# Standalone MC

absorber

# Rationale

- In the previous simulations that gamma conversions happening in the beam pipe window and in the air have a role in the measured signal in the GBP.
  - The average gamma probability for conversions in 100 um sapphire is ~ 1/1000. If the mass in the converter + air is greater than the one in the sapphire detectors, then the number of gamma conversions in window/air is greater than those occurring within the sapphire.
- The spatial distribution of the secondaries produced both in the window and in air is identical to the gamma Compton profile. From the sim. there aren't significative deviations.

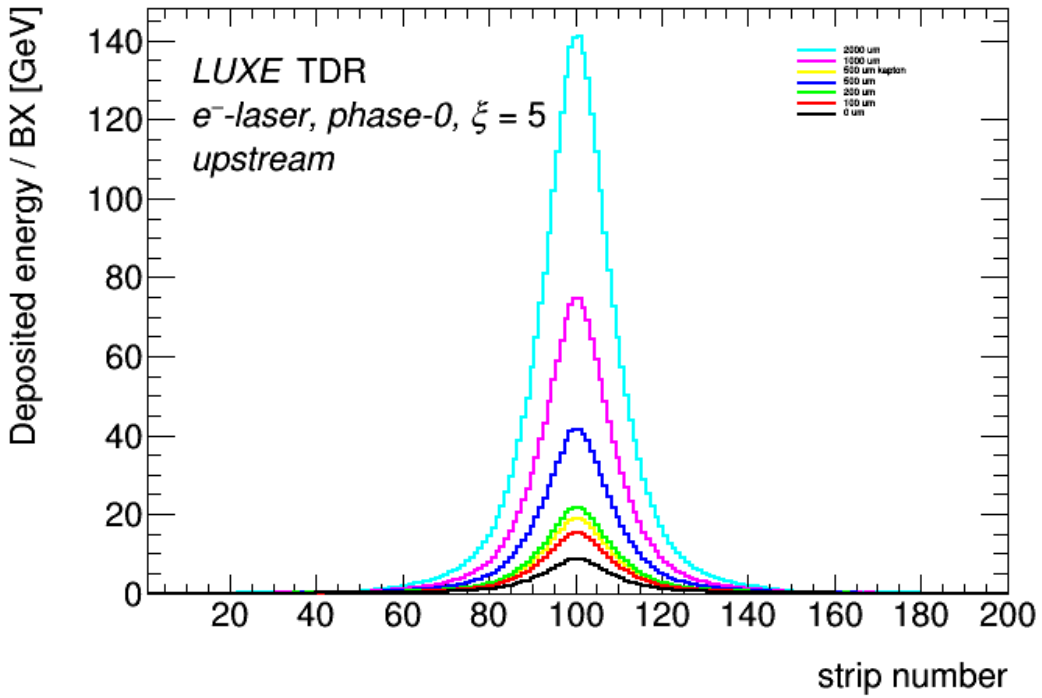
- The proposed idea is to place a material in front of the upstream detector, to increase the amount of gamma conversions and the signal level. With the higher energy depositions, there is the drawback of increasing the absorbed dose the detector has to withstand.

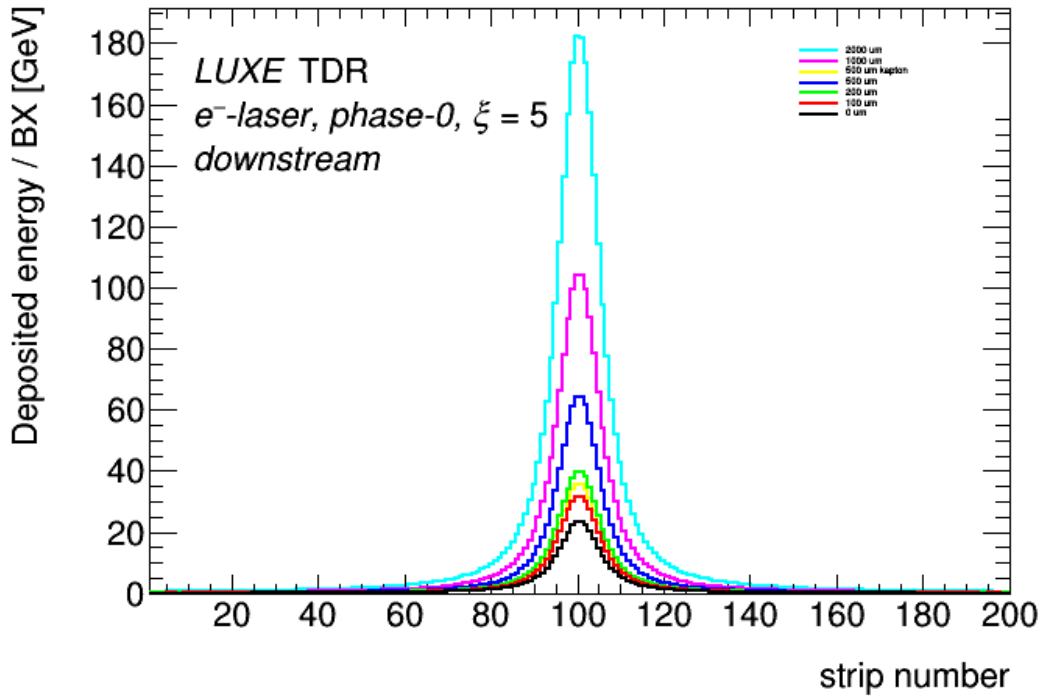
# Case study

- Simulations are performed using \xi=5, beam waist w_0 = 6.69 um
- An Al absorber is placed in front of the upstream detector
- Different thicknesses were used: 100, 200, 500, 1000, 2000 um

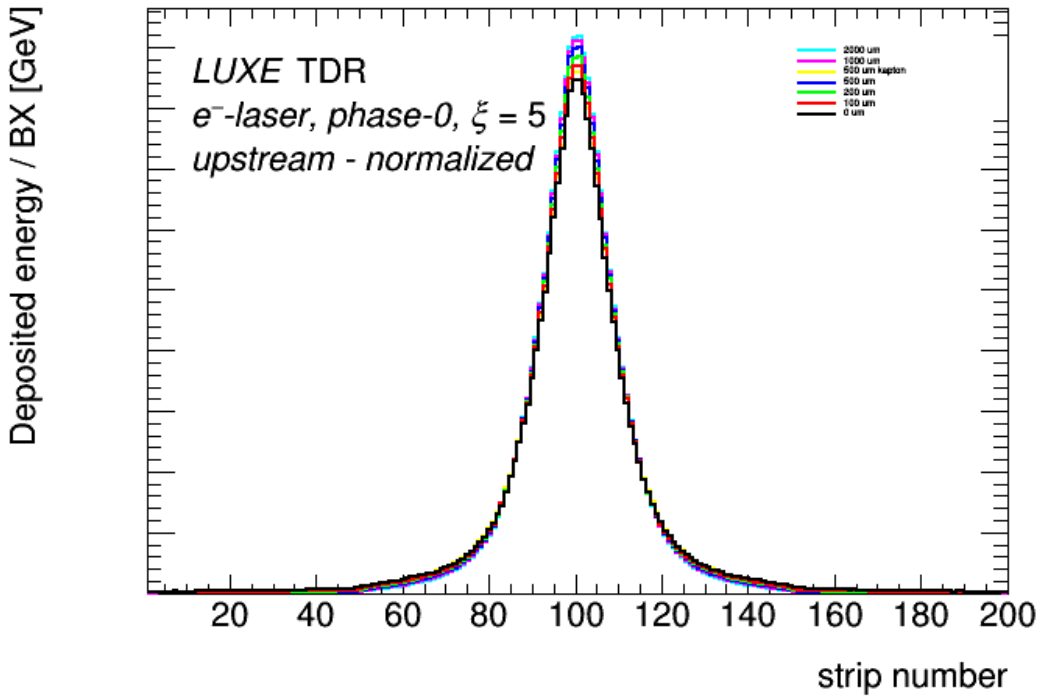
- The profile is compared with the one without the absorber, and the maximum absorbed dose (over a cubic volume of L=100 um) is compared.

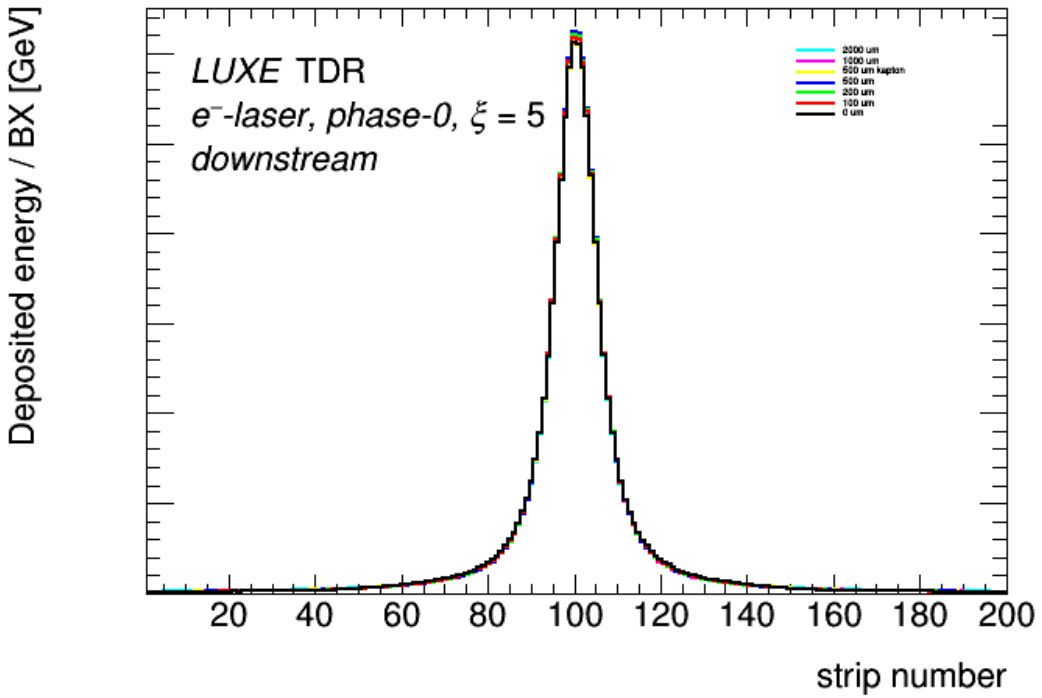
# Profile reconstruction (black – without abs.)



