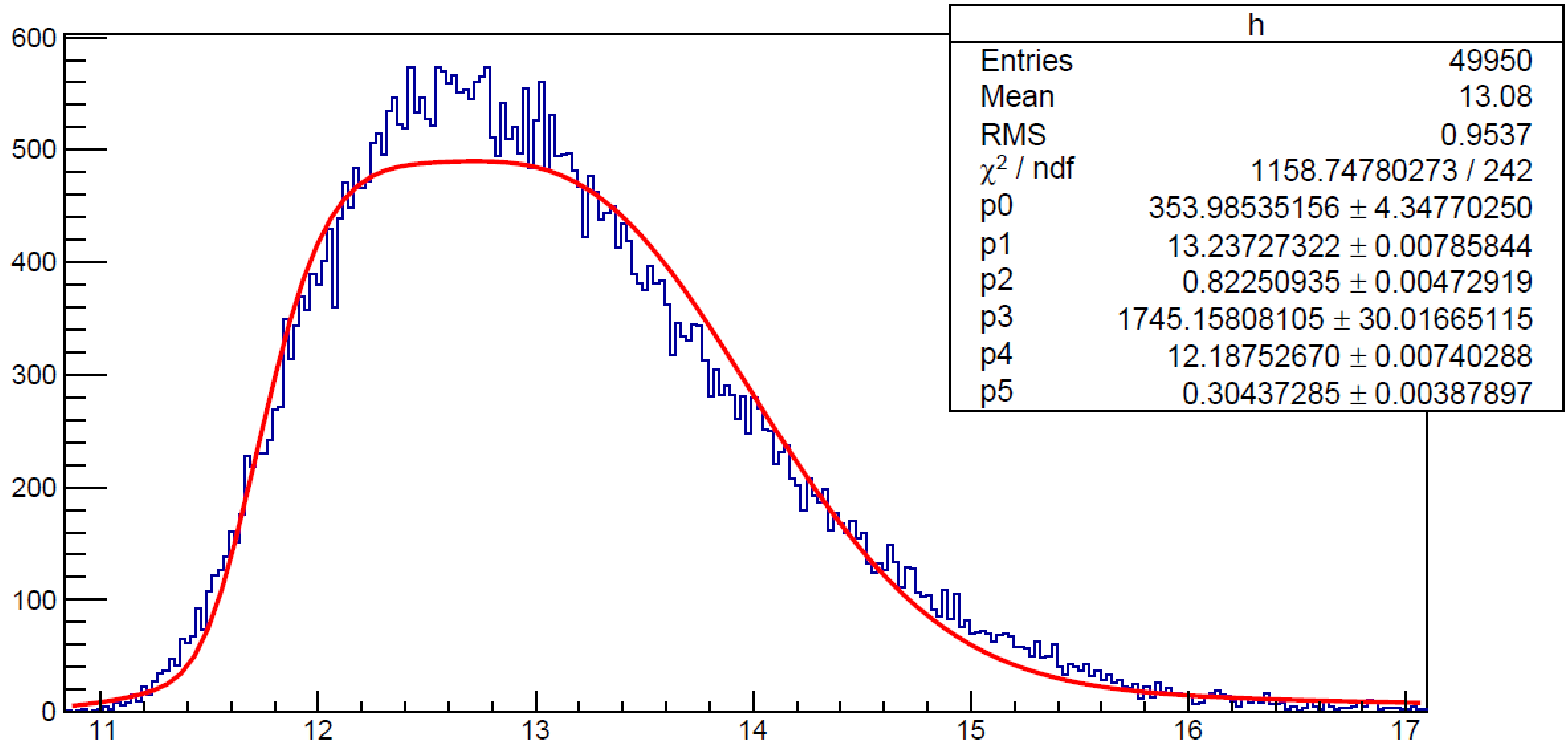
Landau-Gaussian Convolution

04.28.14

Landau-Gaussian Sum (I)

