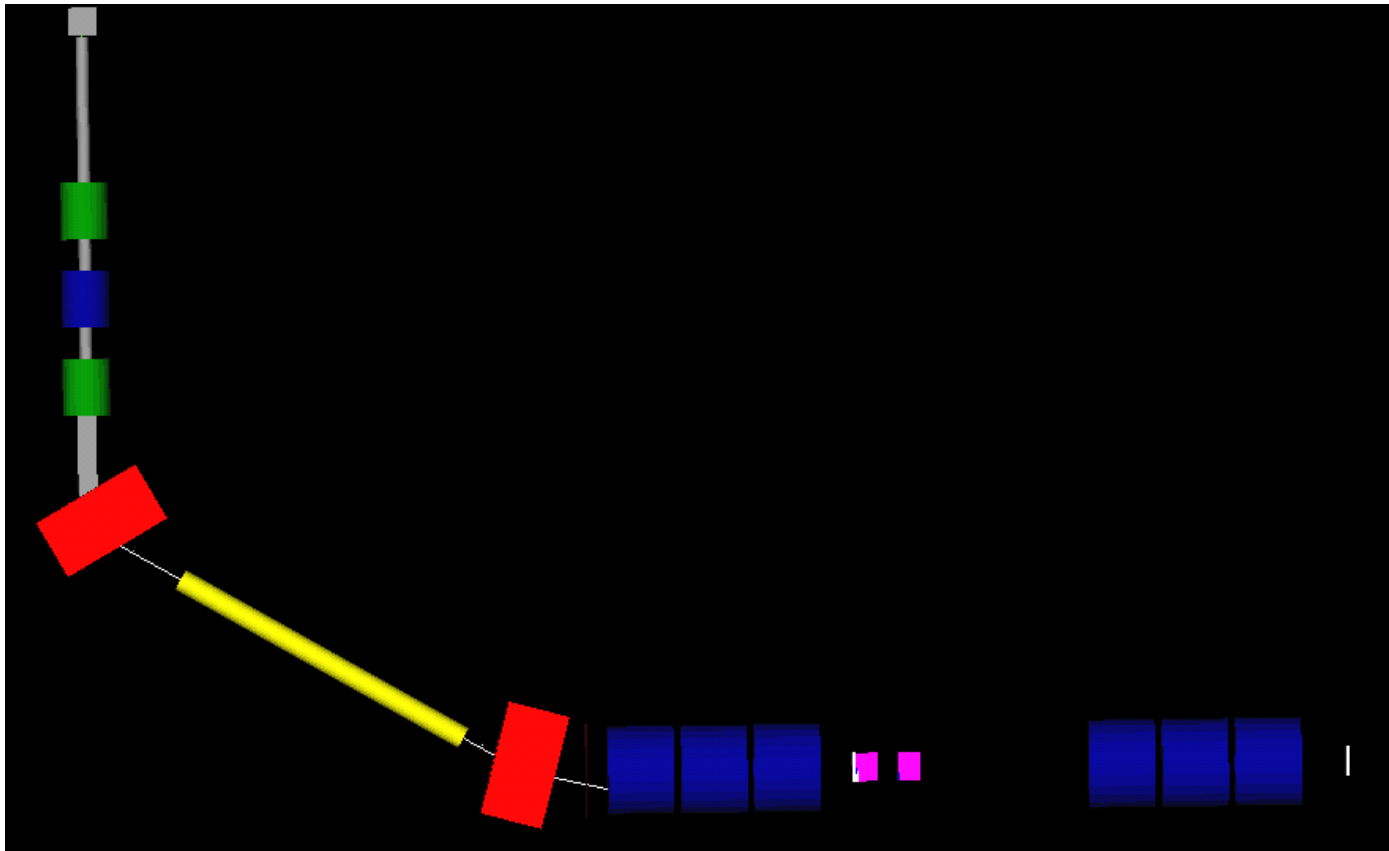


G4beamline studies: D1 scan

Ole Martin Hansen, Alain Blondel

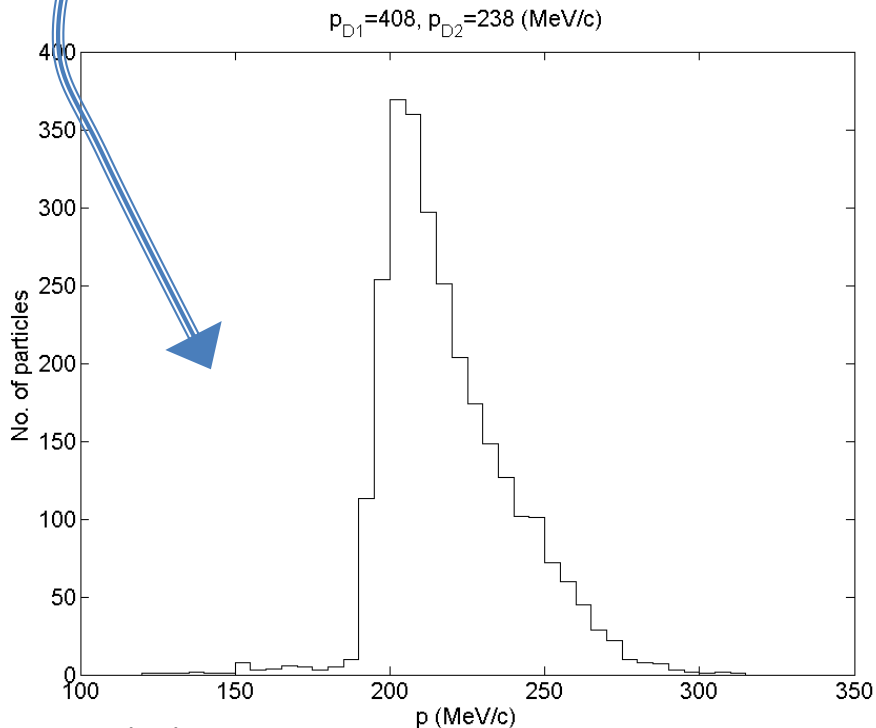
Method

- We set D2 to 238 MeV/c and we perform a D1 scan from 238-450 MeV/c. Q1-3 are changed proportional to the pion momentum in D1.

