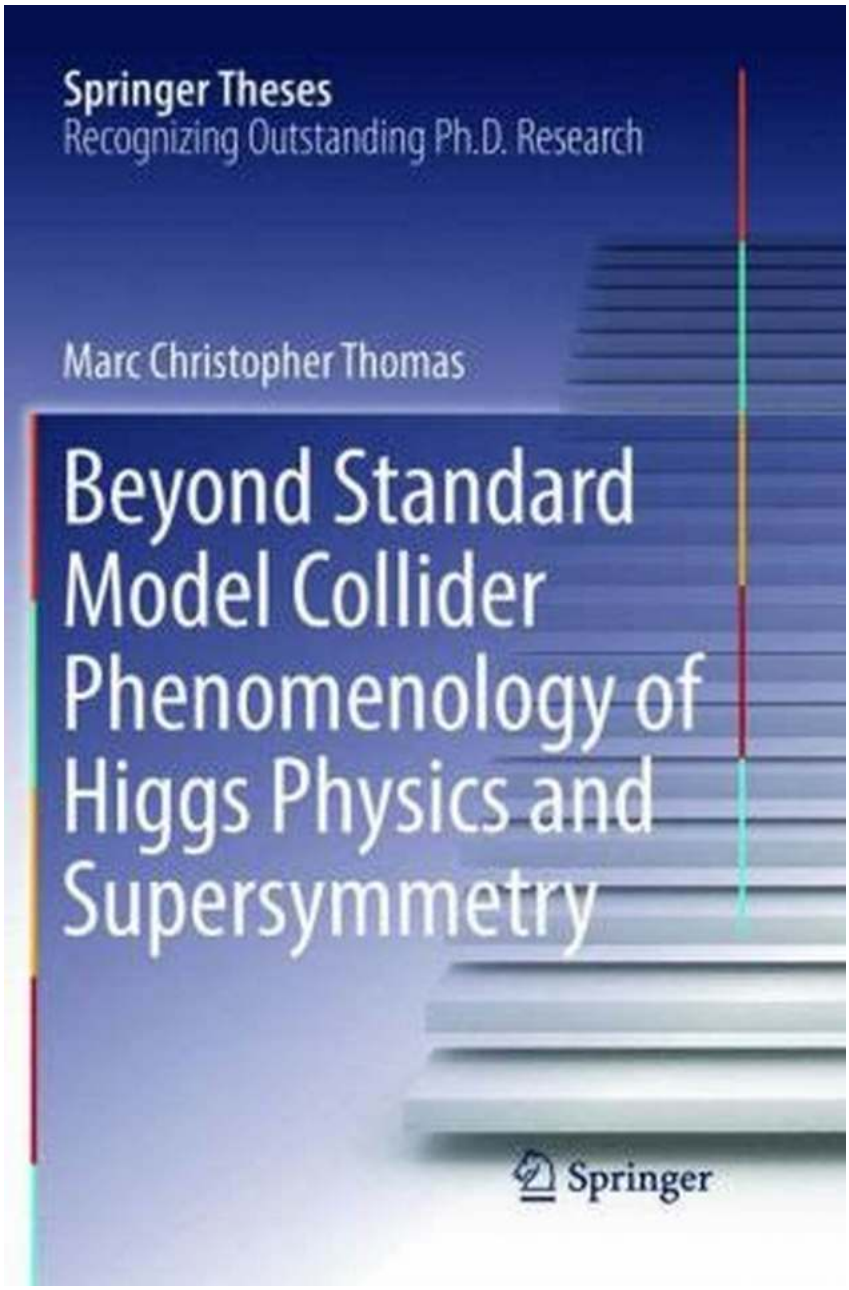
The Mind-Blowing Discovery that Defies Our Understanding of the Universe: Beyond Standard Model Collider Phenomenology of Higgs Physics and Supersymmetry

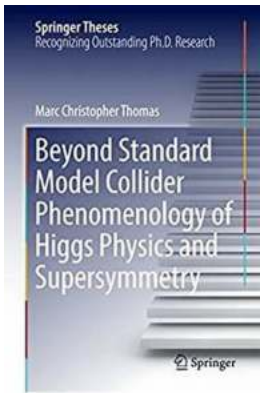


The Enigmatic Nature of the Universe

Since the dawn of civilization, humans have been fascinated by the mysteries and wonders of the universe. Over the centuries, we have relentlessly dissected and explored the fundamental laws governing our existence. However, many questions still baffle us, including the origins of dark matter, the nature of gravity, and the cosmic balance that holds the cosmos together. Scientists have been working tirelessly to unravel these mysteries, peering into the depths of the universe through high-energy particle colliders.