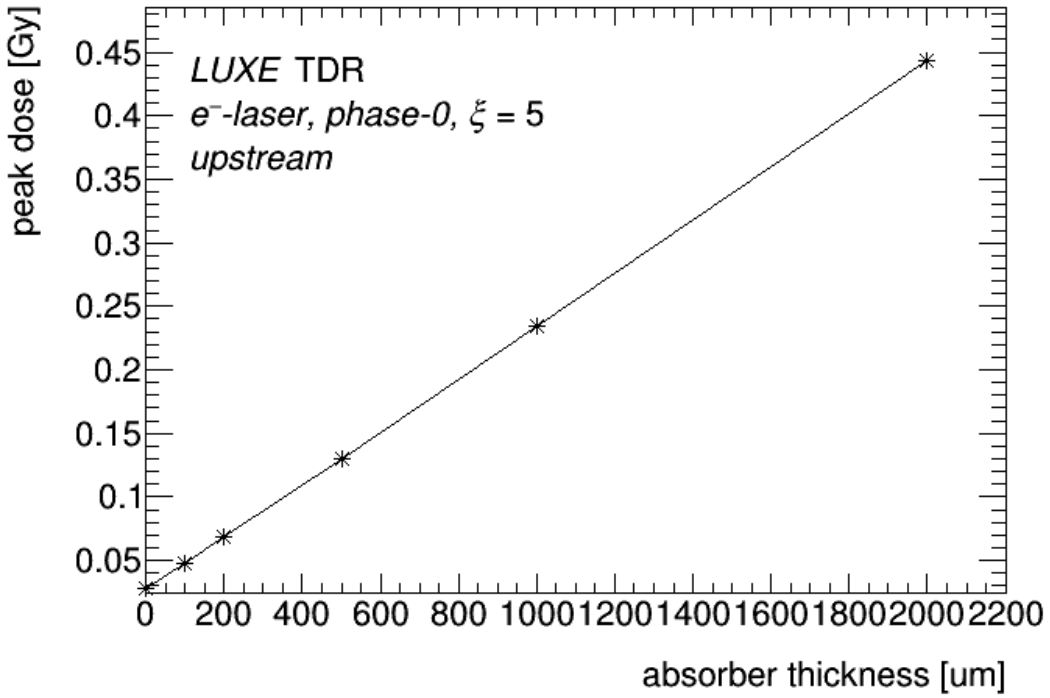
# Profile reconstruction (black – without abs.)

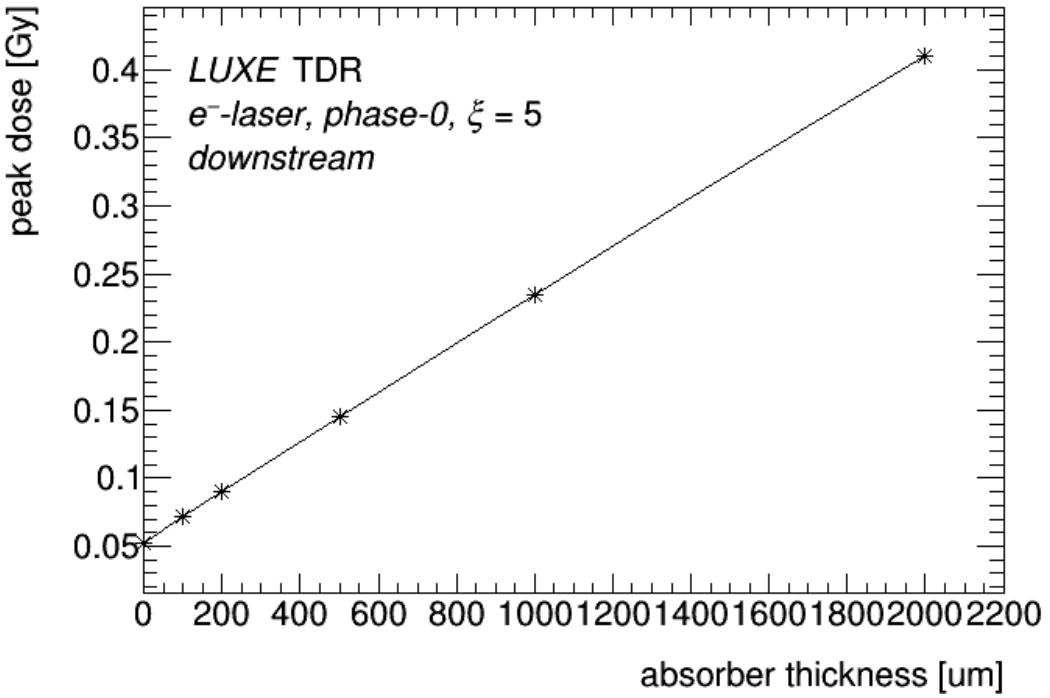


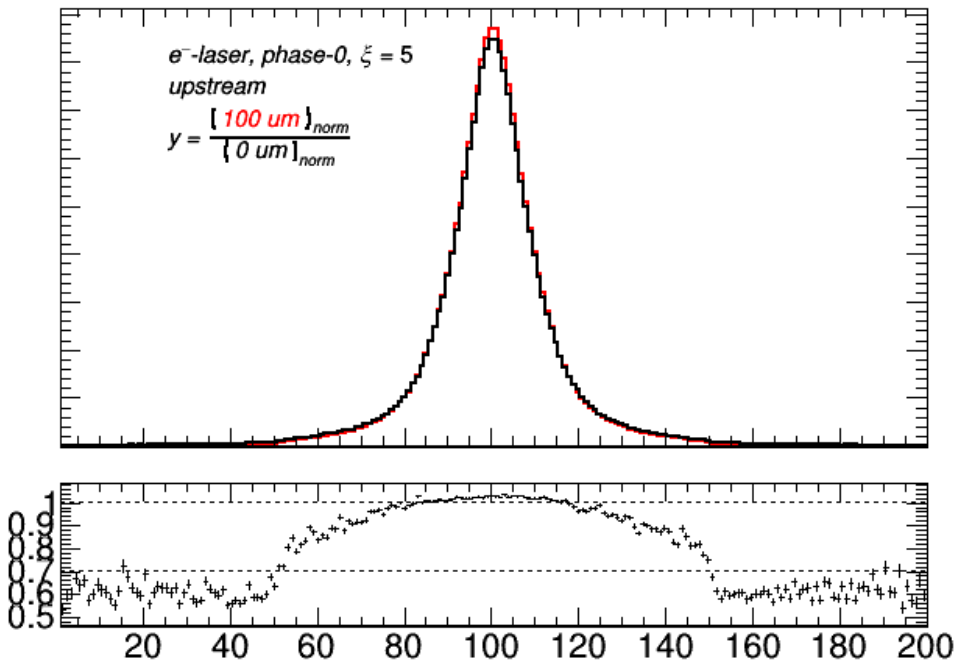
# Peak dose absorbed

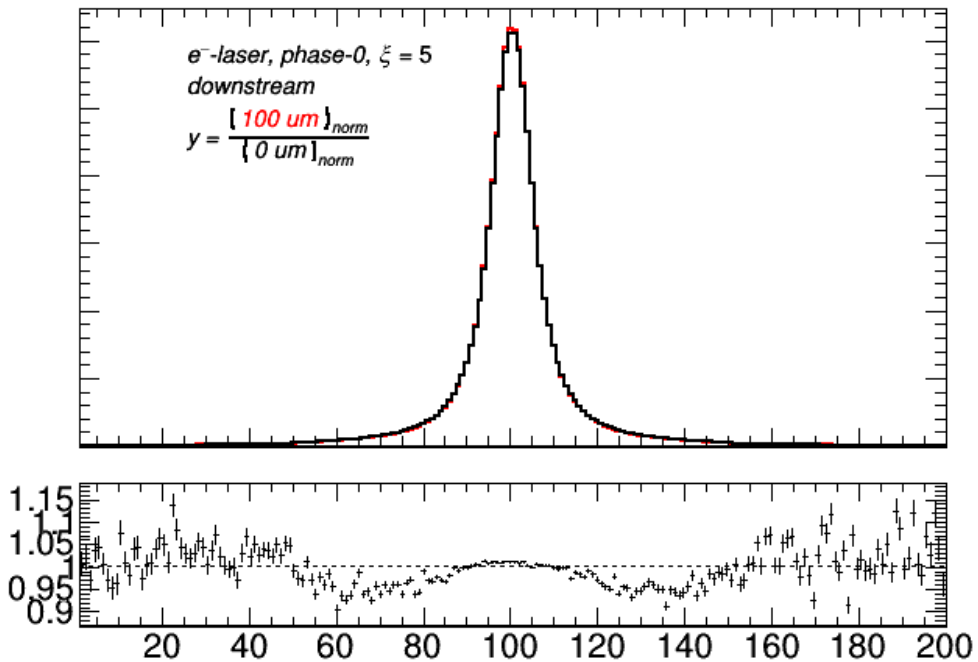
| Al thickness [um] | Upstream peak dose / BX [Gy] | Downstream peak dose / BX [Gy] |
|---|---|---|
| 0 | 0.027526 | 0.051789 |
| 100 | 0.0482028 | 0.0713555 |
| 200 | 0.068764 | 0.0900066 |
| 500 | 0.130259 | 0.144809 |
| 1000 | 0.23456 | 0.235081 |
| 2000 | 0.443305 | 0.409583 |