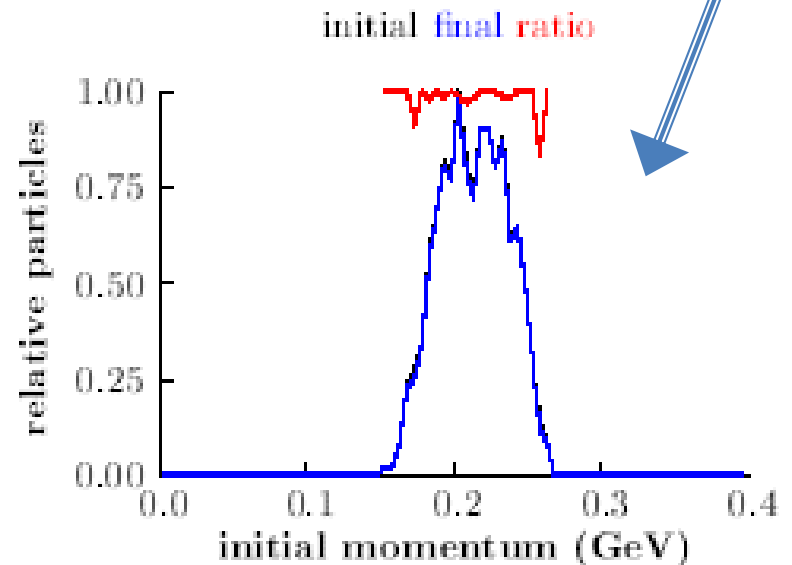


Momentum distribution

- Right figure: The momentum distribution before/after cooling in the Neutrino Factory.
- What we have at TOF1: $p_{D1}=408$, $p_{D2}=238$.
- We try to find a more symmetrical distribution



\neq



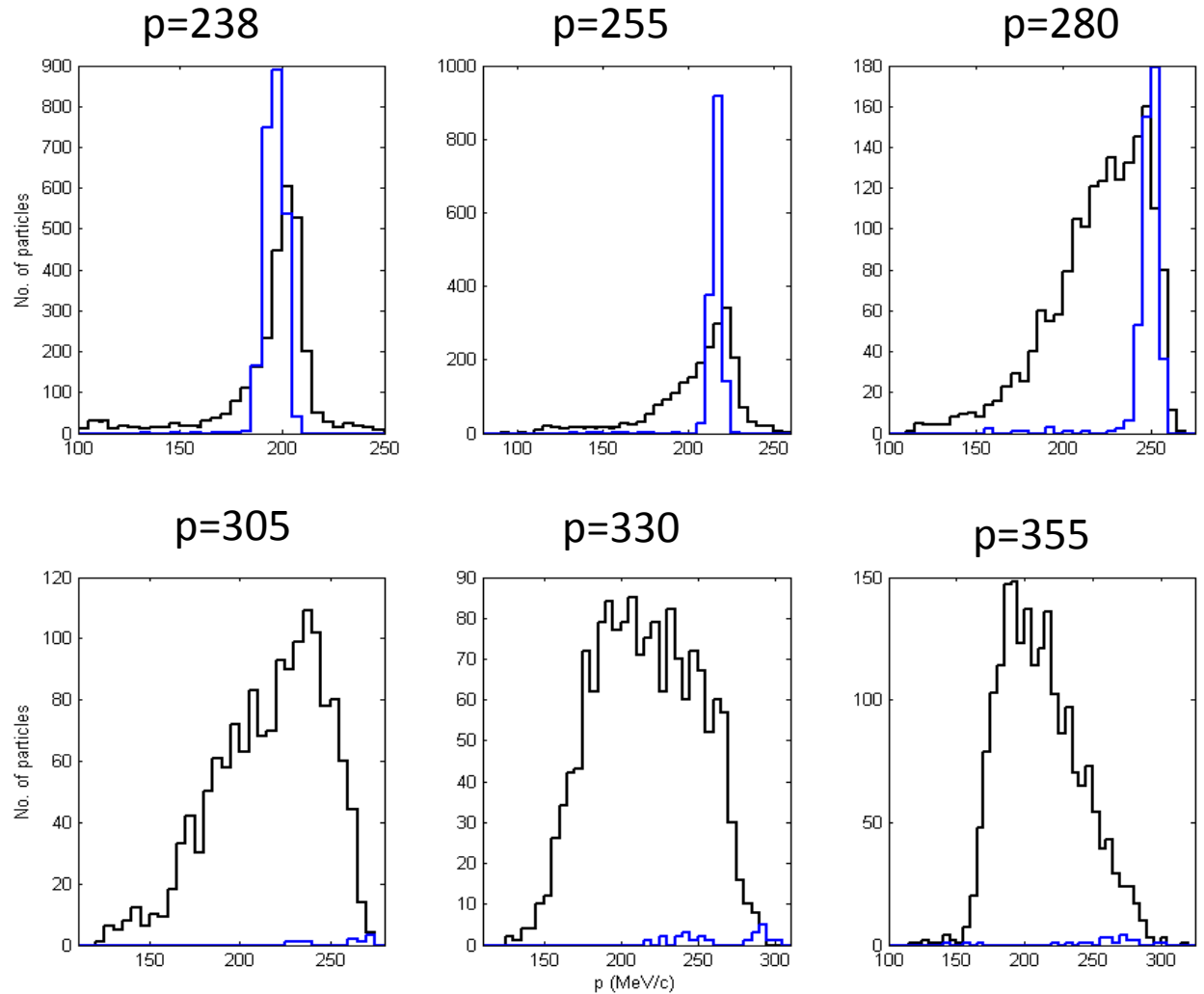
Skewness

- The skewness is used to find a symmetrical distribution.
- If $s=0$ the distribution is perfectly symmetric

$$s = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^3}{\left(\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2\right)^{3/2}}$$

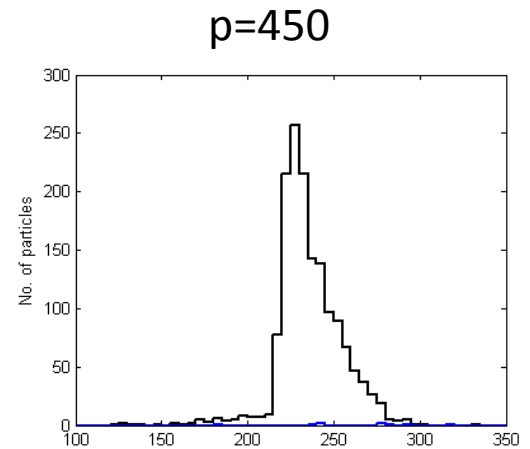
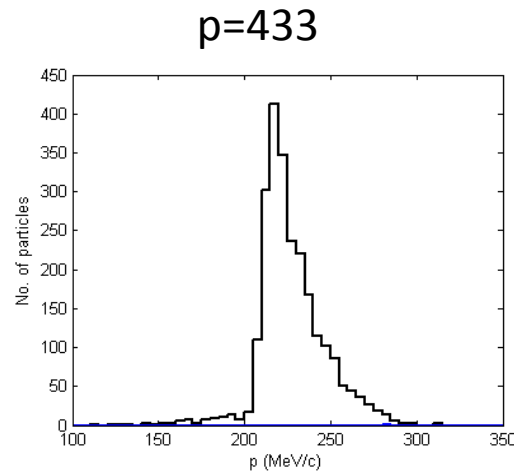
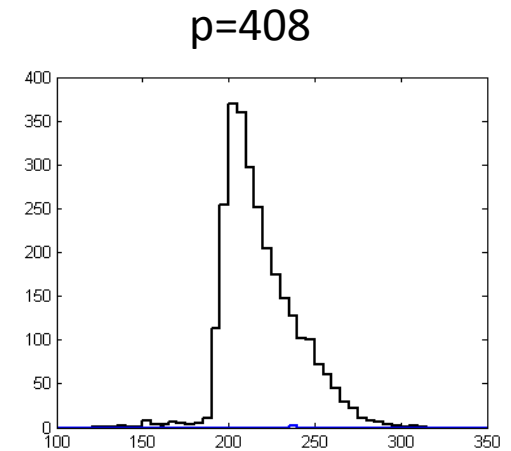
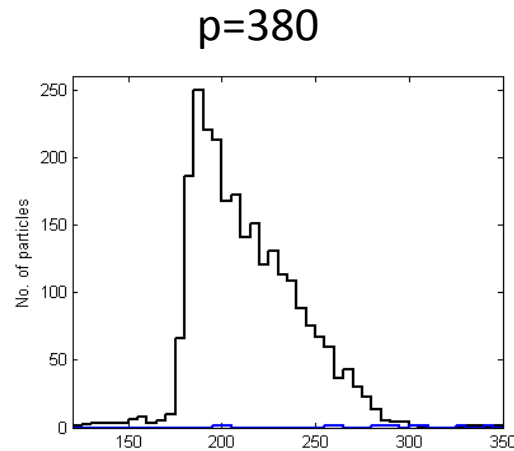
Momentum distribution at TOF1

