Studies of DEPFET performance with $B \longrightarrow D^* D^*$ decay channel

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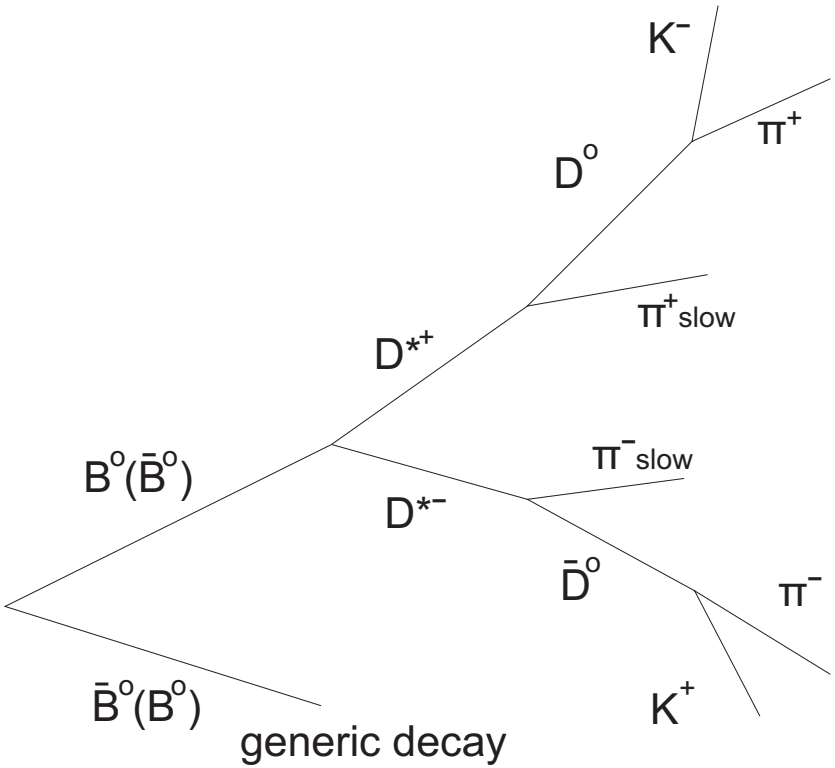
Ringberg DEPFET Meeting, 03.05.2010

Outline

Benchmark study

- Simulated decay channel: $B \longrightarrow D^* D^*$ (generic decay for other B)
- Simulation and reconstruction performed within the ILC-Framework (simulation with Mokka, reconstruction with Marlin)
- D^0, D^*- and B-reconstruction without vertex fit



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Main goals

Belle II

- Compare the performance of different geometry models of the PXD design
- Look especially on the soft pion from the D^* decay (p_t <0.2 GeV)
- Particularly interesting and presented here: comparison of different detector thicknesses
- New models compared to baseline design: 50μm thickness, 1600 pixel, 14 mm radius

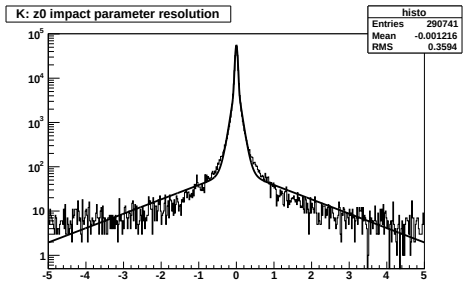
New since B2GM

- Prague release of the ILC-software
- Improved fits for the determination of the impact resolution parameters
- New geometry models (100 μm and 150 μm thick detector)

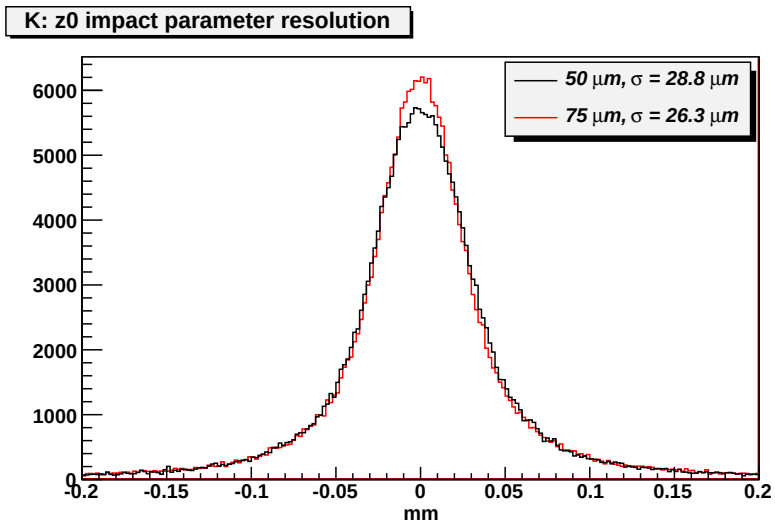
Resolution: kaon

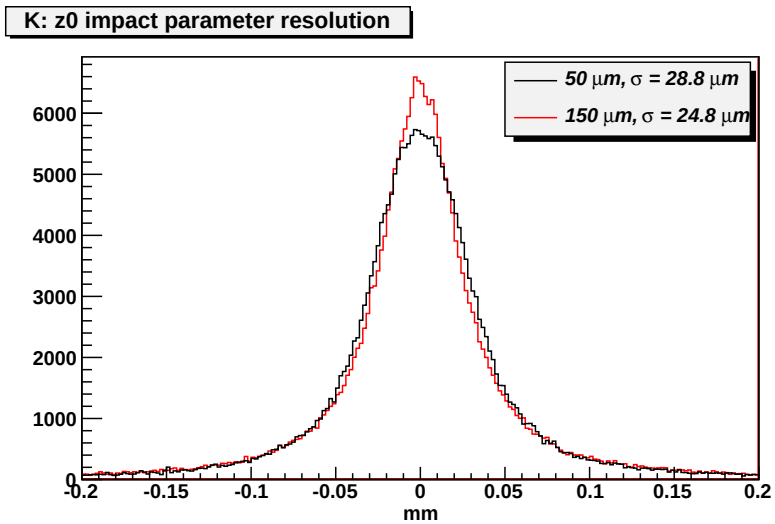
z0 impact parameter resolution for a fast (K from D^0 decay) track

Resolution=Width of the central gaussian

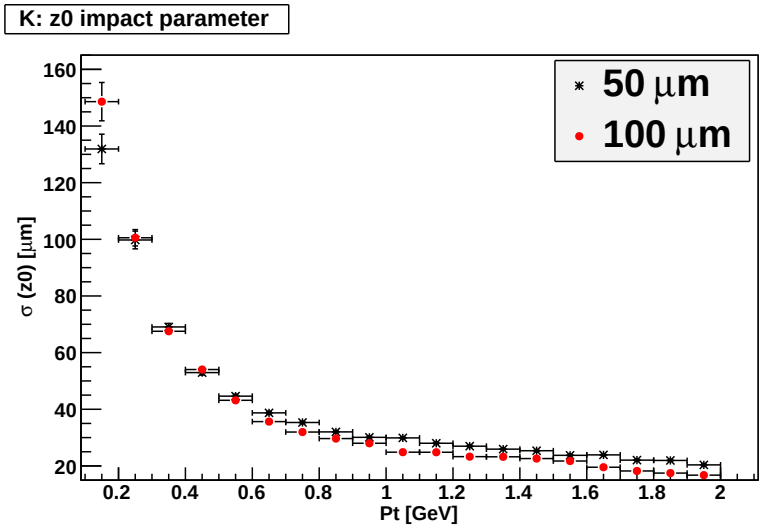


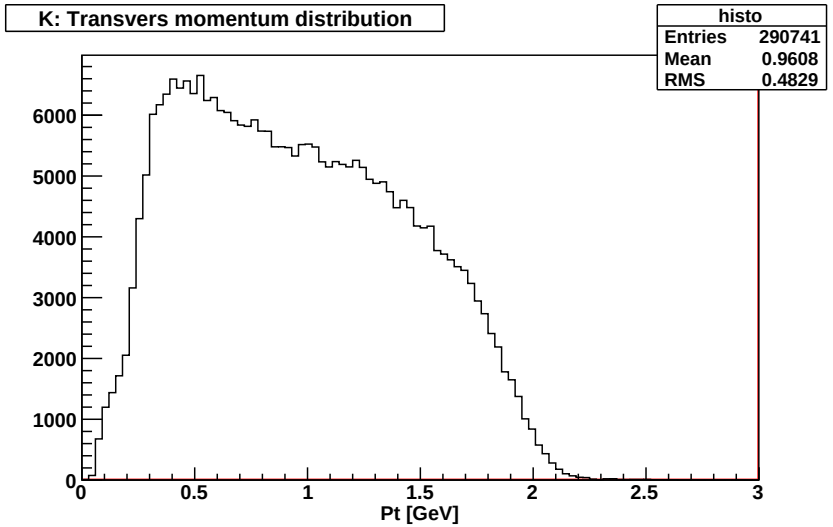
Compare this width for $50\mu m$ sensor to thicker sensor

