Physics Colloquium

Michigan Technological University

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Room 139 Fisher Hall

Charting the Shape of Hilbert Space

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Abstract: Physicists have become accustomed to the idea that a theory's content is always most transparent when written in coordinate-free language. Sometimes, though, the choice of a good coordinate system can be useful for settling deep conceptual issues. This is particularly so for an information-oriented or Bayesian approach to quantum theory: One good coordinate system may be worth more than a hundred philosophical arguments. This talk will motivate and chronicle the search for such a coordinate system for finite dimensional quantum theory, the key arena for quantum information and computing. These are the so-called Symmetric Informationally Complete (SIC) quantum measurements. It has been an open mathematical problem for over 35 years, but great progress has been made recently in understanding them---for instance, it is now known that when they exist, such measurements are optimal for quantum state tomography. Moreover they have deep connections to the theory of quantum error correcting codes. What is particularly surprising however is how their existence would allow a rewriting of the quantum mechanical Born rule to be a formula purely in terms of probabilities, instead of as usual, a formula in terms of quantum states and operators. This suggests a new and powerful way to track the origin of the power of quantum information.

Bio: Christopher Fuchs is a Senior Researcher at the Perimeter Institute for Theoretical Physics in Waterloo, Canada and an Adjunct Professor of physics and mathematics at the University of Waterloo. Previously, he was a research staff member at Bell Labs in Murray Hill, New Jersey and a Prize Postdoctoral Fellow at the California Institute of Technology. He is the author of over 75 scientific papers, a winner of the 2010 International Quantum Communication Award, and currently the Chair of the American Physical Society Topical Group on Quantum Information. Most recently, he is an author of Cambridge University Press book *Coming of Age with Quantum Information.*

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