- Black= μ^+
- Blue= π^+



Momentum distribution at TOF1

- Black= μ^+
- Blue= π^+



Statistics

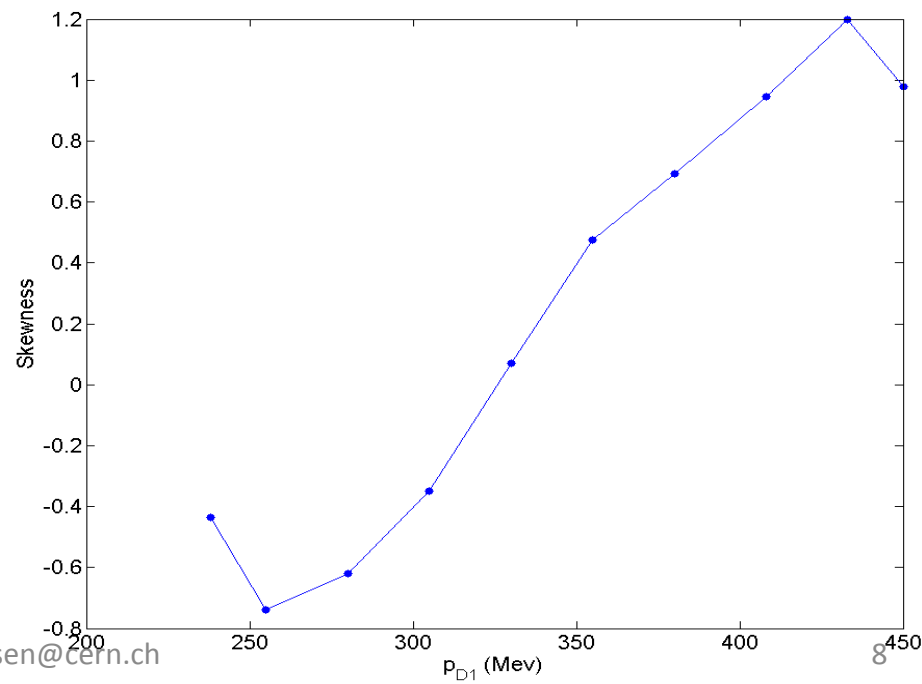
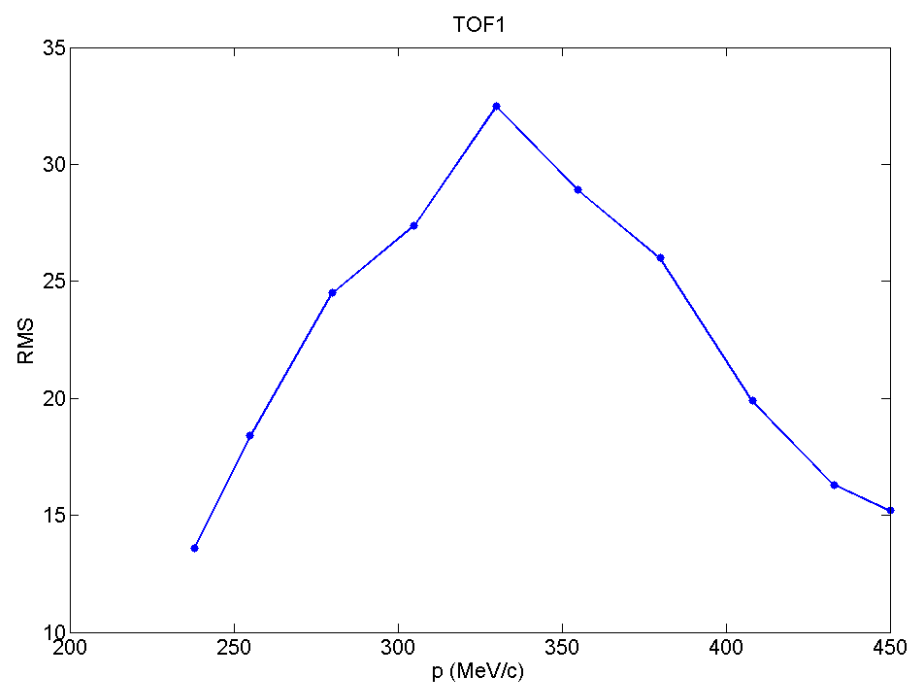
- We want $s=0$
- Low background when $p > 280 \text{ MeV}/c$

$$s = \frac{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^3}{\left(\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2\right)^{3/2}}$$

p (MeV/c)	# of particles at TOF1					From p-distribution		
	mu+	pi+	e+	gamma		Skewness	RMS	mean p
450	1510	12	12	24		0.9791	15.2	237.8
433	2391	5	20	45		1.2	16.3	230.4
408	2814	3	19	48		0.945	19.9	219.6
380	2543	12	12	30		0.692	26	214.4
355	2051	24	17	25		0.476	28.9	212.4
330	1592	23	33	57		0.072	32.5	217.3
305	1478	9	54	86		-0.349	27.4	219.2
280	1800	441	136	329		-0.62	24.5	222.2
255	2268	1470	685	1389		-0.738	18.4	209
238	2852	2391	1226	2054		-0.434	13.6	199.3