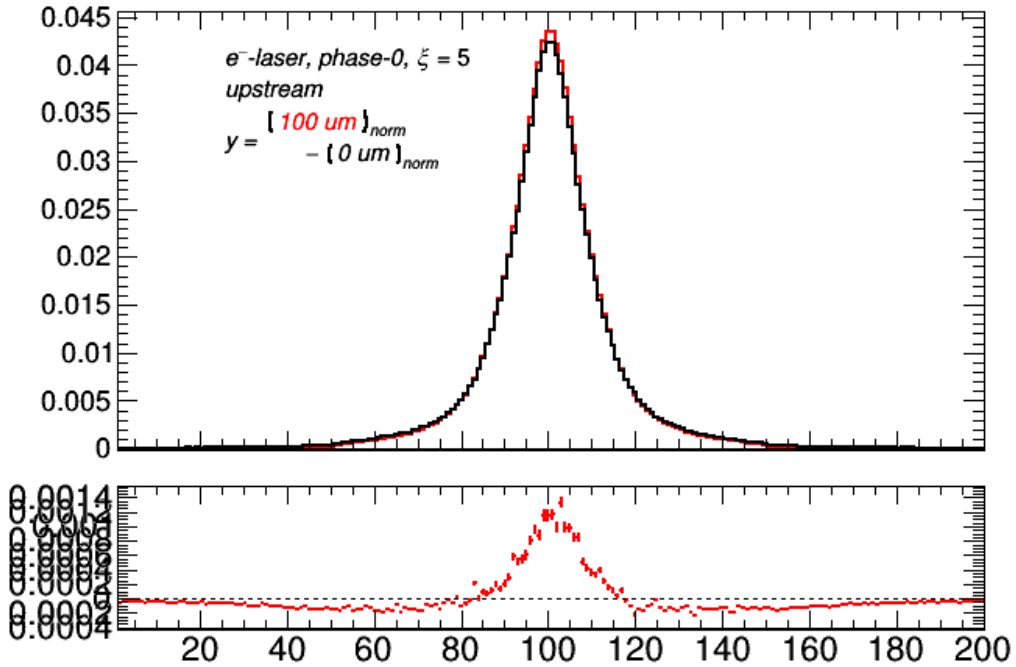



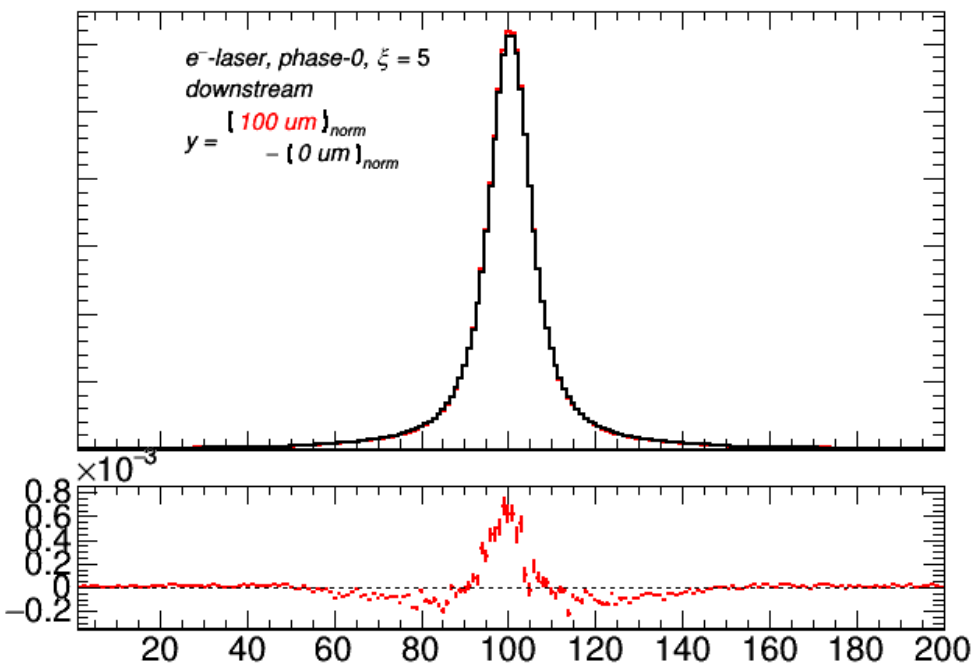
# 100 um


e⁻-laser, phase-0, ξ = 5
upstream
y = [100 um]norm / [0 um]norm
1
0.9
0.8
0.7
0.6
0.5
20 40 60 80 100 120 140 160 180 200

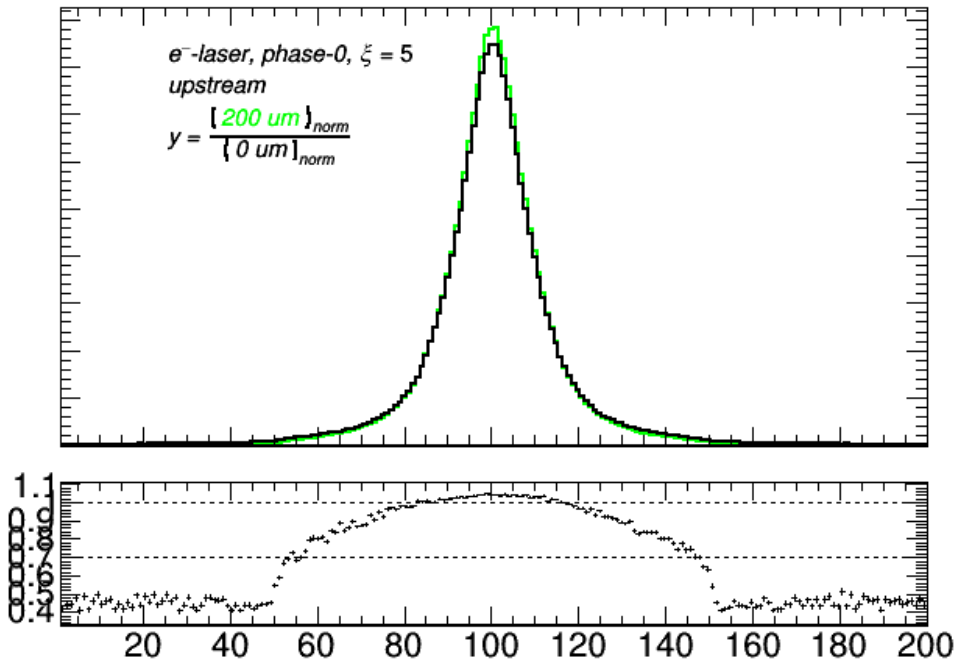

e⁻-laser, phase-0, ξ = 5
downstream
y = [100 um]norm / [0 um]norm
1.15
1.1
1.05
1
0.95
0.9
20 40 60 80 100 120 140 160 180 200

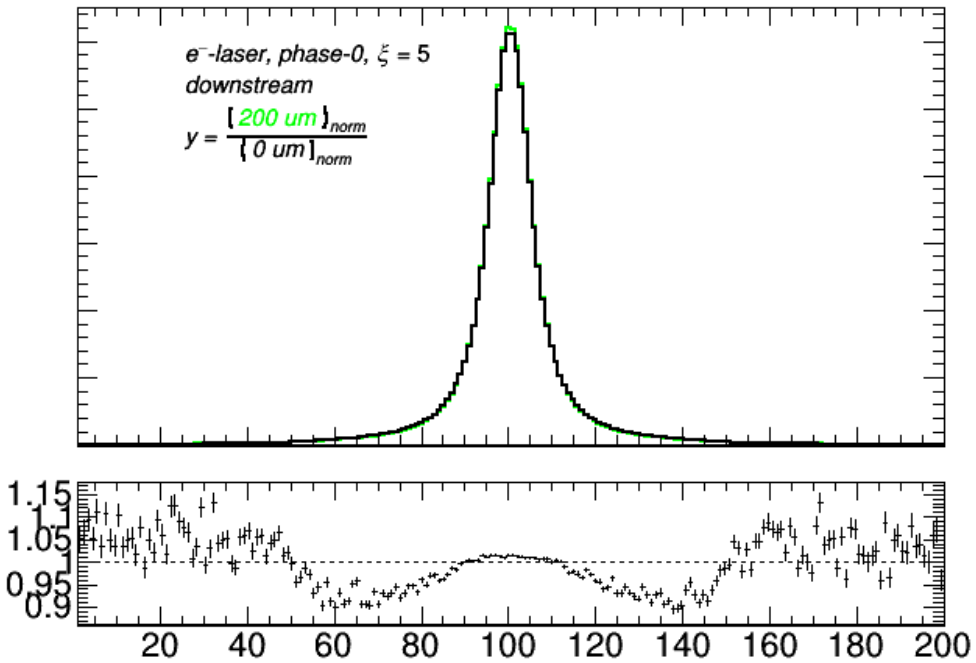
# 100 um


e⁻-laser, phase-0, ξ = 5
upstream
y = {100 um}norm − {0 um}norm
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
20 40 60 80 100 120 140 160 180 200

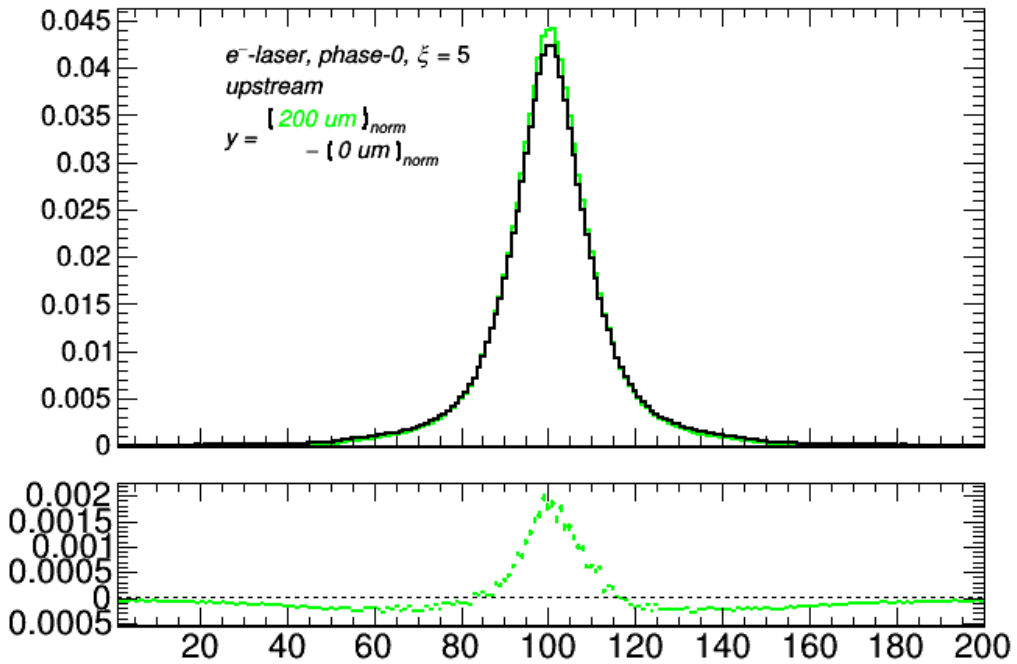

e⁻-laser, phase-0, ξ = 5
downstream
y = {100 um}norm − {0 um}norm
×10⁻³
0.8
0.6
0.4
0.2
0
−0.2
20 40 60 80 100 120 140 160 180 200

