NSF grant to IU researcher funds study of 'fundamental length'

March 23 2010

The National Science Foundation has awarded a $221,660 grant to Indiana University faculty member Amit Hagar for the first comprehensive study of fundamental length, a concept that has intrigued theoretical physicists off and on for nearly a century.

The three-year grant from the NSF Division of Science, Technology and Society to Hagar, an assistant professor in the Department of History and Philosophy of Science in the College of Arts and Sciences, will support study of the idea that space, rather than being continuous, is made up of discrete units.

Titled "Length Matters: The History and the Philosophy of the Notion of Fundamental Length in Modern Physics," the project will combine philosophy with written and oral history, including interviews with leading figures in the debate over fundamental length. It will seek to bring light to some of the most pressing methodological issues in modern theoretical physics.

"The study will consider the diverse scientific and philosophical motivations for introducing the notion of fundamental length into modern theories of physics," Hagar said. "The discussion will characterize and then analyze the possible phenomenological consequences of this notion, which are currently at the center of heated debates among high-energy physicists who are struggling to unify the general theory of relativity with quantum mechanics."

It may seem self-evident that space is a continuum which can be divided into an infinite number of ever-smaller units, and that there is no "fundamental" unit of length. But Hagar points out that scientific advances have often involved "shifts in perspective" that allow us to see the world in new ways -- much as understanding the Earth's rotation demolished the idea that the Sun was circling the Earth.

In the case of fundamental length, the notion goes back to the ancient Greek philosopher Zeno, whose paradoxes exposed tension between views of space as infinite and discrete. In the 1930s, Werner Heisenberg and other physicists were drawn to the concept of fundamental length as they attempted to write down a quantum theory of electromagnetism. But the idea was largely rejected as impossible to reconcile with established findings.

Remarkably, Hagar said, the notion of fundamental length made a comeback in the 1950s and '60s with efforts to develop a theory of quantum gravity, a next step in the attempt to develop a unified theory that has driven theoretical physics for decades. But incorporating the idea will not be easy. It would require a theoretical structure that allows for new predictions while maintaining agreement with well-established principles.

"This challenge, currently faced by theories of quantum gravity, is also what makes the story of the notion of fundamental length so timely," Hagar said, "as it best exemplifies the delicate balance between conservatism and innovation that characterizes the practice of extending 'old' physics into new regimes."

Hagar has previously published two chapter-length articles on the history and philosophy of the concept of fundamental length. The grant will enable him to produce six more chapters, resulting in the first extended monograph on the topic.

PHYS.ORG

Provided by Indiana University

Citation: NSF grant to IU researcher funds study of 'fundamental length' (2010, March 23) retrieved 2 May 2024 from https://phys.org/news/2010-03-nsf-grant-iu-funds-fundamental.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.