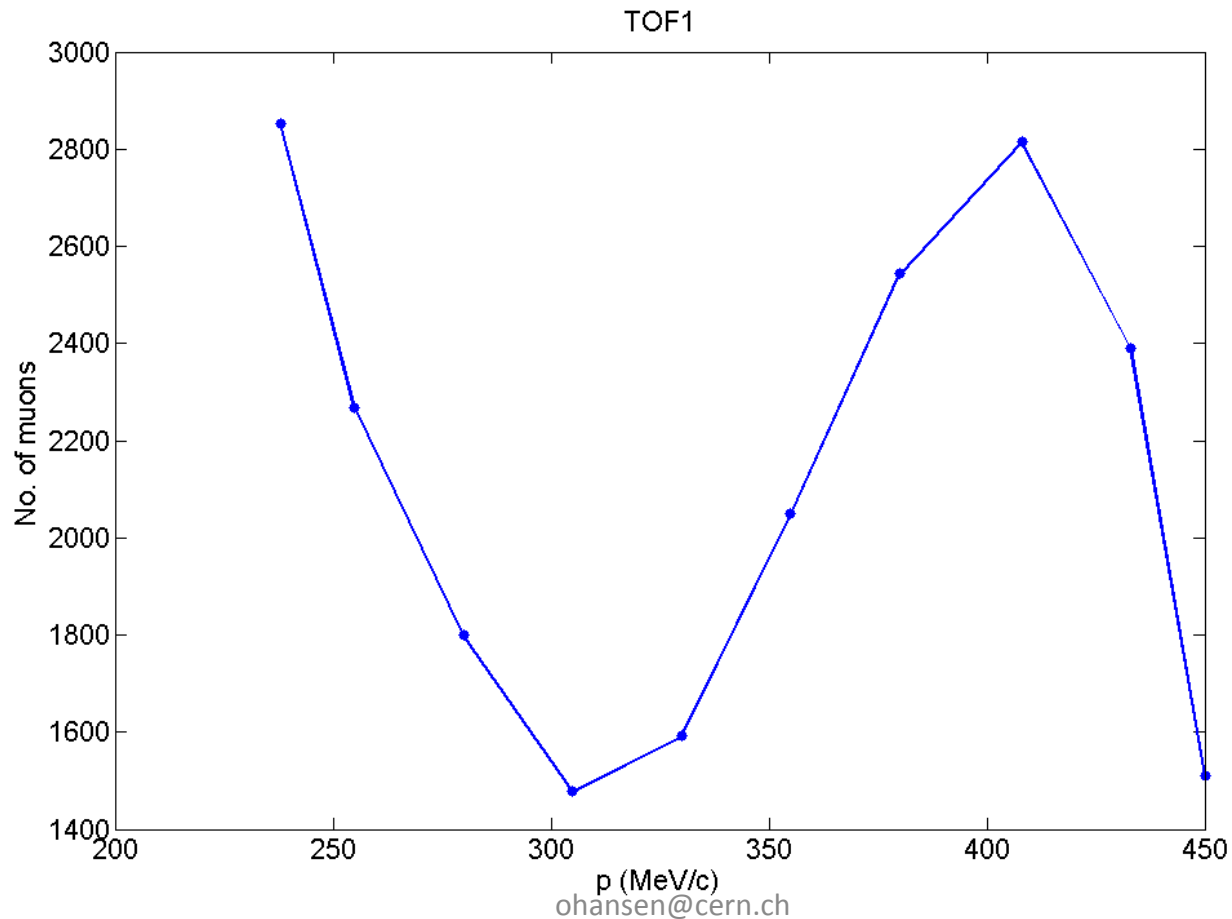
Skewness vs RMS

**With symmetrical beam
($s=0$)
we get a
wider
momentum distribution**



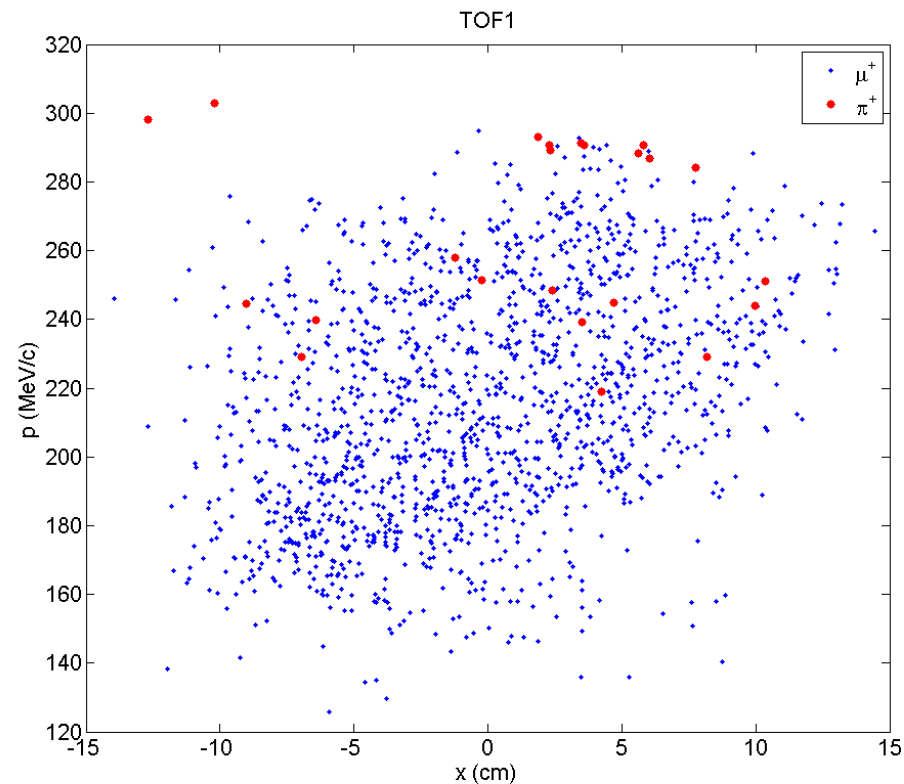
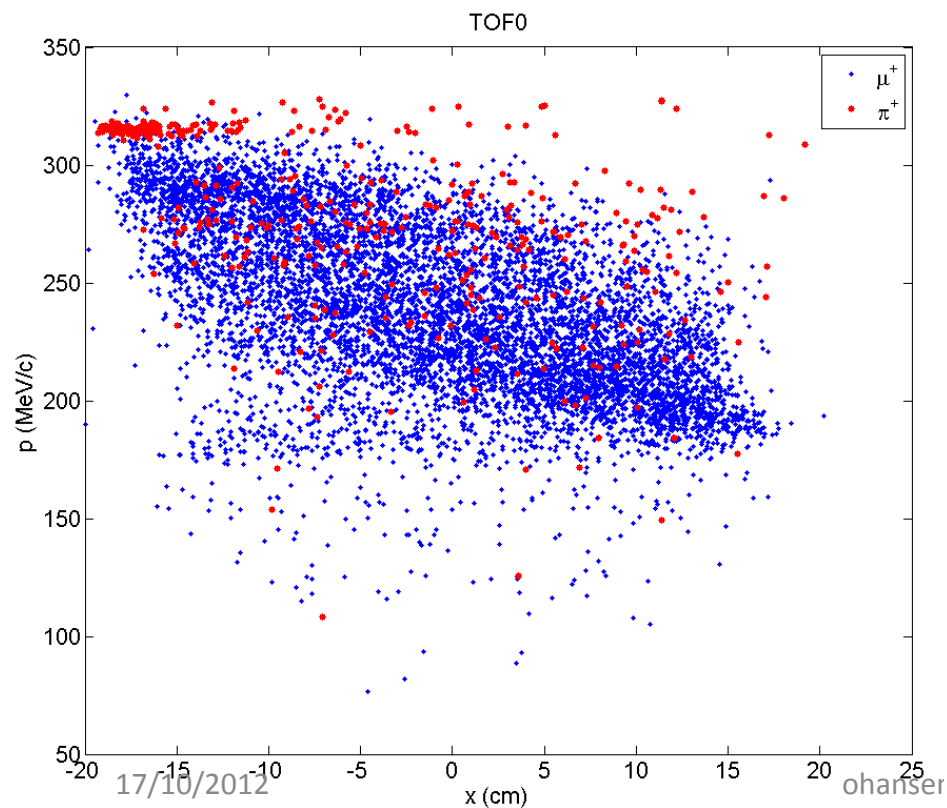
Muon count at TOF1

