Comparison of experimental and MC production of Λ and K-short for the Xe run

R. Barak

Analysis and Detector Meeting of the BM@N Experiment,

March 12-13, 2024, Dubna, Russia

Contents

1. Data used and fitting analysis performed
2. Signal analysis
3. Background analysis
4. Conclusions

Purpose

- Study of experimental and MC production of Λ and K_S^0 in the Xe run.
- Minimize the differences between the experimental and MC case.

Mass distribution Λ and K_S^0

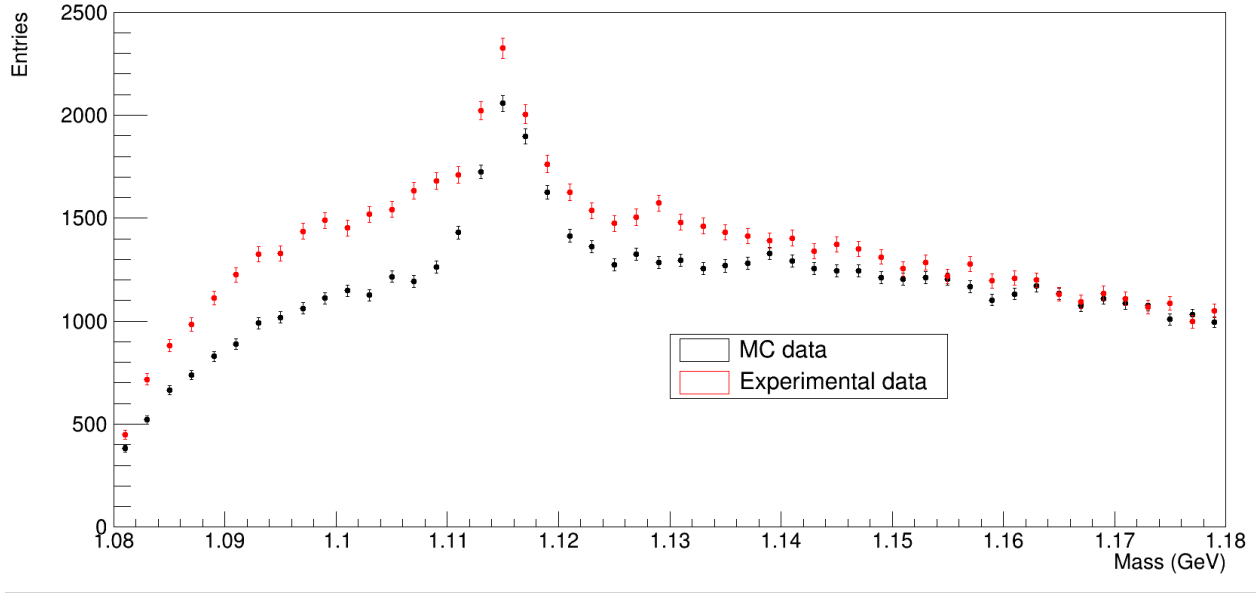
Amount of simulated events:

- MC (DCMSMM, Xe, CsI, 3.9 GeVA) -> 1000000
- Experimental (run 8142) -> 1050000

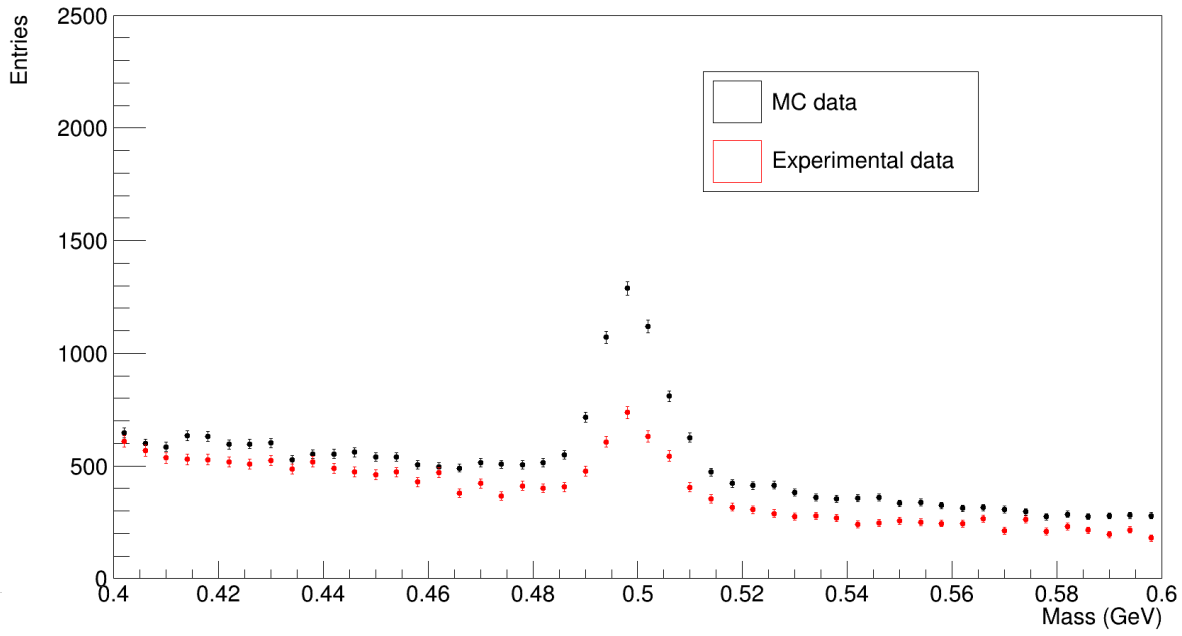
Amount of events with reconstructed vertex (Ntracks>1):

- MC (DCMSMM, Xe, CsI, 3.9 GeVA) -> 879947
- Experimental (run 8142) -> 611868

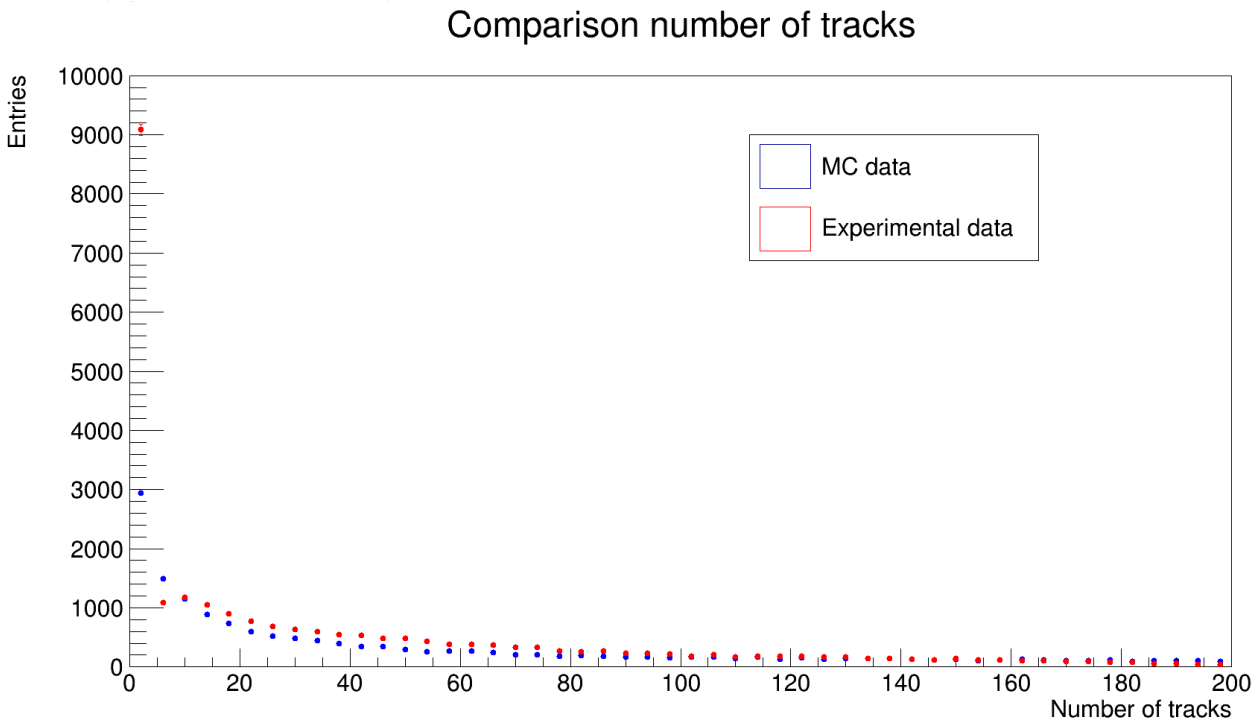
Λ:

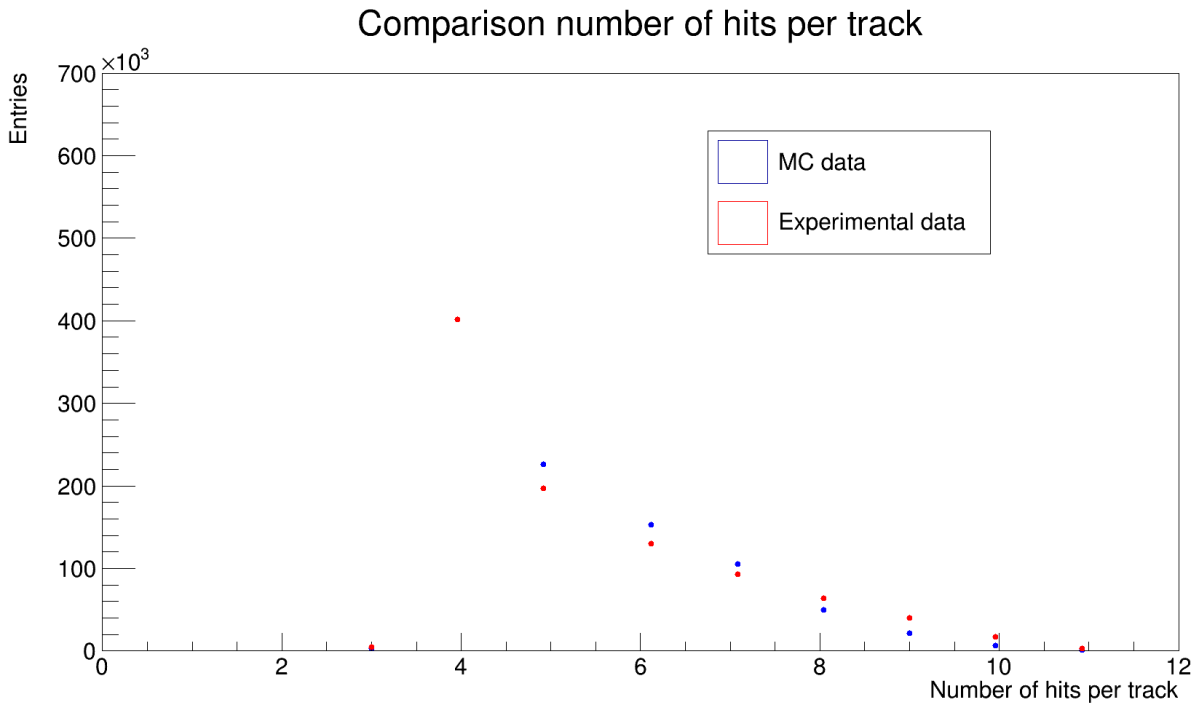


K_S^0:



Comparison MC vs experimental data

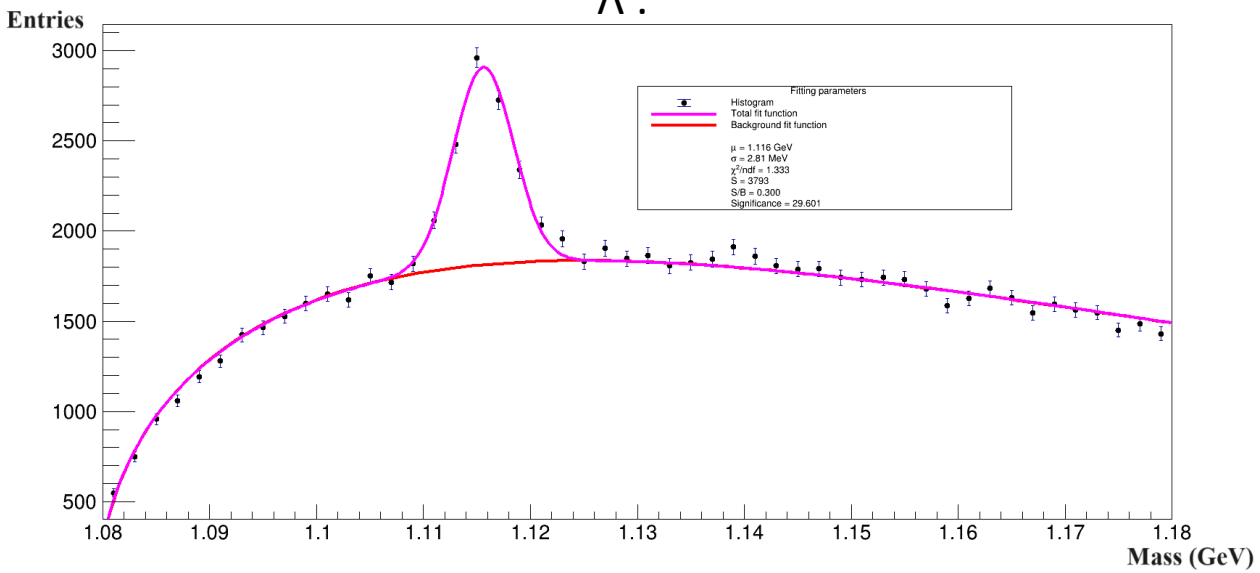




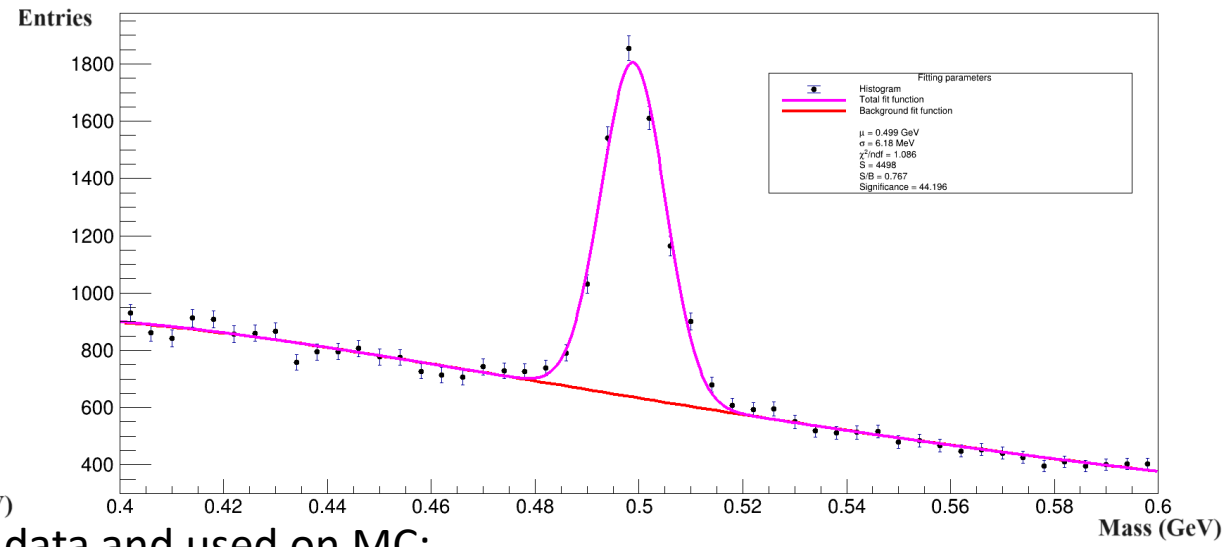
Optimization significance

Optimized on experimental data and used on MC:

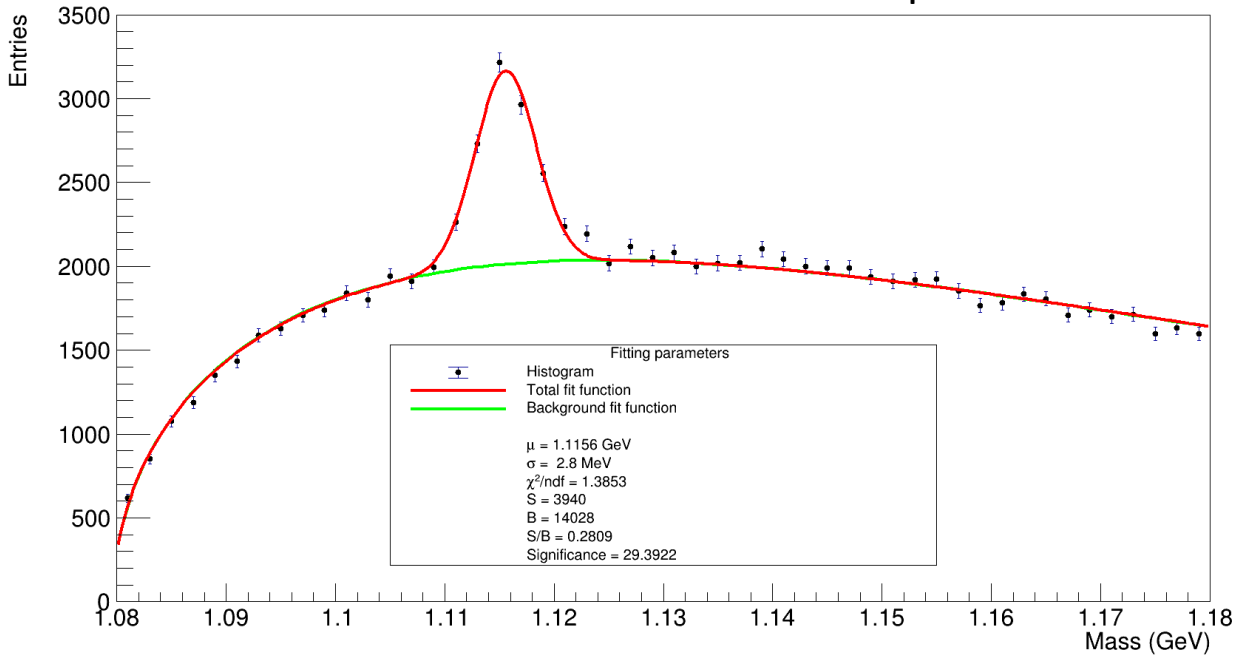
Λ :

