Z^0 decay into μ^+ and μ^-

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Goal: Using LHCb open data measure Z boson mass and other important variables (observables?).

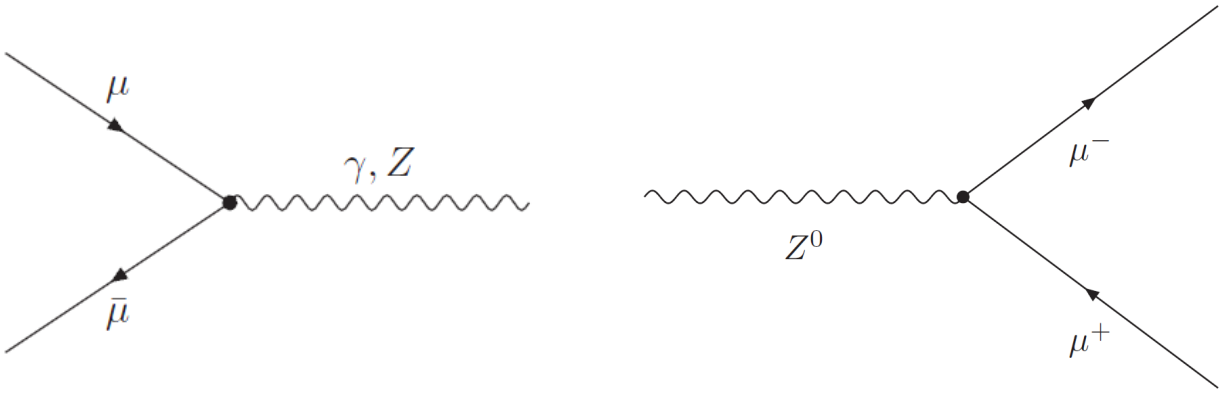
1 Milestones

1. Data is downloaded and ready for local analysis.
2. Theoretical understanding of how LHCb gathers its data is developed.
3. Theoretical understanding of how two muons arise from two protons is developed.
4. Pratical skill to write root macros is learned.
5. The data is filtered in such a manner that there is only one evident peak in the Z boson mass graph.
6. A boson mass graph is drawn, the data is fitted against appropriate theoretical function.

2 Theory

1. Feynman diagrams

   They are figurative depictions of contributions from interactions between particles, which are described by quantum field theory[1].



(a) muon-antimuon anihilation [1]. (b) Z^0 decay into muon-antimuon pair [1].

1 pav.: Feynman diagrams for the processes with Z boson and muon-antimuon pair.

   [TODO: maybe add more complicated diagrams, if something is relevant]

   [TODO: maybe address the Drell-Yan process here]

2. Processes mimicking Z boson signal

   [TODO: answer]

3. Main graphs and charts drawn when analysing Z boson decay into two muons. What properties are usually analysed?

   Most accurately known parameters (at least back in 1999) are G_μ, $\bar{\alpha}$, m_Z [2];

   Possibly useful, since the paper is very similar to this one: muon, Z-boson momentum, pseudorapidity [3];

   [TODO: add more descriptions and explanations here]

4. Theoretical calculation of Z boson mass from two muons.

   Born model[**[TODO: ?]**]

   [TODO: answer]

5. LHCb detector structure, trigger, reconstruction, data validity and error.

   [TODO: answer]

6. Data types used in LHCb.

   [TODO: answer]

3 Results

Literatūra

[1] K. Jende, M. Kobel, G. Pospiech, U. Bilow, M. Pedersen, F. Ould-Saada, E. Gramstad, Hands on particle physics.

[2] V. Novikov, L. Okun, A. N. Rozanov, M. Vysotsky, Theory of z boson decays, Reports on Progress in Physics **62**(9), 1275 (1999).

[3] M. D. Khodaverdian, Accuracy and precision of the z boson mass measurement with the atlas detector (2019).