F91: Studying the Z boson with the ATLAS Detector at the LHC

Mathieu Kaltschmidt* and Quirinus Schwarzenböck†
Heidelberg University, D-69117 Heidelberg, Germany
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This experiment has been performed as part of the advanced lab course for physics students (FP) at Heidelberg University. The goal of this computer-based experiment was to determine the invariant mass spectrum for the Z boson using data acquired by the Large Hadron Collider at CERN in Geneva. For a better c

I. INTRODUCTION

Taking the geometric properties into account, it is very easy to see the following connection between momentum and transversal momentum

$$p_x = p_T \cos(\phi) \tag{1}$$
$$p_y = p_T \sin(\phi) \tag{2}$$
$$p_z \tan(\theta) = p_T \tag{3}$$

From the definition of the pseudorapidity (eq: **??**) we have $\theta = 2\arctan(e^{-\eta})$. Using the identity $\tan(2\arctan(x)) = \frac{2x}{1-x^2}$, these equations lead to

$$p_z = p_T \sinh(\eta) \tag{4}$$
$$|\mathbf{p}| = p_T \cosh(\eta) \tag{5}$$

Just wanted to set up the `TikZ-feynman` package:

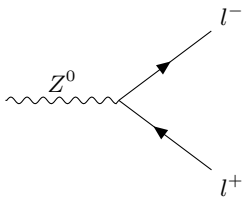

Figure 1: Leading order Feynman diagram for the Z boson decay into lepton pairs, inspired by [1]

Introducing Drell-Yan diagrams:

Figure 2: A simple Drell-Yan diagram, inspired by [2]

Already implementing the formulas mentioned in the theory part of [2] to speed things up a little.

$$\mathcal{L} = \frac{N_1 N_2 f_{\text{rev}} n_b}{4\pi\sigma_x\sigma_y} \tag{6}$$

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$$\mathcal{L}_{\text{int}} = \int \mathcal{L}\, \mathrm{d}t \tag{7}$$

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$$N = \sigma_{pp\to X} \cdot \mathcal{L}_{\text{int}} \tag{8}$$

II. THEORY

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* M.Kaltschmidt@stud.uni-heidelberg.de
† Schwarzenböck@stud.uni-heidelberg.de

A. This is a subsection

1. *This is a subsubsection*

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III. EXPERIMENT

A. Experimental Setup

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IV. RESULTS

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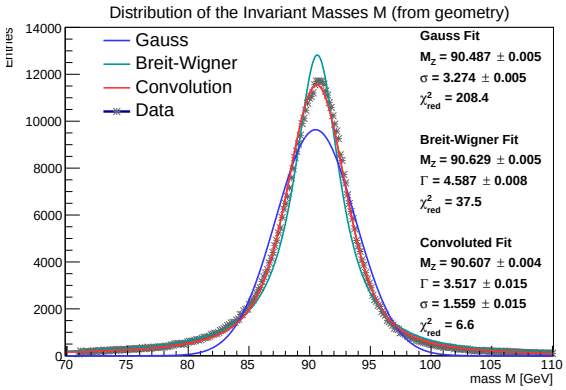

Figure 3: Distribution of the Z masses M_z with Gauß, Breit-Wigner and a convoluted fit.

Test	x_1 [AU]	x_2 [AU]	x_3 [AU]	Quantity
A	2,2	3,8	6,2	Q1
B	2,3	7,0	-	Q2
C	2,1	11,6	-	Q3
D	3,9	6,3	-	Q4
E	2,2	7,0	-	Q5

Table I: This is an example table.

V. DISCUSSION

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This is the second paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

After this fourth paragraph, we start a new paragraph sequence. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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ACKNOWLEDGMENTS

We would like to thank our supervisor Philipp Ott for his guidance throughout the operation of this experiment.

[1] M. Jende et al. *International Masterclasses - Hands on Particle Physics*. https://atlas.physicsmasterclasses.org/en/zpath_lhcphysics2.htm. (Accessed: March 5th, 2019).

[2] M. Wessels et al. *Studying the Z boson with the ATLAS Detector at the LHC - Manual V0.6*. Heidelberg University, 2018.