- We also have fewer muons at TOF1



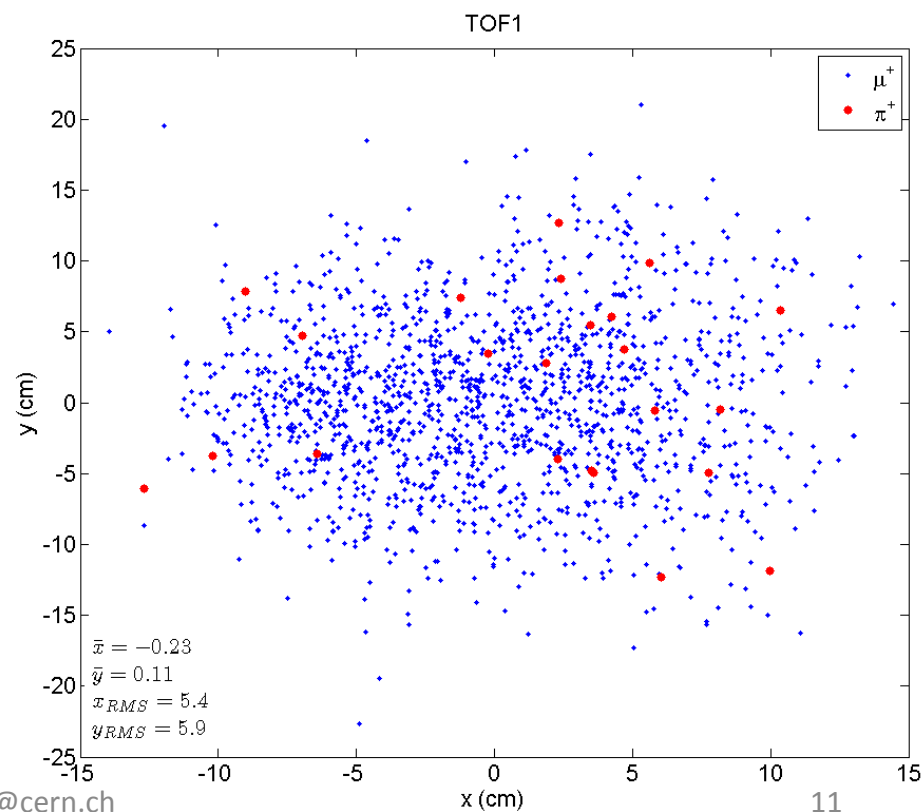
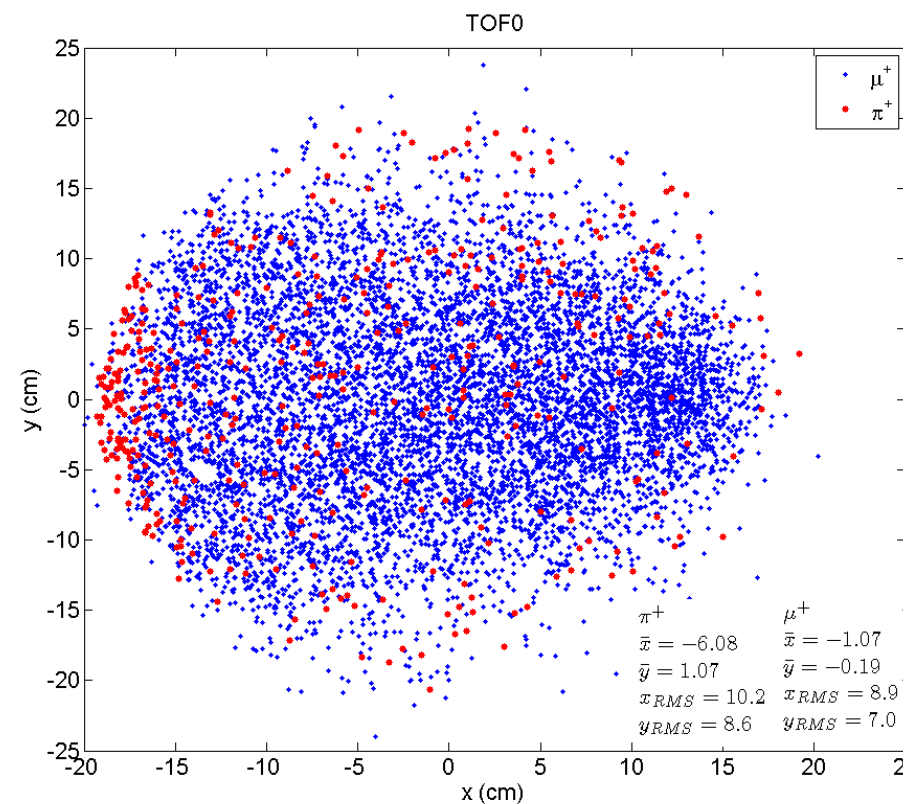
Momentum vs position after D2 ($P_{D1}=330 \text{ MeV/c}$)

- Higher momentum muons and pions at the lower part of TOF0.
- Lower momentum muons at upper part of TOF0



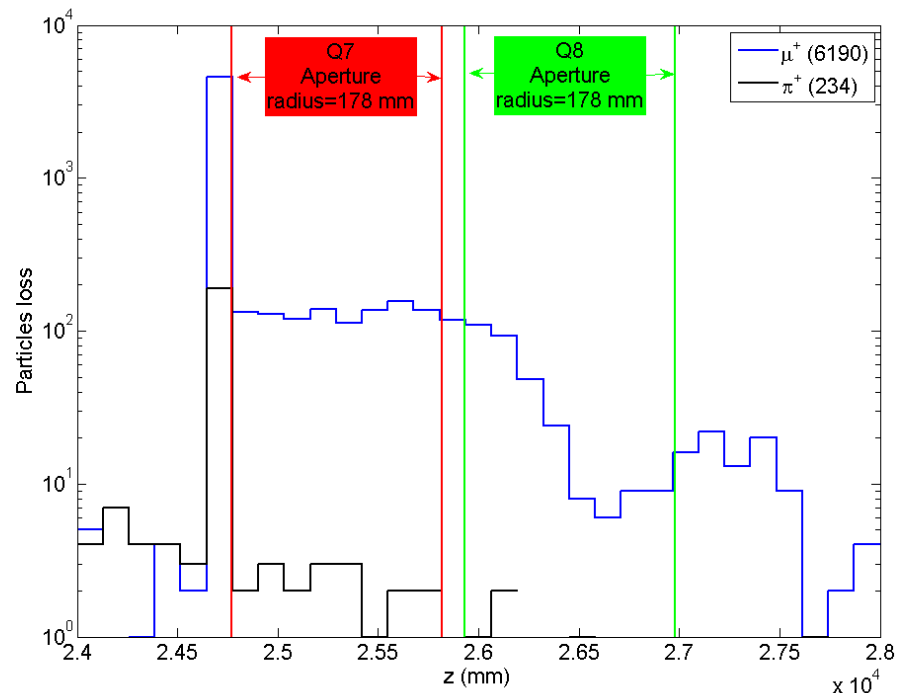
x-y plots at TOF0/1 ($P_{D1}=330$ MeV/c)

- Pions are found in the lower part of the x-position at TOF0.