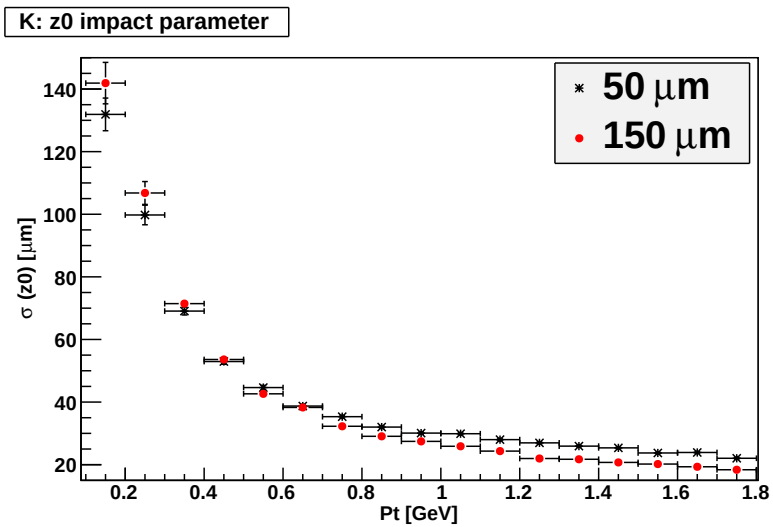




Resolution over P_t: kaon

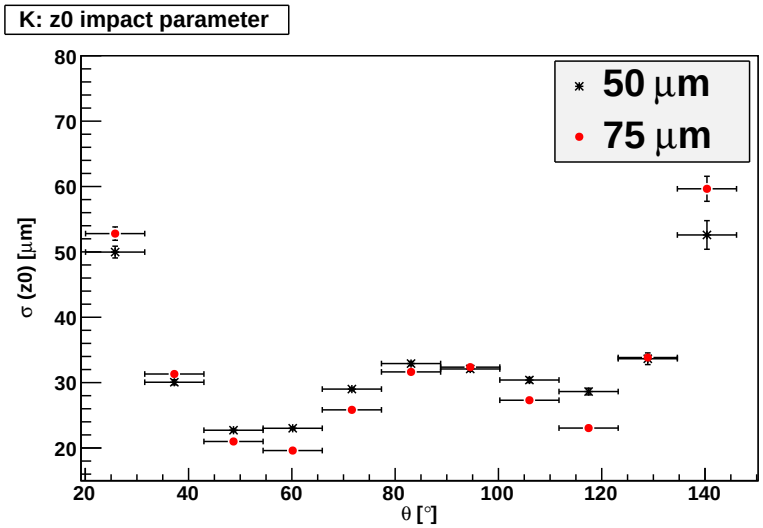


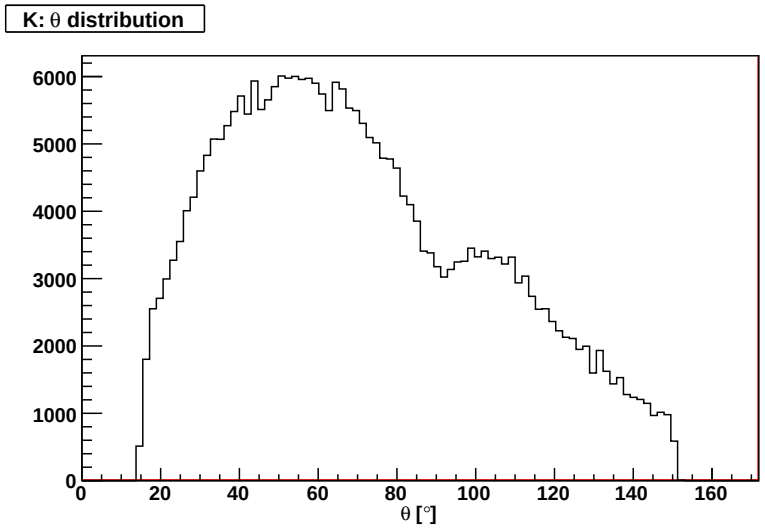


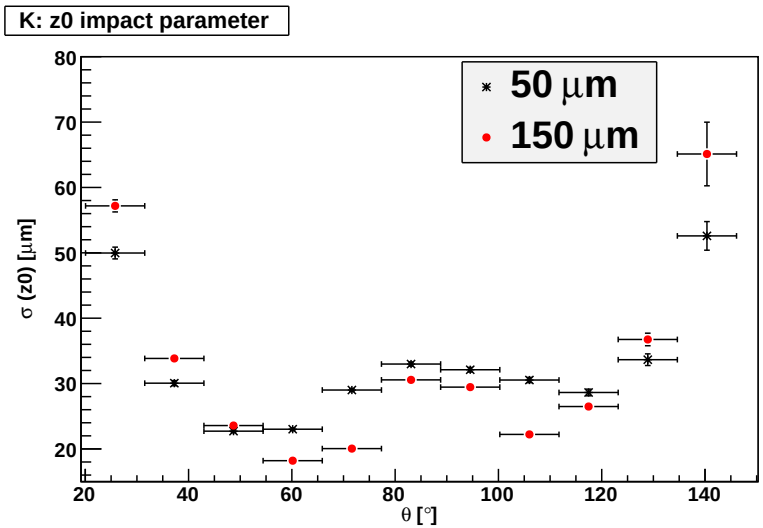


Thick sensors provide a better resolution for $P_t > 0.4$ GeV $\rightarrow$ large fraction of all kaons $\Rightarrow$ the overall resolution impoves despite of worse resolution for low P_t tracks

Resolution over θ: kaon





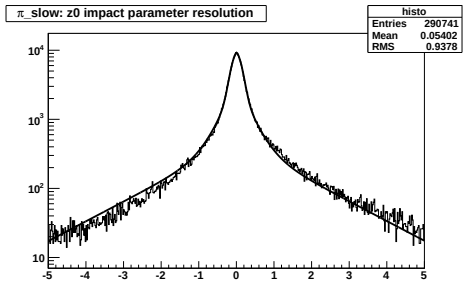


Thick sensors provide a better resolution for $50° < \theta < 130° \rightarrow$ large fraction of all kaons $\Rightarrow$ the overall resolution impoves

Resolution: soft pion

z0 impact parameter resolution for a slow (π_{soft} from D^* decay) track

Resolution = Width of the central gaussian



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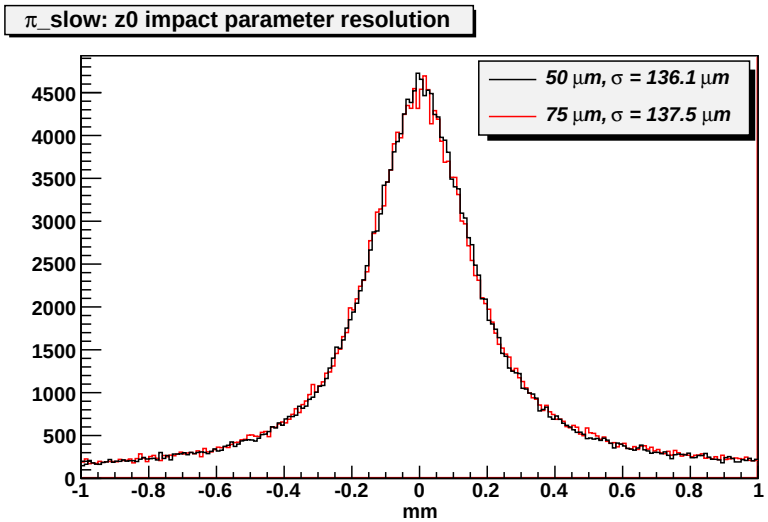
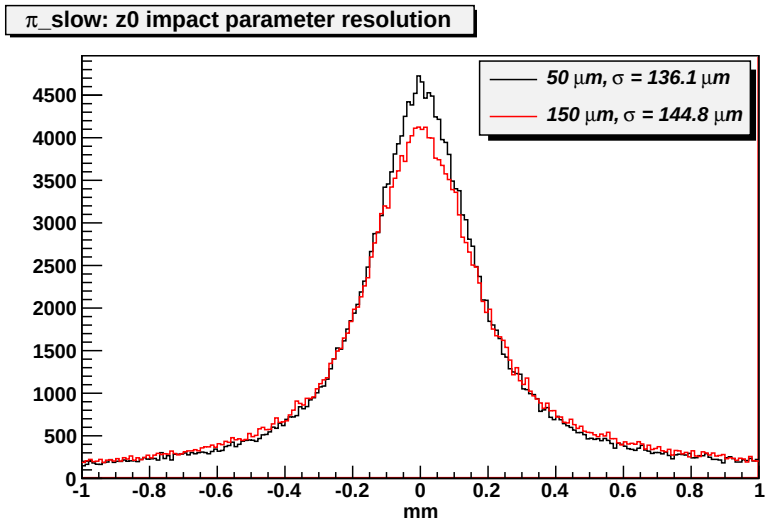
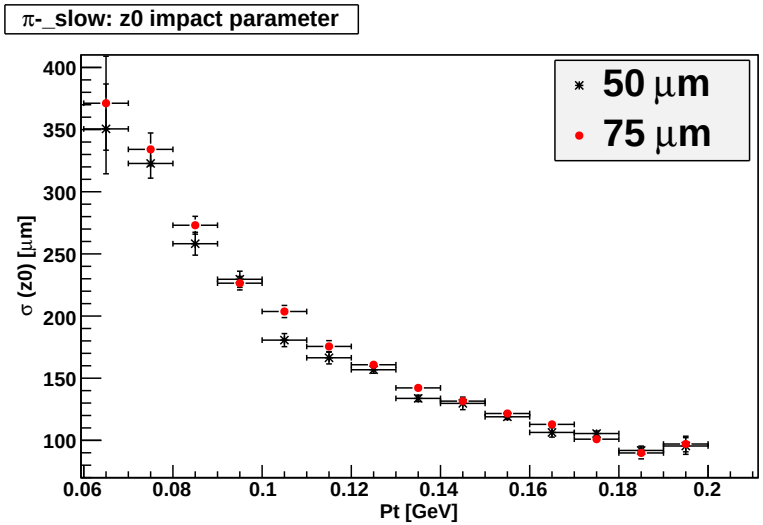
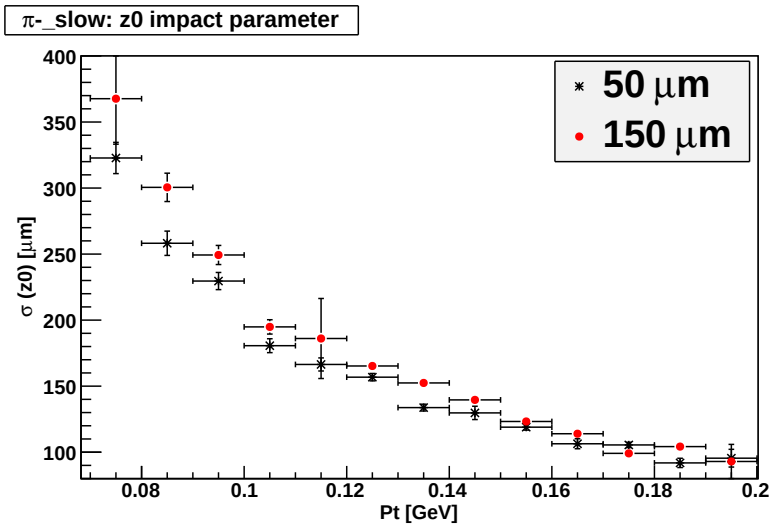
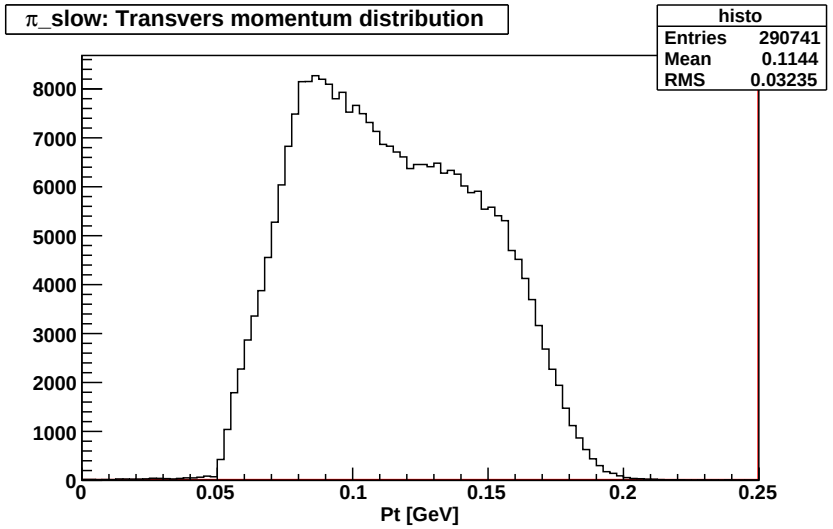