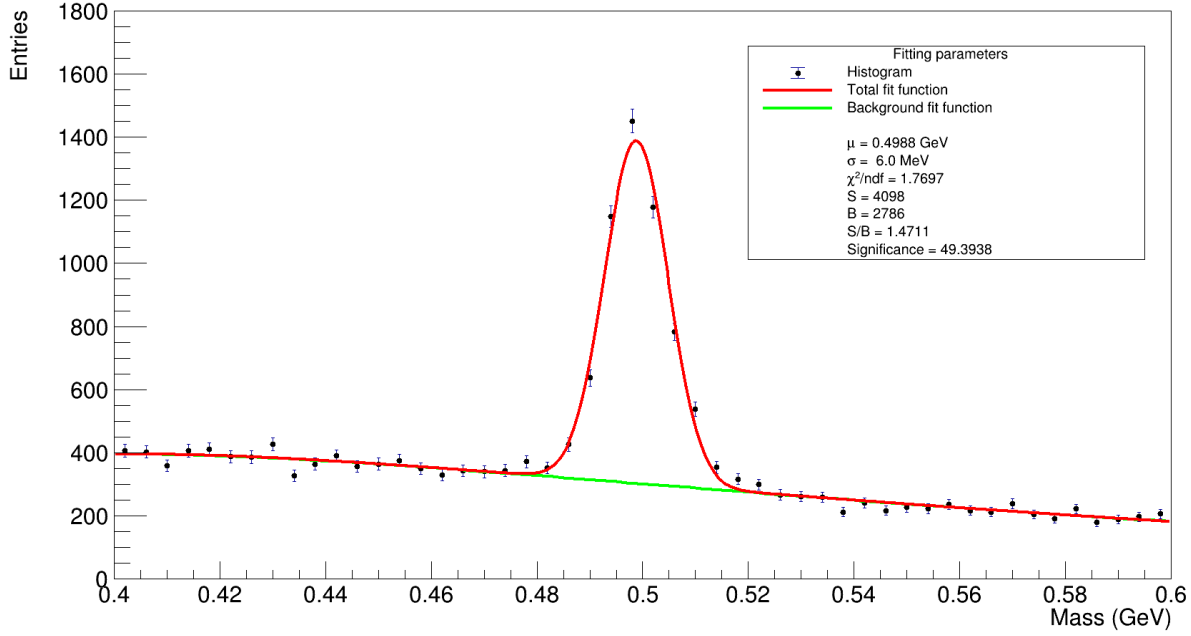


K_S^0 :

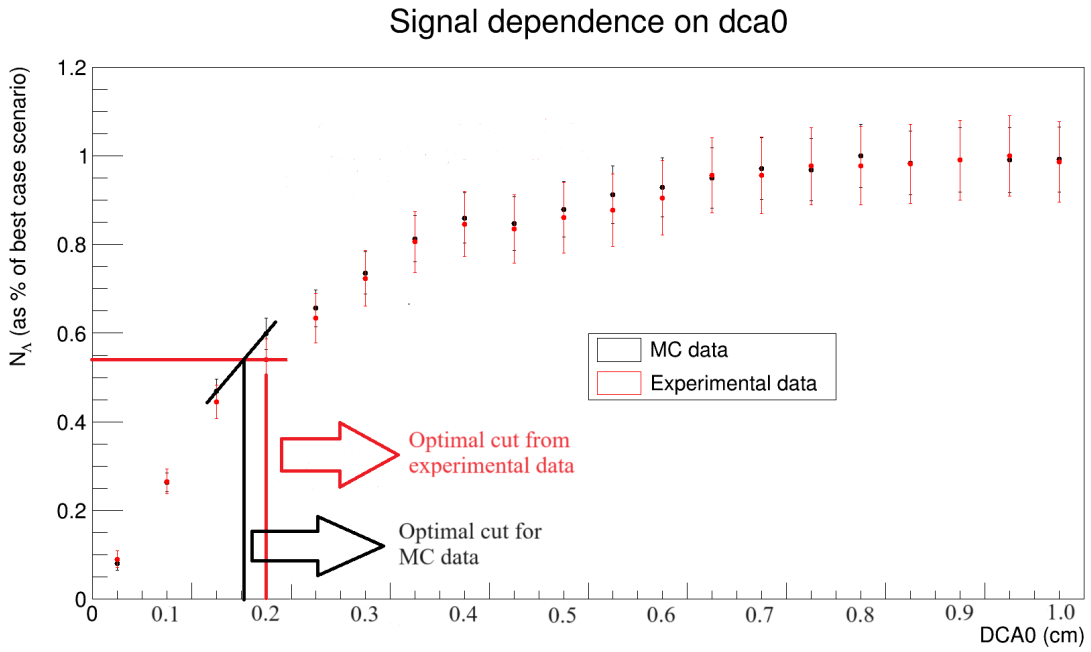


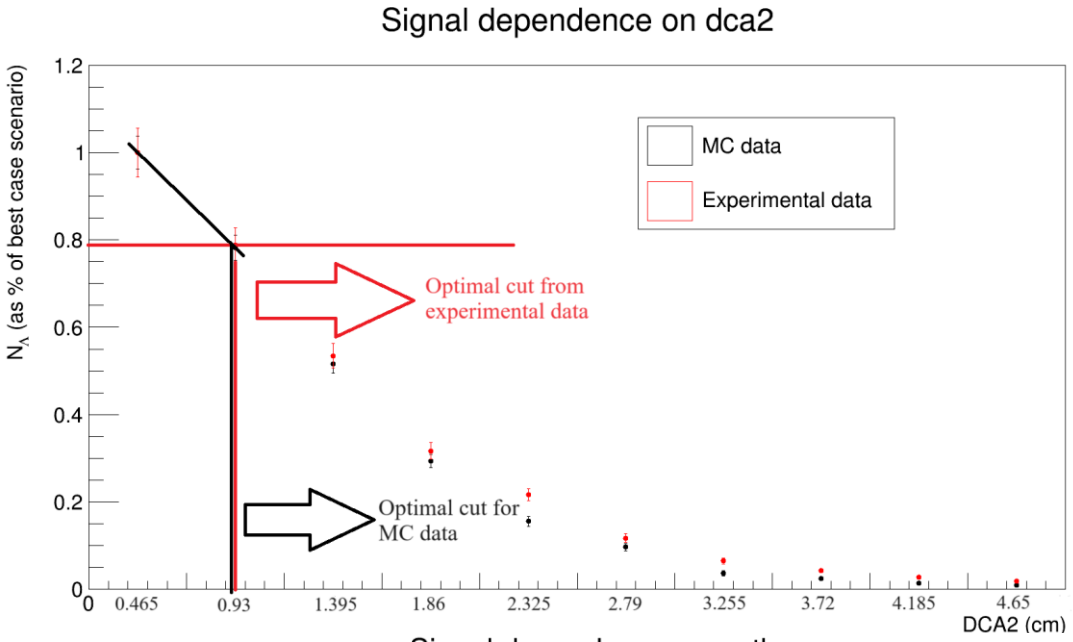
Optimized on MC data and used on MC:

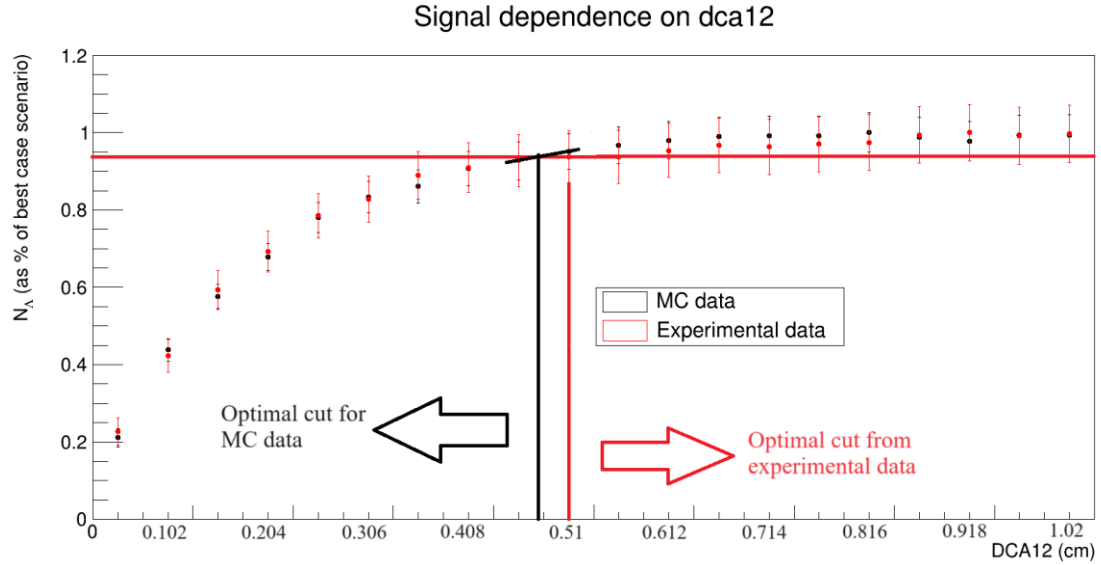


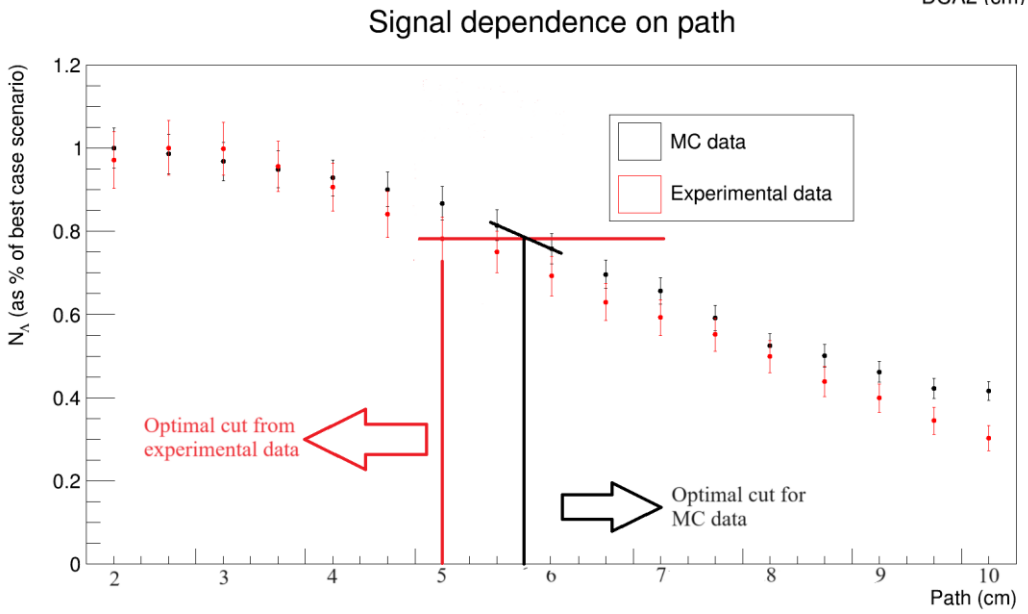


Signal dependence on different parameters Λ

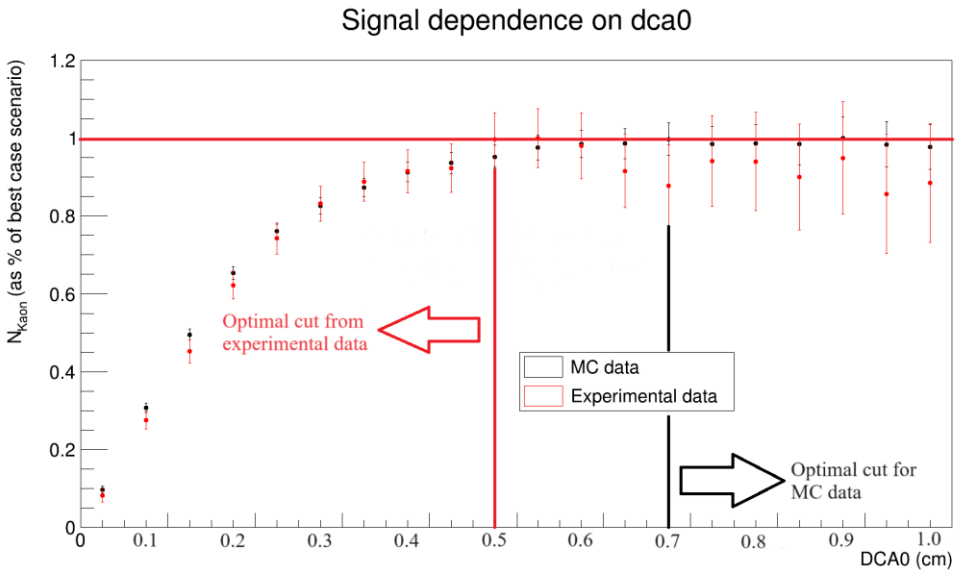


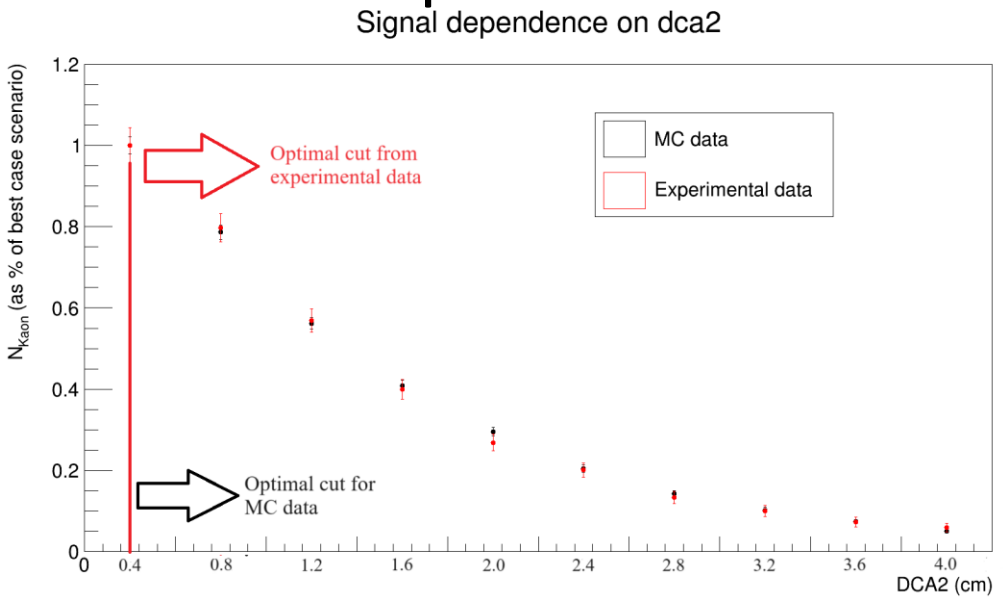


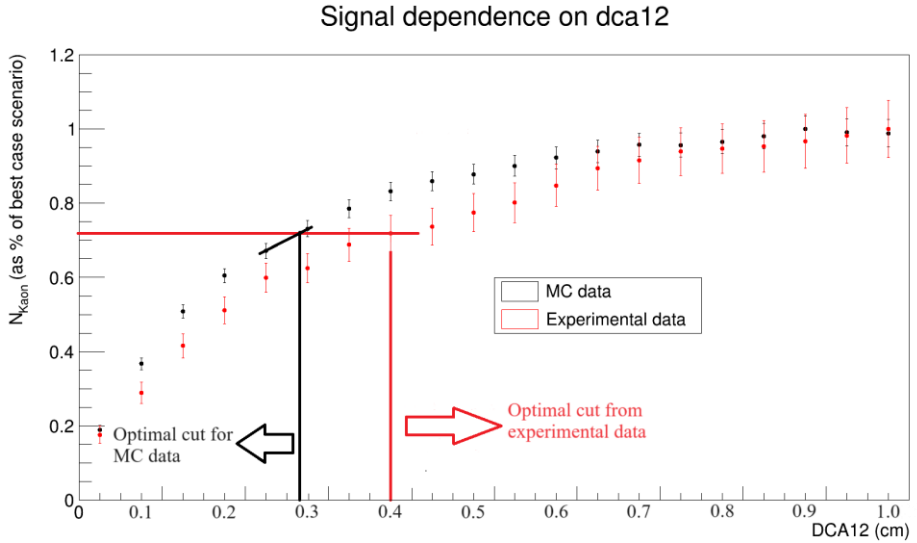


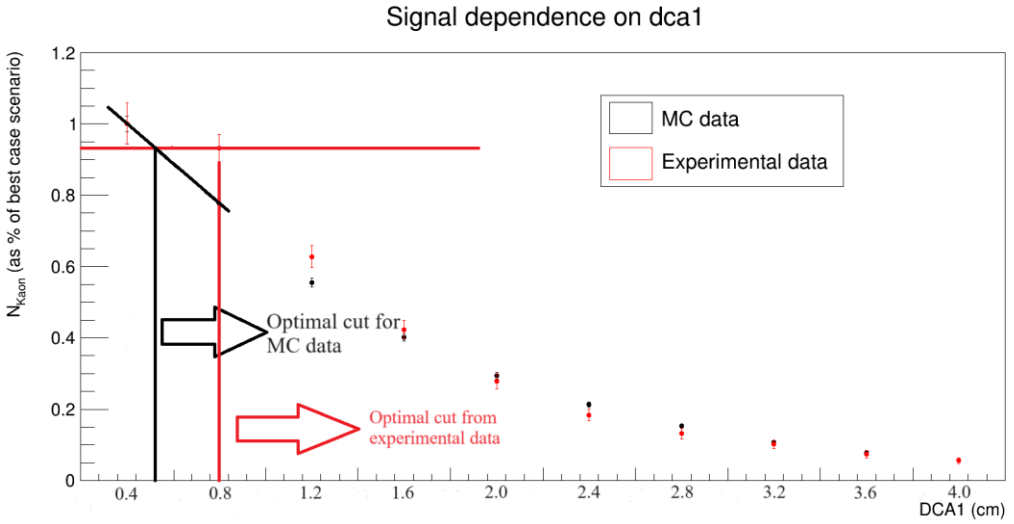


Signal dependence on different parameters K_S^0





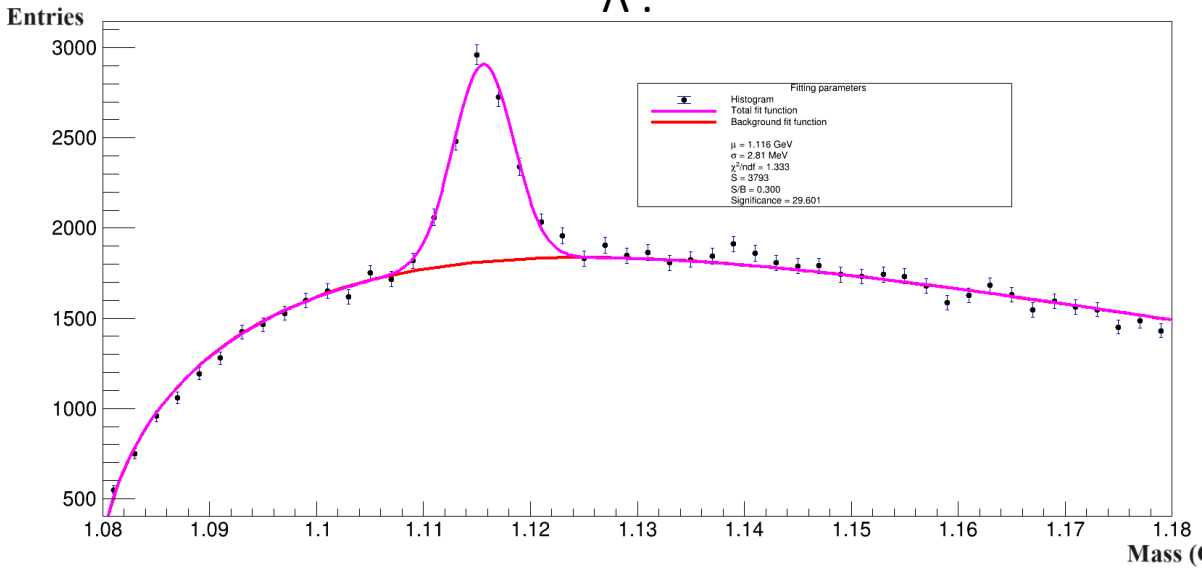




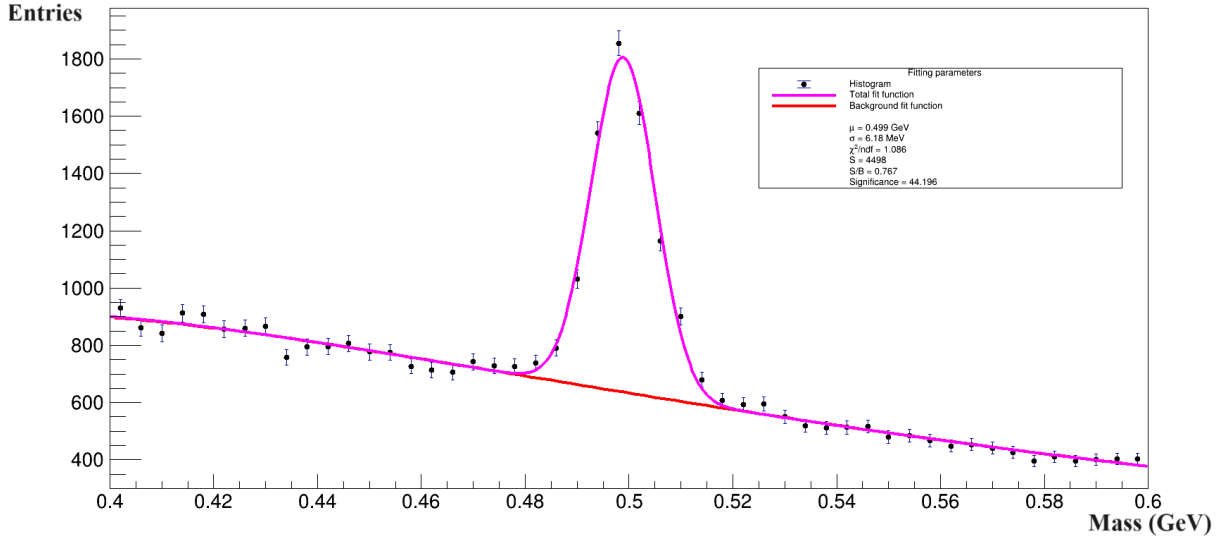
Fits for MC cuts derived from signal analysis

Previous cuts:

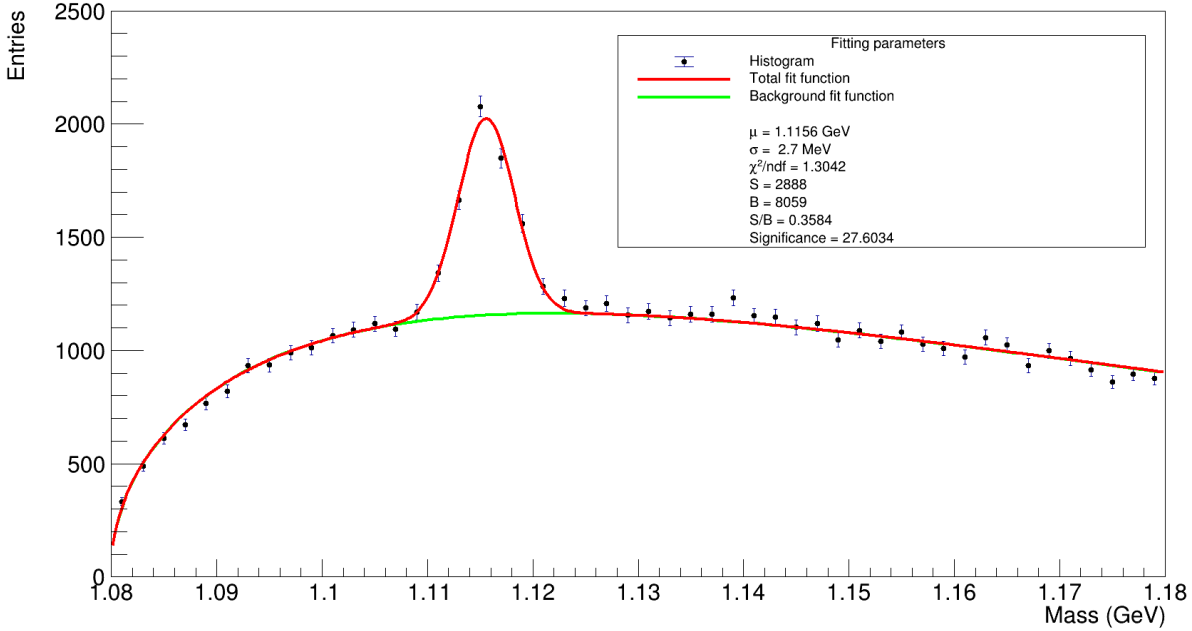
Λ :

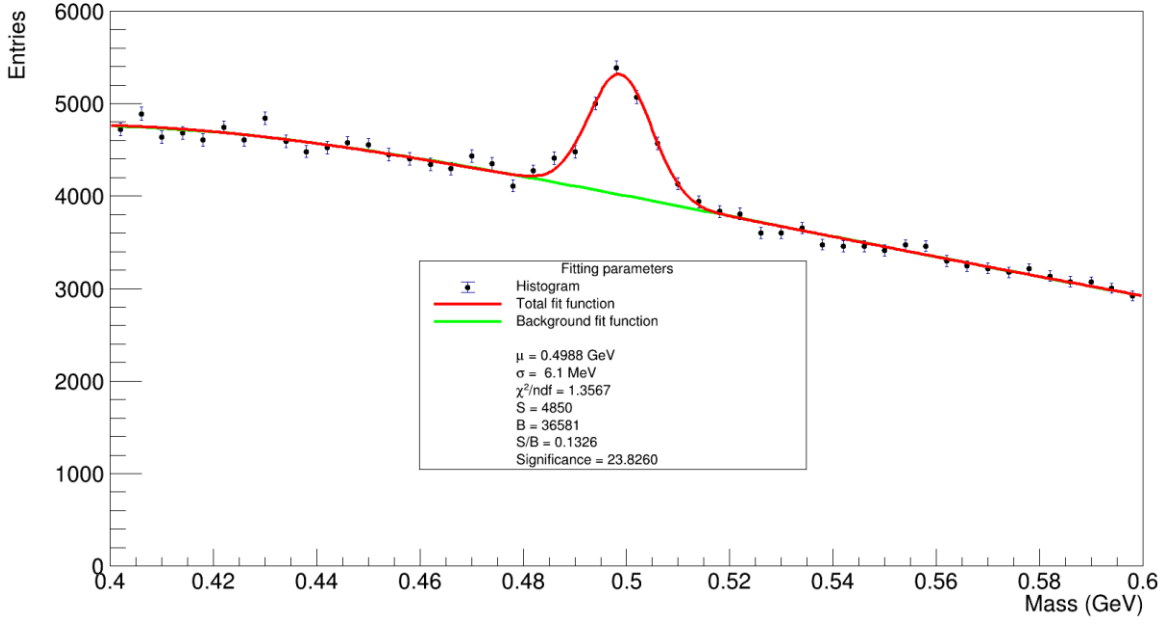


K_S^0 :



Newest cuts:





Cuts

Previous:

Λ :

4 cuts used:

- 5.0 cm <= path <= 50.0 cm
- 0.0 cm <= dca12 <= 0.51 cm
- 0.0 cm <= dca0 <= 0.20 cm
- 0.93 cm <= dca2 <= 10.0 cm

K_S^0:

4 cuts used:

- 0.8 cm <= dca1 <= 10.0 cm
- 0.0 cm <= dca12 <= 0.4 cm
- 0.0 cm <= dca0 <= 0.5 cm
- 0.4 cm <= dca2 <= 10.0 cm

From signal analysis:

4 cuts used:

- 5.75 cm <= path <= 50.0 cm
- 0.0 cm <= dca12 <= 0.483 cm
- 0.0 cm <= dca0 <= 0.176 cm
- 0.929 cm <= dca2 <= 10.0 cm

4 cuts used:

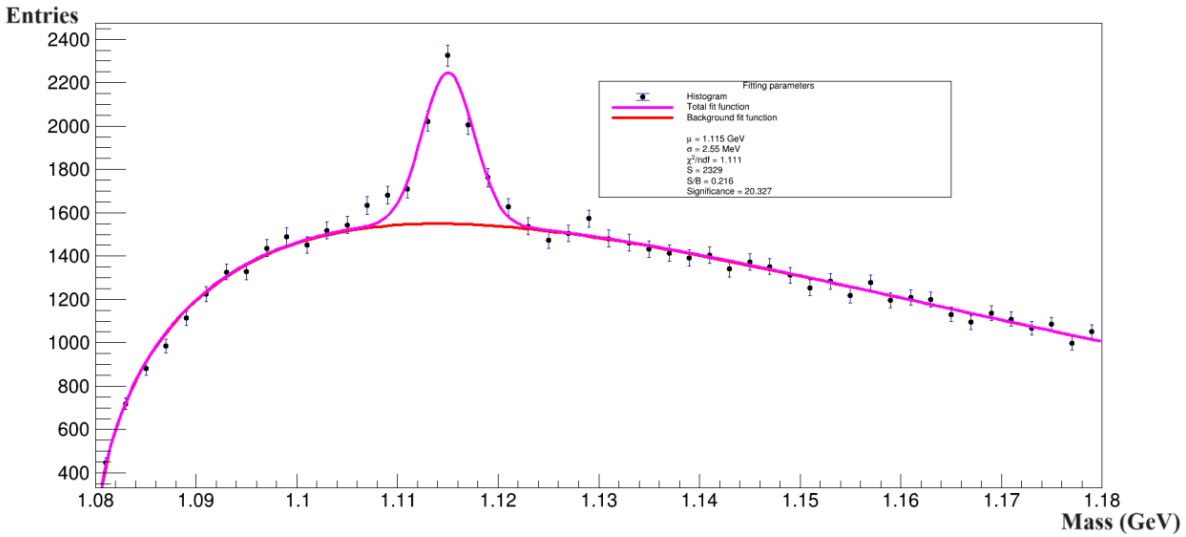
- 0.52 cm <= dca1 <= 10.0 cm
- 0.0 cm <= dca12 <= 0.2875 cm
- 0.0 cm <= dca0 <= 0.7 cm
- 0.4 cm <= dca2 <= 10.0 cm

Fits for new cuts Λ

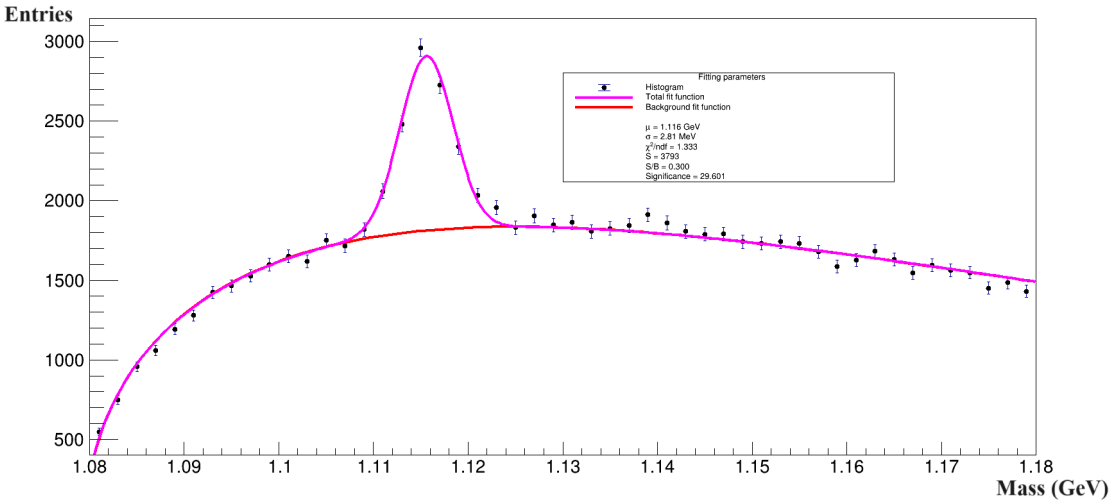
Corresponding to 80 % of maximal signal value

Before:

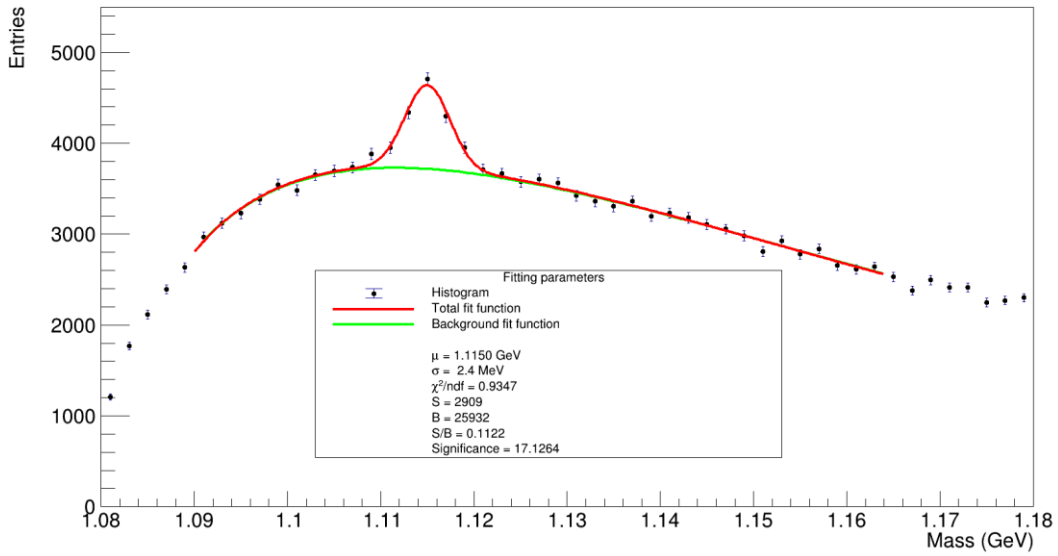
Experimental data:

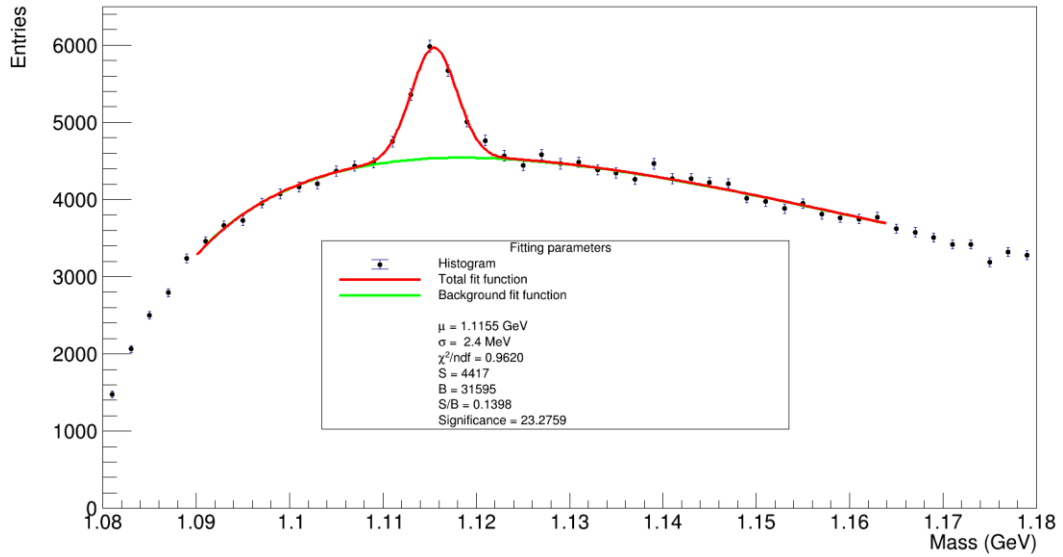


MC data:



After:



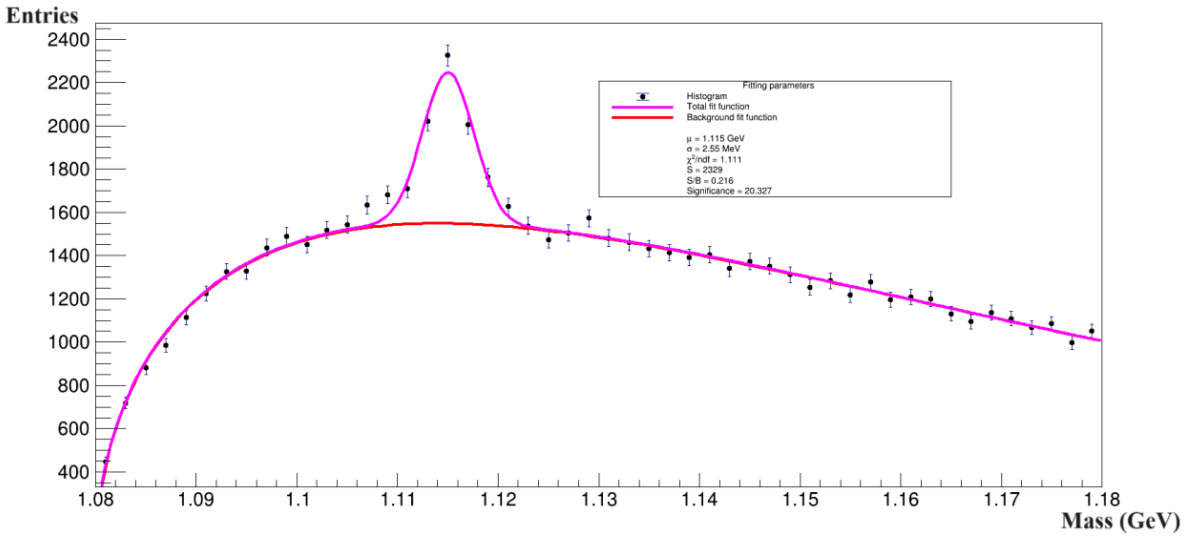


Fits for new cuts Λ

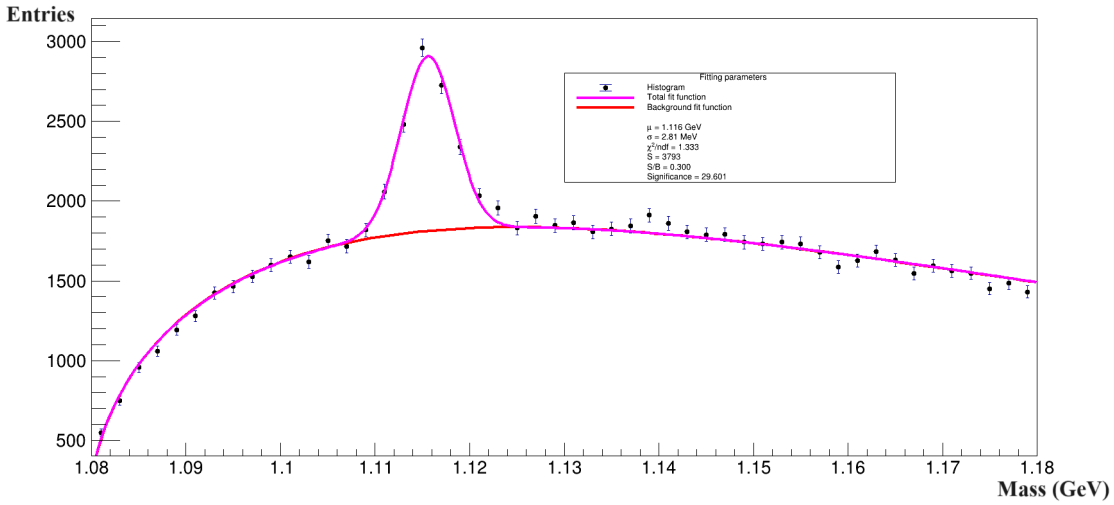
Corresponding to 90 % of maximal signal value

Before:

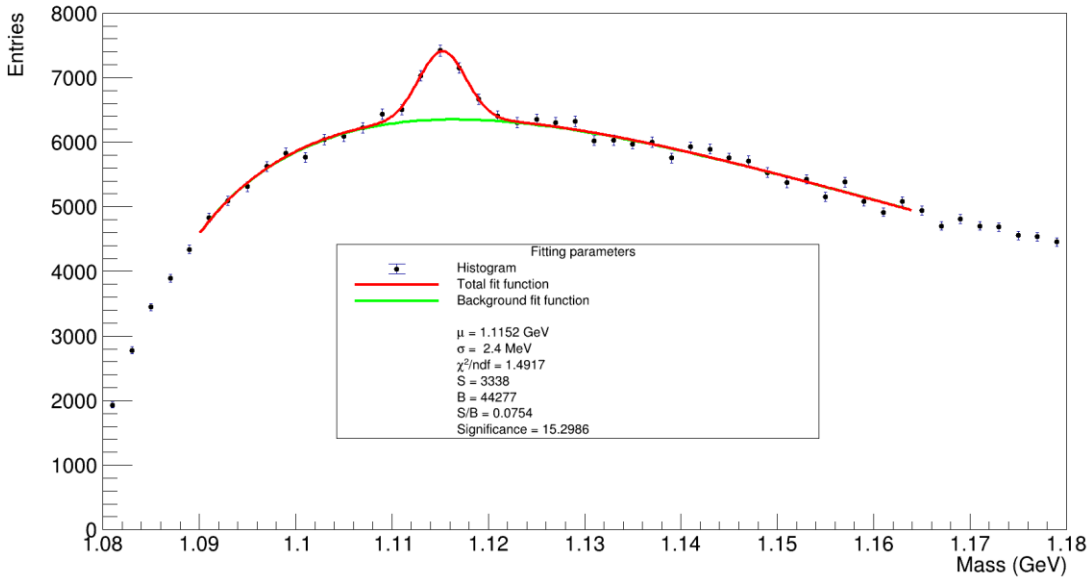
Experimental data:

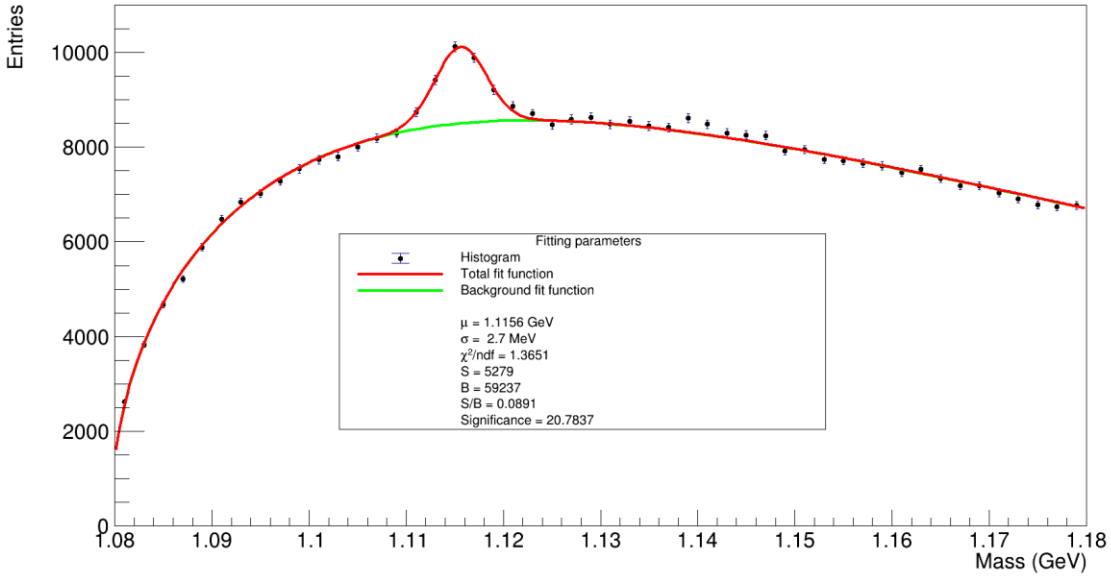


MC data:



After:



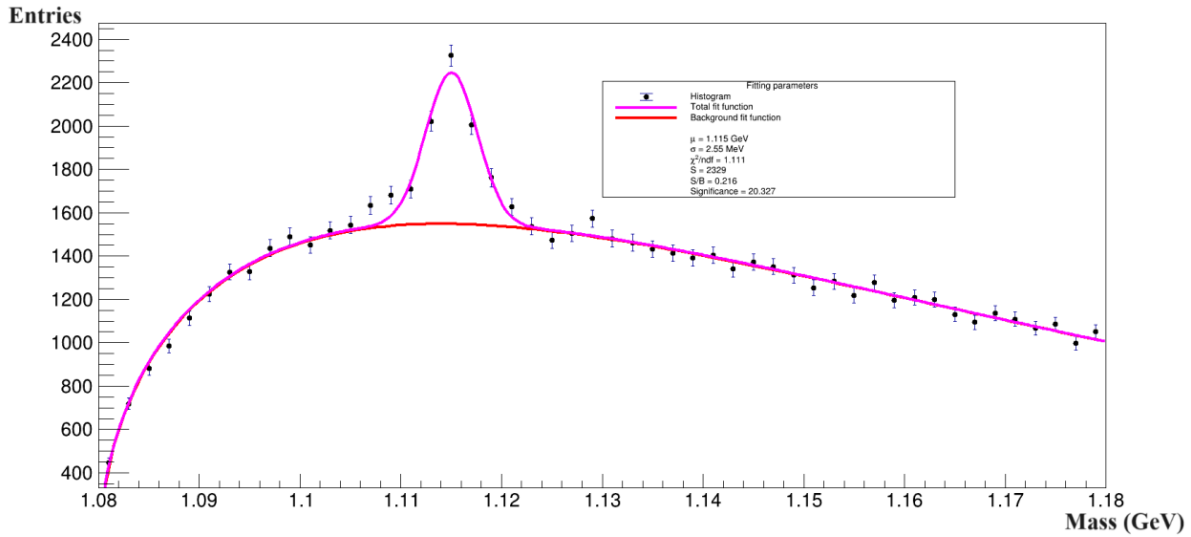


Fits for new cuts Λ

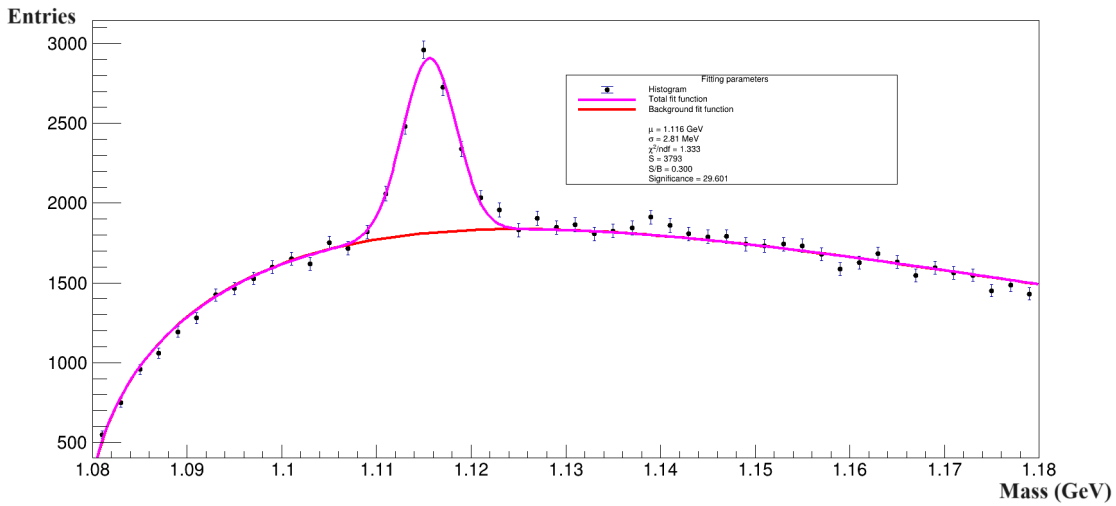
Corresponding to 100 % of maximal signal value

Before:

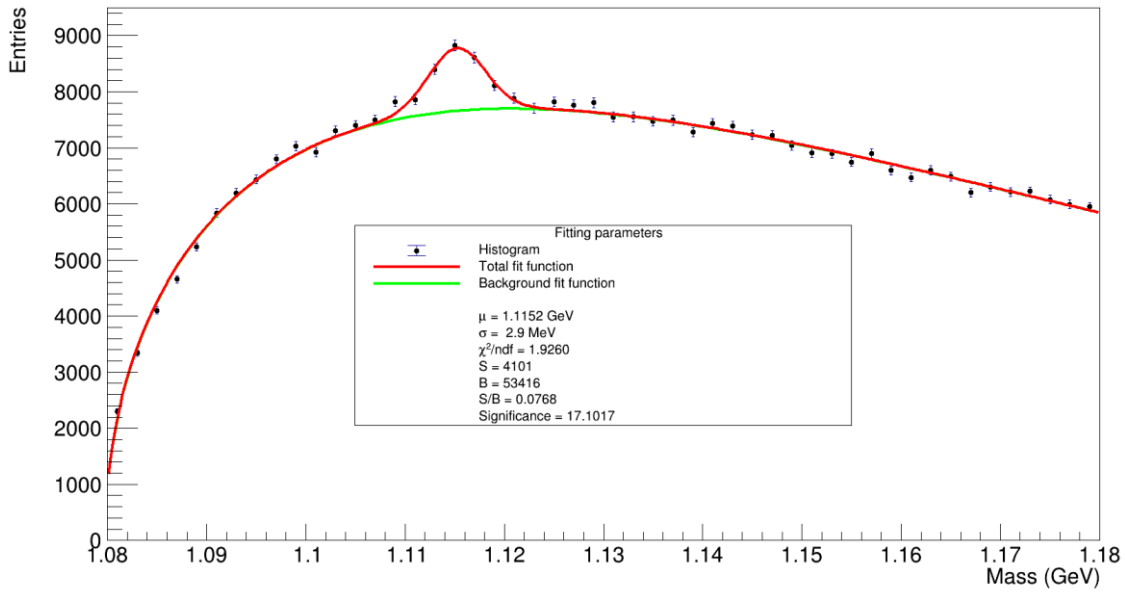
Experimental data:

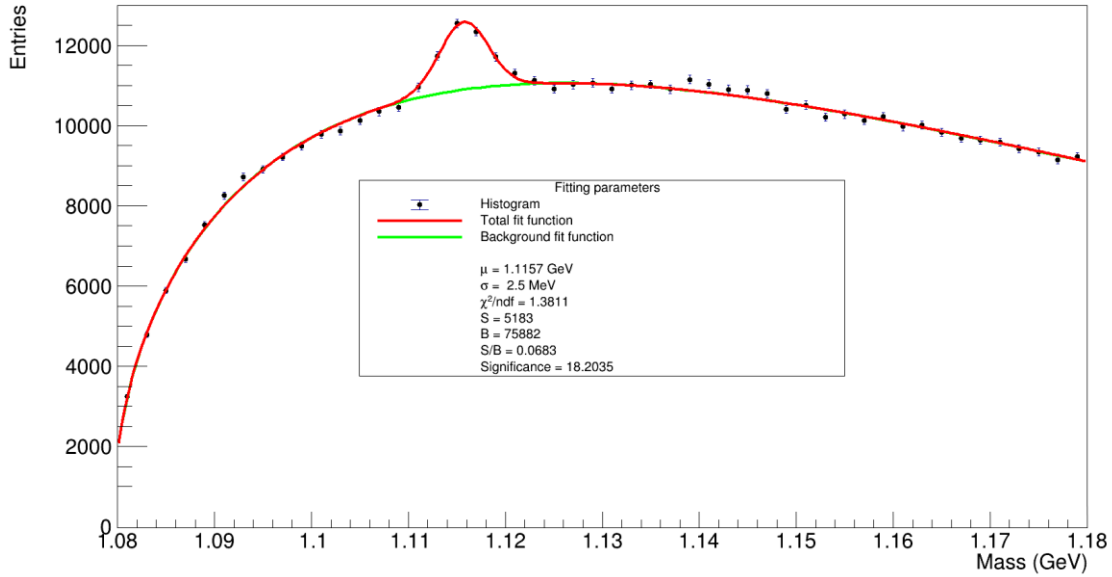


MC data:



After:

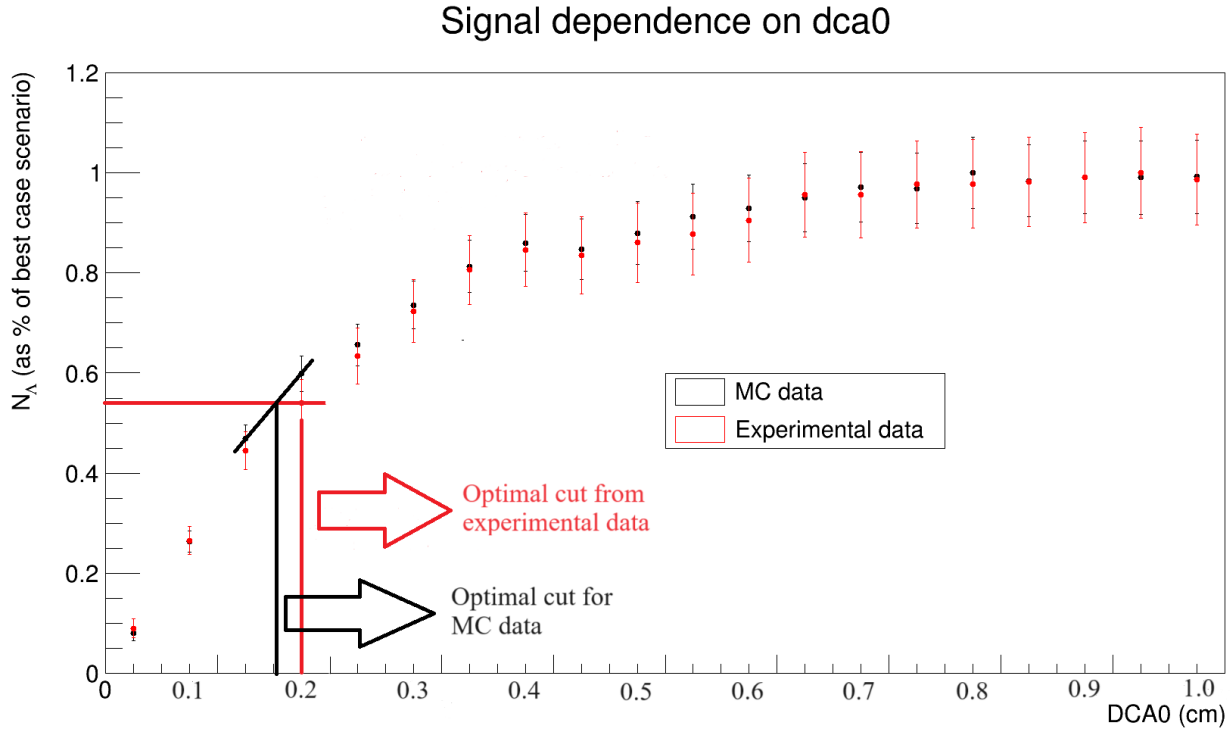




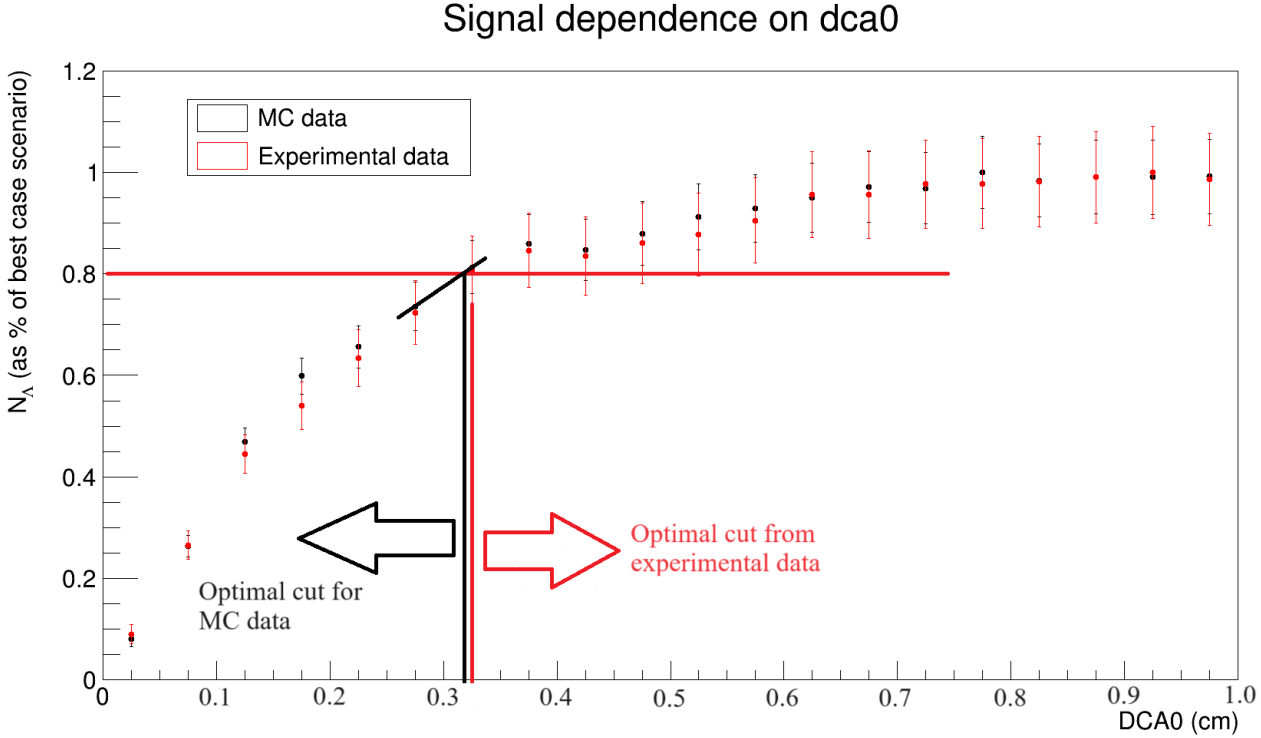
Signal analysis

Λ

Before:



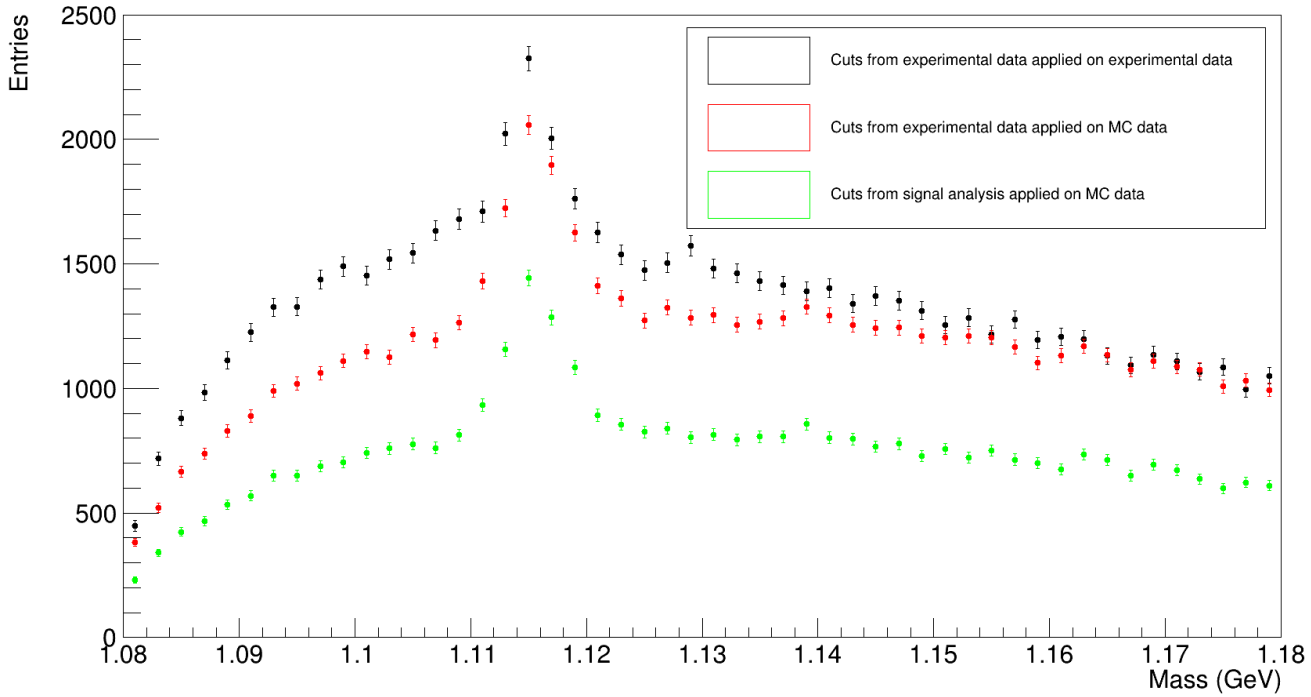
After:



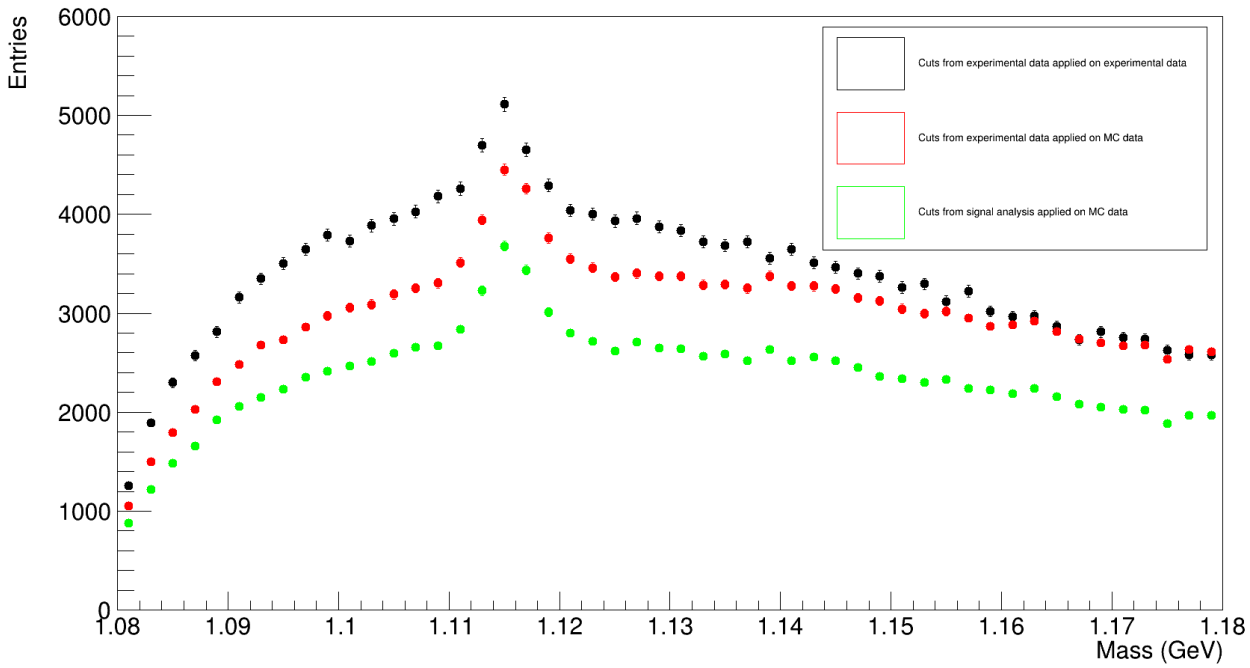
Comparison effect cuts

Λ

Before:



After:

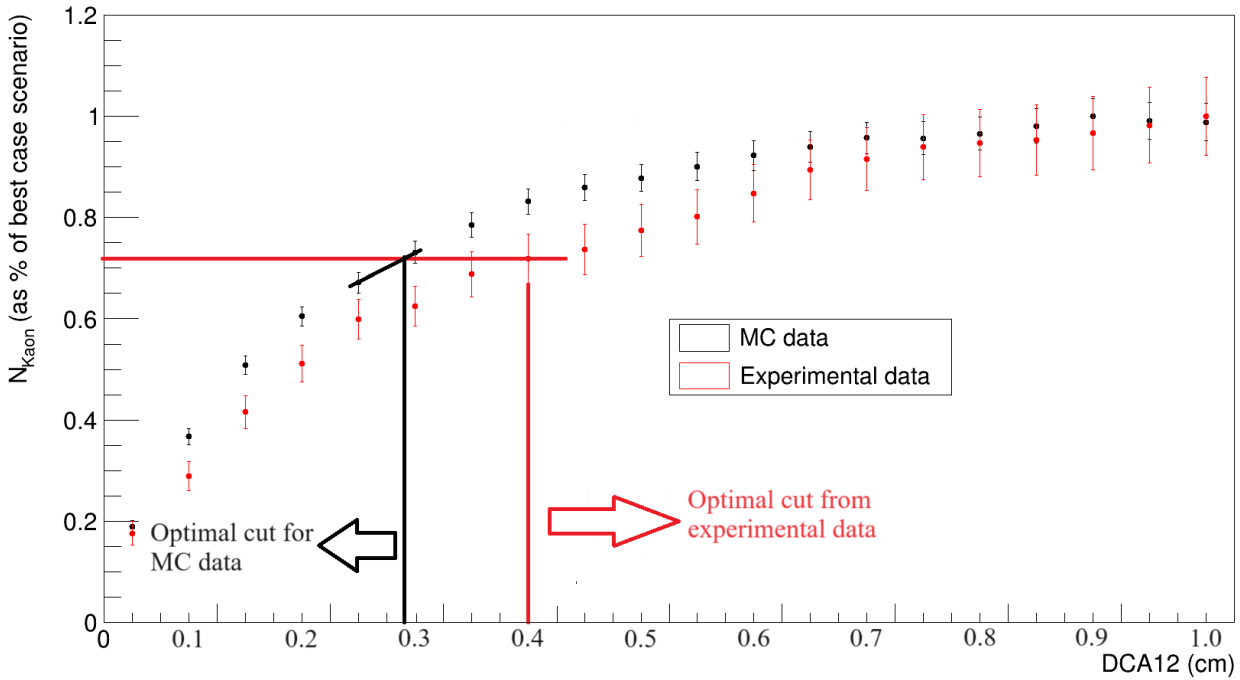


Signal analysis

K_S^0

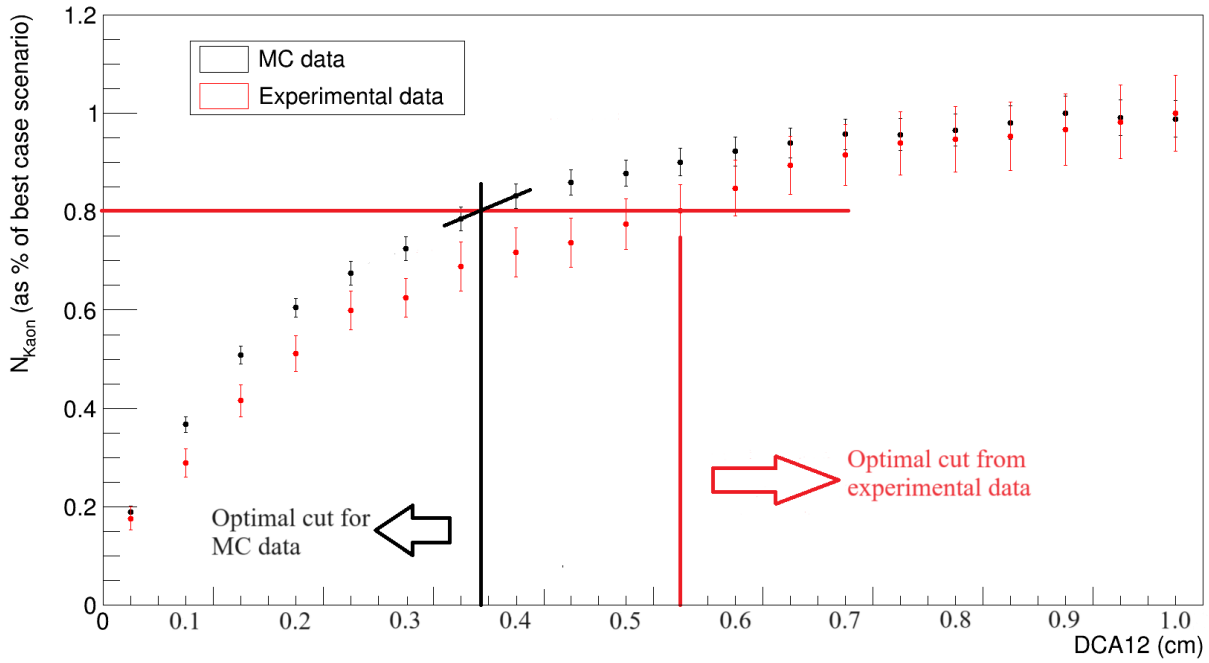
Before:

Signal dependence on dca12



After:

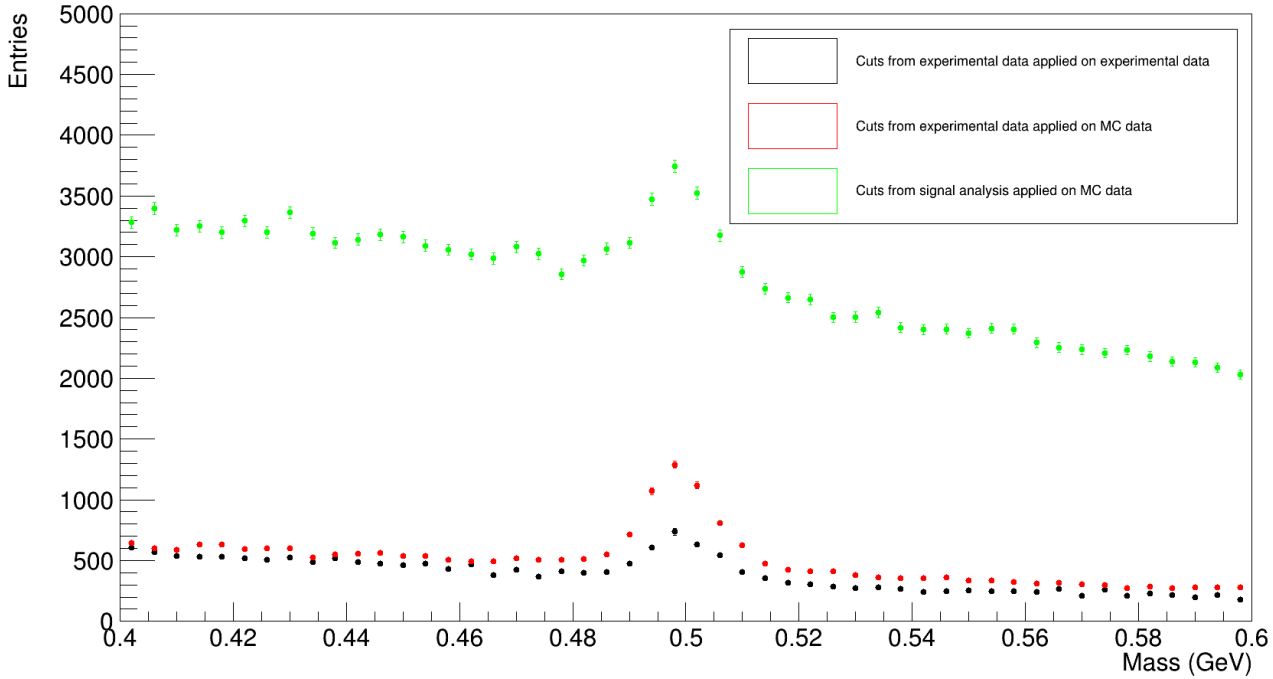
Signal dependence on dca12



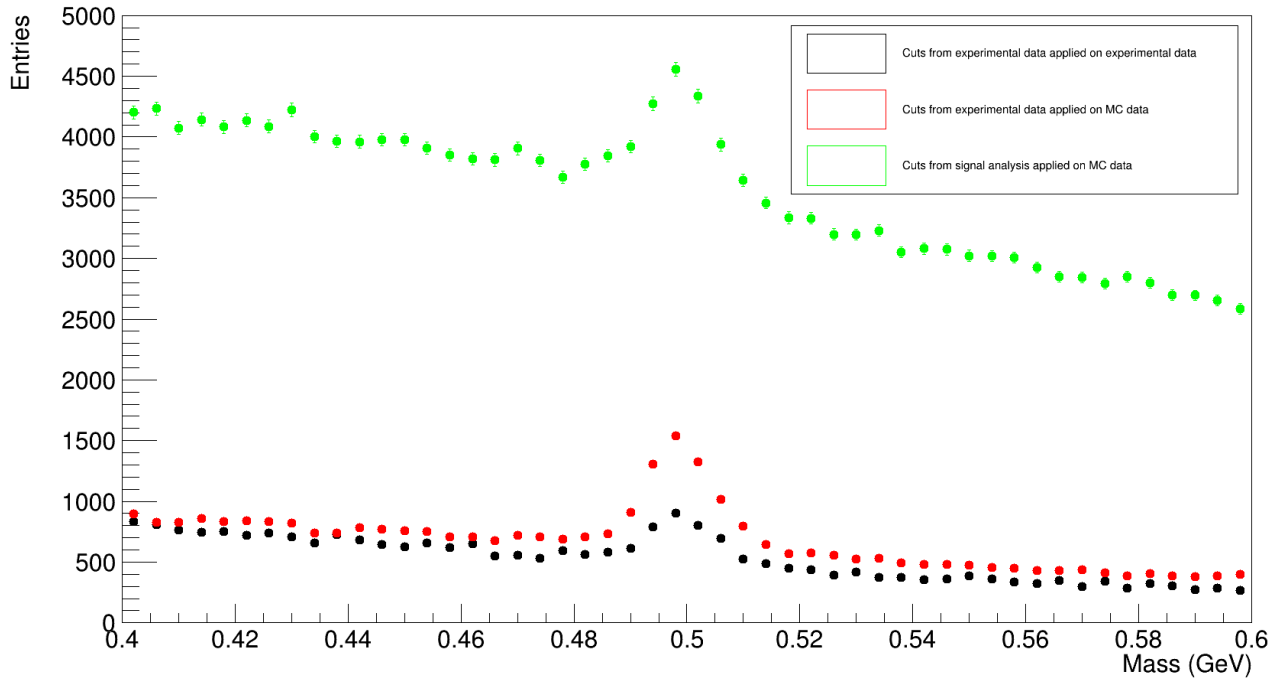
Comparison effect cuts

K_S^0

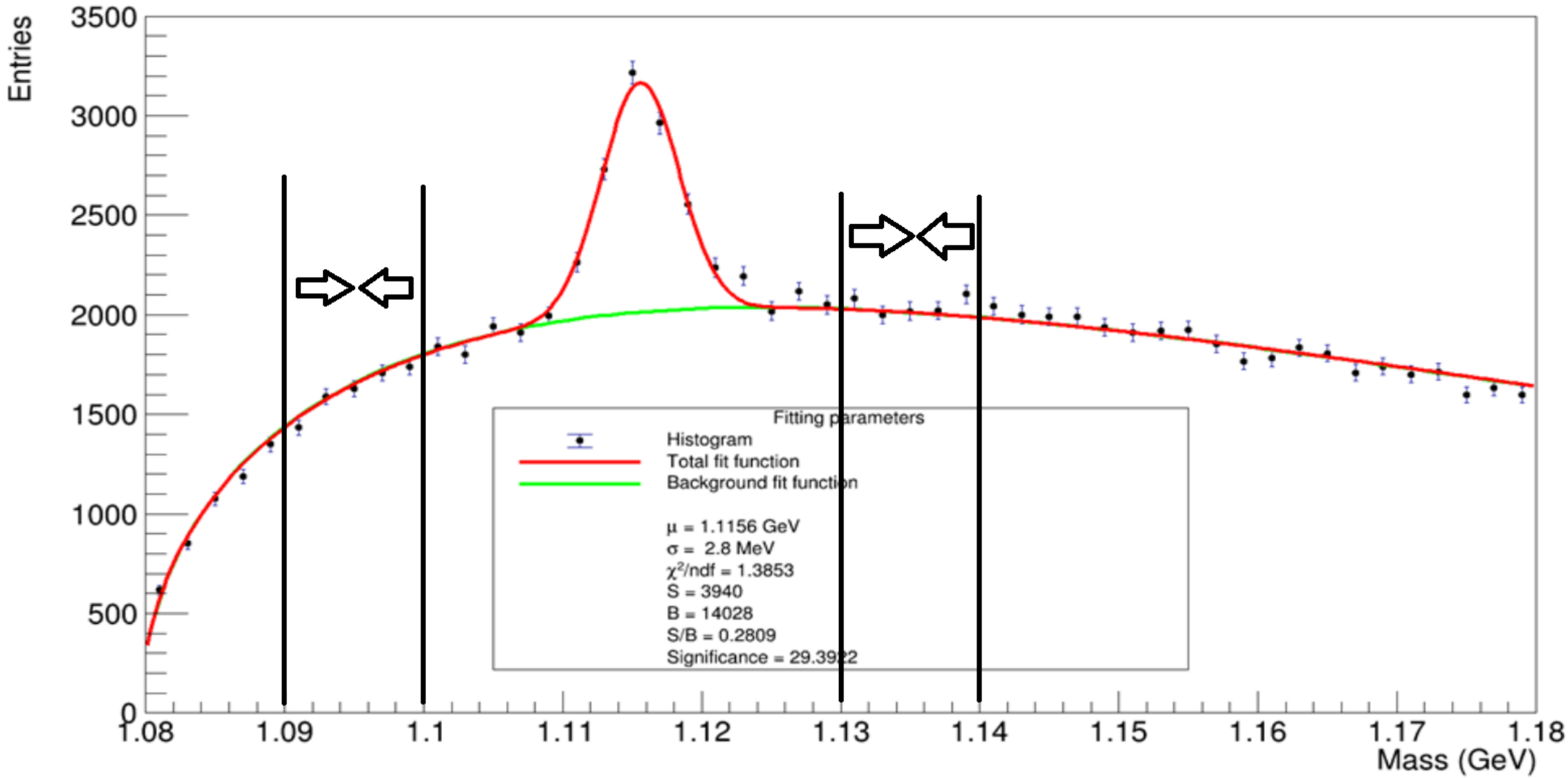
Before:



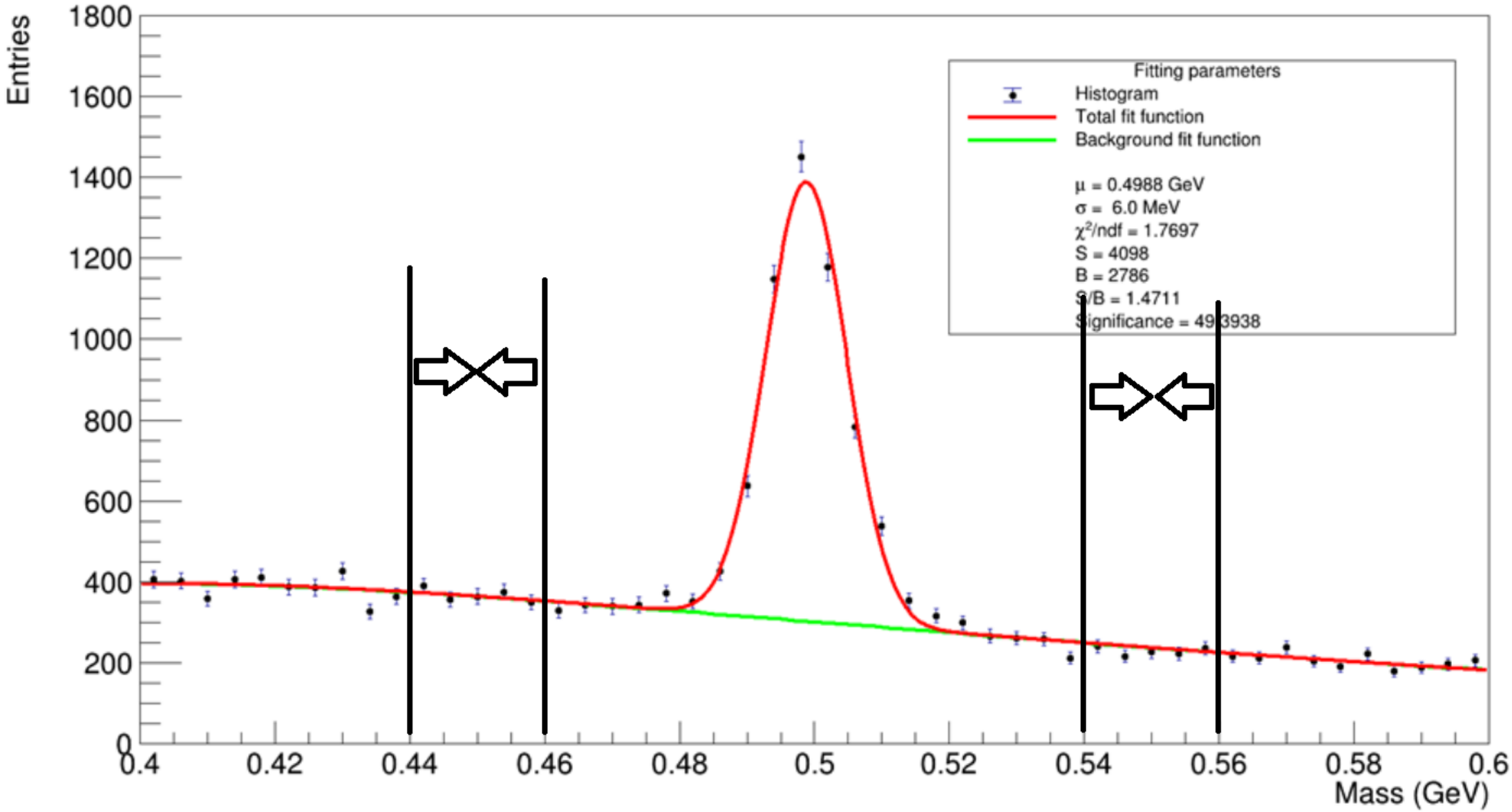
After:



Background analysis

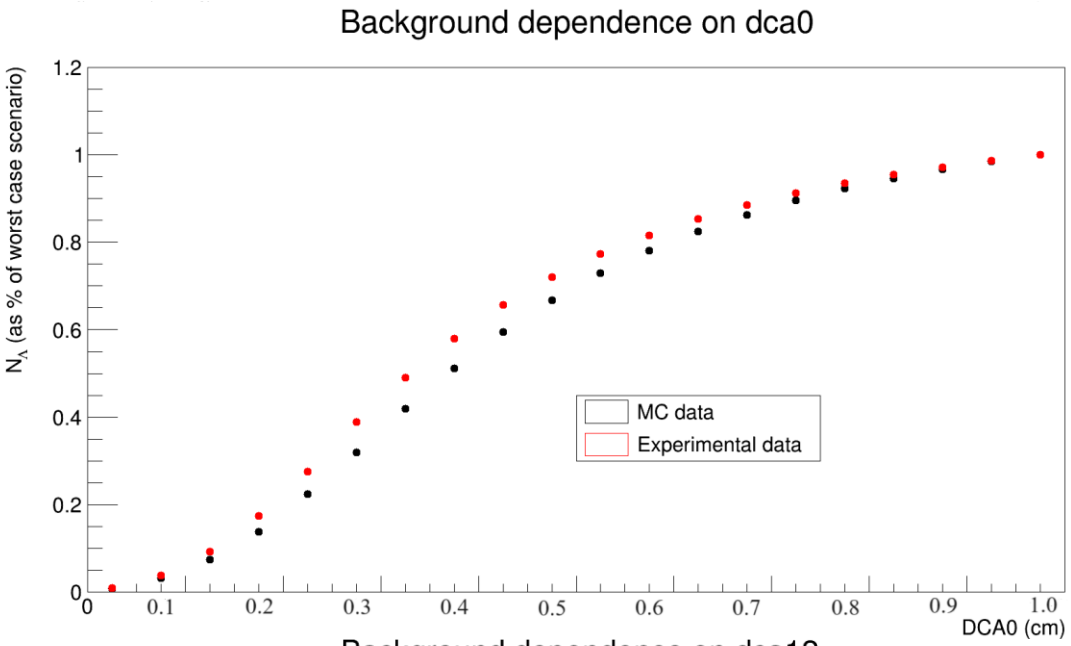


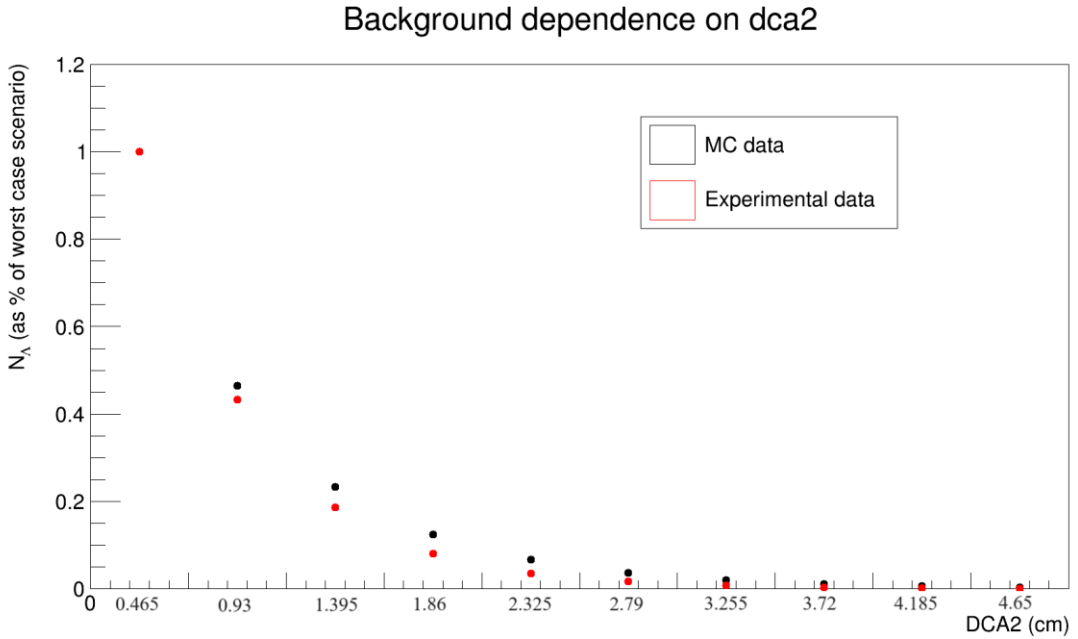
Background analysis

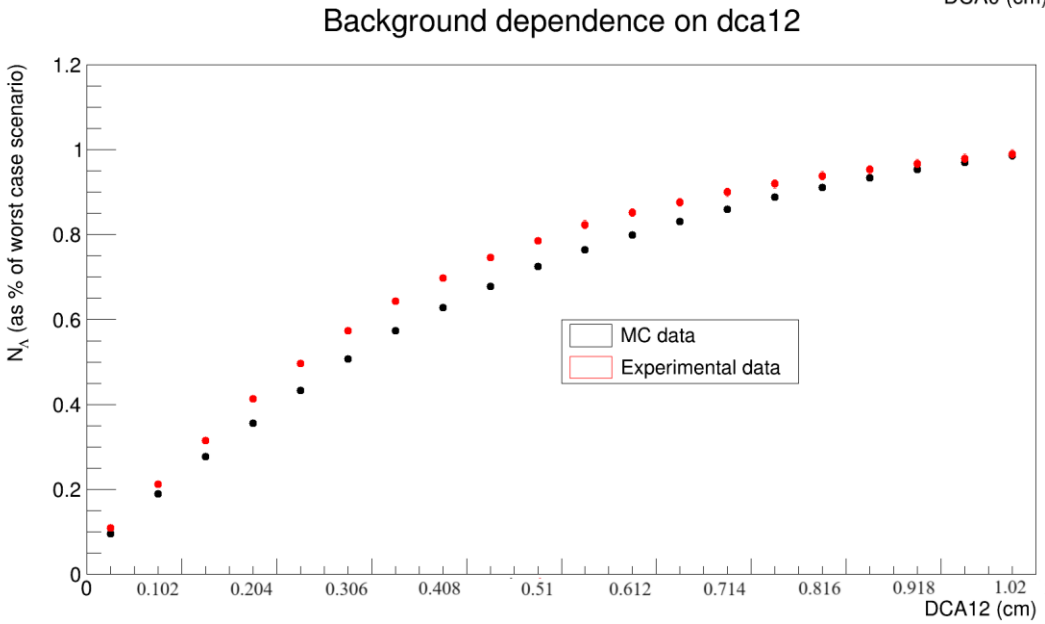


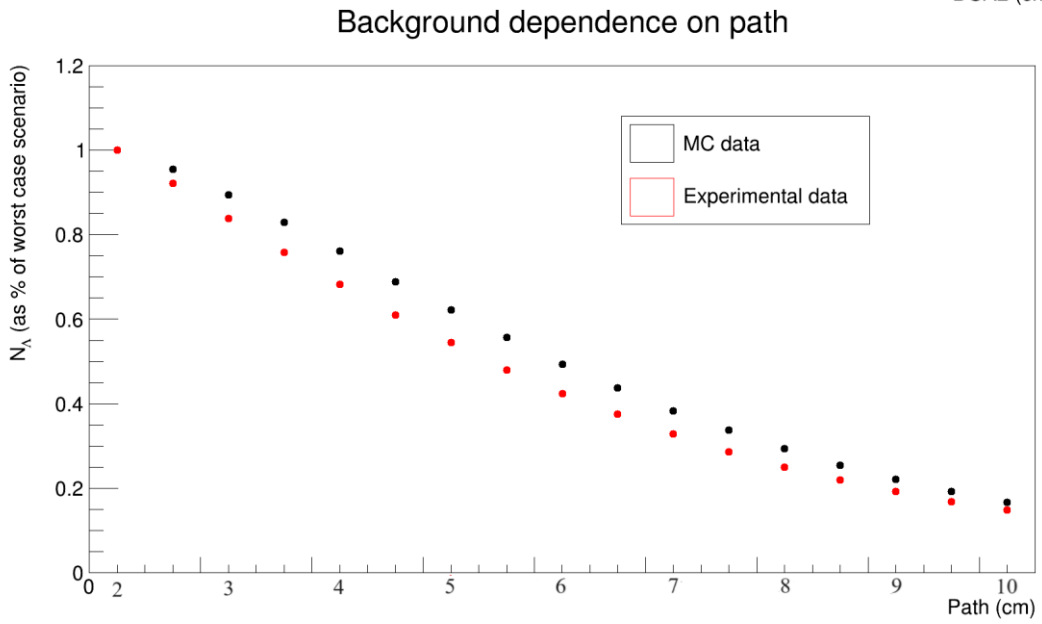
Background analysis for different cuts

Λ : interval 1.09 - 1.1 GeV



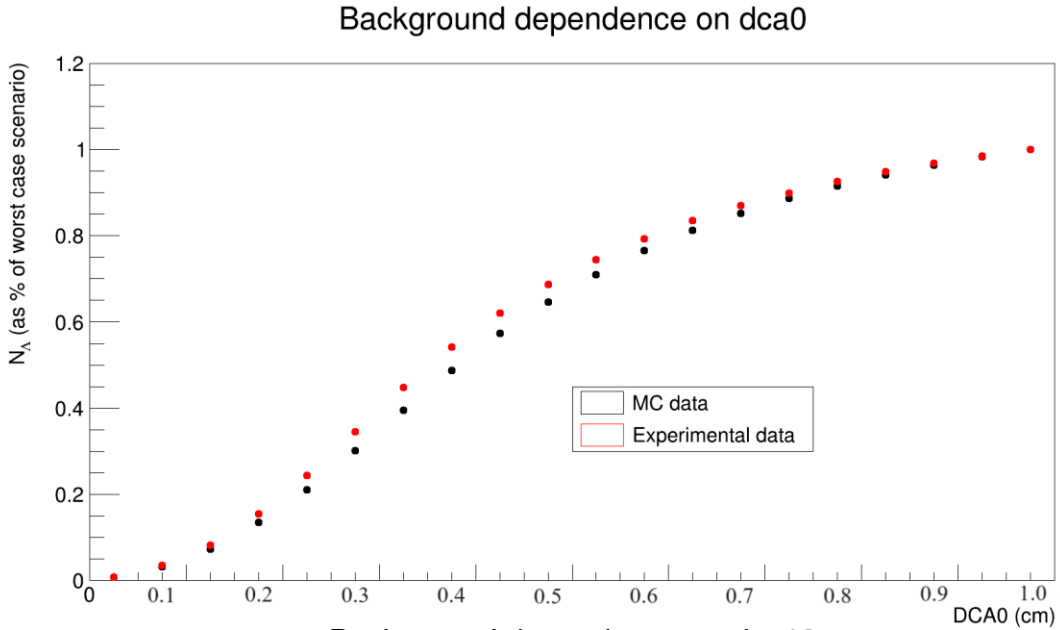


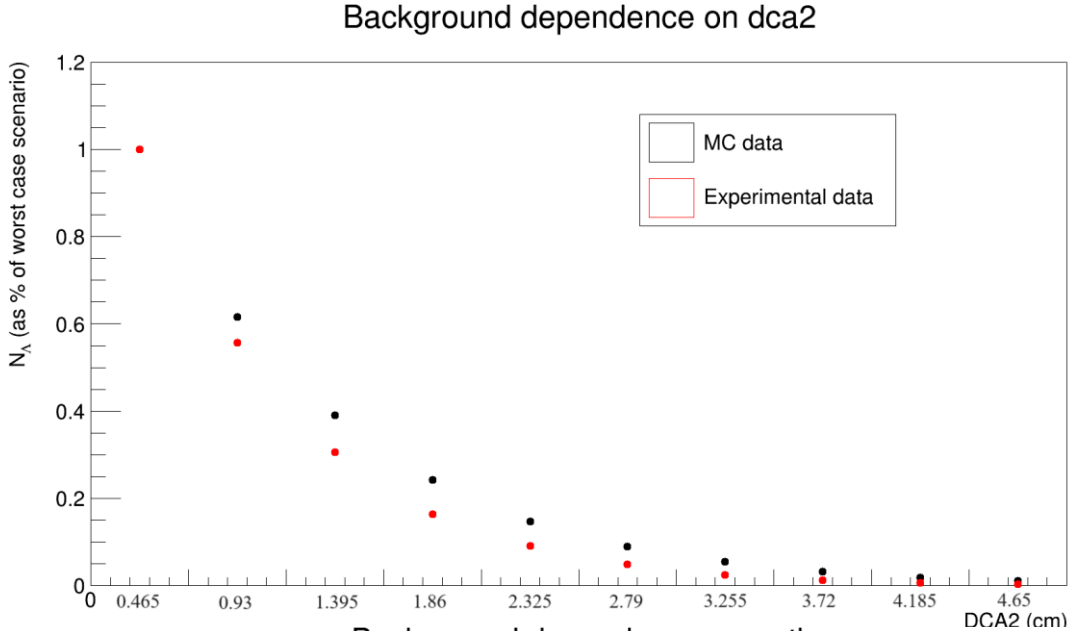


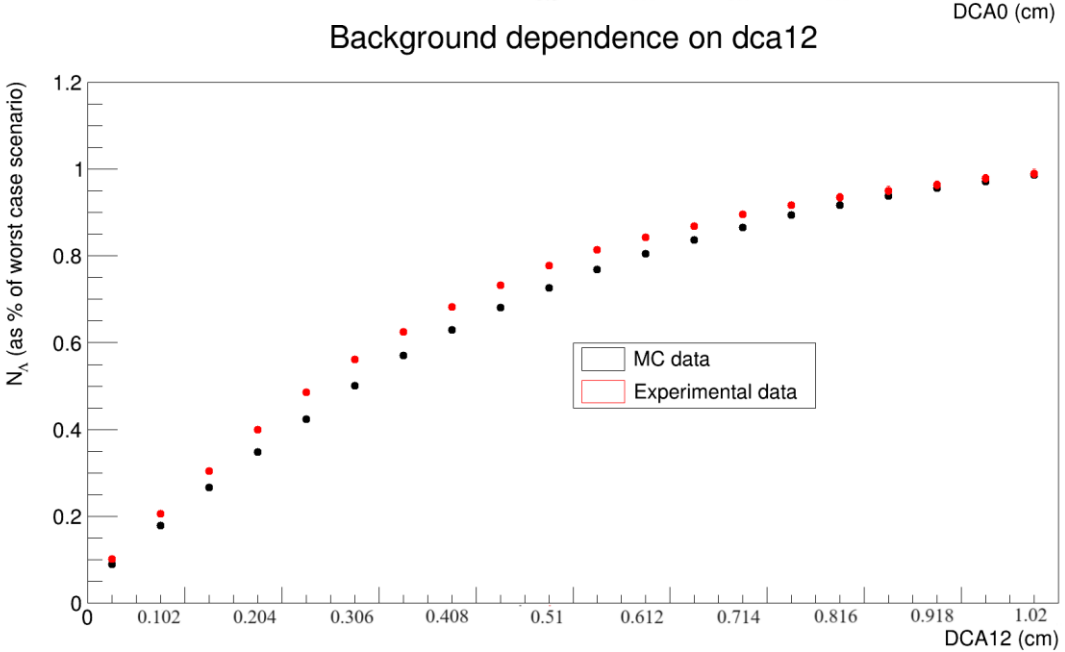


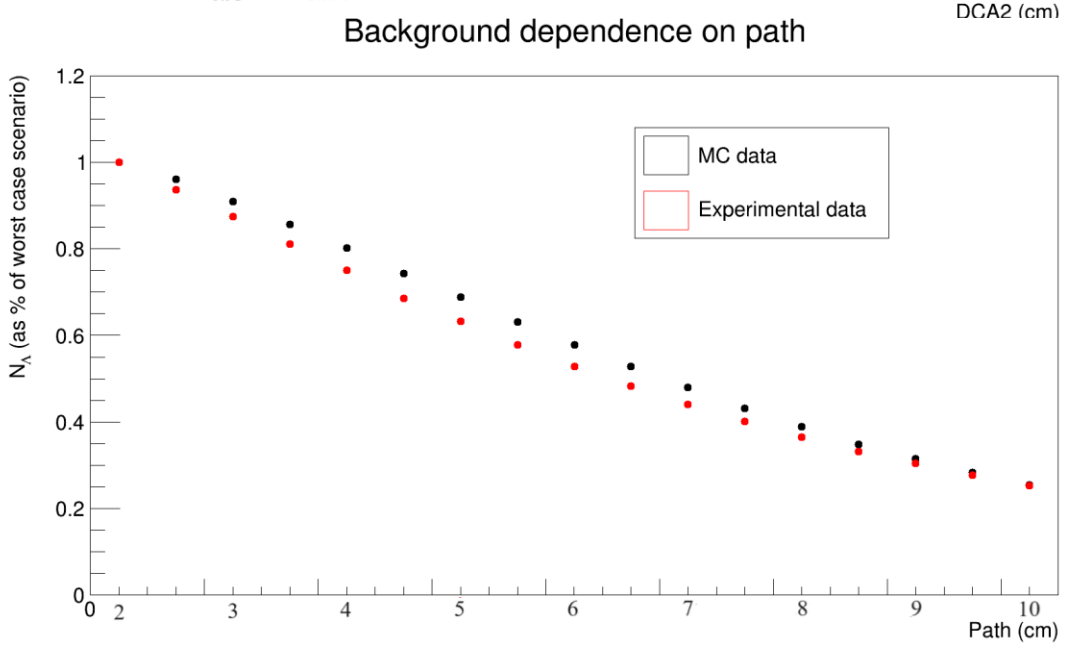
Background analysis for different cuts

Λ : interval 1.13 - 1.14 GeV



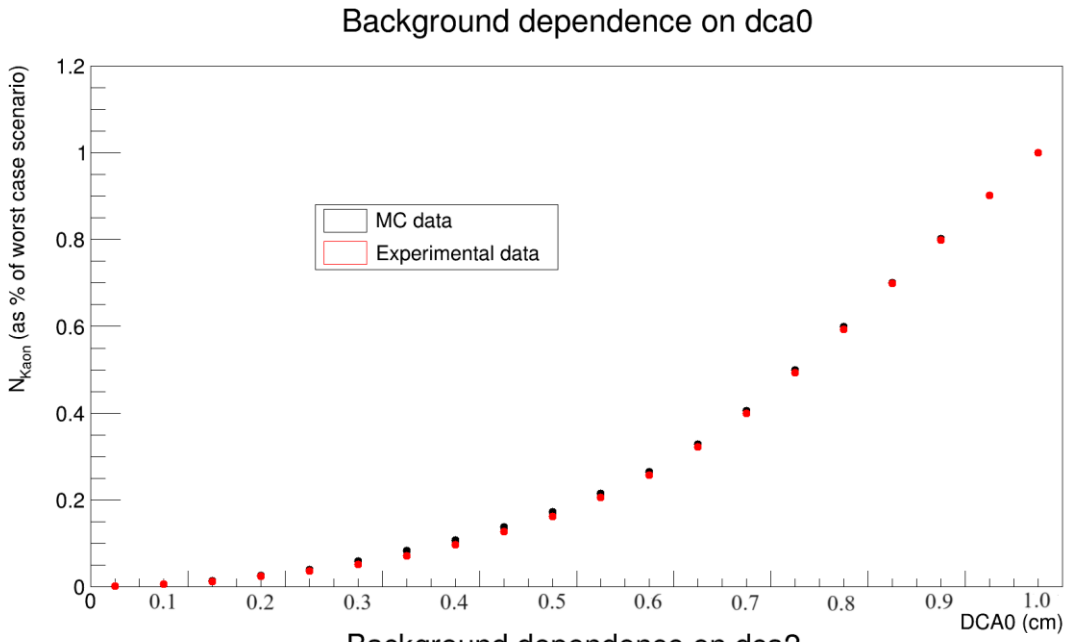


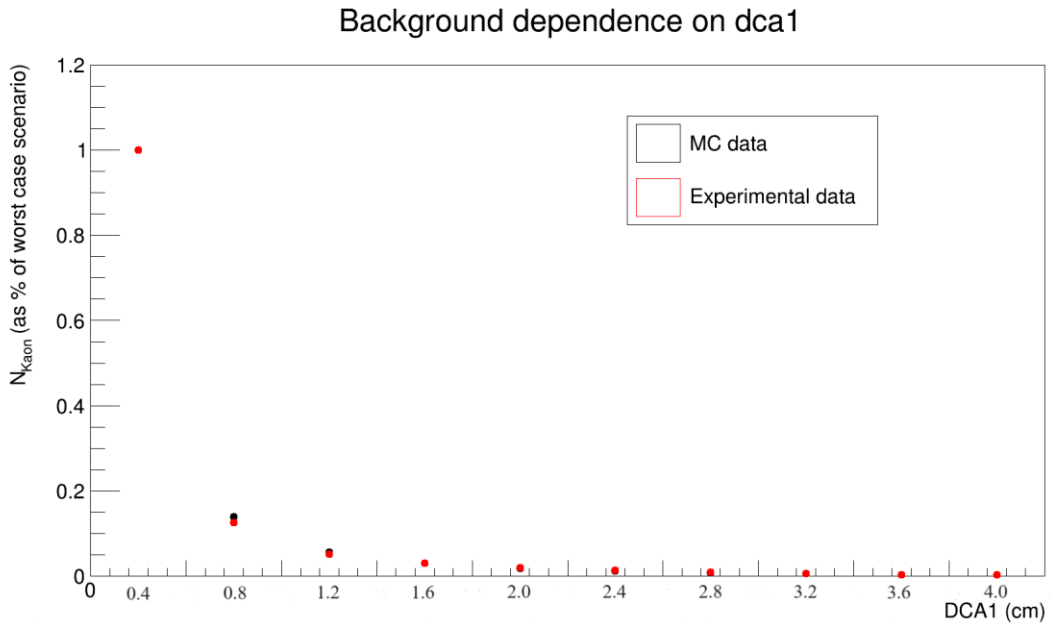


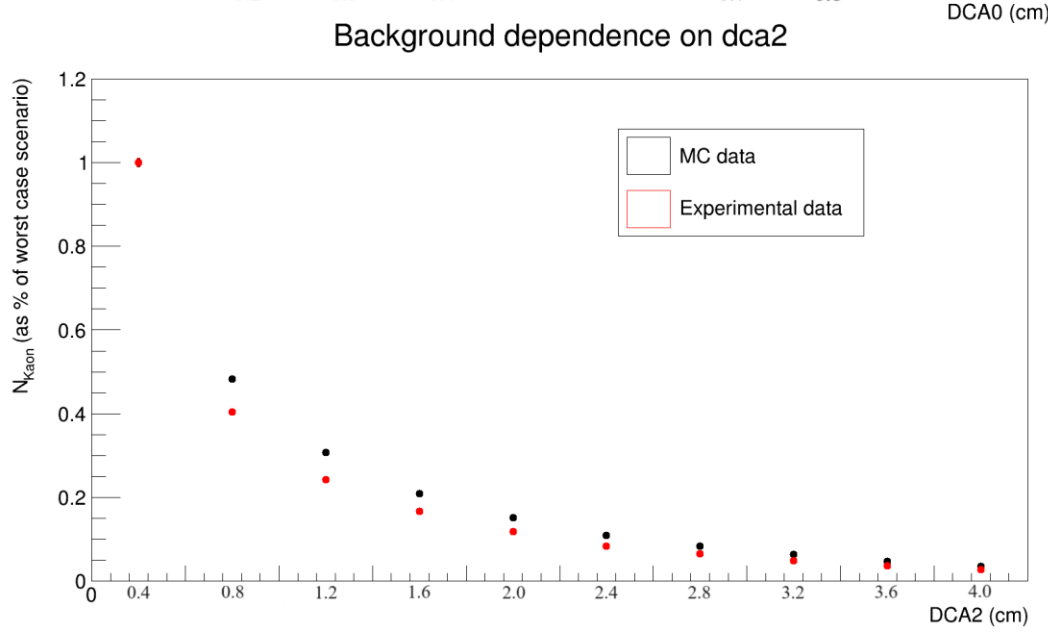


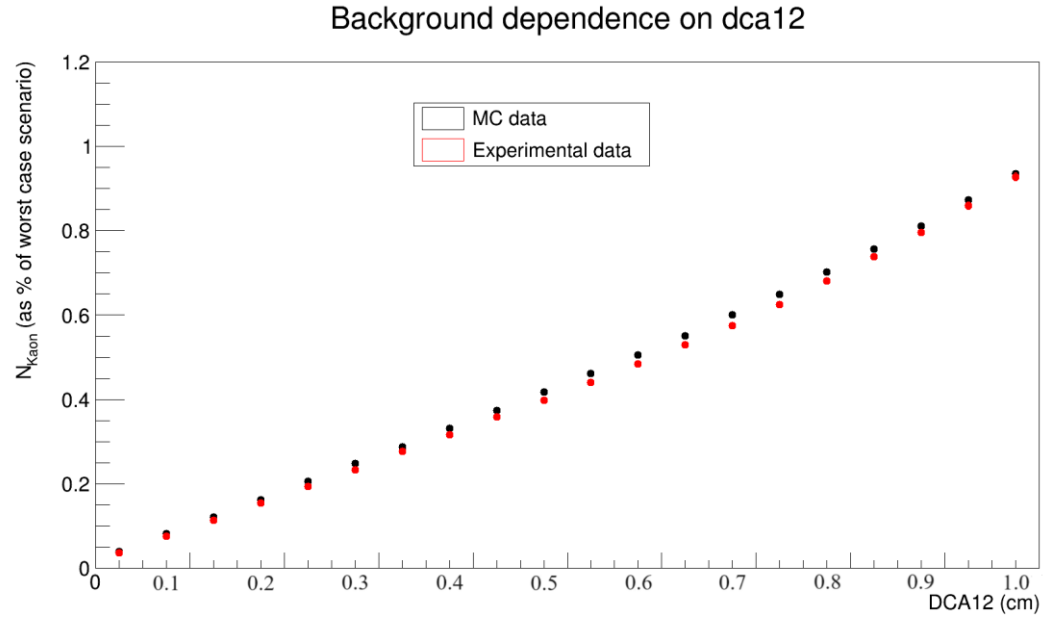
Background analysis for different cuts

K_S^0: interval 0.44 – 0.46 GeV



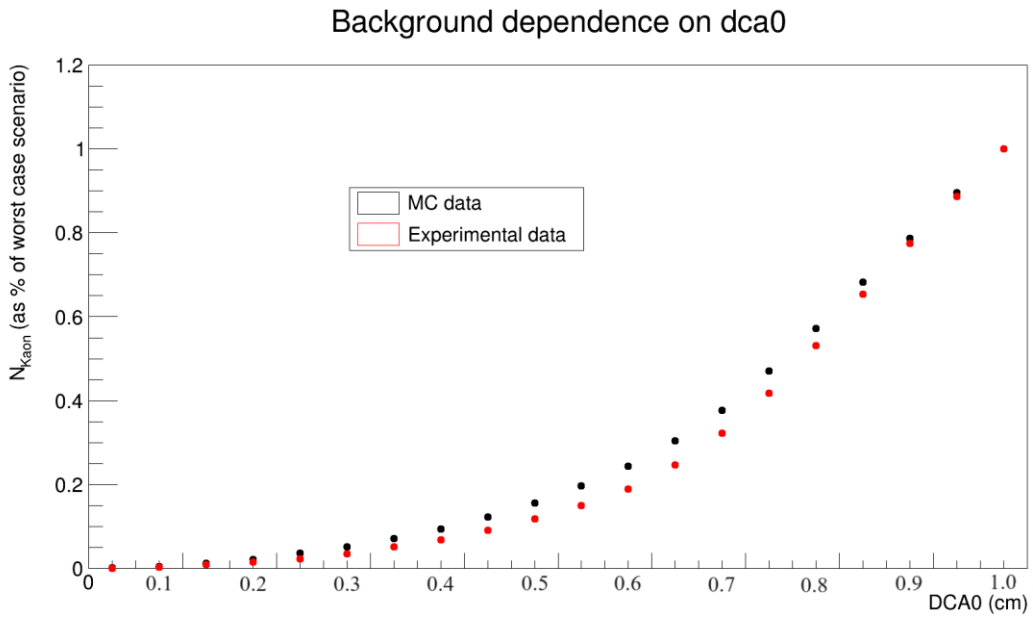


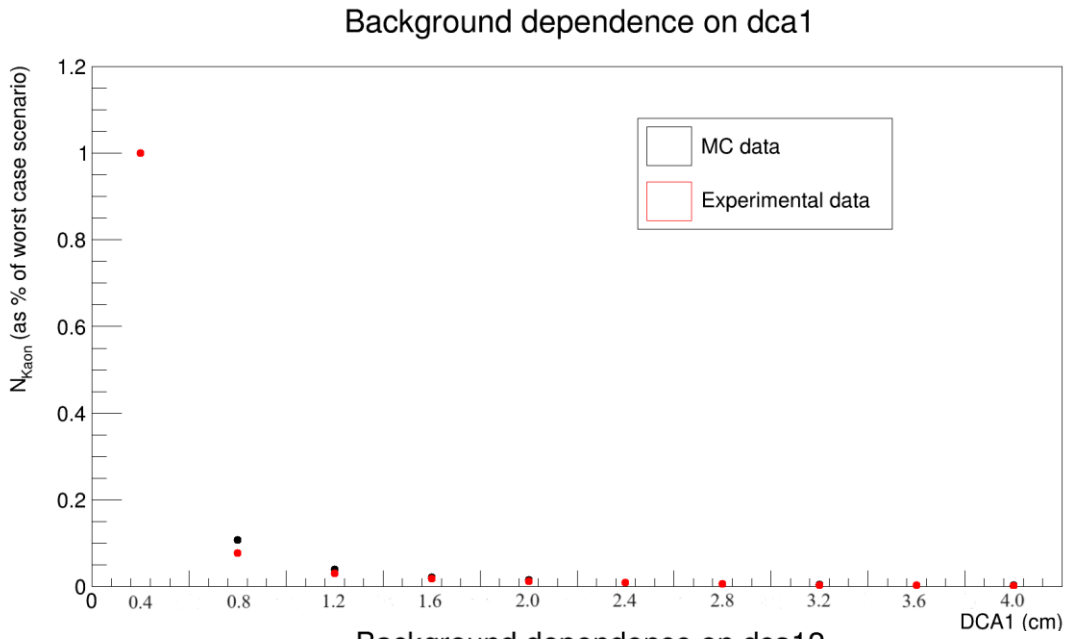


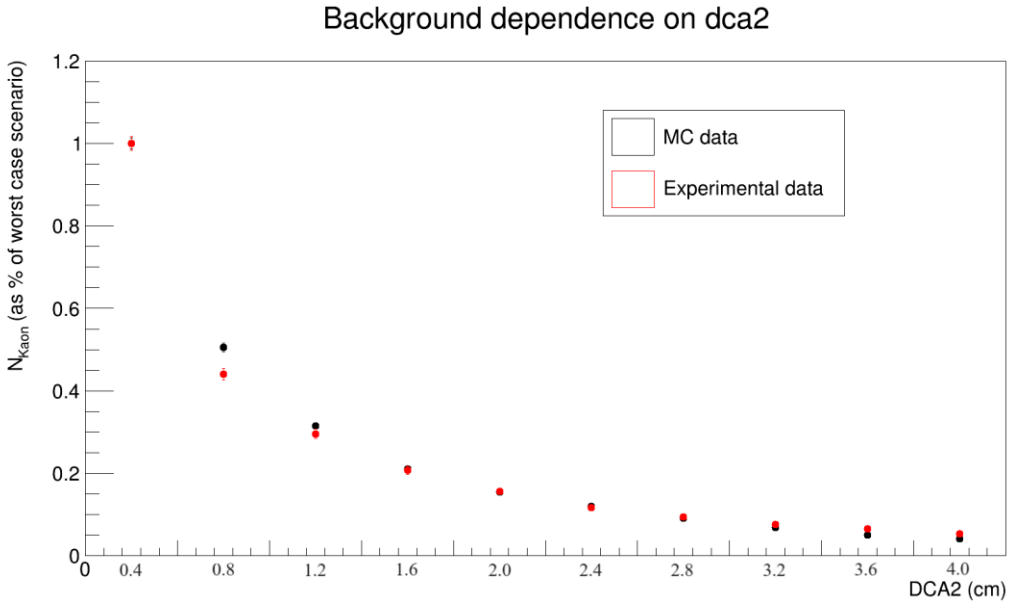


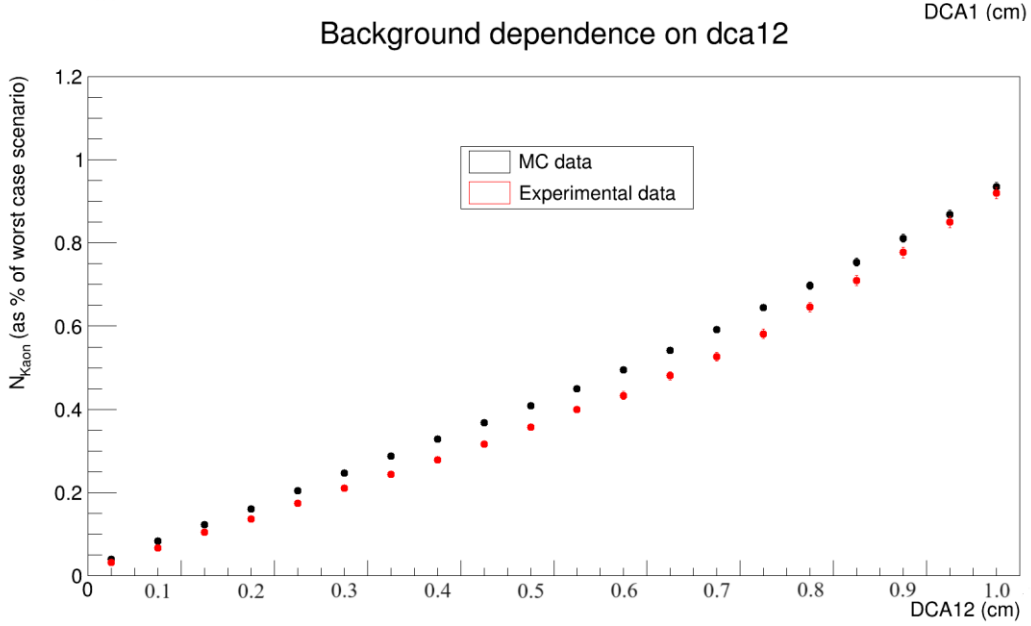
Background analysis for different cuts

K_S^0: interval 0.54 – 0.56 GeV





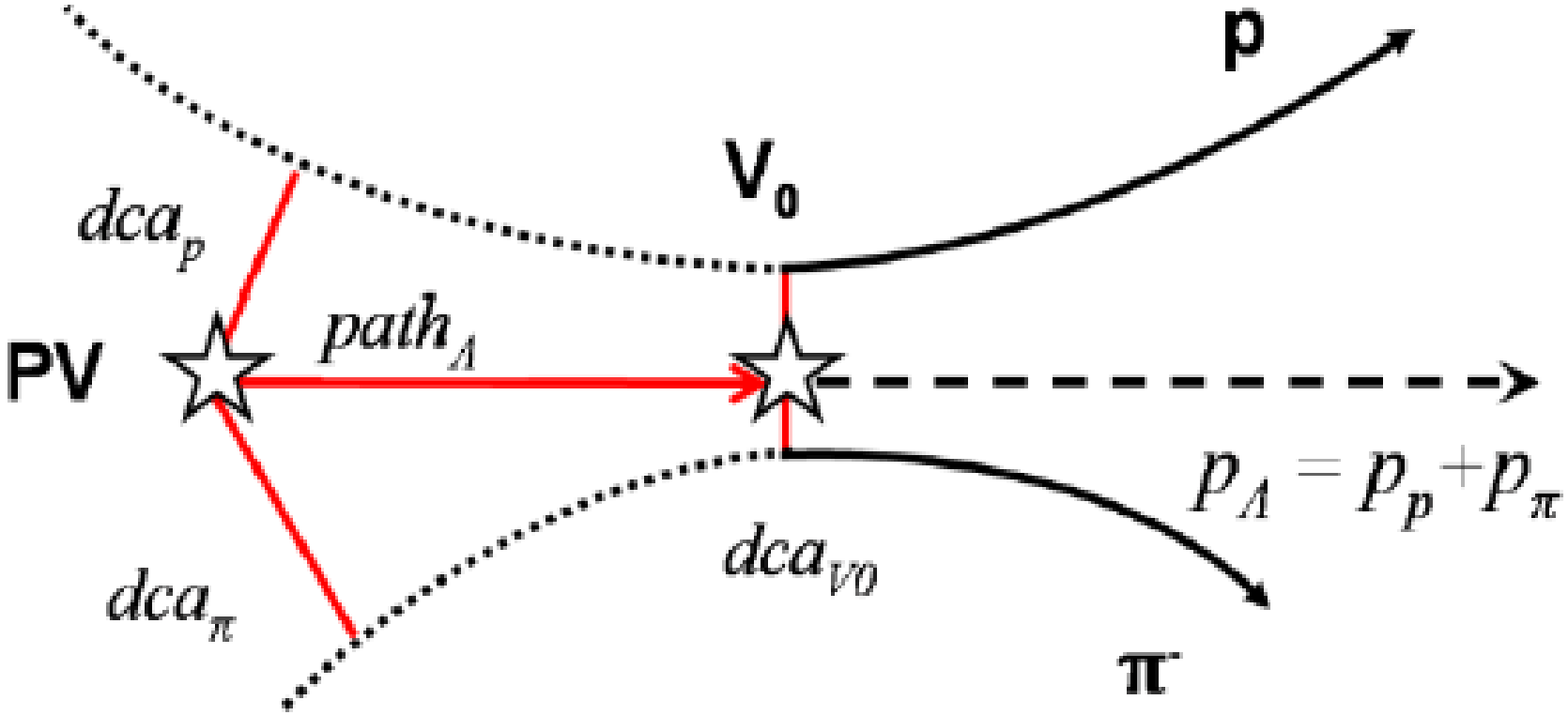




Conclusions

