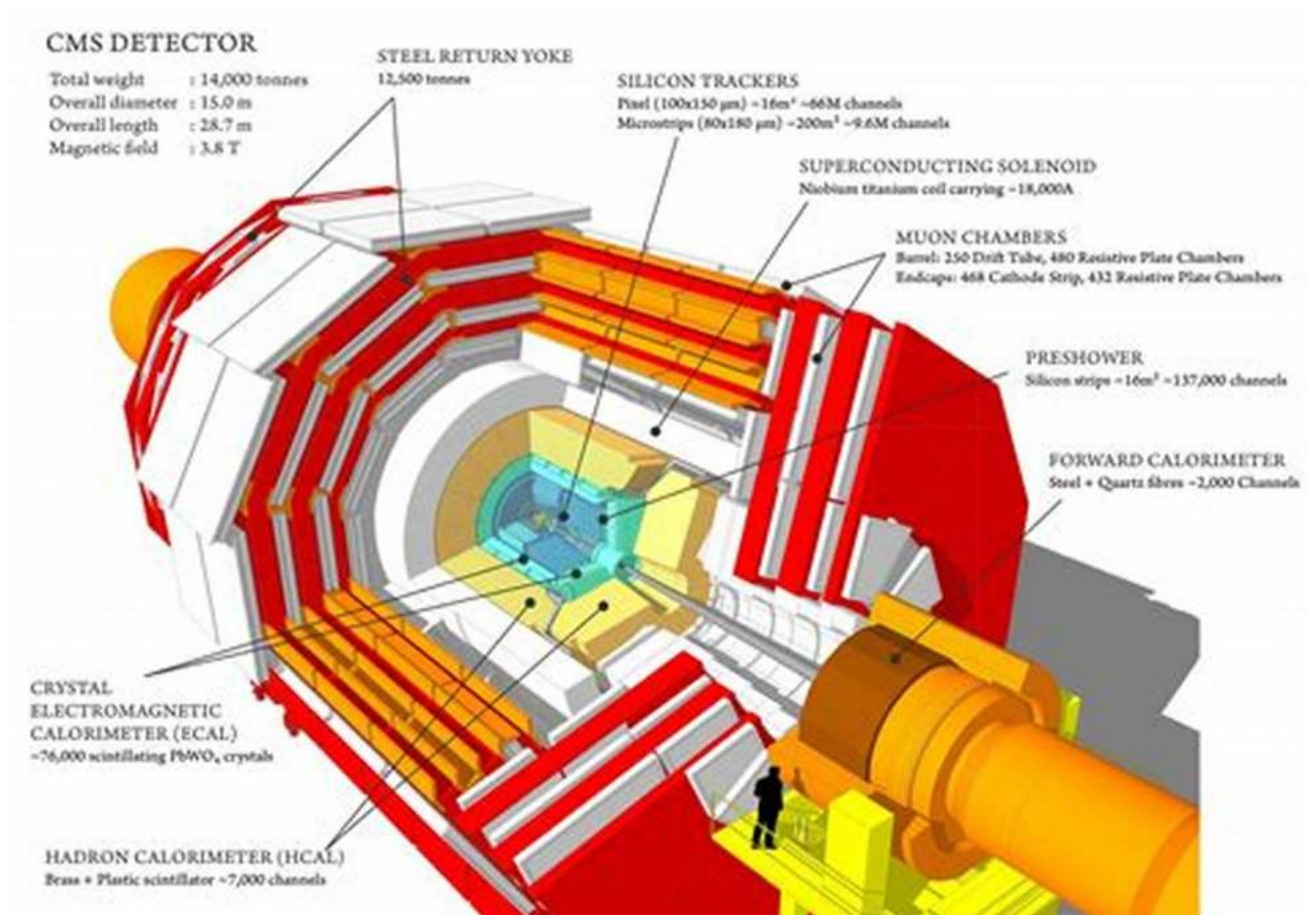


Groundbreaking Measurements Performed □□ With the CMS Detector using LHC Run Proton Proton

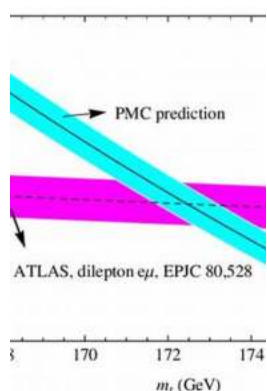


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The Large Hadron Collider (LHC) at CERN has revolutionized our understanding of the fundamental building blocks of the universe. One of the key detectors used at the LHC is the Compact Muon Solenoid (CMS) detector, which enables scientists to perform precise measurements and explore the mysteries of particle physics.

The CMS Detector:

The CMS detector, with its intricate design and advanced technologies, plays a vital role in the discovery and analysis of subatomic particles. It consists of several sub-detectors, including the pixel tracker, silicon strip tracker, electromagnetic calorimeter, hadron calorimeter, and the muon chambers. These detectors work in unison to capture and measure the particles produced during high-energy proton-proton collisions.