Resolution over P_t: soft pion

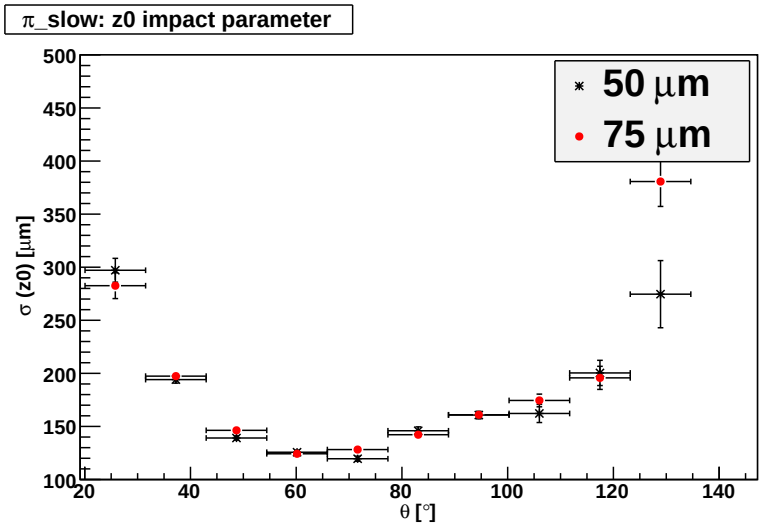


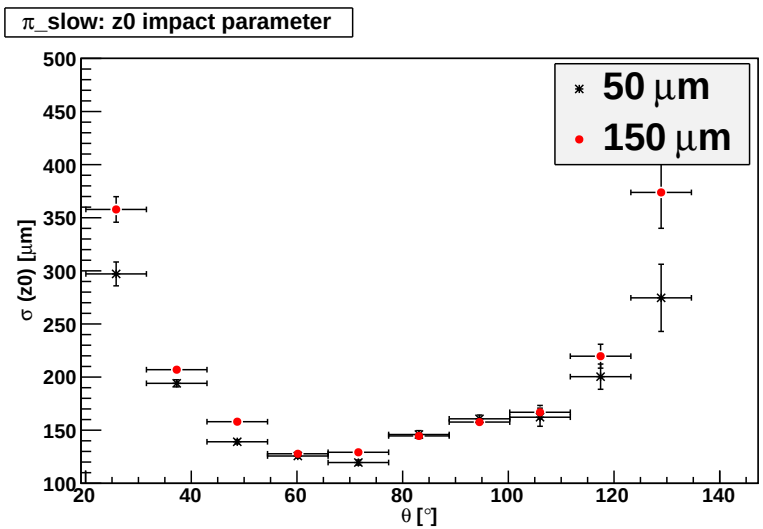


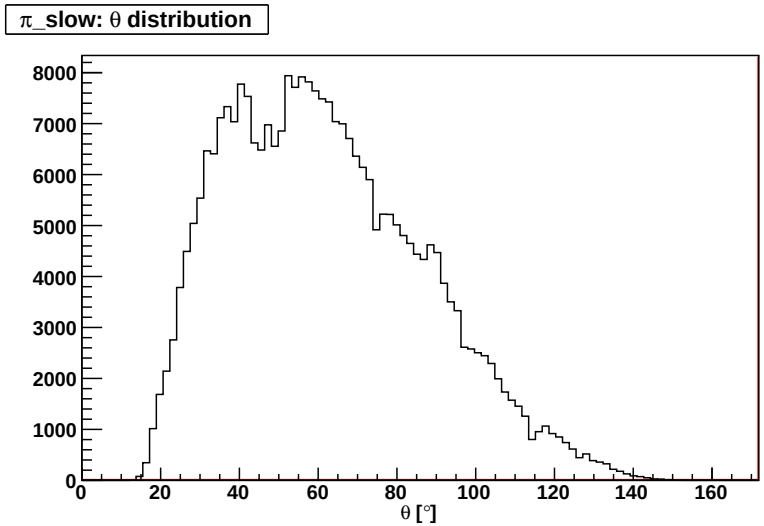


Very low momentum tracks $\rightarrow$ worse resolution for thick sensors over the whole P_t spectrum
Smaller impact on resolution in comparison to fast tracks for 75μm

Resolution over θ: soft pion



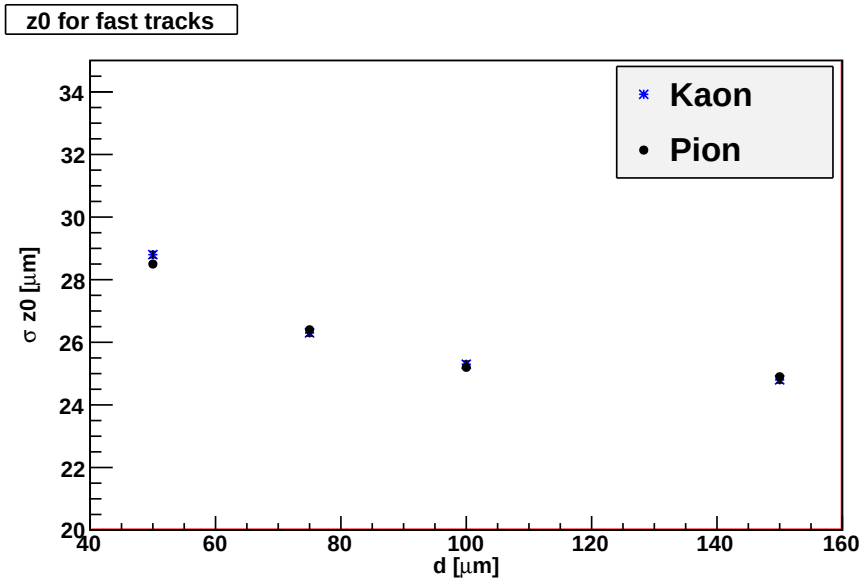


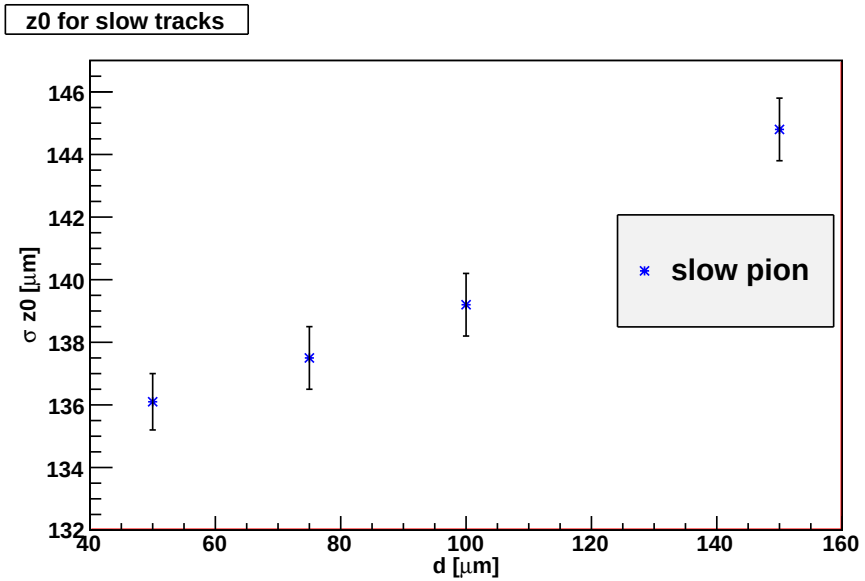


Worse resolution in forward and backward region for thicker sensors, nearly no influence in the central region

Resolution over the sensor thickness

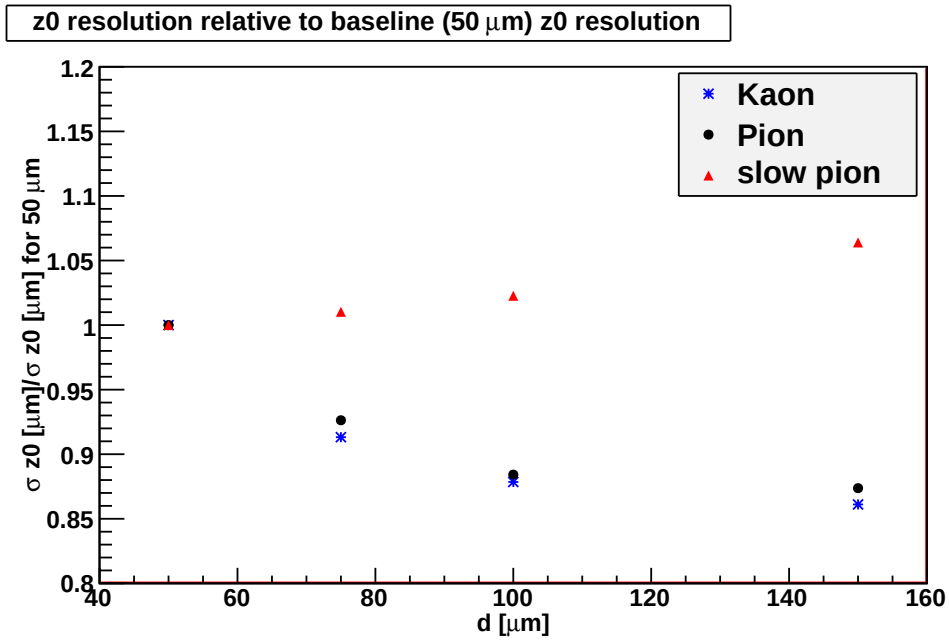
d [μm]	K z0	K d0	π z0	π d0	π_{soft} z0	π_{soft} d0
50	28.8	25	28.5	25	136.1	126.1
75	26.3	23.6	26.4	23.4	137.5	127.7
100	25.3	22.6	25.2	22.4	139.2	127.9
150	24.8	21.9	24.9	21.8	144.8	133.7

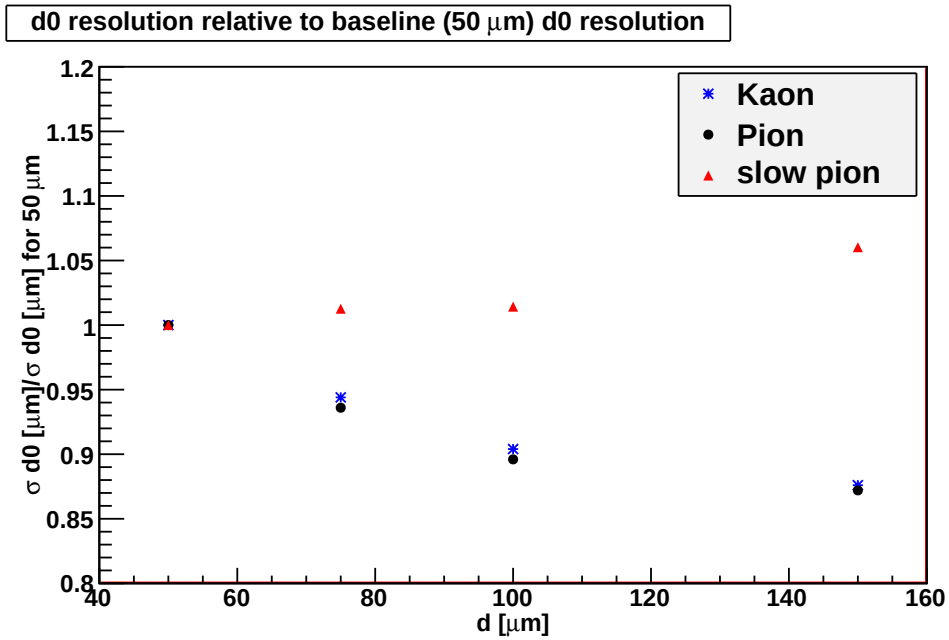




Summary

Resolution relative to baseline (50 μm) resolution:





$\Rightarrow$ Continuous improvement for fast tracks (biggest step between 50μm and 75μm, very small improvement above 100 μm)

$\Rightarrow$ No very big effect up to 75 μm (or even 100 μm) for soft pion, worser resolution for 150μm

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Conclusions

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- Study dedicated to optimize the detector thickness using D^* reconstruction was performed
- Resolution for kaon and pion from D^0-decay improves with greater thickness, especially up to 100μm ($\sim$ 12 %)
- Resolution for soft pion from D^*-decay becomes worse with greater thickness, but it is still a small effect up to 100μm ($\sim$ 2.3 %)

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Belle II

Thank you for your attention

Thanks to the MPI and Prague groups for their support

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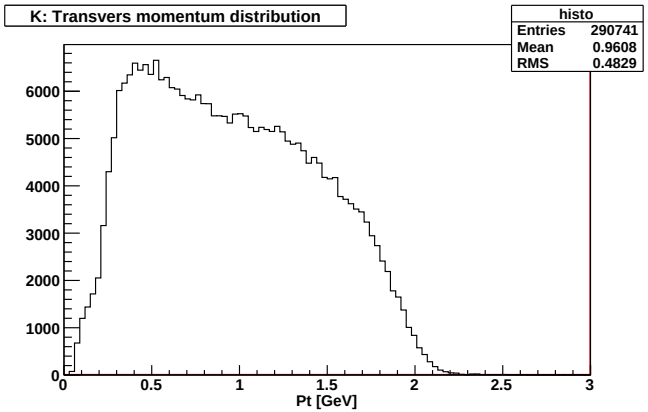
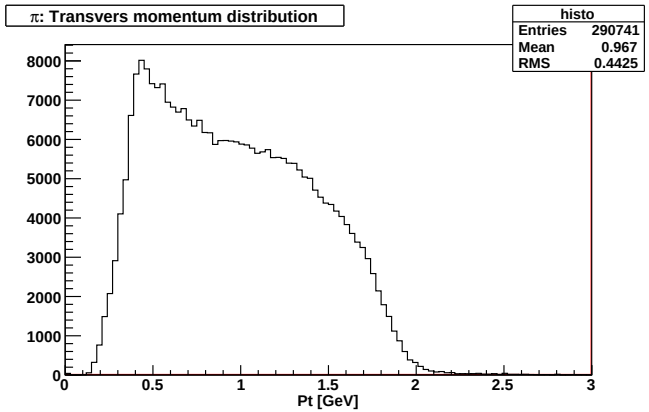
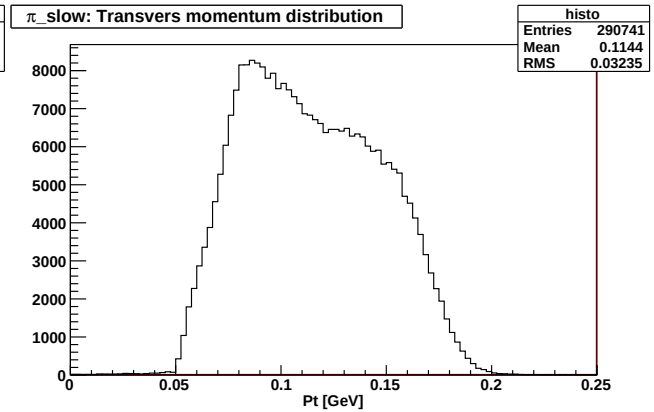
Belle II