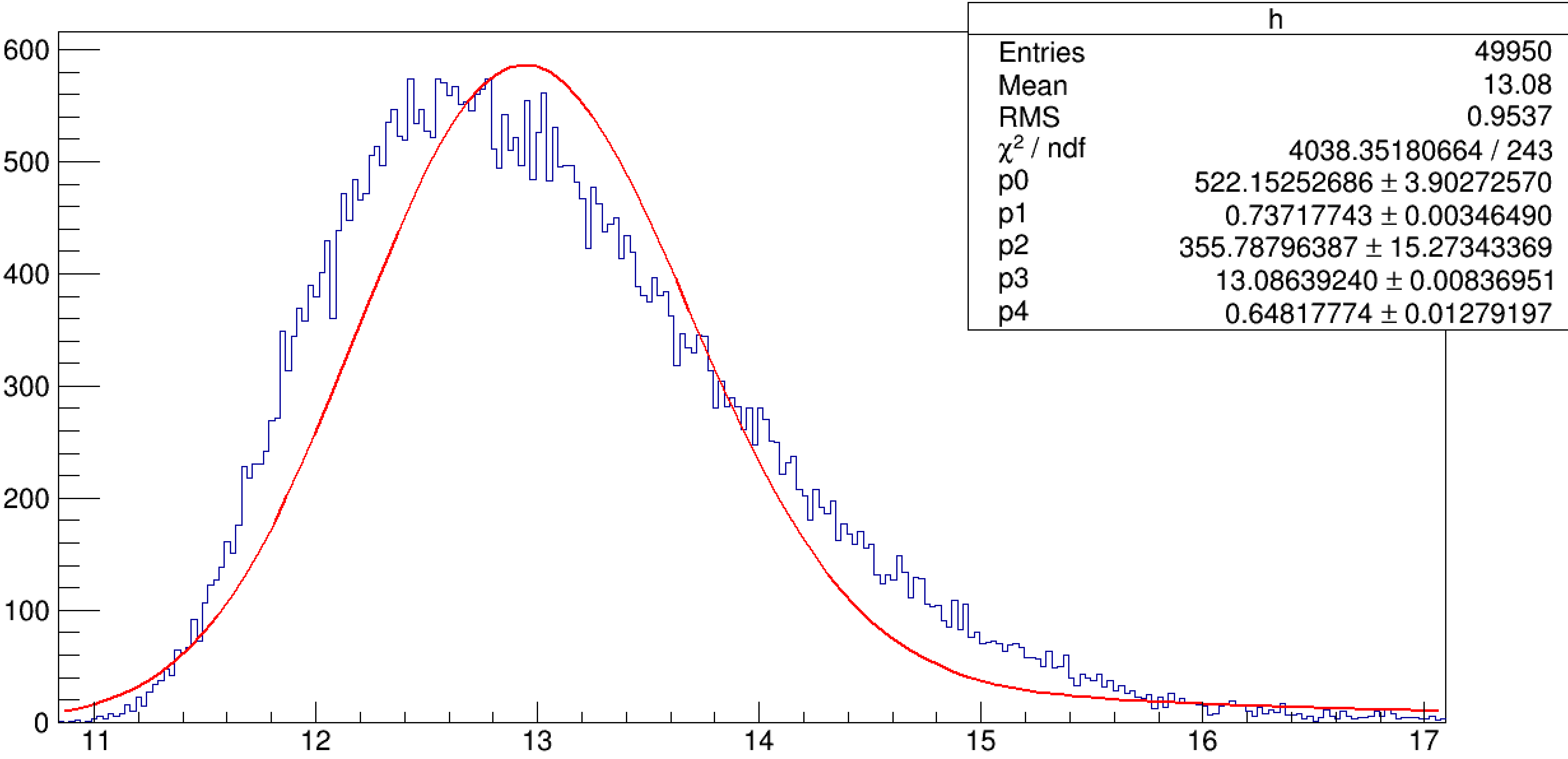
- PDF:

$$[0] * \mathrm{Gauss}(\mathrm{x}, [1], [2]) + [3] * \mathrm{Landau}(\mathrm{x}, [4], [5])$$


h
Entries 49950
Mean 13.08
RMS 0.9537
χ^2 / ndf 1158.74780273 / 242
p0 353.98535156 ± 4.34770250
p1 13.23727322 ± 0.00785844
p2 0.82250935 ± 0.00472919
p3 1745.15808105 ± 30.01665115
p4 12.18752670 ± 0.00740288
p5 0.30437285 ± 0.00387897
600
500
400
300
200
100
0
11
12
13
14
15
16
17

Landau-Gaussian Sum (II)

- Landau(x, α, β)
- $MPV = -0.22278 * \beta + \alpha$
- PDF:
  $$[0] * \mathrm{Gauss}(\mathrm{x}, \underbrace{-0.22278 * [4] + [3]}_{\mu}, [1]) + [2] * \mathrm{Landau}(\mathrm{x}, [3], [4])$$



h
Entries 49950
Mean 13.08
RMS 0.9537
χ2 / ndf 4038.35180664 / 243
p0 522.15252686 ± 3.90272570
p1 0.73717743 ± 0.00346490
p2 355.78796387 ± 15.27343369
p3 13.08639240 ± 0.00836951
p4 0.64817774 ± 0.01279197
600
500
400
300
200
100
0
11
12
13
14
15
16
17

Landau-Gaussian Product

- Deviations in pion and proton energy losses for very thin silicon detectors (<300 μm):
- Similar thing happens with high-energy muons through thin silicon [here (by Davidek, Leitner)]().