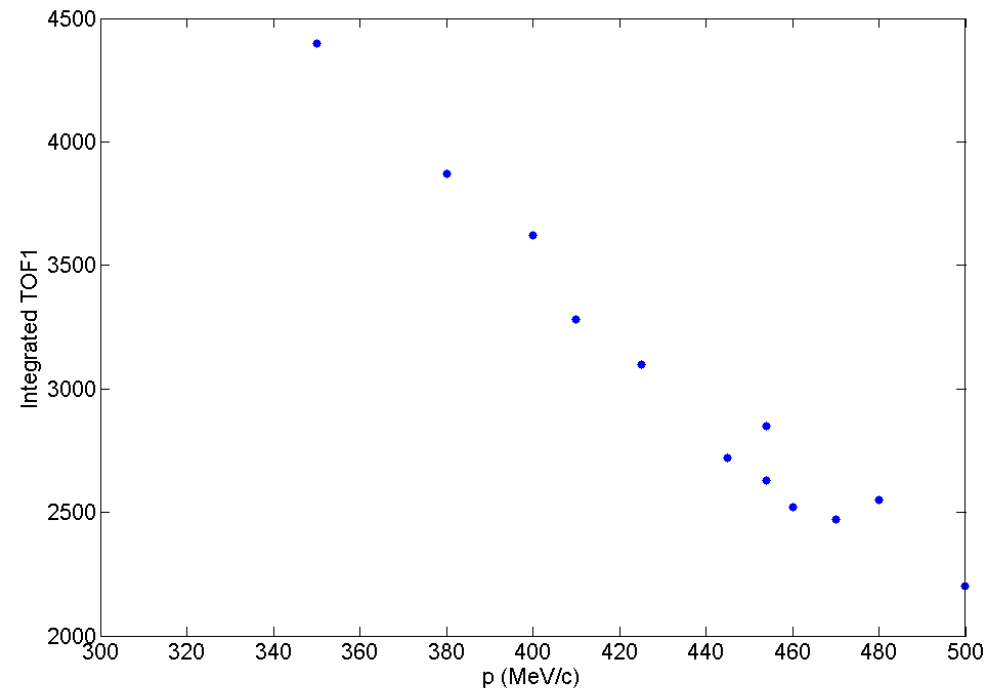
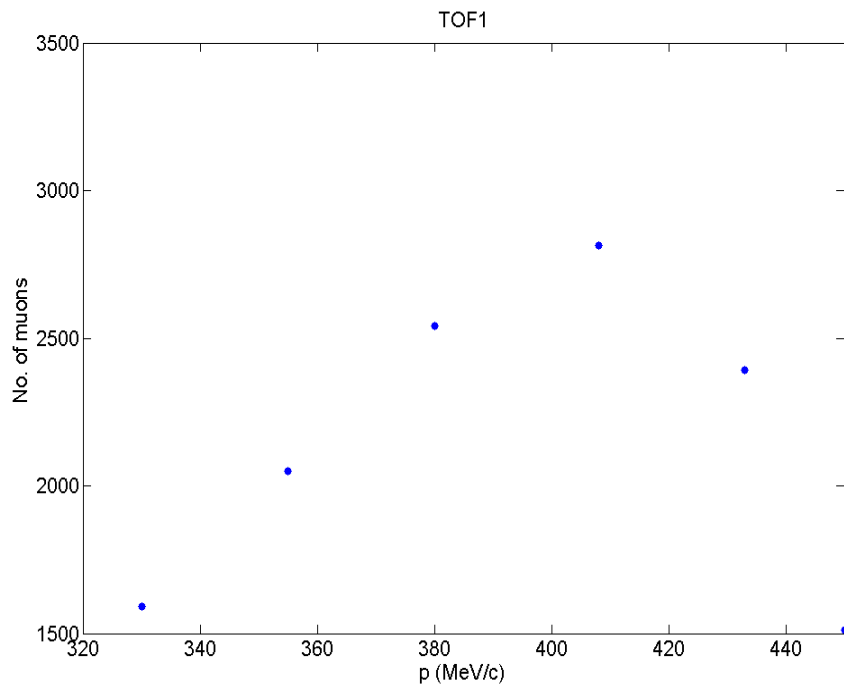
Particle loss

- TOF0: 7750 μ^+ and 422 π^+
- TOF1: 1592 μ^+ and 23 π^+
- ~80 % of muons lost, hits aperture of Q7, Q8 and Q9.



MICE data vs simulations

- Difference between simulations and MICE data
- Preliminary, needs to be analysed

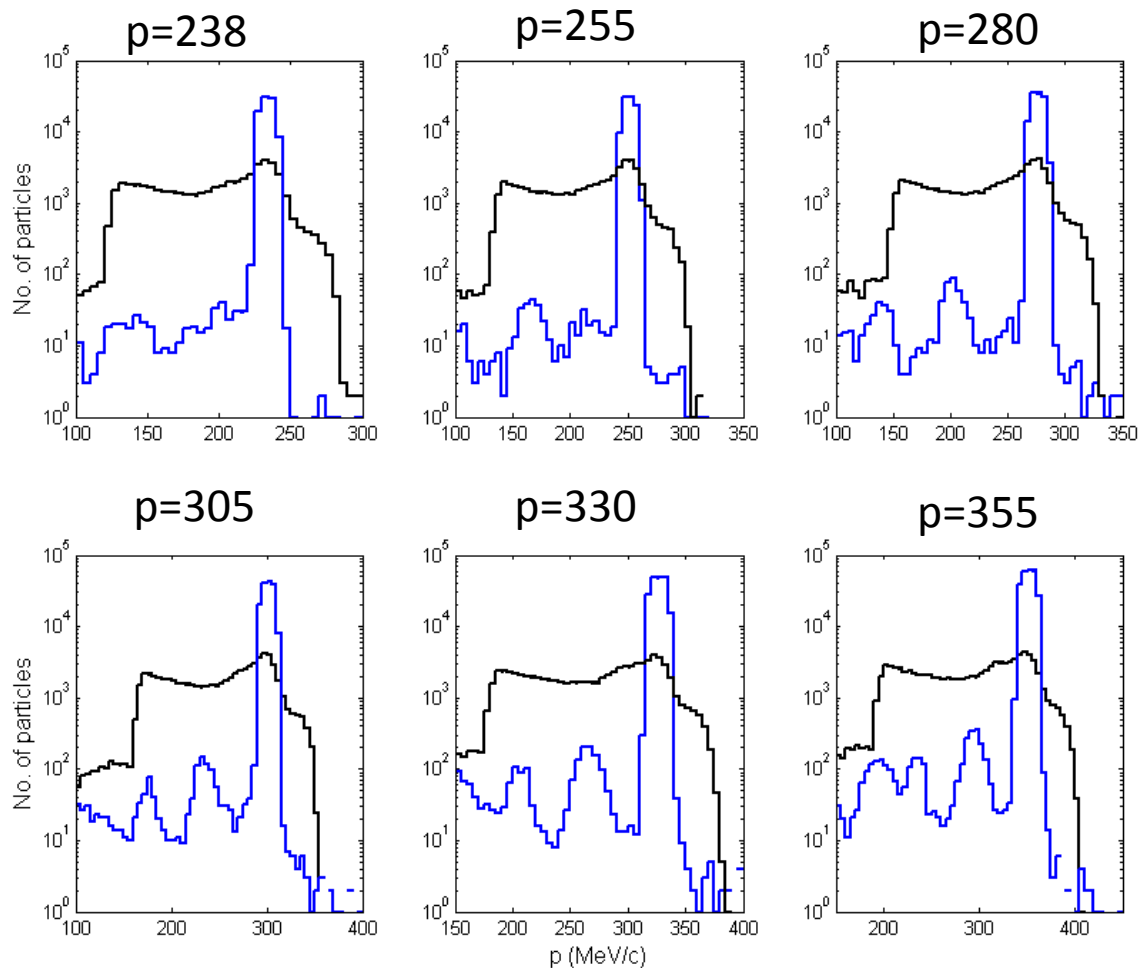


Conclusion

- We get a symmetric p-distribution when $p_{D1}=330$ MeV/c (and $p_{D2}=238$ MeV/c), similar to the p-distribution found in Study2.
- The p-distribution is also wider and has fewer muons
- Next step: Explain the difference between MICE data and simulations