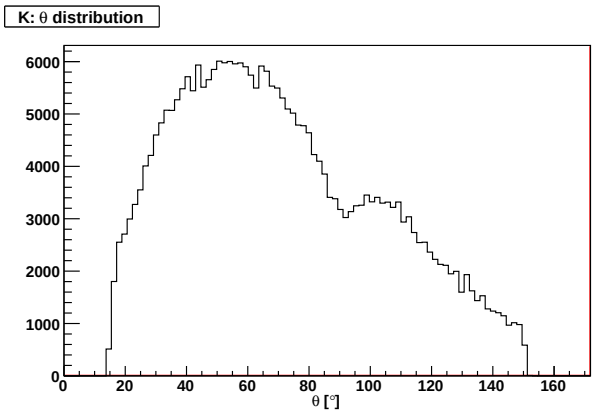
BACKUP

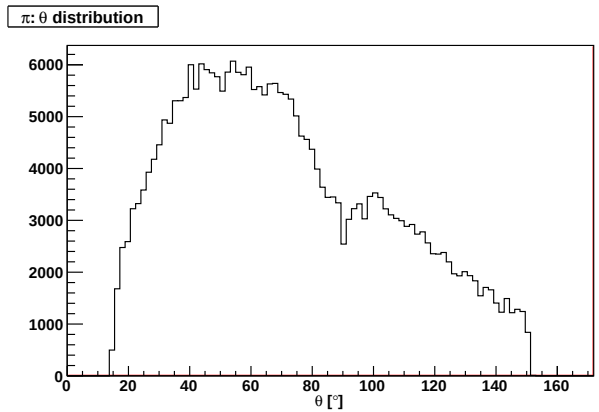
Pt and θ distributions

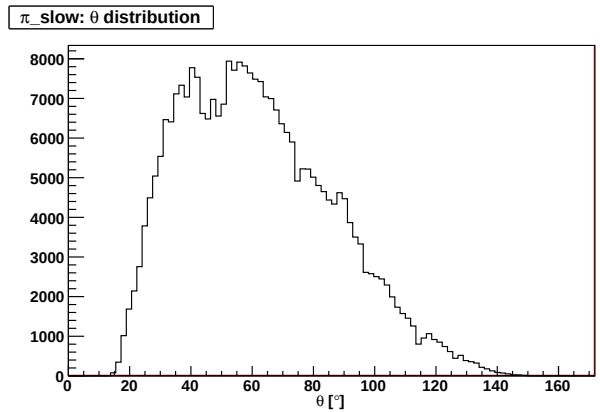




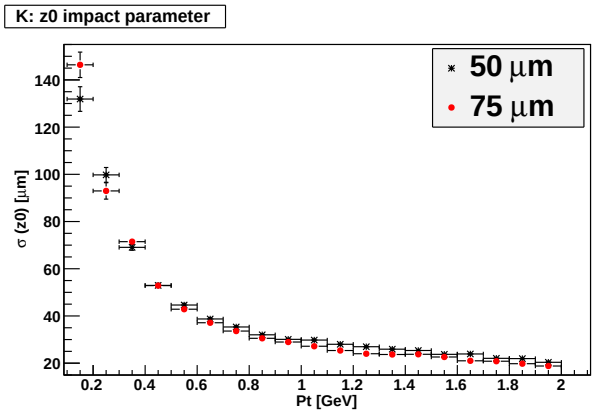


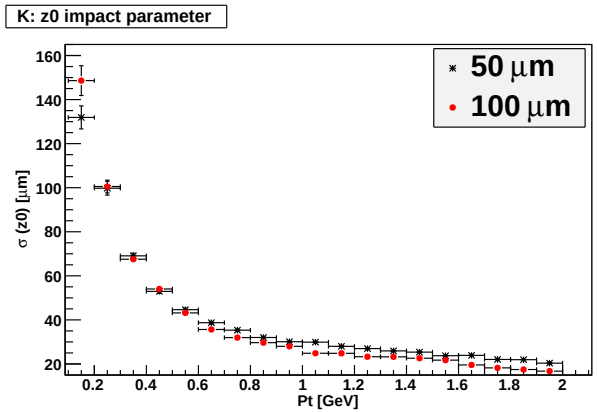


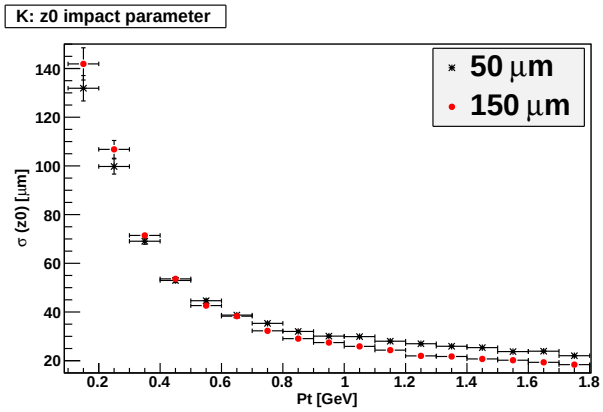


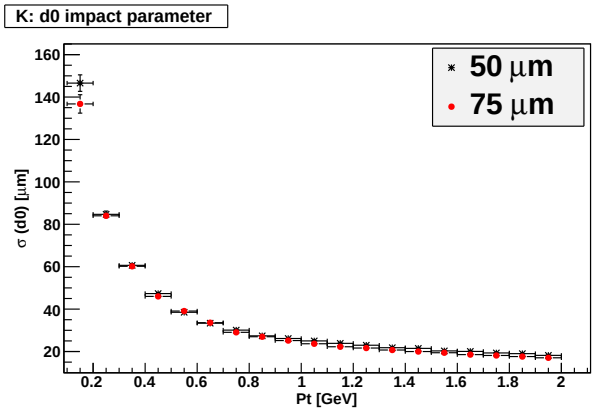


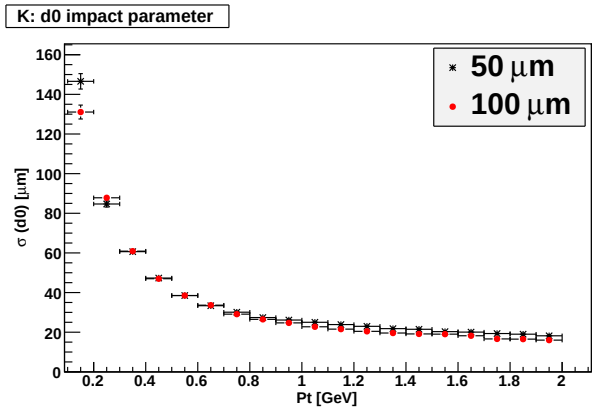
Kaon resolution over Pt

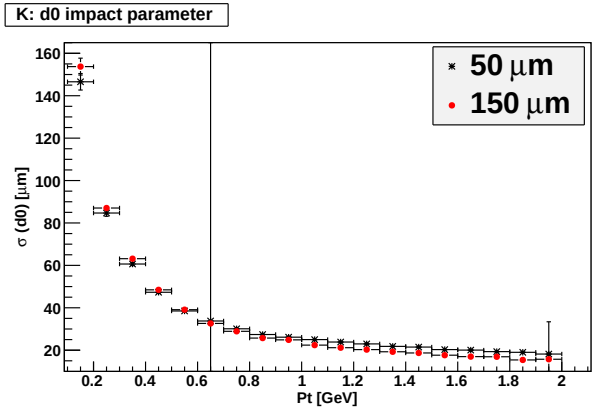




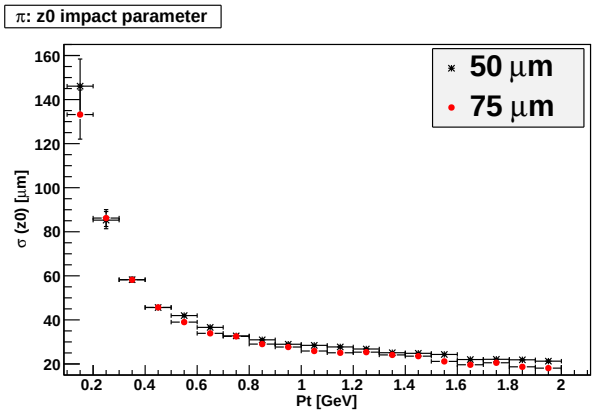


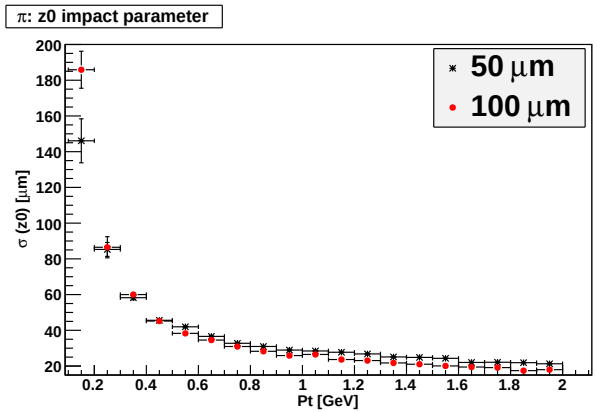


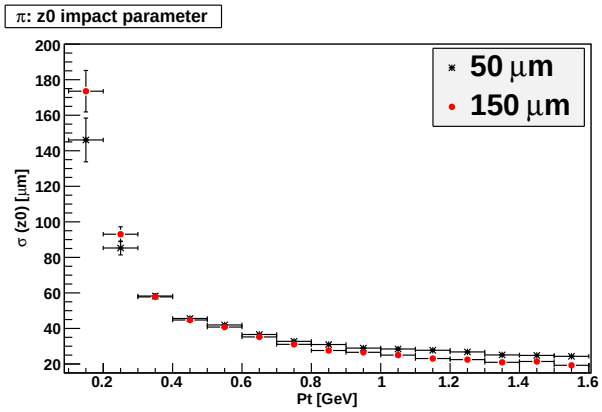


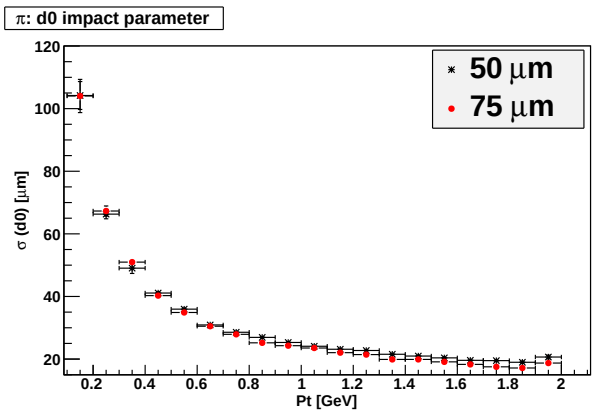