- 1000k MC and experimental events were used to perform fitting for both Λ and $\mathrm{K}_{\mathrm{S}}^{0}$, employing significance as an optimum criterion.
- Signal analysis was performed in order to find new optimal cuts.
- Background analysis was performed to study background behavior at different energy intervals and for different values of the cuts applied.
- Both signal and background increased in case of an increase of interval of interest, as was to be expected.
- Careful compromise between signal and background is essential to achieve the best possible results.

Backup
Graphical overview geometric parameters



Backup
Optimization significance experimental vs MC
Experimental

Λ :

mu = 1.116 GeV
sigma = 2.81 MeV
chi^2/ndf = 1.333
S = 3793
S/B = 0.300
significance = 29.601

K_S^0 :

mu = 0.499 GeV
sigma = 6.18 MeV
chi^2/ndf = 1.086
S = 4498
S/B = 0.767
significance = 44.196

Backup
Fits for MC cuts derived from signal analysis

Λ :

mu = 1.116 GeV
sigma = 2.81 MeV
chi^2/ndf = 1.333
S = 3793
S/B = 0.300
significance = 29.601

K_S^0 :

mu = 0.499 GeV
sigma = 6.18 MeV
chi^2/ndf = 1.086
S = 4498
S/B = 0.767
significance = 44.196