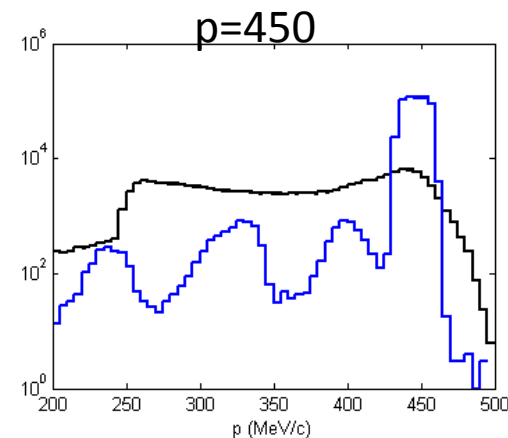
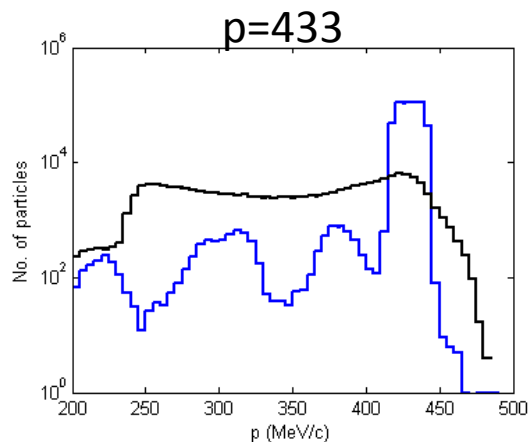
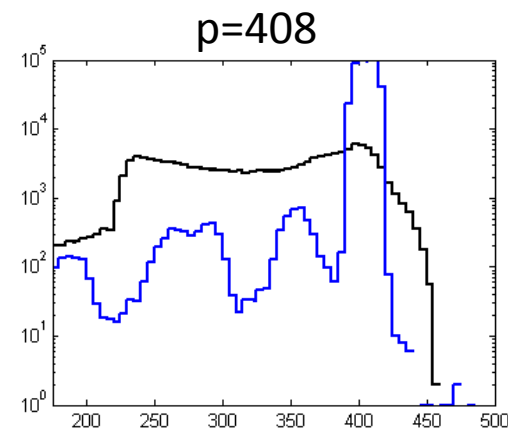
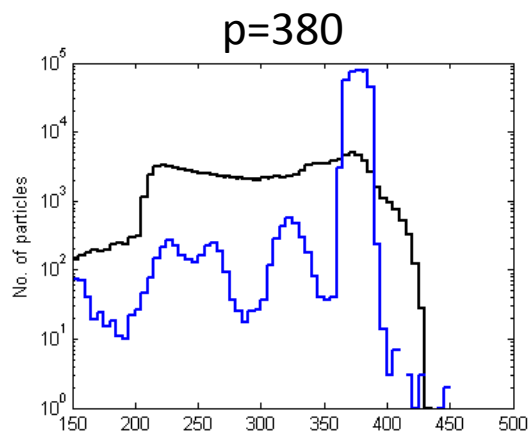
Mu+/Pi+ distributions

- We select the pion momentum with D1 and let them decay in the decay solenoid and analyze the particles when they exit the solenoid.
- Black=mu+
- Blue=pi+
- z=14740mm