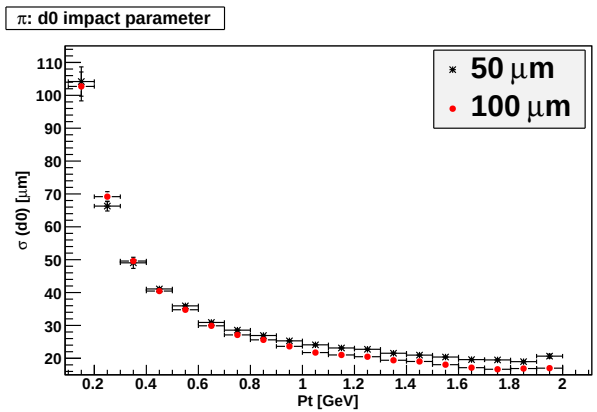
Pion resolution over Pt

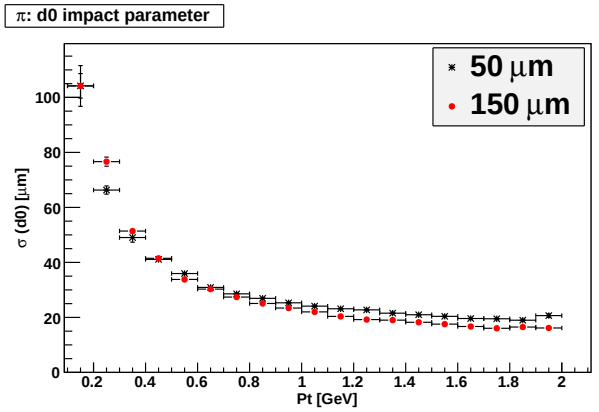




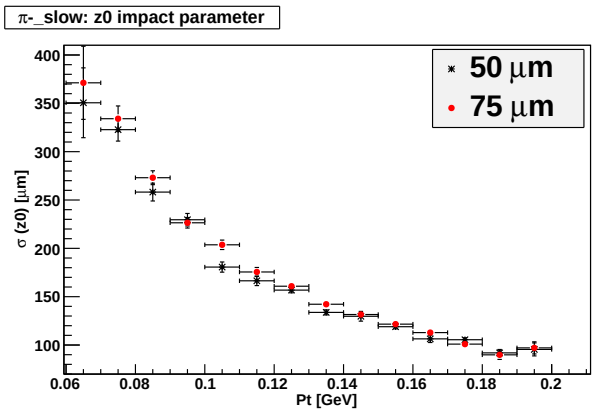


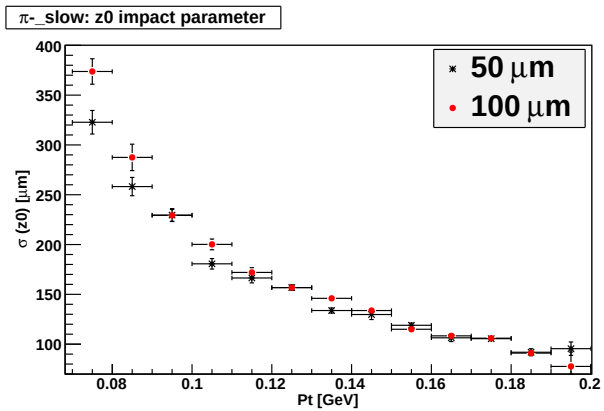


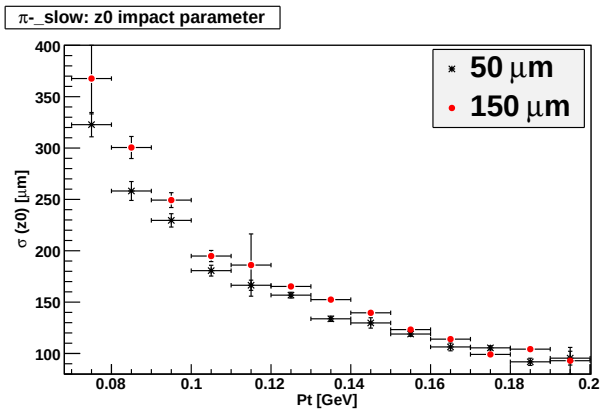


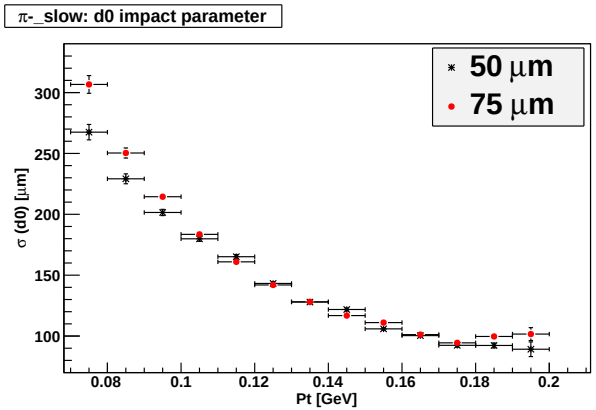


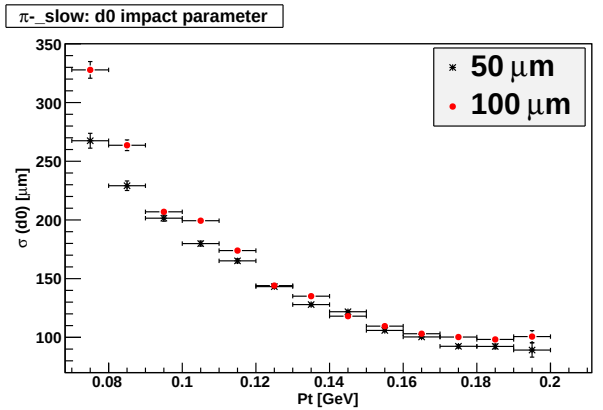
Soft pion resolution over Pt

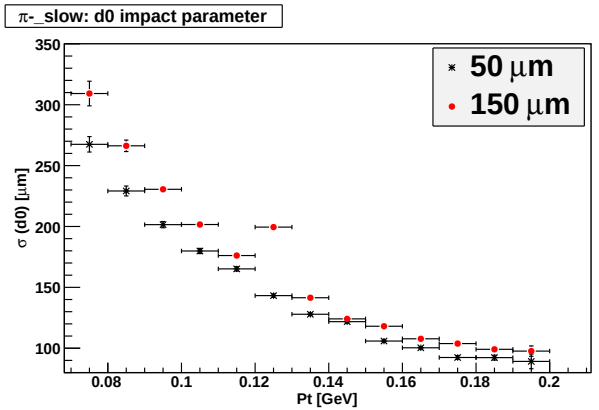




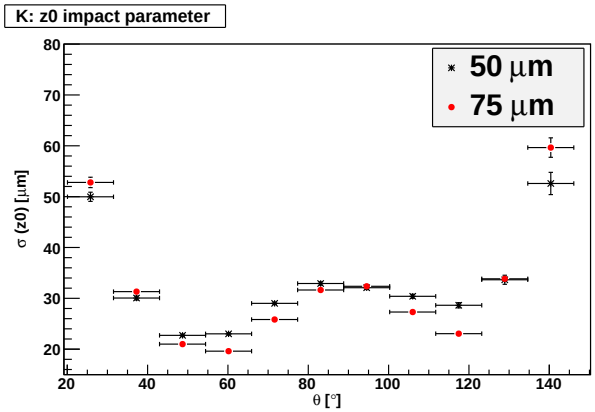


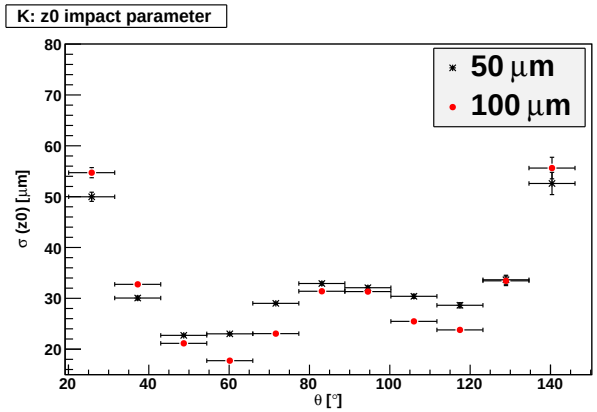


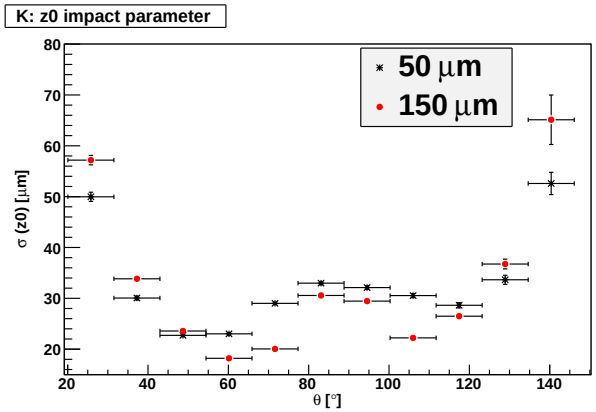




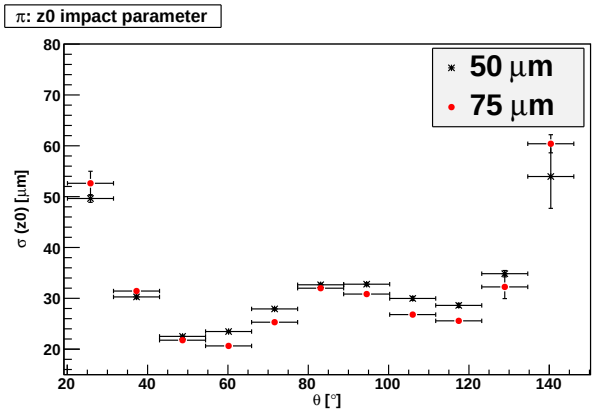
Kaon resolution over θ

