

SUPERSYMMETRY AND BEYOND

FROM THE HIGGS BOSON TO THE NEW PHYSICS

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GORDON KANE

FOREWORD BY EDWARD WITTEN

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Preface

CHAPTER 1 — Toward the Big Questions

To understand nature we need to know the particles, forces, and rules — Research in progress (RIP) — Equations? — Prediction, postdiction, and testing — Where are the superpartners? — The boundaries of science have moved

CHAPTER 2 — A Little Bit About The Standard Model Of Particle Physics

The forces — Mass, decays, and quanta — The particles: Do we know the fundamental constituents? — Particles and fields — There are more particles: antiparticles, neutrinos, more quarks and leptons, Higgs bosons — New ideas and remarkable predictions of the Standard Model — Experimental foundations of the Standard Model — Spin, fermions, and bosons — Beyond the Standard Model

CHAPTER 3 — Why Physics Is The Easiest Science — Effective Theories

Understanding the world one piece at a time — Organizing effective theories by distance scales — Supersymmetry is an effective theory too — The Physics of the Planck scale — The human scales

CHAPTER 4 — Supersymmetry and Sparticles – What Supersymmetry Adds

What is supersymmetry? — Why do so many physicists expect supersymmetry to be observed experimentally soon? — The superpartners — Supersymmetry as a space-time symmetry, superspace — Hidden or “broken” supersymmetry

CHAPTER 5 — Testing Supersymmetry Experimentally

Detectors and colliders — Collisions produce previously unknown particles — Recognizing superpartners — Sparticles: their personalities, backgrounds, and signatures — Future colliders — Can we do the experiments we need to do?

CHAPTER 6 — What Is The Universe Made Of?

What particles are there in the universe? — Is the lightest superpartner the dark matter of the universe?

CHAPTER 7 — Why Is Higgs Physics So Exciting And Important

The Higgs field, the Higgs mechanism, Higgs bosons – Not the Standard Model Higgs boson

CHAPTER 8 — M/string Theory

Extra small dimensions – What is M/string theory? – Testing M/string theory – Hidden or broken or partial supersymmetry – The role of data

CHAPTER 9 — How Much Can We Understand?

Testing M/string theory and the final theory – Practical limits? – Anthropic questions and string theory – The Cosmological Constant – The role of extra dimensions – The end of science?

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