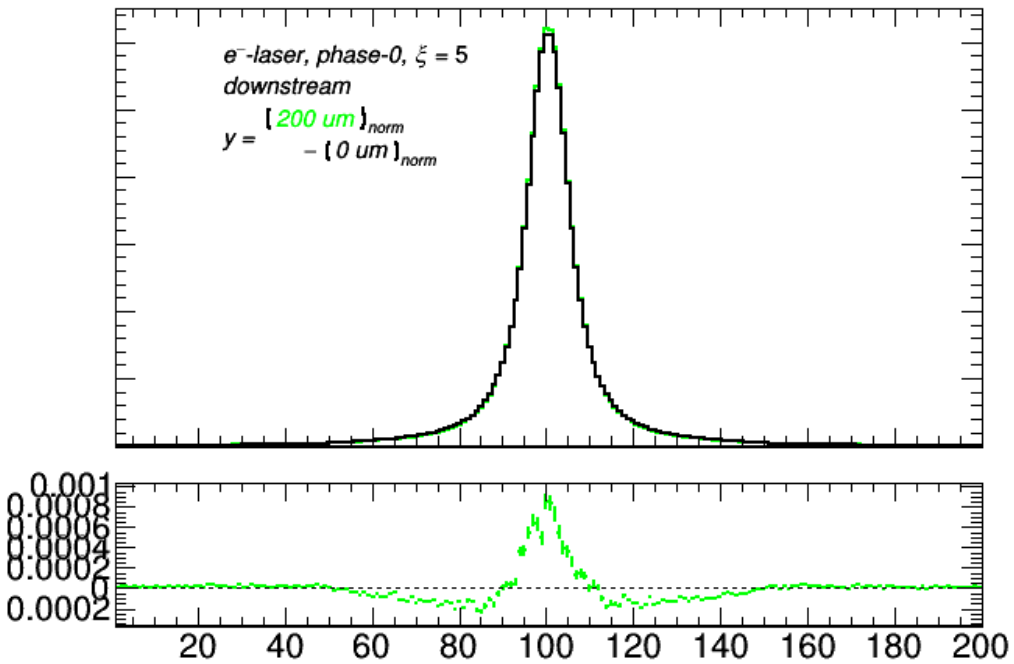
# 200 um


e⁻-laser, phase-0, ξ = 5
upstream
y = [200 um]norm / [0 um]norm
1.1
0.4
20 40 60 80 100 120 140 160 180 200

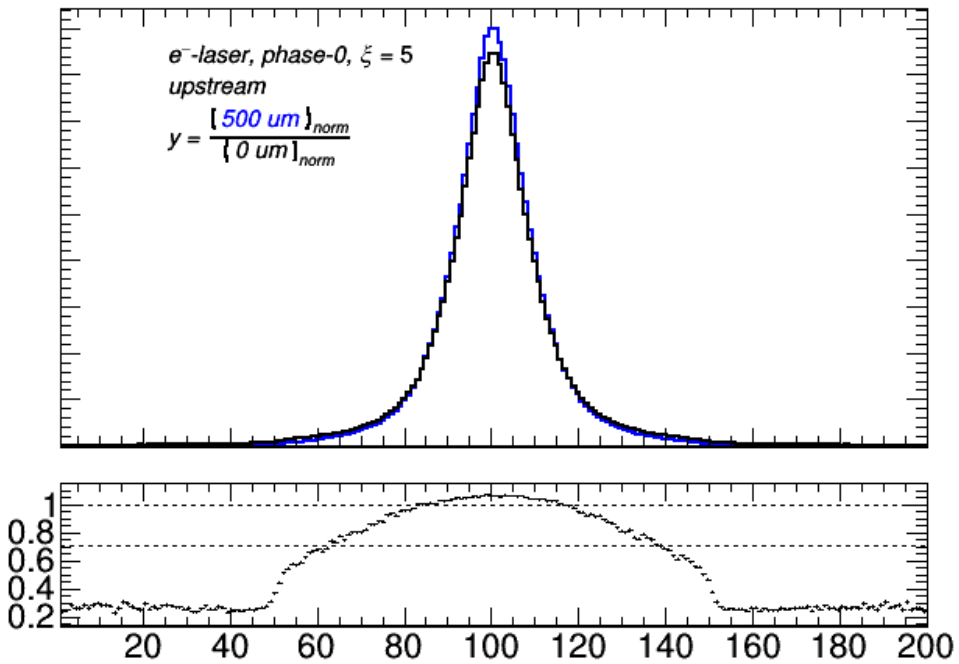

e⁻-laser, phase-0, ξ = 5
downstream
y = [200 um]norm / [0 um]norm
1.15
1.05
0.95
0.9
20 40 60 80 100 120 140 160 180 200

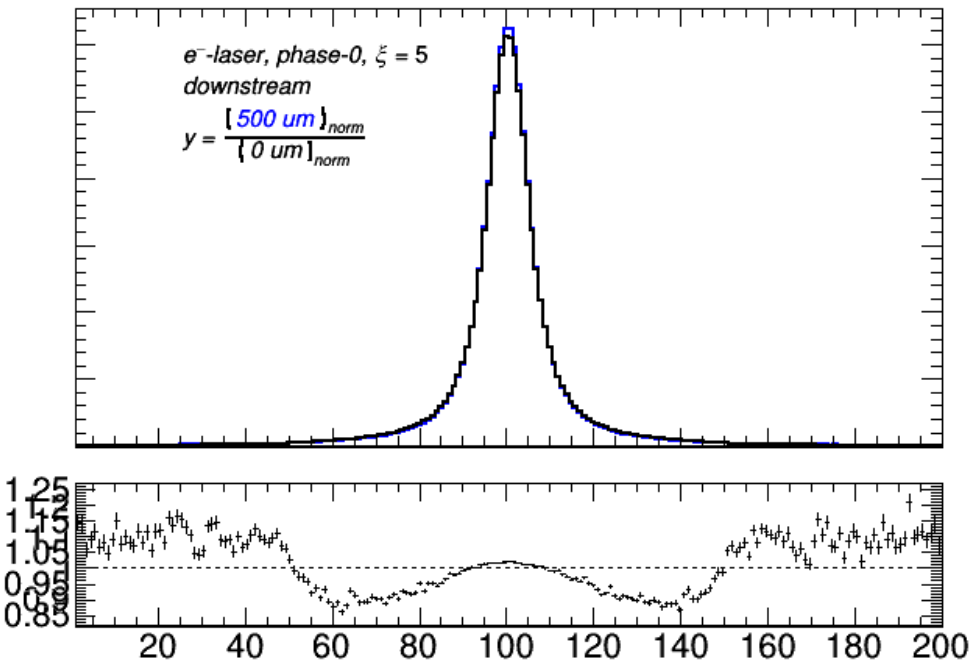
# 200 um


e⁻-laser, phase-0, ξ = 5
upstream
y = {200 um}norm − {0 um}norm
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0.002
0.0015
0.001
0.0005
0
0.0005
20 40 60 80 100 120 140 160 180 200

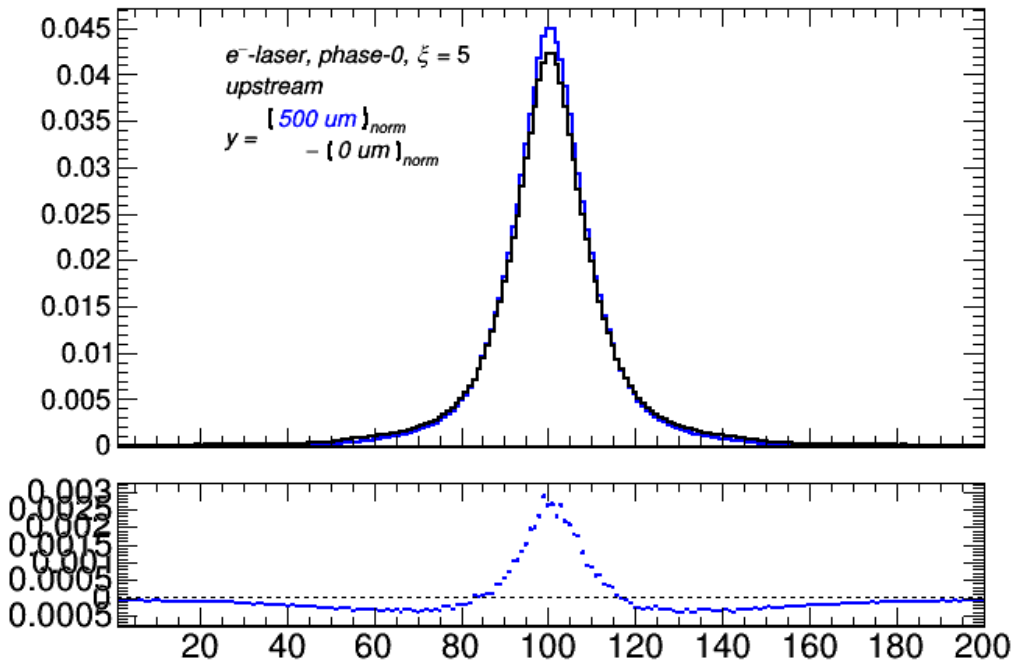

e⁻-laser, phase-0, ξ = 5
downstream
y = {200 um}norm − {0 um}norm
0.001
0.0008
0.0006
0.0004
0.0002
0
0.0002
20 40 60 80 100 120 140 160 180 200