Higgs Physics: Unraveling the Fundamental Building Blocks of Matter

One of the groundbreaking discoveries in modern physics was the identification of the Higgs boson particle at the Large Hadron Collider (LHC) in 2012. This particle is associated with the Higgs field, which permeates the universe and gives fundamental particles their mass. Its existence confirms the validity of the Higgs mechanism, a crucial component of the Standard Model of particle physics.



Beyond Standard Model Collider Phenomenology of Higgs Physics and Supersymmetry (Springer Theses) by Mary Cronk Farrell (1st ed. 2016 Edition, Kindle Edition)

4.7 out of 5

Language	: English
File size	: 5892 KB
Text-to-Speech	: Enabled
Screen Reader	: Supported
Enhanced typesetting	: Enabled
Word Wise	: Enabled
Print length	: 196 pages

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The Standard Model successfully describes three of the four fundamental forces of nature: electromagnetism, the weak nuclear force, and the strong nuclear force. However, it fails to incorporate gravity and falls short in explaining phenomena such as dark matter and the asymmetry between matter and antimatter in the universe.

The Limitations of the Standard Model

The Standard Model has been an incredibly successful theory, but it is merely a stepping stone towards an all-encompassing theory of everything. It has sparked the curiosity of scientists worldwide to explore beyond its boundaries and find an extended framework that can accommodate the remaining mysteries of the universe.

Enter Supersymmetry, a theoretical framework that proposes a profound connection between particles with integer spin (bosons) and particles with half-integer spin (fermions). This symmetry could provide a solution to several long-standing issues in physics, including the hierarchy problem and the origin of dark matter.

Collider Phenomenology: Peering into the Subatomic World

Colliders are scientific marvels that enable scientists to recreate the conditions that existed in the early universe, allowing us to observe the smallest constituents of matter. These high-energy experiments provide valuable insights into the fundamental laws governing the cosmos.

Collider phenomenology is the study of the behavior of particles produced in high-energy collisions. Scientists analyze the experimental data to search for new particles and interactions that could shed light on the mysteries beyond the Standard Model.

Unveiling the Secrets of Supersymmetry

Supersymmetry predicts the existence of new particles, referred to as supersymmetric partners, which could be observed at colliders. These partners may provide a solution to the fine-tuning problem known as the hierarchy problem, by canceling out the quantum corrections to the Higgs boson mass. Moreover, some supersymmetric particles could serve as viable dark matter candidates, contributing to our understanding of the mysterious substance that dominates the universe.

Experimental searches for supersymmetry at colliders, such as the LHC, aim to detect the signatures left by these new particles. By analyzing the collision data, scientists can reconstruct the events and identify potential supersymmetric particles, providing evidence for or ruling out various theoretical models.

Challenges in the Quest for New Physics

Despite years of extensive research, no direct evidence for supersymmetry or new physics beyond the Standard Model has been found at colliders. This absence poses significant challenges and leads researchers to explore alternative explanations or modifications to existing theories.

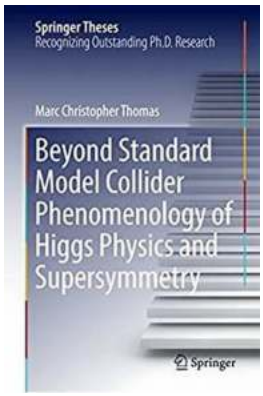
However, the absence of evidence should not be confused with evidence of absence. The search for new physics is an ongoing process, constantly refining our understanding of the universe.