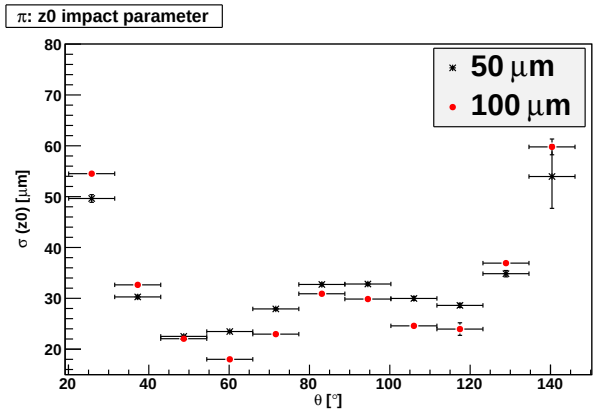


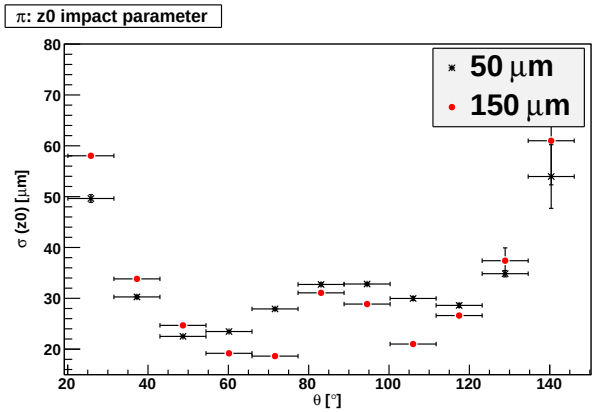




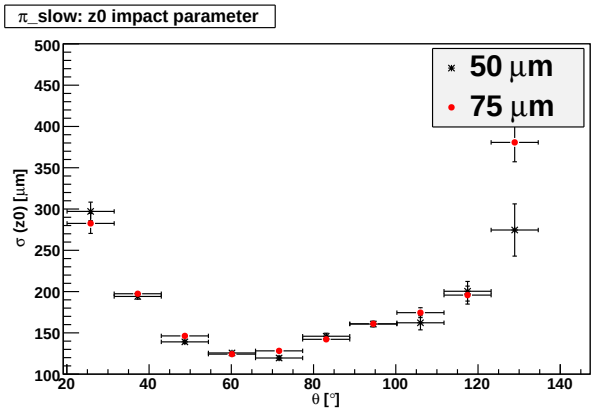
Pion resolution over θ

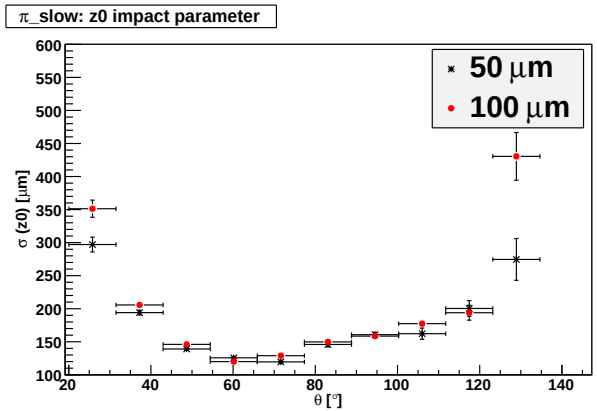


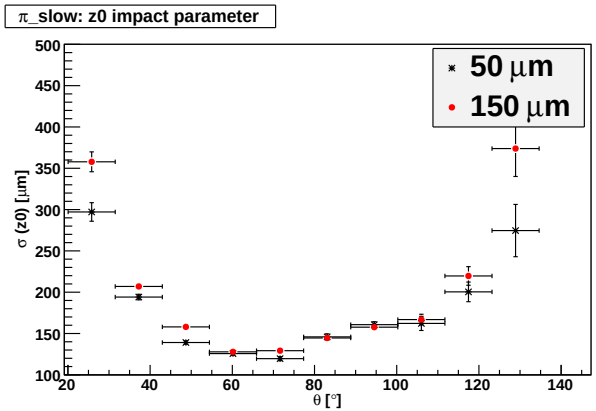




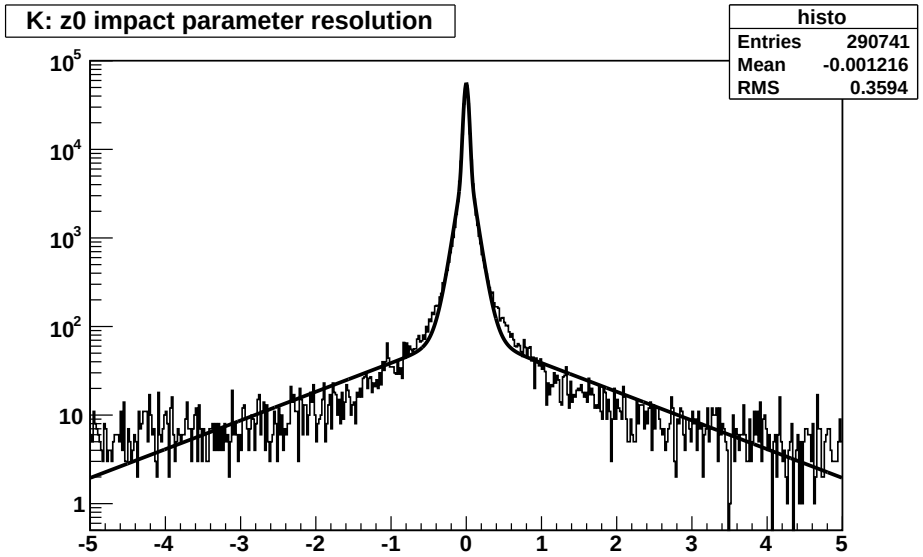
Soft pion resolution over θ

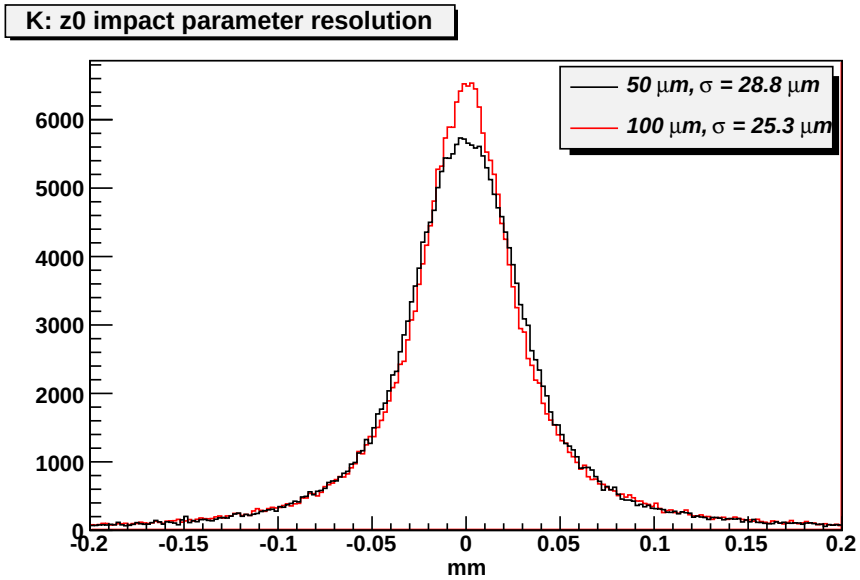


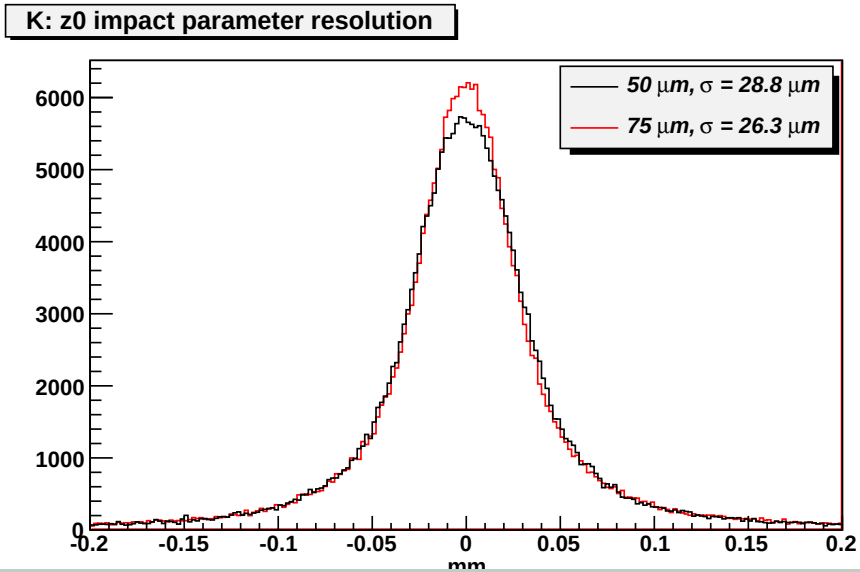


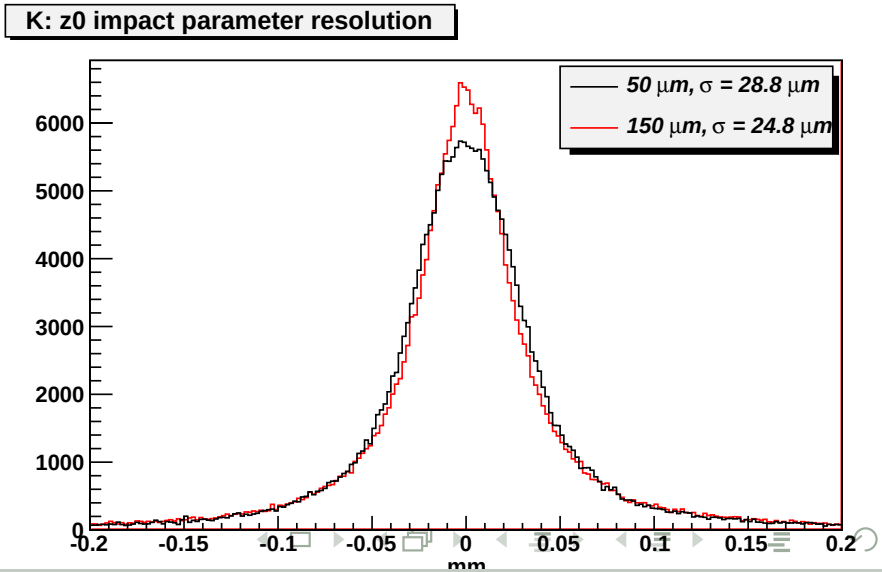


Kaon overall z0 resolution

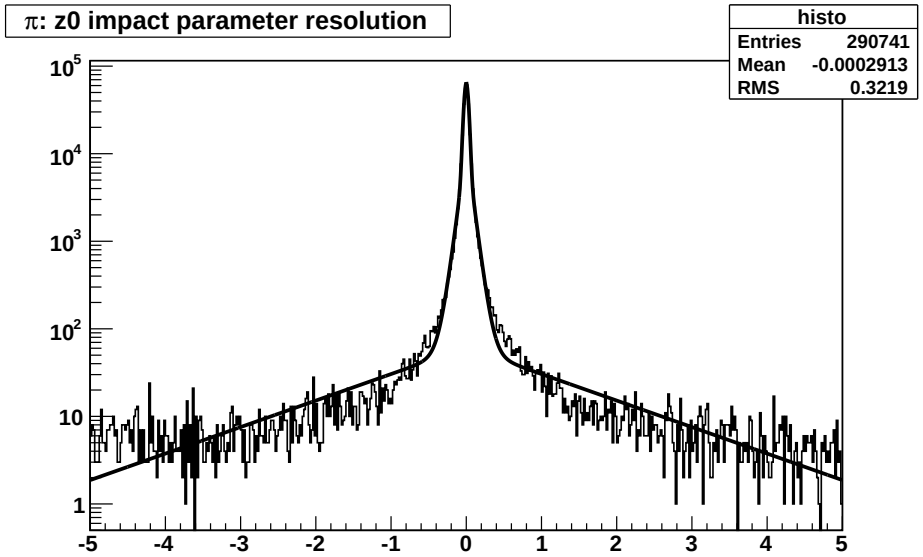


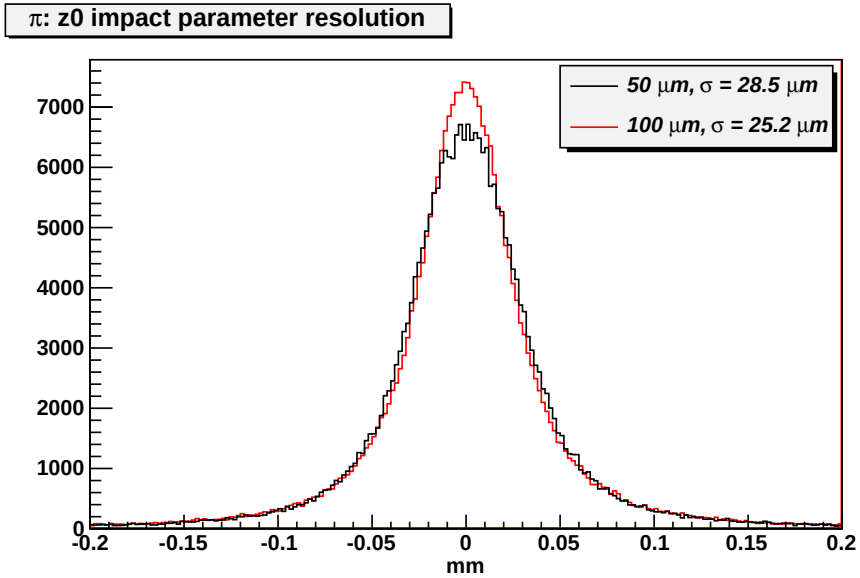


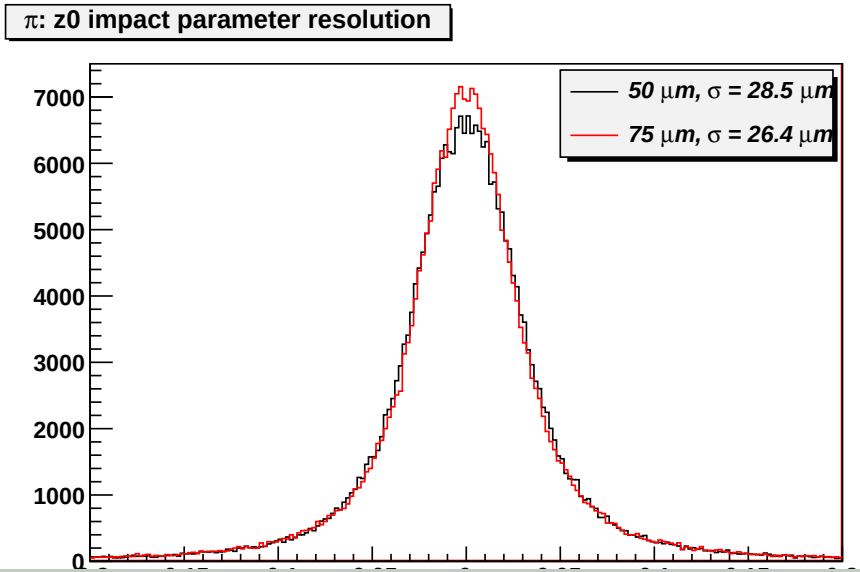