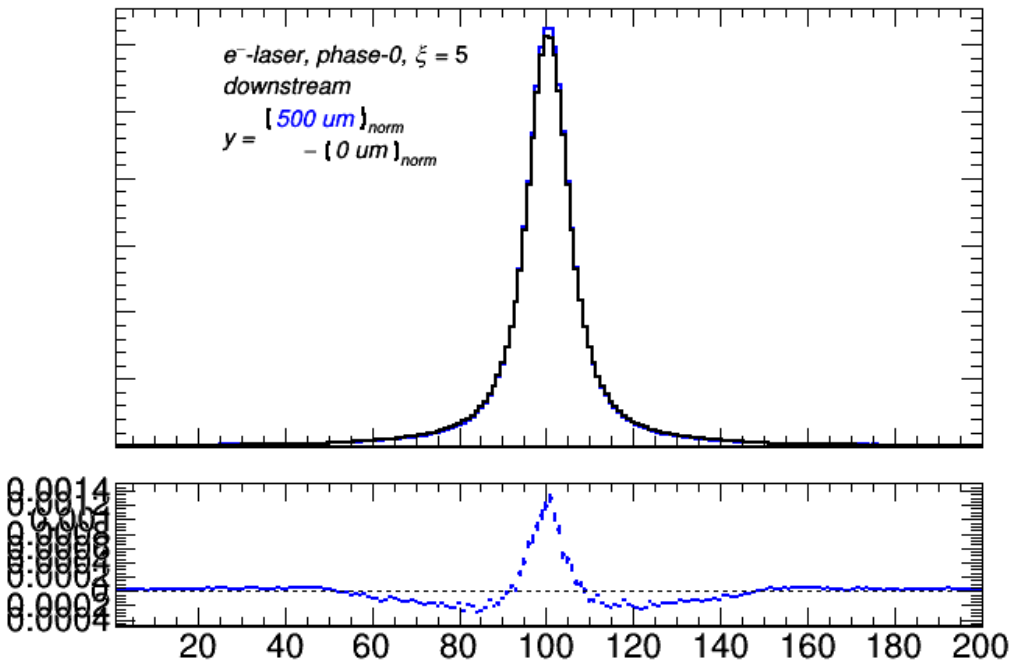
# 500 um


e⁻-laser, phase-0, ξ = 5
upstream
y = [500 um]norm / [0 um]norm
1
0.8
0.6
0.4
0.2
20 40 60 80 100 120 140 160 180 200

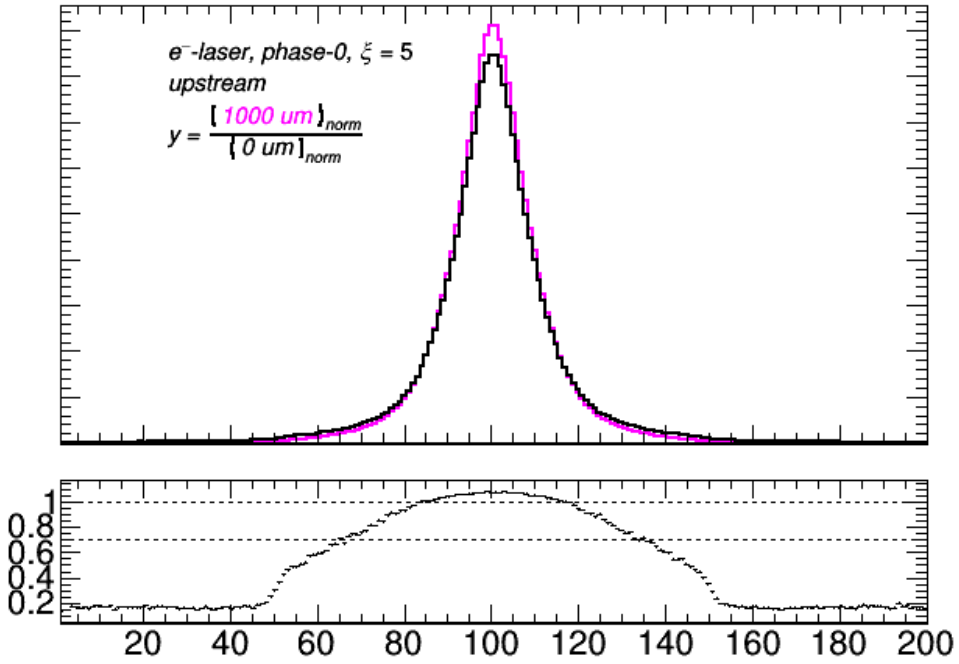

e⁻-laser, phase-0, ξ = 5
downstream
y = [500 um]norm / [0 um]norm
1.25
1.15
1.05
0.95
0.85
20 40 60 80 100 120 140 160 180 200

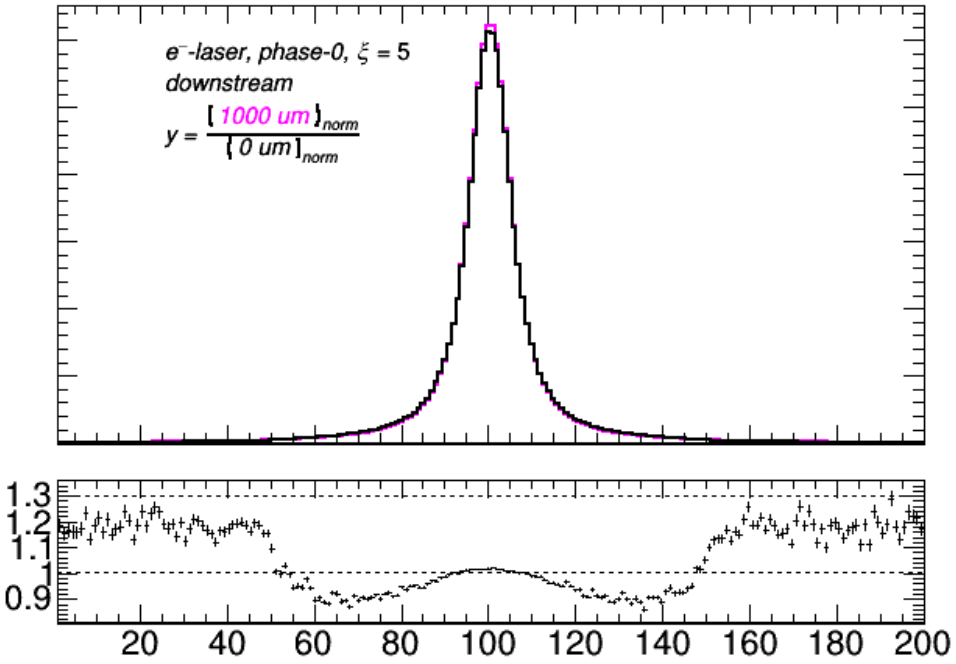
# 500 um


e⁻-laser, phase-0, ξ = 5
upstream
y = {500 um}norm − {0 um}norm
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
0.0005
20 40 60 80 100 120 140 160 180 200

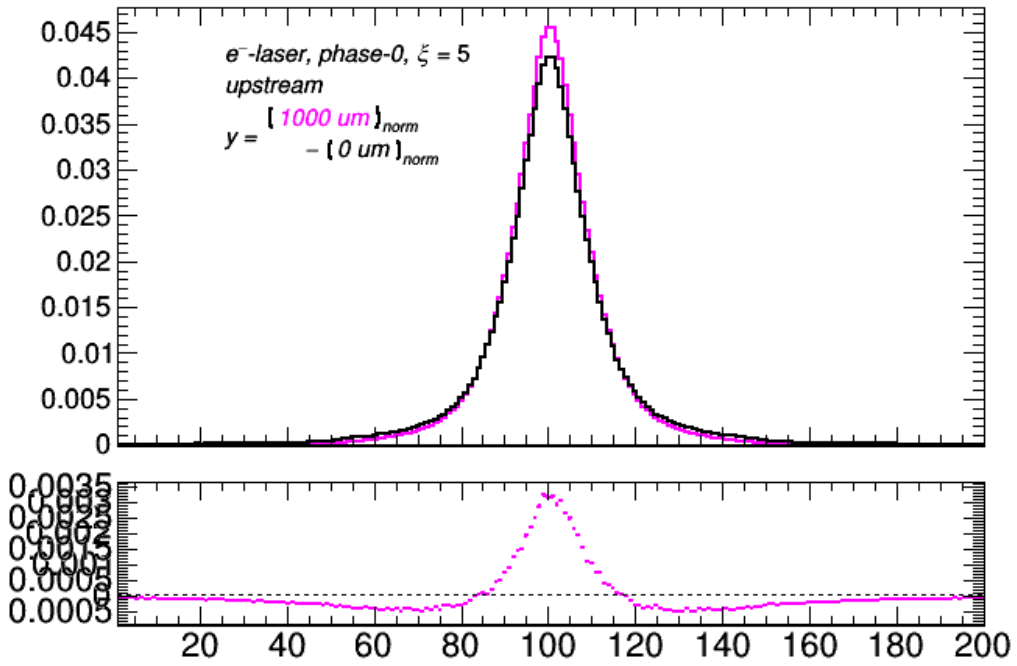

e⁻-laser, phase-0, ξ = 5
downstream
y = {500 um}norm − {0 um}norm
0.0014
0.0004
20 40 60 80 100 120 140 160 180 200

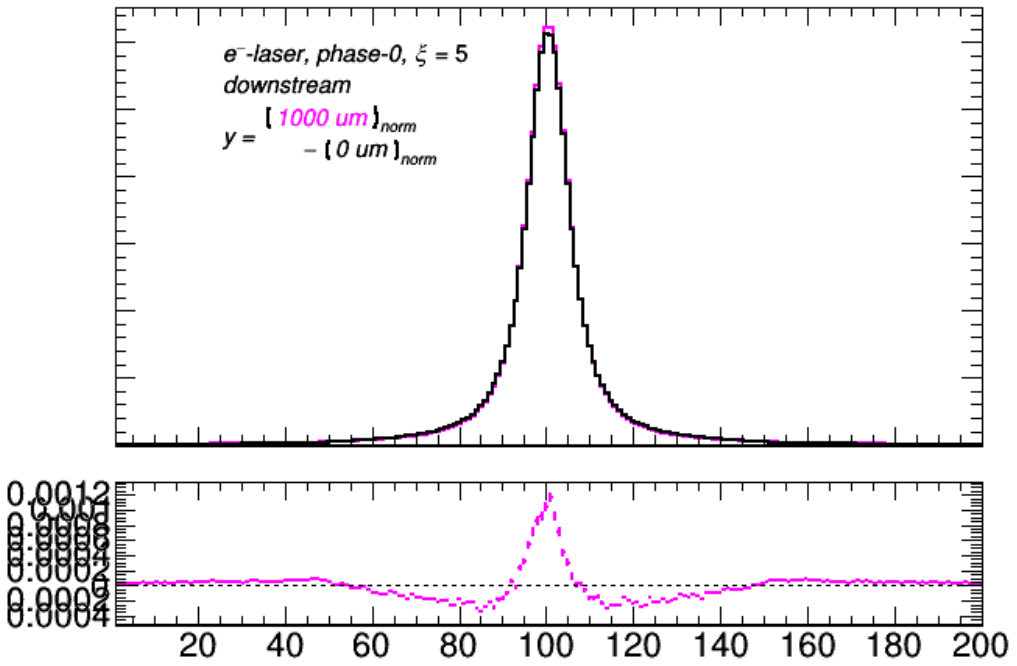
# 1000 um


e⁻-laser, phase-0, ξ = 5
upstream
y = [1000 um]norm / [0 um]norm
1
0.8
0.6
0.4
0.2
20 40 60 80 100 120 140 160 180 200