Top-Quark Pair Production Cross Sections and Calibration of the Top-Quark Monte-Carlo Mass: Measurements Performed with the CMS Detector Using LHC Run I Proton-Proton Collision Data (Springer Theses)

by Baby Professor (1st ed. 2016 Edition, Kindle Edition)

★★★★☆ 4.2 out of 5

Language : English

File size : 13522 KB

Text-to-Speech : Enabled

Screen Reader : Supported

Enhanced typesetting : Enabled

Print length : 301 pages



Proton-Proton Collisions:

The LHC operates by colliding protons, which are accelerated to nearly the speed of light inside a circular tunnel spanning 27 kilometers. When two proton beams collide, an enormous amount of energy is released, which allows scientists to recreate the conditions that existed shortly after the Big Bang. Proton-proton collisions generate a plethora of interesting particles and phenomena that scientists can study.

Measurements with the CMS Detector:

Using the CMS detector, scientists have performed a wide range of measurements that have enhanced our understanding of the universe. Let's explore some of the groundbreaking measurements:

1. Discovery of the Higgs Boson:

The CMS detector played a crucial role in the discovery of the Higgs boson in 2012. This elusive particle, which is responsible for endowing other particles with mass, was predicted by the Standard Model of particle physics. The CMS detector contributed to the observation and measurement of the Higgs boson, confirming its existence and properties.

2. Precise Measurements of the Top Quark:

The top quark, the heaviest known fundamental particle, was discovered in 1995. Since then, the CMS detector has enabled precise measurements of its properties, such as its mass and decay channels. These measurements have contributed to our understanding of the fundamental forces that govern the universe.

3. Search for New Particles and Phenomena:

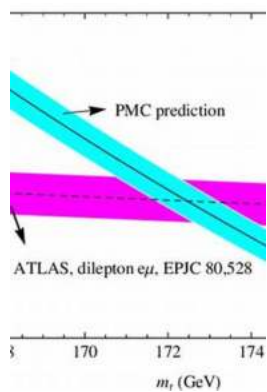
The CMS detector is also used to search for new particles and phenomena beyond the predictions of the Standard Model. Scientists analyze the data collected by the CMS detector to look for anomalies or deviations from the expected results. These searches have the potential to reveal new physics and revolutionize our understanding of the universe.

4. Measurements of Dark Matter Candidates:

Dark matter, which constitutes a significant portion of the universe, remains a mystery to scientists. The CMS detector has been instrumental in searching for dark matter candidates by investigating various signatures that could indicate their presence. These measurements contribute to the ongoing quest to unveil the nature of dark matter.

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The measurements performed with the CMS detector using LHC run proton-proton collisions have revolutionized our understanding of particle physics. From the discovery of the Higgs boson to the search for dark matter, the CMS detector has played a pivotal role in unraveling the mysteries of the universe. As scientists continue to analyze the data collected by the CMS detector, we can anticipate even more groundbreaking discoveries and insights into the fundamental fabric of our existence.



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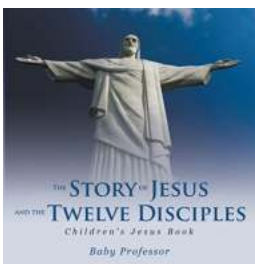
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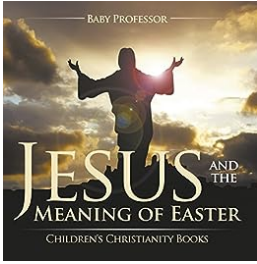
This thesis presents the first experimental calibration of the top-quark Monte-Carlo mass. It also provides the top-quark mass-independent and most precise top-quark pair production cross-section measurement to date. The most precise measurements of the top-quark mass obtain the top-quark mass parameter (Monte-Carlo mass) used in simulations, which are partially based on heuristic models. Its interpretation in terms of mass parameters used in theoretical calculations, e.g. a running or a pole mass, has been a long-standing open problem with far-reaching implications beyond particle physics, even affecting s on the stability of the vacuum state of our universe.

In this thesis, this problem is solved experimentally in three steps using data obtained with the compact muon solenoid (CMS) detector. The most precise top-quark pair production cross-section measurements to date are performed. The Monte-Carlo mass is determined and a new method for extracting the top-quark mass from theoretical calculations is presented. Lastly, the top-quark production cross-sections are obtained – for the first time – without residual dependence on the top-quark mass, are interpreted using theoretical calculations to determine the top-quark running- and pole mass with unprecedented precision, and are fully consistently compared with the simultaneously obtained top-quark Monte-Carlo mass.



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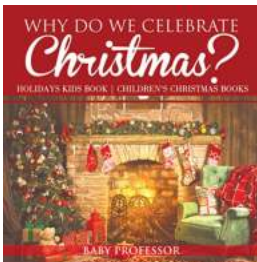
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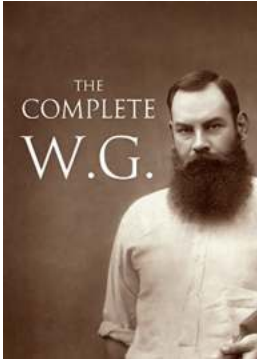
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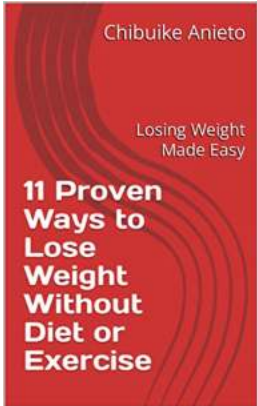
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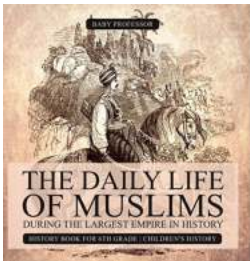
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