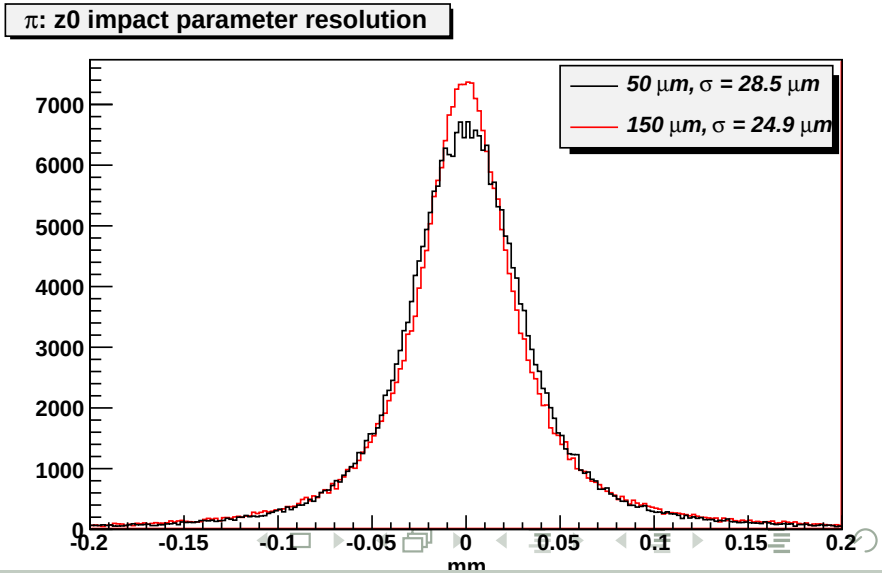


Pion overall z0 resolution

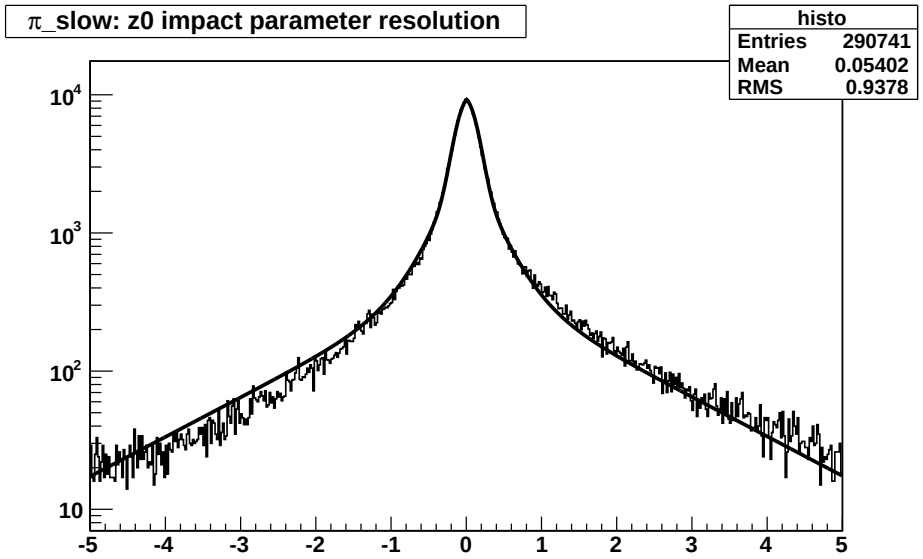


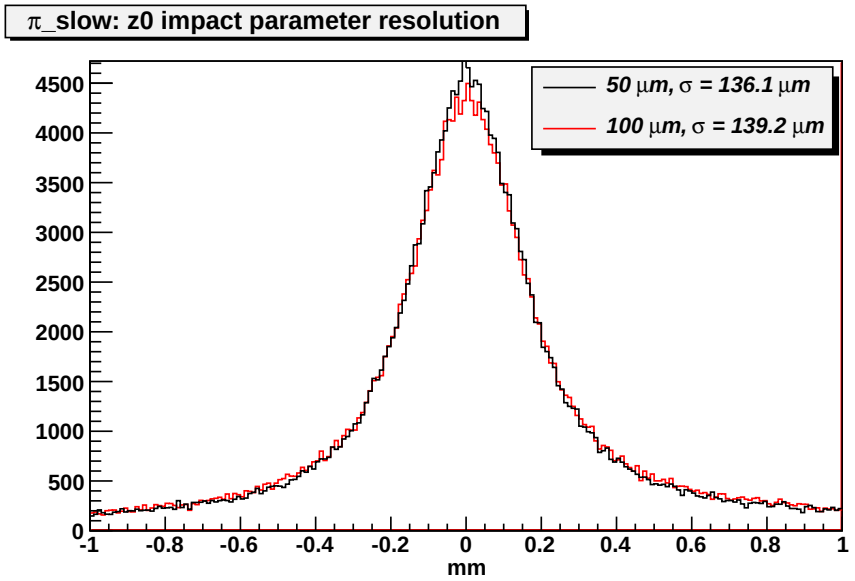


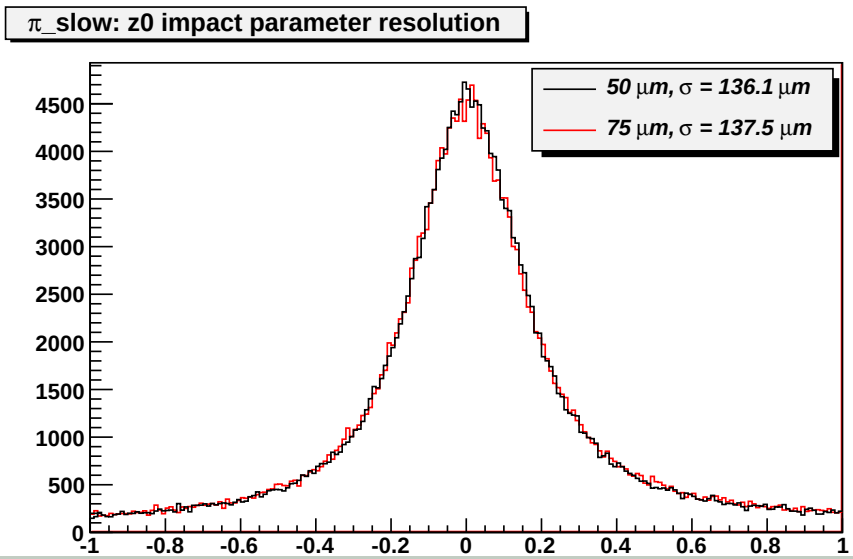


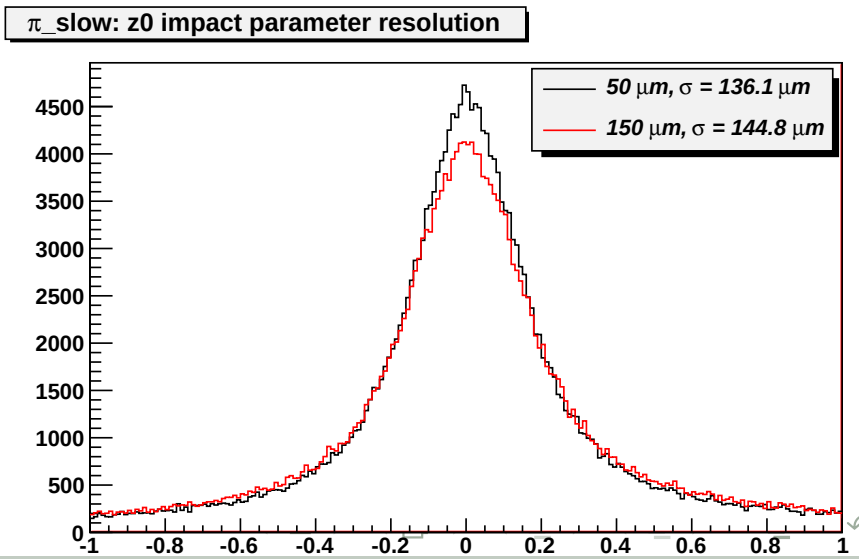


Soft pion overall z0 resolution

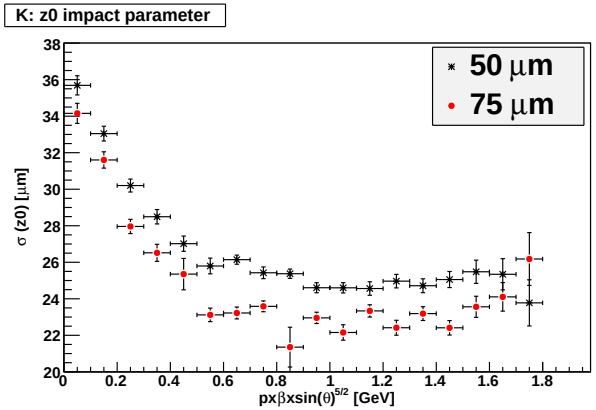


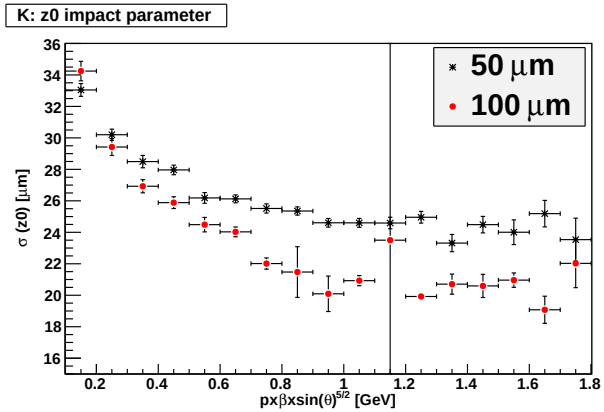


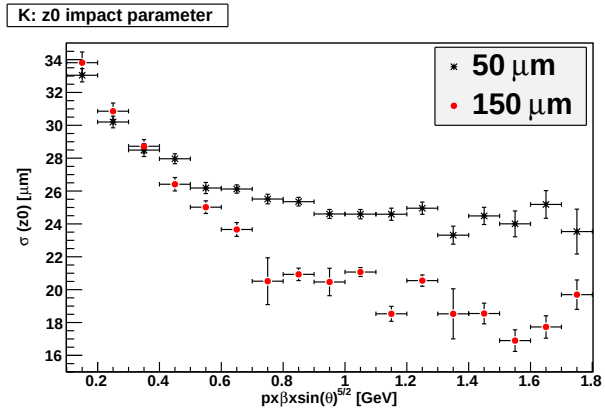


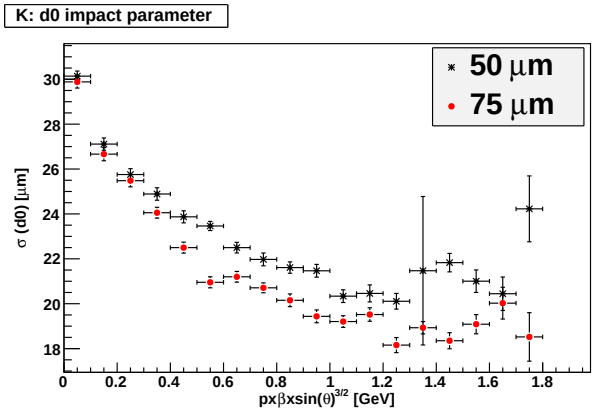


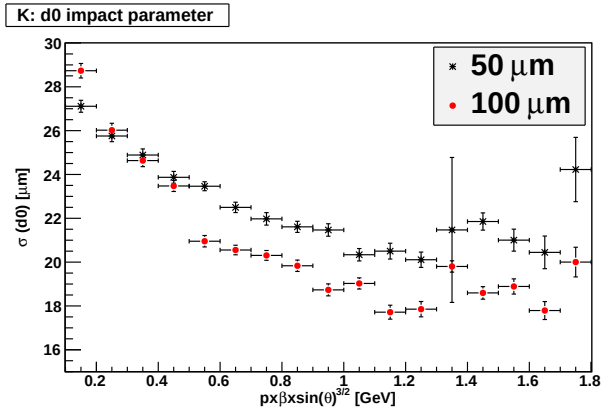
Kaon resolution over pseudomomentum

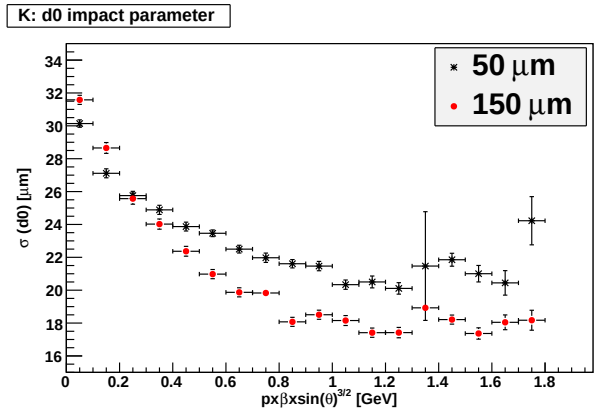




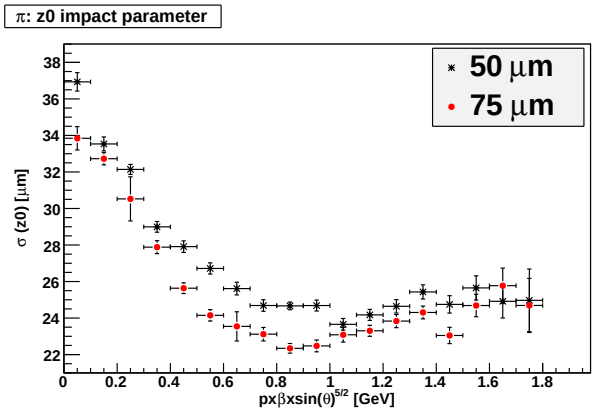