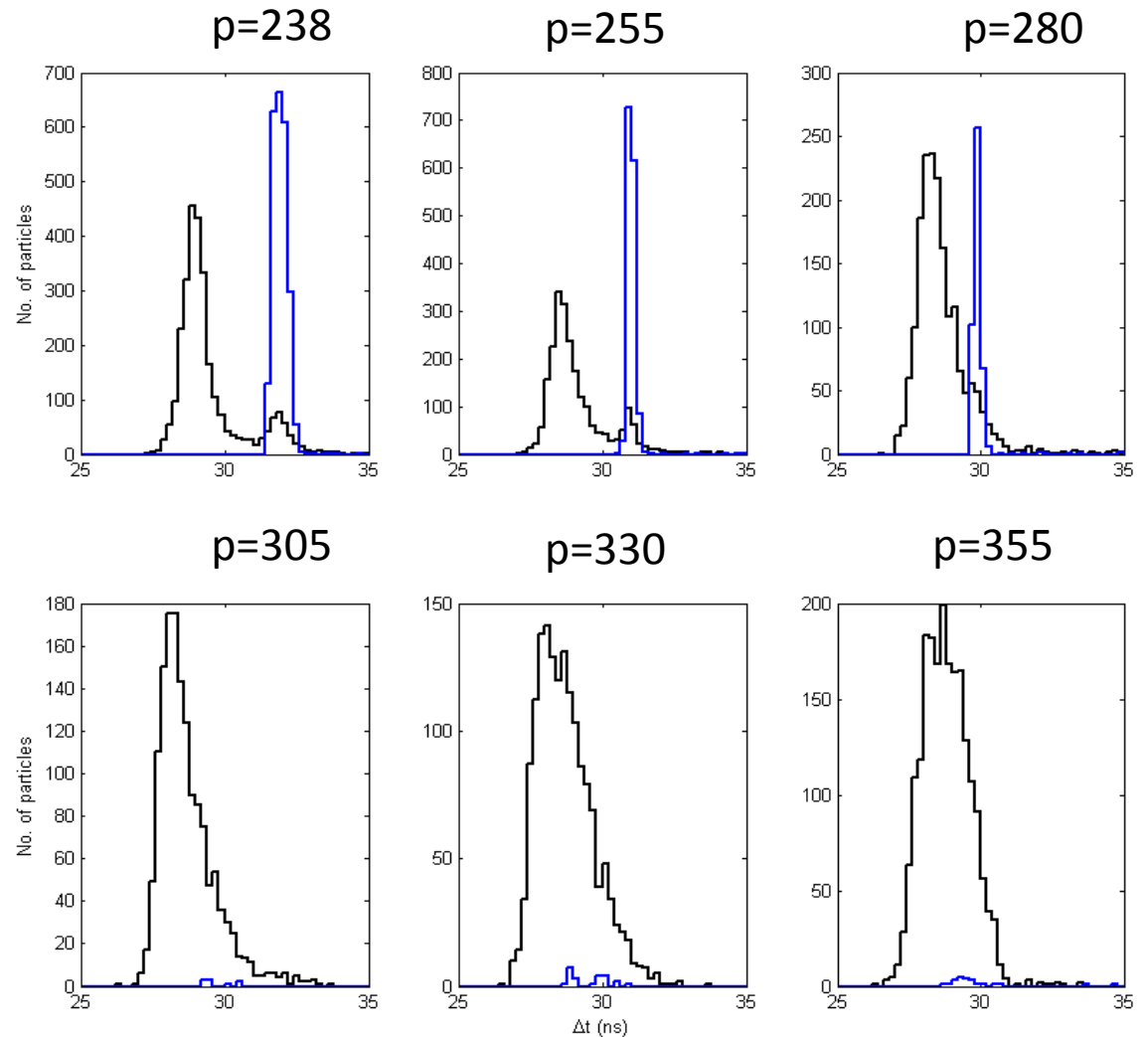
Mu+/Pi+ distributions

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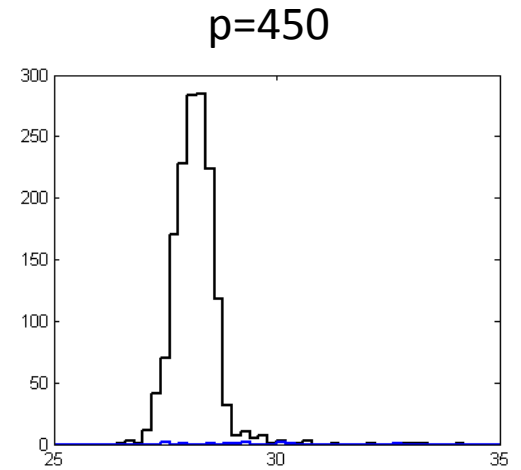
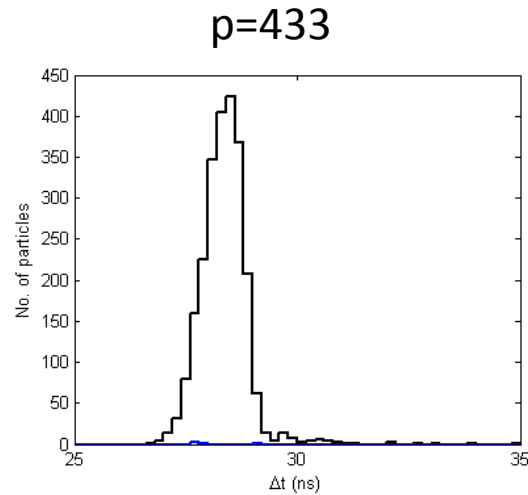
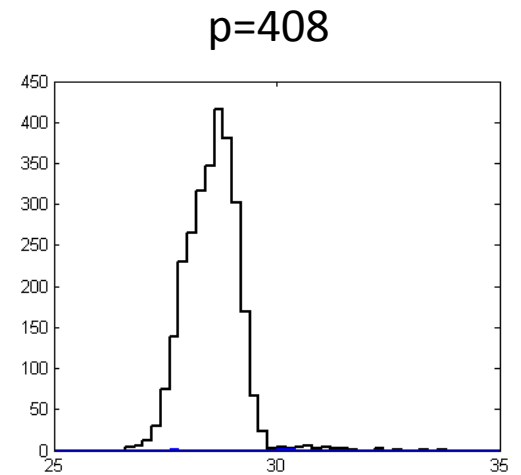
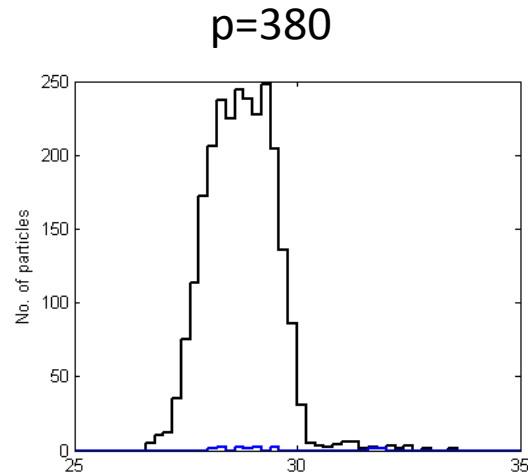
TOF distribution

- Black= μ^+
- Blue= π^+



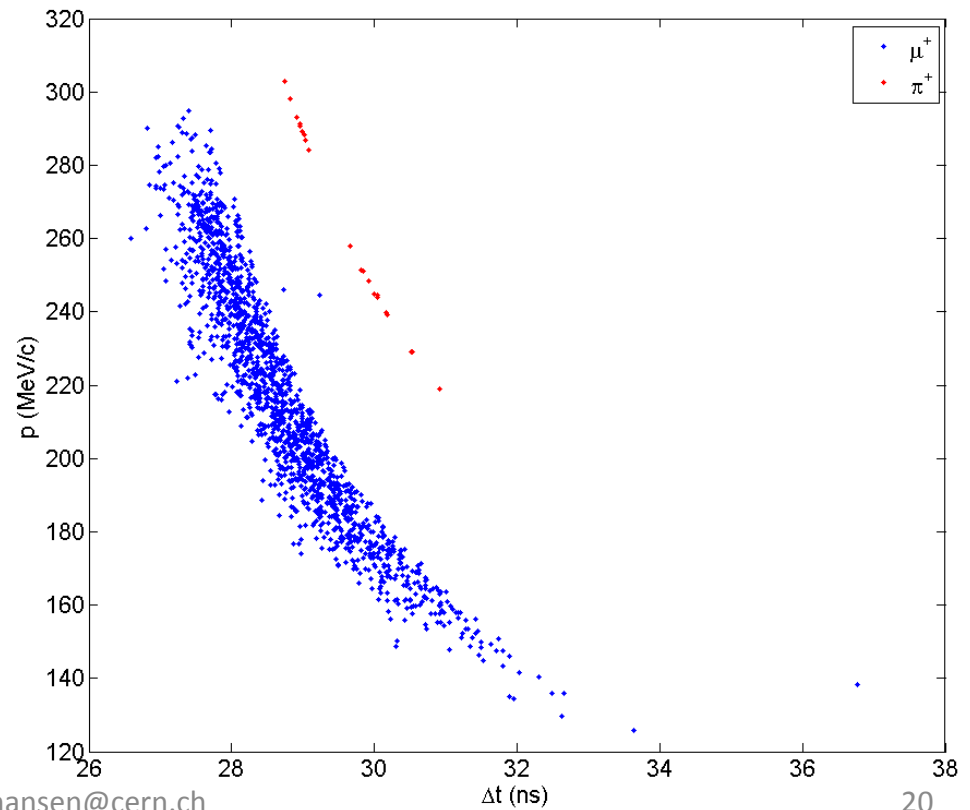
TOF distribution

- Black= μ^+
- Blue= π^+



$$P_{D1} = 330 \text{ MeV}/c$$

- Momentum at TOF1 and Δt (TOF1-TOF0)
- Easy to separate muons and pions



Momentum vs position ($P_{D1}=330 \text{ MeV/c}$)

- Pions have higher momentum than muons