The Future of Particle Physics

The quest for a deeper understanding of the universe continues. Upcoming collider experiments, such as the High-Luminosity LHC and future generations of colliders, hold great promise in the search for new physics. These experiments

will provide even higher collision energies and larger datasets, increasing our chances of making groundbreaking discoveries.

As we venture into the realm of uncharted territories, the secrets of the universe await. With each new discovery and technological advancement, we edge closer to unraveling the mysteries that have captivated us since the beginning of time.



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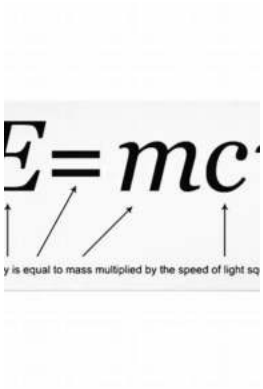
This thesis studies collider phenomenology of physics beyond the Standard Model at the Large Hadron Collider (LHC). It also explores in detail advanced topics related to Higgs boson and supersymmetry – one of the most exciting and well-motivated streams in particle physics. In particular, it finds a very large enhancement of multiple Higgs boson production in vector-boson scattering when Higgs couplings to gauge bosons differ from those predicted by the Standard Model. The thesis demonstrates that due to the loss of unitarity, the very large enhancement for triple Higgs boson production takes place. This is a truly novel finding.

The thesis also studies the effects of supersymmetric partners of top and bottom

quarks on the Higgs production and decay at the LHC, pointing for the first time to non-universal alterations for two main production processes of the Higgs boson at the LHC–vector boson fusion and gluon–gluon fusion.

Continuing the exploration of Higgs boson and supersymmetry at the LHC, the thesis extends existing experimental analysis and shows that for a single decay channel the mass of the top quark superpartner below 175 GeV can be completely excluded, which in turn excludes electroweak baryogenesis in the Minimal Supersymmetric Model. This is a major new finding for the HEP community.

This thesis is very clearly written and the and s are accessible to a wide spectrum of readers.



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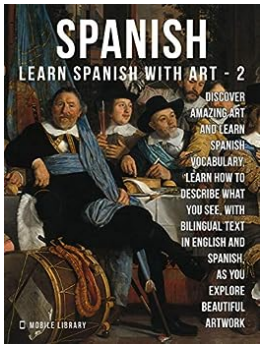

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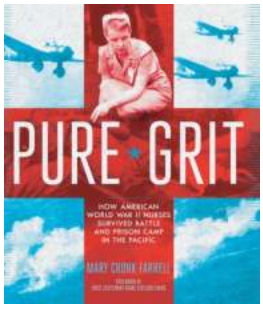

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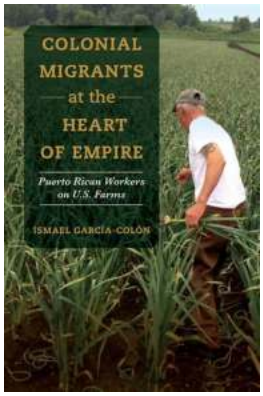

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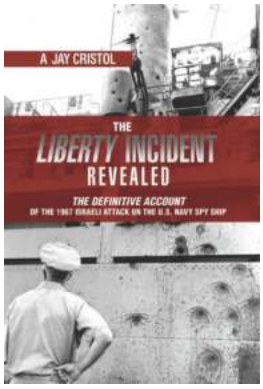

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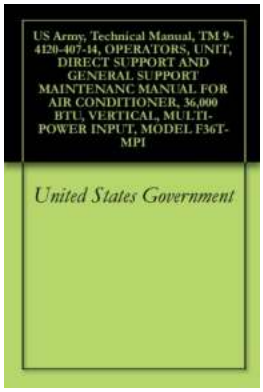

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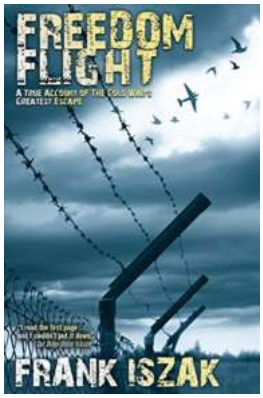

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