS, given by its threshold set above minimal ionizing particles (electrons in this case).

If reasonable agreement between data and MC can be achieved, the tuned model can be use to predict stopping distribution and optimal momentum for different window choices.