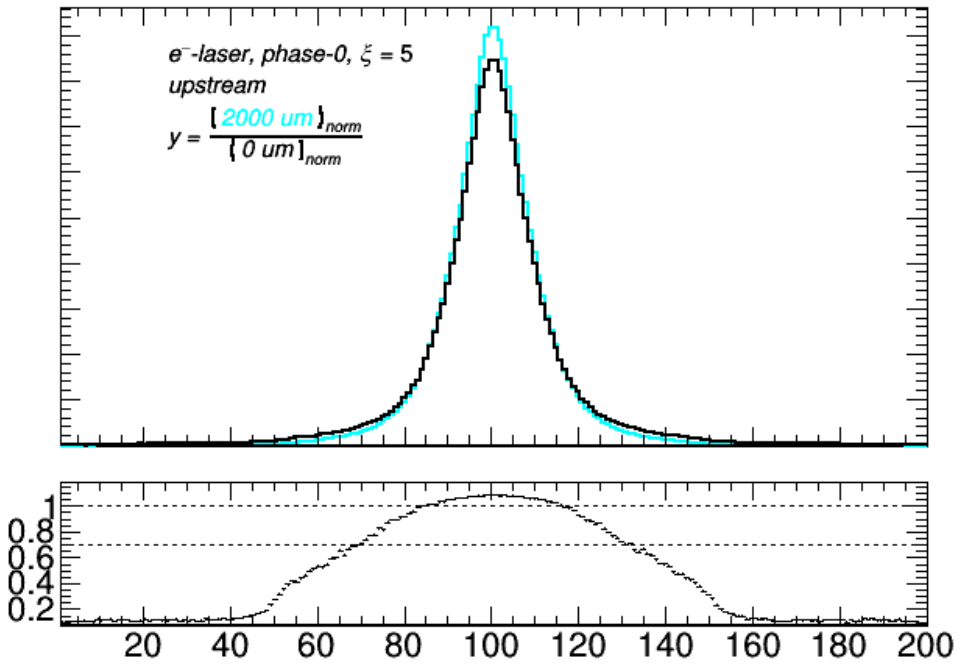

e⁻-laser, phase-0, ξ = 5
downstream
y = [1000 um]norm / [0 um]norm
1.3
1.2
1.1
1
0.9
20 40 60 80 100 120 140 160 180 200

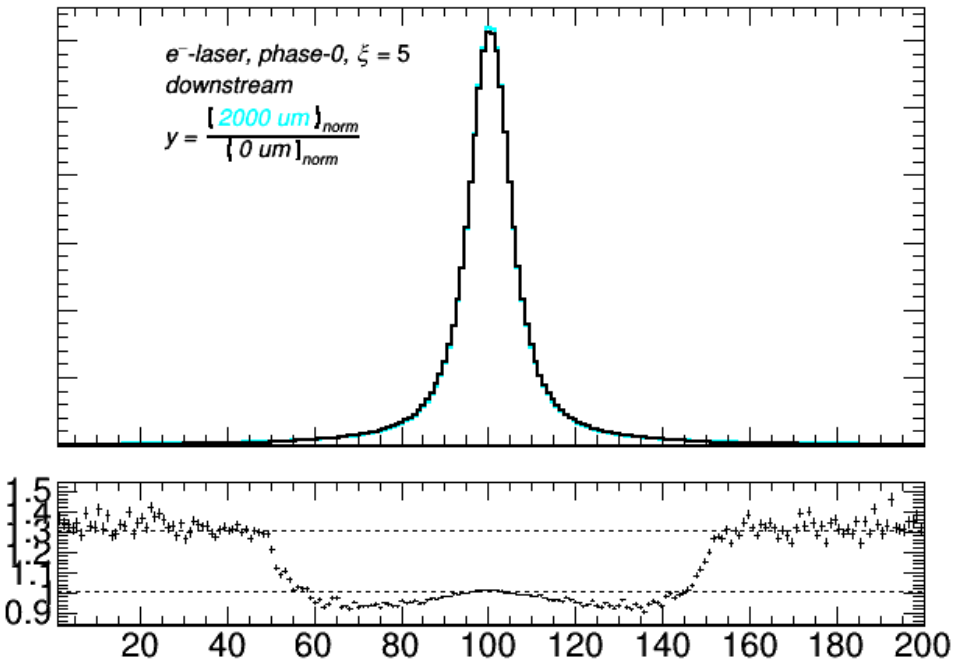
# 1000 um


e⁻-laser, phase-0, ξ = 5
upstream
y = {1000 um}norm − {0 um}norm
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
20 40 60 80 100 120 140 160 180 200

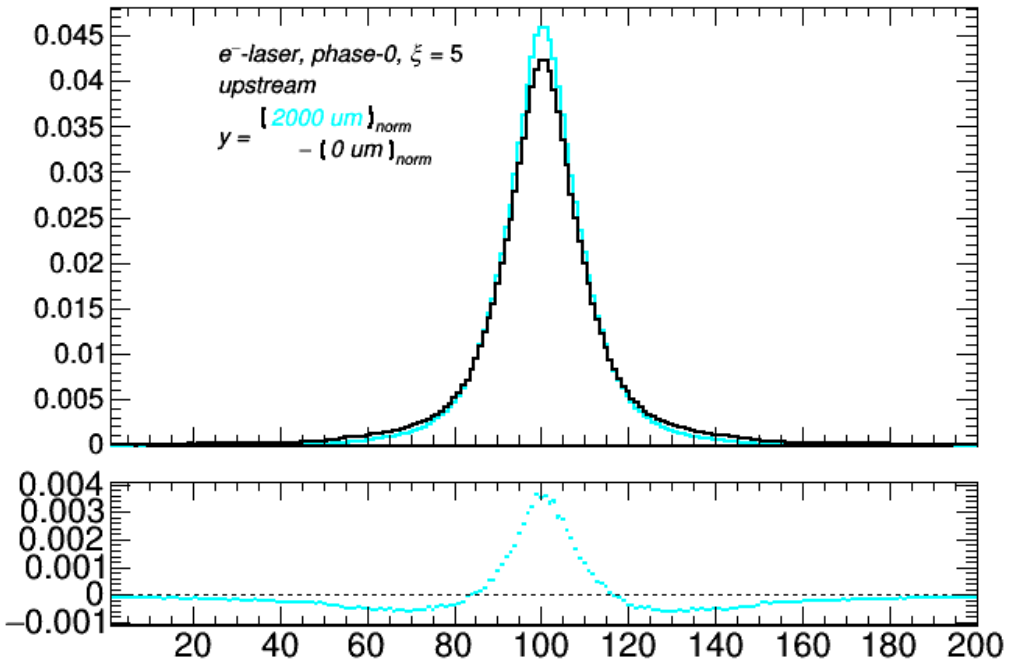

e⁻-laser, phase-0, ξ = 5
downstream
y = {1000 um}norm − {0 um}norm
20 40 60 80 100 120 140 160 180 200

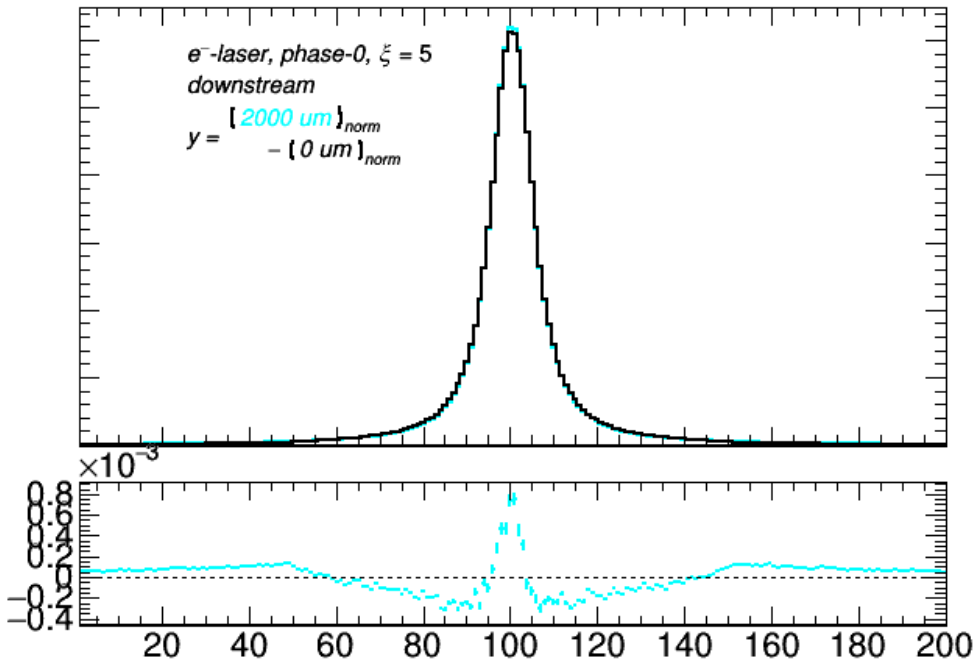
# 2000 um


e⁻-laser, phase-0, ξ = 5
upstream
y = [2000 um]norm / [0 um]norm
1
0.8
0.6
0.4
0.2
20 40 60 80 100 120 140 160 180 200


e⁻-laser, phase-0, ξ = 5
downstream
y = [2000 um]norm / [0 um]norm
1.5
1.4
1.3
1.2
1.1
0.9
20 40 60 80 100 120 140 160 180 200

