

## Charting the Space of Quantum Field Theories

Written by Administrator  
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Leonardo Rastelli of the YITP and the Department of Physics and Astronomy will lead a groundbreaking ["Collaboration on the Non-Perturbative Bootstrap"](#) as Director for a new grant that includes fourteen other principal investigators at institutions in the United States, Canada and Europe.

On August 25th, the Simons Foundation [announced](#) the establishment of the "Simons Collaboration on the Non-perturbative Bootstrap", with total funding of \$10M over four years. Quantum Field Theory (QFT) is the language of modern theoretical physics. Quantum fields describe our knowledge of nature at the shortest distances, accessible by high energy accelerators, and also in phenomena like superconductivity, states of matter that can be created in the laboratory. A critical challenge for theoretical physics is to chart and understand the "space" of all possible QFTs, including strongly interacting models that are difficult to study by conventional methods. The Collaboration will bring to bear new theoretical tools, some developed here at the YITP, to address this question. The starting point is the astonishing discovery that the space of QFTs can be determined by using only general principles: symmetries and quantum mechanics. By analyzing the full implications of these general principles, one can make sharp predictions for physical observables without resorting to approximations. This strategy is called the

*bootstrap*

. New developments within the past few years suggest that the time is right for a concerted effort to open a new window on nature at its most fundamental. The Foundation considers the Collaboration as "the beginning of a much larger enterprise, crossing the traditional boundaries" in physics, mathematics and computer science.