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Foundational Questions
in Physics & Cosmology

SCIENTIFIC CHARTER

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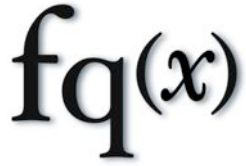


TABLE OF CONTENTS

I.	MISSION	2
II.	SCOPE & IMPETUS	2
III.	GOALS	4
IV.	STRUCTURE	4
V.	PROGRAMMING	5



I. MISSION

To catalyze, support, and disseminate research on questions at the foundations of physics and cosmology, particularly new frontiers and innovative ideas integral to a deep understanding of reality, but unlikely to be supported by conventional funding sources.

II. SCOPE & IMPETUS

In the centuries since Galileo revolutionized human thought by insisting that physical phenomena be observed systematically and described mathematically, physics and cosmology have formed the bedrock of our understanding of the physical world, as well as the preeminent source of new insight into our deepest questions of reality. A few examples, now familiar but profoundly radical in their time, will suffice:

☞ Newton showed that most motions of earthly and nearby heavenly objects were well described by simple equations and a clockwork conception of space and time. ☞ Einstein realized that our conceptions of space and time must be fundamentally reworked, and that by doing so we may describe the structure of the entire observable universe within physical theory. ☞ The creators of quantum mechanics produced equations explicating reality on the smallest scales, but were forced to dispense with or generalize prior notions of causality, repeatability, and objectivity, in ways we still may not fully appreciate. ☞

At FQXi, we believe that similar paradigm-shifting discoveries may now be occurring in physics and cosmology. For, as far as we have come, many questions at the foundations of physics and cosmology remain – some arising from the scientific progress we have achieved, and some even predating science. For example:

- What, if anything, happened *before* the Big Bang? What determined the characteristics of the universe? Is our observed universe all that exists, or is it just one “universe” among many, a mere part of a much bigger picture, in which we misinterpret local conditions as fundamental laws? What will happen in the distant future? Will dark energy collapse or rip apart our universe? Will all particles and black holes ultimately decay away?
- What do the fantastically effective but bafflingly counterintuitive laws of quantum mechanics tell us about reality? How do quantum measurements occur: are there really “many worlds,” and if not, how do quantum possibilities collapse into a single observed reality? Can we find a self-consistent theory of nature that unifies gravity and quantum mechanics?

- What distinguishes the future from the past, if the universe is governed by physical laws that make no such distinction? How does *duration*, which we experience, relate to the *time* described by physics and mathematics?
- What is the relationship between physics, mathematics and information? What determines what exists? How ‘real’ is the world of mathematics – and how ‘real’ is the world of matter?
- Why does the universe seem so complex, given its simple initial conditions, and the elegant mathematics that describes it? Is life ubiquitous in the universe (or beyond)? How does matter give rise to consciousness – or does it?

Questions like these lie at the frontier of science and at the foundation of our understanding of the universe, and intimately connect with and inform not just scientific fields, but also philosophy, theology and religious belief systems. Answers to these questions will have profound intellectual, practical, and spiritual implications for anyone with deep curiosity about the world’s true nature.

Indeed, many giants of modern science – and their colleagues – were passionately concerned with and inspired by the deep philosophical implications of the novel notions of reality they were engaging. Moreover, their bold discoveries expanded rigorous science to encompass many previously ‘speculative’ or ‘philosophical’ matters.

Nonetheless, some – now as then – dismiss such matters as meaningless philosophy or empty metaphysics, encouraging colleagues to eschew such thinking and focus on concrete calculations. Most grant-awarding and research organizations institutionalize this pragmatic approach, primarily funding incremental investigations using known methods and familiar conceptual frameworks, rather than the uncertain and often interdisciplinary methods required to develop and comprehend prospective revolutions in physics and cosmology.

