

WHY TRUST A THEORY? Epistemology of Fundamental Physics

Do we need to reconsider scientific methodology in light of modern physics? Has the traditional scientific method become outdated, does it need to be defended against dangerous incursions, or has it always been different from what the canonical view suggests? To what extent should we accept non-empirical strategies for scientific theory assessment? Many core aspects of contemporary fundamental physics are far from empirically well-confirmed. There is controversy with regard to the epistemic status of the corresponding theories, in particular cosmic inflation, the multiverse, and string theory. This collection of essays is based on the high profile workshop ‘Why Trust a Theory?’ (Munich, 2015) and provides interdisciplinary perspectives on empirical testing in fundamental physics from leading physicists, philosophers and historians of science. Integrating different contemporary and historical positions, it will be of interest to philosophers of science and physicists, as well as anyone interested in the foundations of contemporary science.

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Edited by Radin Dardashti, Richard Dawid, Karim Thébault

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In December 2015, a few days before the start of the conference “Why Trust a Theory?” that provided the basis for the present volume, Joseph Polchinski became ill, which forced him to cancel his participation. The manuscript of his talk, *String Theory to the Rescue*, was read at the conference and is part of this volume. During the weeks before his surgery in early 2016, he wrote “Why Trust a Theory?: Some Further Remarks,” which is also included in this volume. Joseph Polchinski died on February 2, 2018. This book is dedicated to him.

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Preface

In a 2014 letter to *Nature* entitled “Scientific method: Defend the integrity of physics,” the noted cosmologists George Ellis and Joseph Silk expressed criticism of what they described as a dangerous tendency to soften principles of scientific reasoning in contemporary fundamental physics. This letter spurred the organization of a workshop in Munich in December 2015 entitled “Why Trust a Theory? Reconsidering Scientific Methodology in Light of Modern Physics.” The workshop brought together leading physicists, historians, and philosophers of science to discuss and debate a range of pressing epistemological issues that confront contemporary fundamental physics. The majority of the contributions to this book are based on talks delivered at this meeting. As such, what the reader will find is the fruits of a sustained and constructive critical engagement between the various contributors that has taken place both in print and in person. Additional contributions were solicited by the editors with the aim of ensuring as full and balanced presentation as possible of the various positions in the debate.

We are extremely grateful to the organizations that supported the original conference, without which this volume would not have existed. In particular, we are appreciative of the support of Deutsche Forschungsgemeinschaft (German Research Foundation), Foundational Questions Institute, Munich Center for Mathematical Philosophy, and Arnold Sommerfeld Center for Theoretical Physics. Particular personal thanks are due to the other members of the organizational committee, George Ellis, Dieter Lüst, and Joseph Silk; to Stephan Hartmann and Sabine Beutlhauser; and to the audience members at the conference. We are appreciative to Cambridge University Press, in particular Sarah Lambert and Nicholas Gibbons, for outstanding support throughout the editorial process, as well as the volume’s copyeditor, Jill Hobbs. We are also very grateful for comments on drafts of the introductory chapter provided by Michael Talibard and Fernando Quevedo. We would like to thank Michael Kreisel for preparing the index for this volume. Finally, we would like to express our deep gratitude to the contributors for their diverse and fascinating contributions.

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