However, the effects of atomic binding of the electrons have been disregarded in both the Landau and Vavilov theories. The theories can be improved by using a modified cross section to take into account the electron binding energy.[13] The modified energy-loss distributions can be expressed as the convolution of a Gaussian function with a Landau or Vavilov distribution, respectively.[8,10,14] Thus

$$f(\Delta,x)=(1/\sigma\sqrt{2\pi})\int_{-\infty}^{+\infty} f_{L,V}(\Delta',x) \times \exp[-(\Delta-\Delta')^2/2\sigma^2]\,d\Delta' , \tag{3}$$

where $f_{L,V}(\Delta',x)$ is either the Landau or the Vavilov distribution and Δ is the actual energy loss.

Landau-Gaussian Product

- Additionally: high-energy muons through thick iron [(diploma work by Elin Bergeas, Stockholm University)](#).

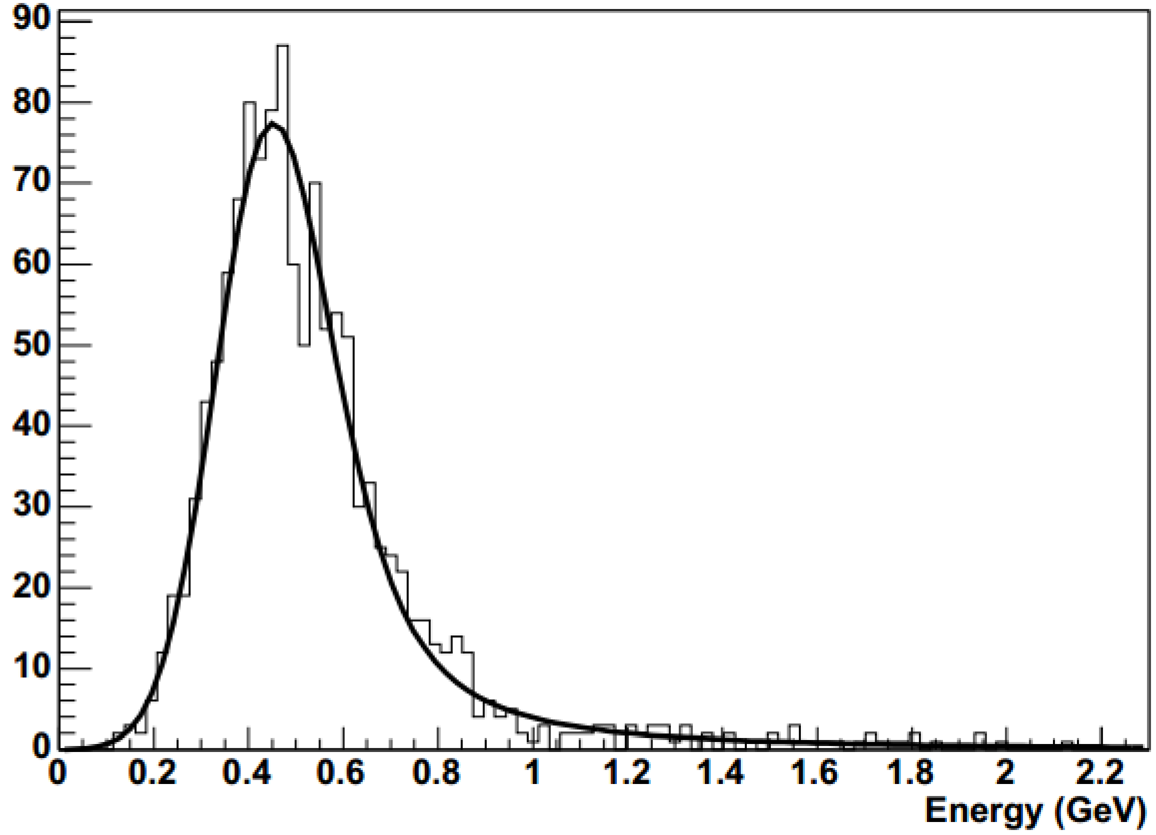


Figure 2.3: A Gauss-Landau convolution fitted to the distribution of the energy loss from 5 GeV muons passing about 25 cm iron.