# 2000 um


e⁻-laser, phase-0, ξ = 5
upstream
y = [2000 um]norm − [0 um]norm
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0.004
0.003
0.002
0.001
0
−0.001
20 40 60 80 100 120 140 160 180 200

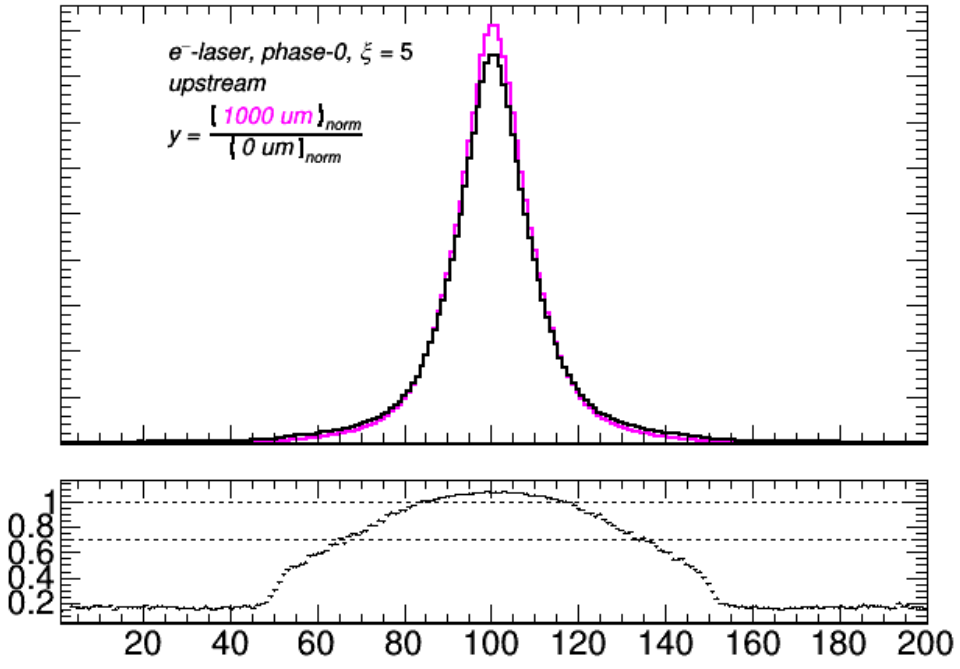

e⁻-laser, phase-0, ξ = 5
downstream
y = [2000 um]norm − [0 um]norm
×10⁻³
0.8
0.6
0.4
0.2
0
−0.2
−0.4
20 40 60 80 100 120 140 160 180 200

# Conclusions

- The introduction of an absorber doesn’t change appreciably the spatial distribution of the profile from Compton gammas.

- The energy depositions in the sapphire increases, and so does the amount of charge deposit (ΔE/22 eV). This leads to an increase of the signal level.
- The peak dose absorbed increases as well. For the Al 2mm case:
  - upstream up to a factor $0.44/0.03 < 16$
  - and downstream up to a factor $0.41/0.052 < 8$

# Further investigations



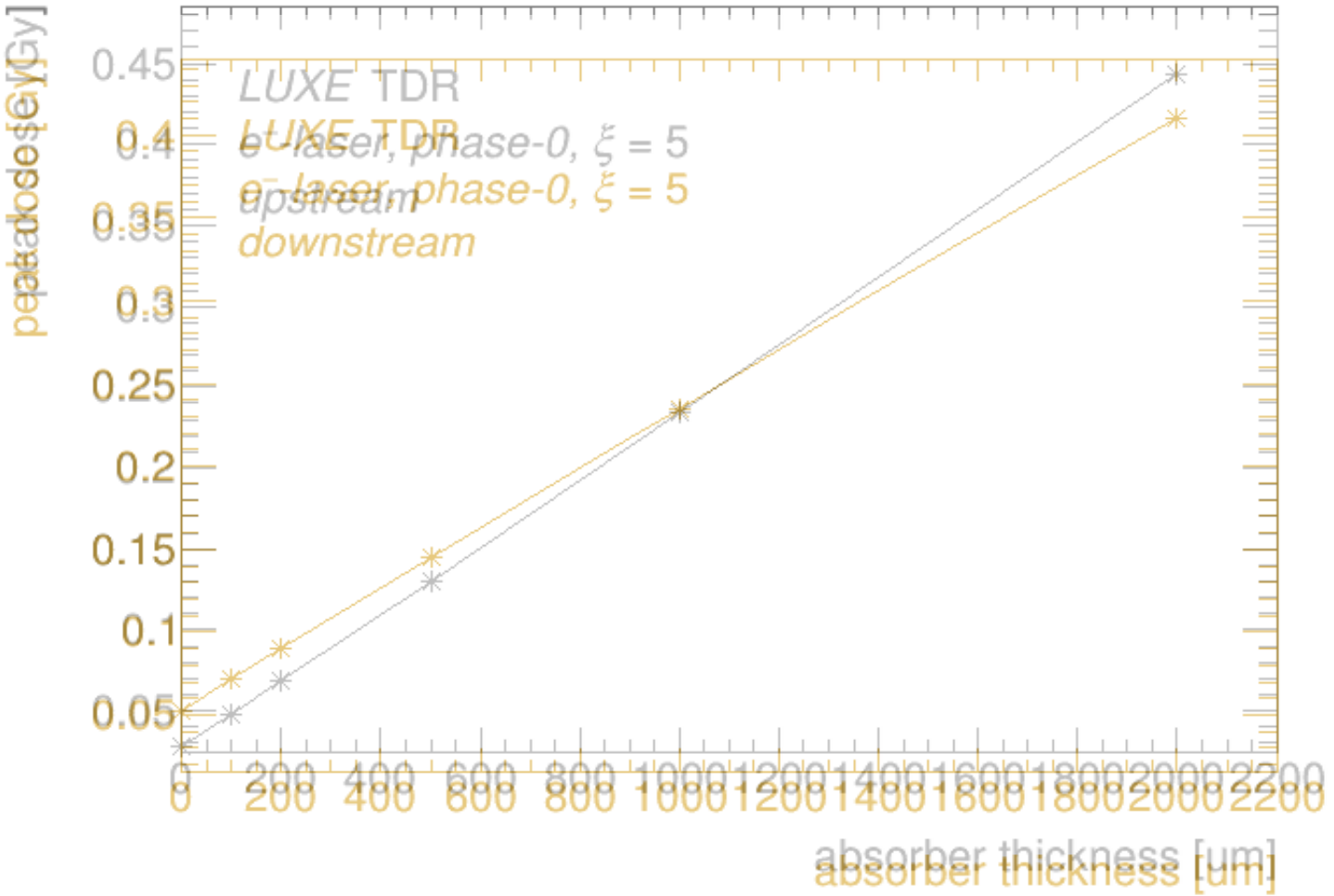

- There is no error propagation in this analysis.
- One idea to estimate the error is:
  - take the energy deposits profile and convert it to a plot for the #MIP produced (using the 48 keV mip signal)
  - attach to the number of MIP a Poisson error
  - propagate the error when we make the difference/ratio of the plot with/without absorber

What do you think?