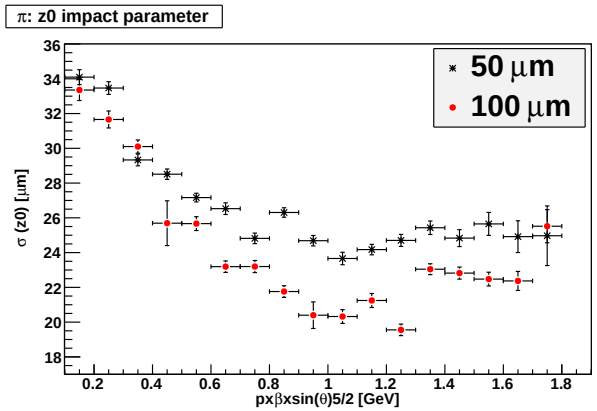


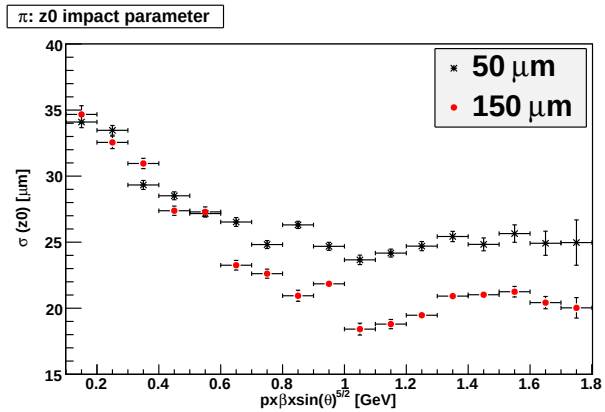


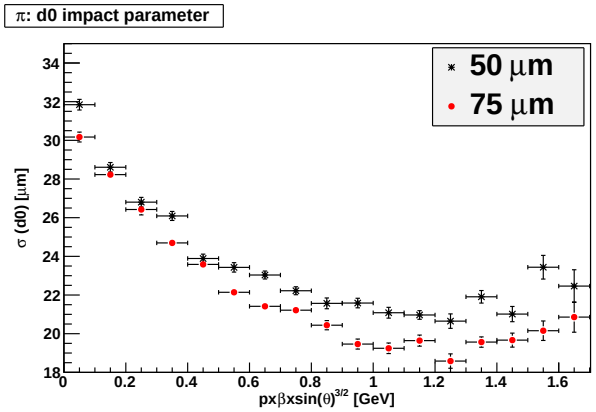


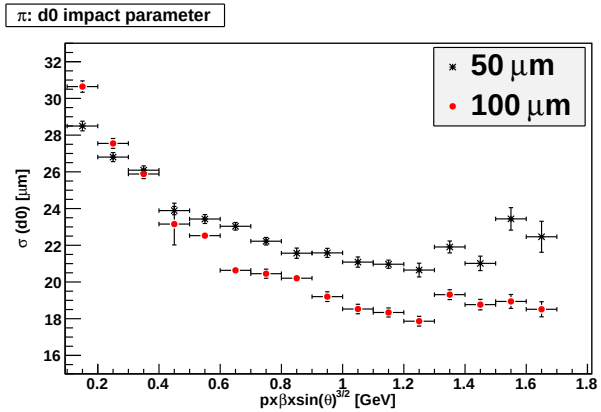
Pion resolution over pseudomomentum

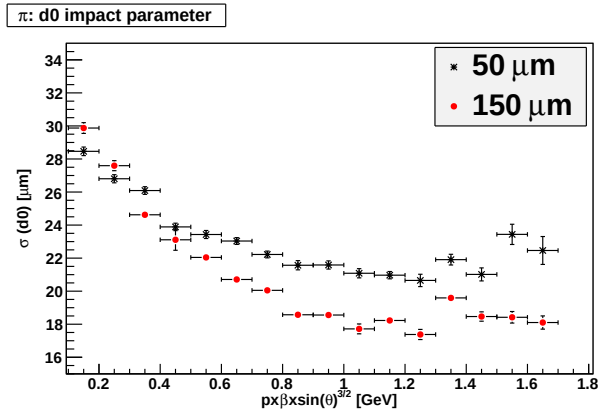




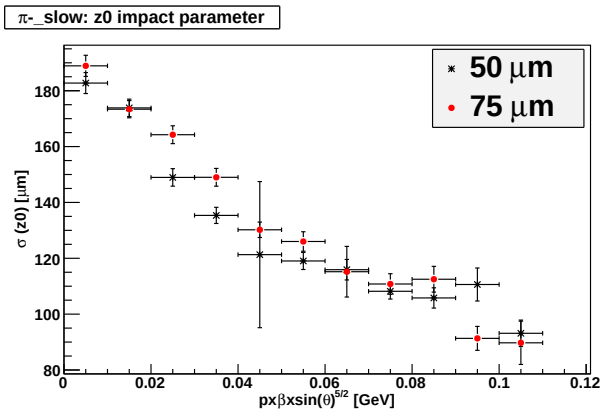


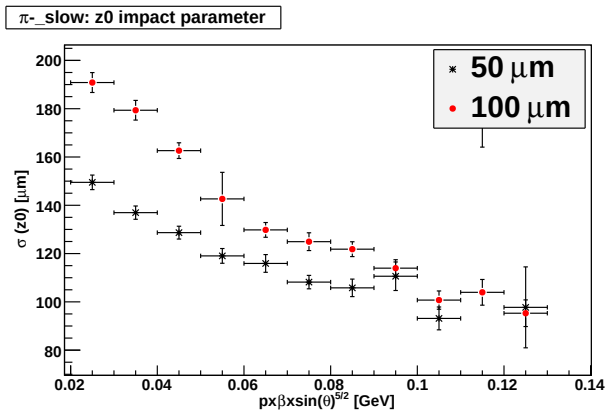


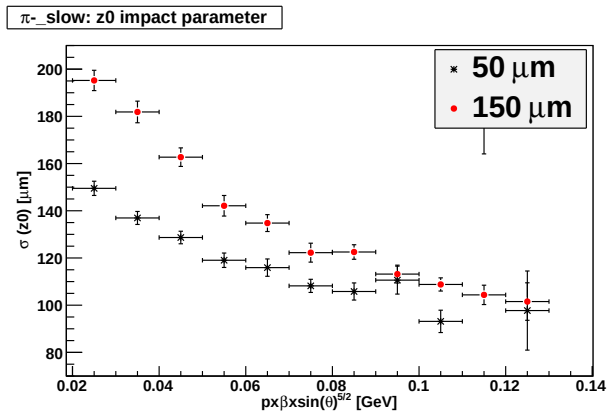


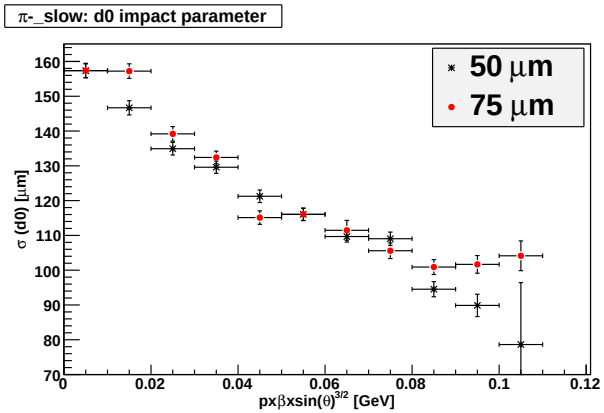


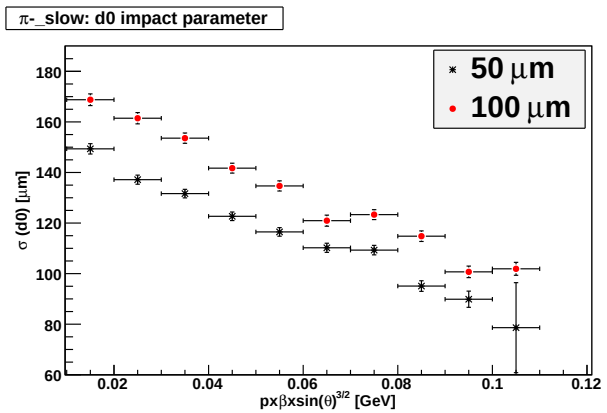
Soft pion resolution over pseudomomentum

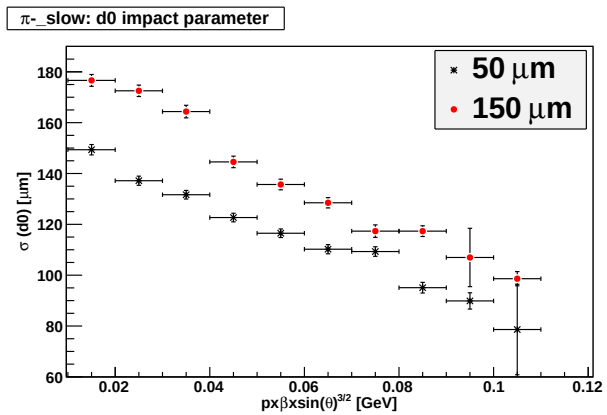












Reconstructed B mass