In addition to curtailing the potential for discovery, this mode of thinking greatly diminishes the excitement and meaning of modern science in the public consciousness; partly as a result of this, many otherwise well-educated people, including political leaders, maintain either a pre-scientific worldview, or one informed by outdated concepts.

The Foundational Questions Institute (FQXi) encourages rigorous researchers not to avoid such foundational questions, but rather to tackle them head-on.



III. GOALS

The mission of FQXi is to support rigorous, innovative, and influential scientific research to address foundational questions in physics and cosmology, particularly ones with potentially broad implications for our understanding of the deep or “ultimate” nature of reality, which may not be funded by conventional sources.

More specifically, FQXi has five goals:

1. To expand the purview of scientific inquiry to include scientific disciplines fundamental to a deep understanding of reality, but which are currently largely unsupported by conventional grant sources
2. To redress incrementalism in research programming by establishing or expanding new ‘islands’ of understanding via flexible funding of high-risk, high-reward research in these areas
3. To forge and maintain useful collaborations between researchers working on foundational questions in physics, cosmology, and related fields
4. To provide the public with a deeper understanding of known and future discoveries in these areas, and their potential implications for our worldview
5. To create a logistically, intellectually, and financially self-sustaining independent Institute to accomplish these goals during and beyond the initial four year program beginning in 2006, thereby pioneering a new model of philanthropically-funded scientific research

FQXi funding is therefore aimed at supporting research that is both *foundational* (with potentially significant and broad implications for our understanding of the deep or “ultimate” nature of reality) and *unconventional* (enabling research that, because of its speculative, non-mainstream, or high-risk nature, would otherwise go unperformed due to lack of funding.)

IV. STRUCTURE

The **Foundational Questions Consortium** is an international, diverse group of visionaries in physics, cosmology, and closely related fields, which seeks answers to foundational questions in these disciplines. This Consortium provides the core structure for a global research network of researchers working on foundational questions.

At the core of the Consortium is the **Foundational Questions Institute (FQXi)**, an independent non-profit organization that provides monetary, organizational, and intellectual support for the study of foundational questions in physics and cosmology, by dispensing



funds donated for these purposes. Building on seed funding from the John Templeton Foundation (JTF), the Institute will seek to expand its support structure to include other donors with a vision consistent with that of FQXi.

The Institute's activities are enhanced by the active participation of its **Members**. Consortium Membership consists of all researchers funded by the Institute, as well as researchers with membership granted by the FQXi Administration via invitation or application.

V. PROGRAMMING

In support of these goals, the Institute will fund a number of programs, including:

- *Grants:* Approximately \$5M in grants will be awarded, in two phases, as part of the Institute's initial four-year program.
 - Funding will be provided as research grants to theorists and experimenters in support of personnel, equipment, travel, workshops, and experiments; some funding will also target projects that effectively disseminate information about foundational questions in physics and cosmology to laypeople.
 - Grants will support work on questions at the foundations of physics and cosmology, performed by researchers in physics, cosmology, and, insofar as the research bears directly on physics and cosmology, closely related fields. Although the distribution of funds across subject areas will be driven by the quality of proposals received, the review process will aim to fund a diverse body of research that spans the small and the large, ranges from the elementary to the complex, and covers numerous fields such as high-energy and quantum physics, cosmology, and complex systems.
 - Proposals will be subject to a standard competitive process of expert peer review similar to that employed by national scientific funding agencies, and will target research unlikely to be otherwise funded by conventional sources.
- *Mini-grants:* A number of 'mini-grants' will be available each year via a streamlined application process for travel, lecture programs, workshops, and other small projects initiated by Consortium Members.
- *Contests:* The Institute will support essay and other contests, with a number of prizes awarded for a variety of subjects, with the purpose of identifying and supporting pioneering thinkers, and stimulating interesting and innovative thinking on foundational questions.
- *Conferences:* Two or more international conferences will be convened during the first four years, to connect the Membership, share results, and disseminate supported research to professionals and the public.