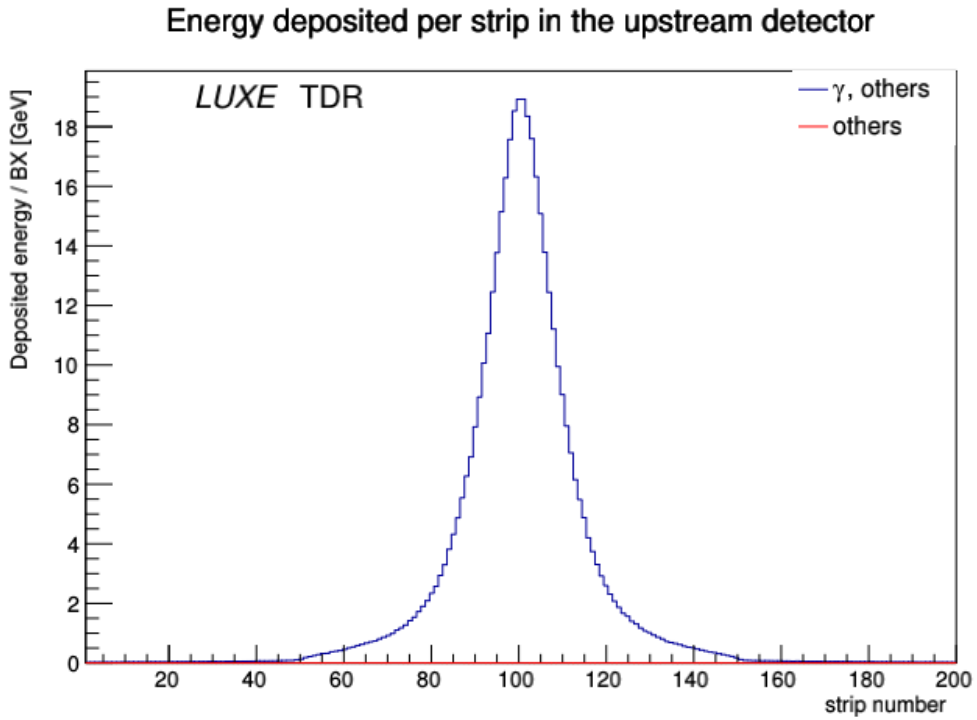
# backup

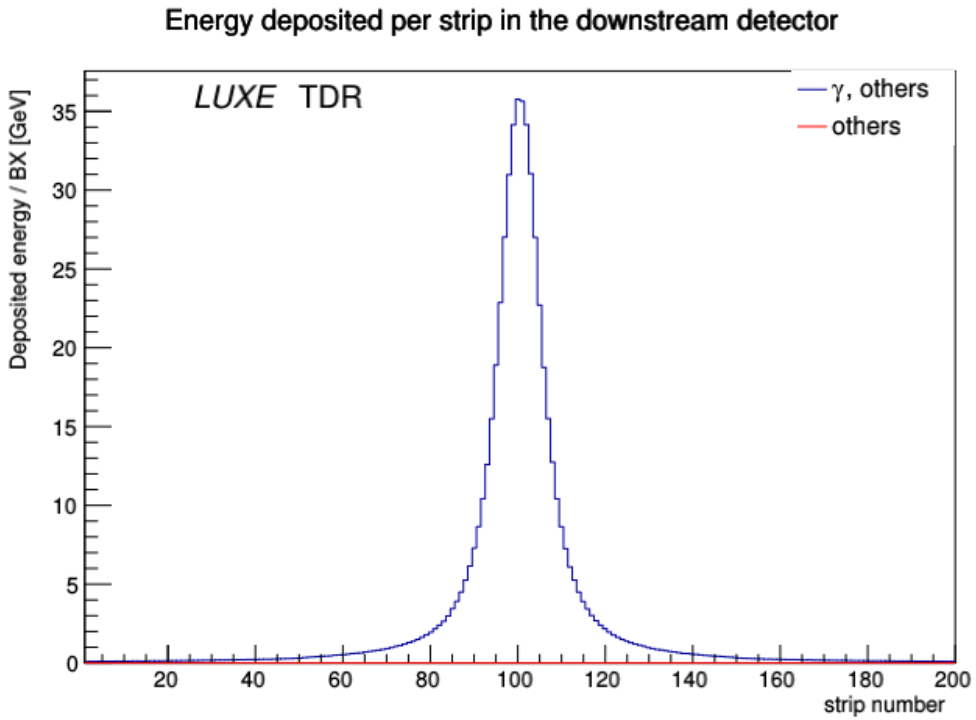
# Peak dose absorbed

| [um] | Upstream peak dose / BX [Gy] | Downstream peak dose / BX [Gy] |
|---|---|---|
| **500 Al.** | 0.130259 | 0.144809 |
| **500 kap.** | 0.0588963 | 0.0804789 |

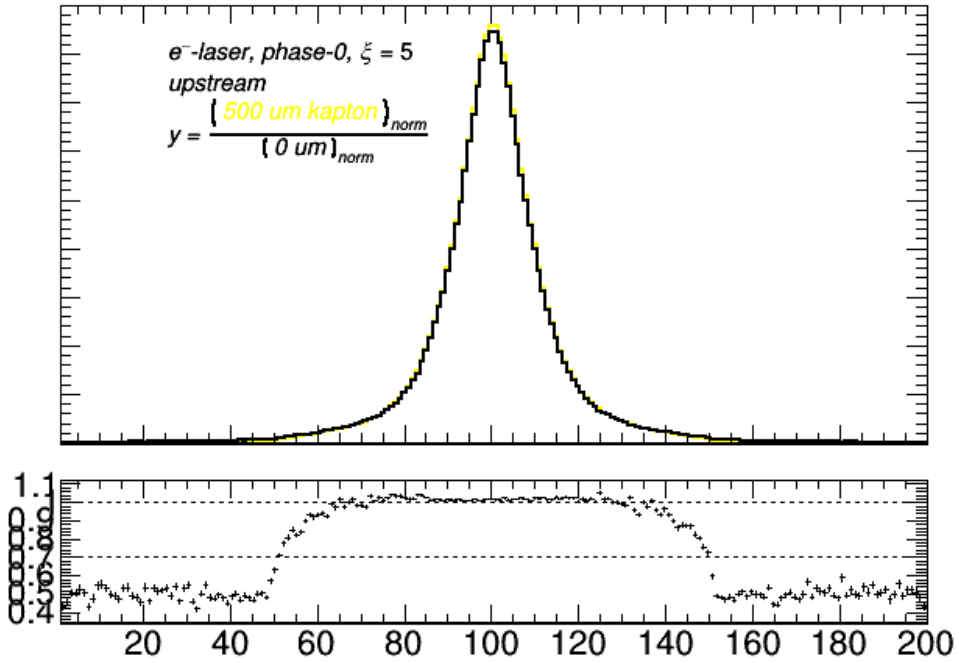


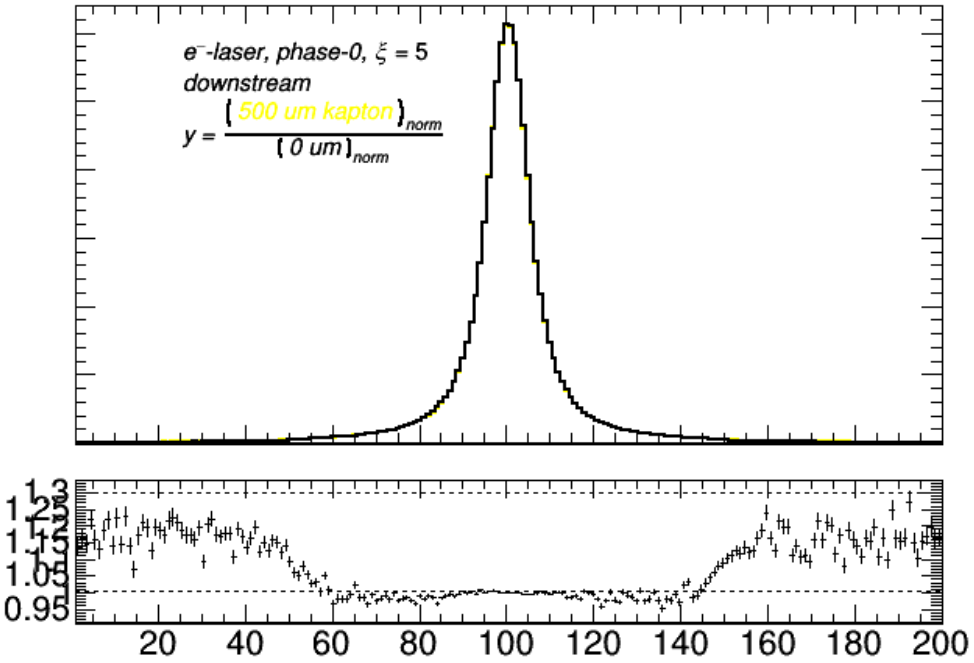
# Profile 500 um kapton



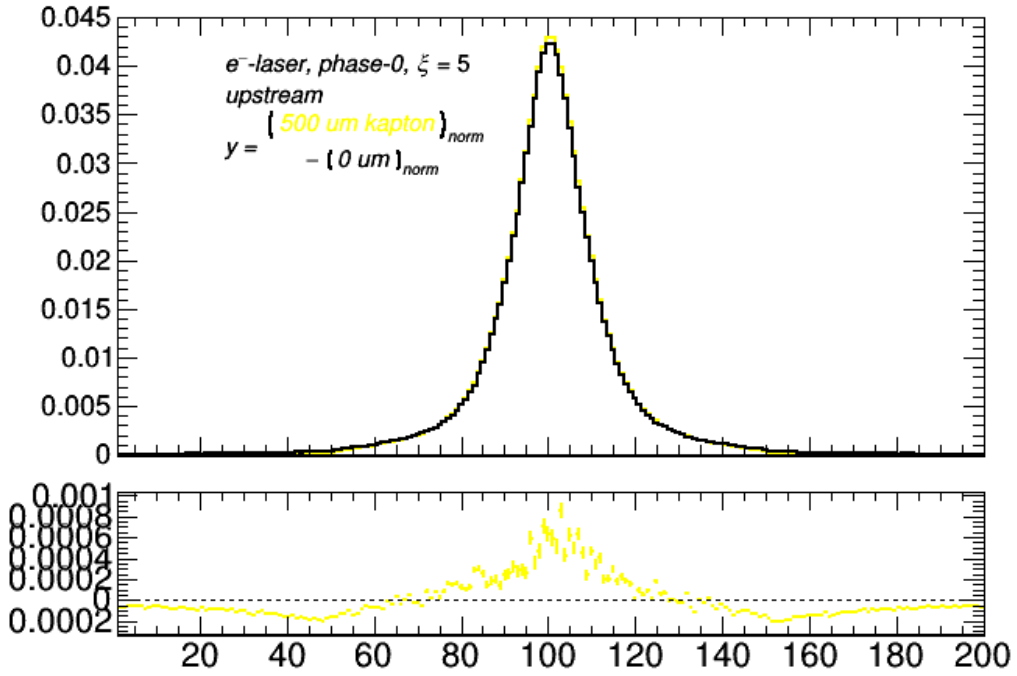



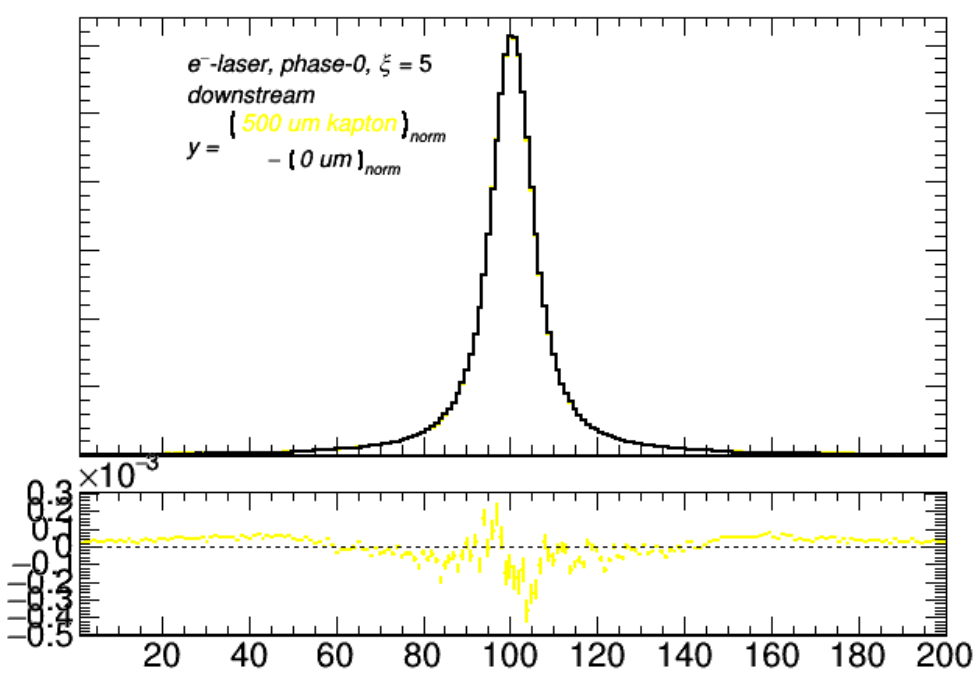
# 500 um kapton



# 500 um kapton



# Spectrum of energy depositions Pphys == 2013 - comptonscattering