

Title:

Quantum Theory from Quantum Information? (What would Feynman say?)

Abstract:

How did the field of quantum information begin? To my mind, it was when John Archibald Wheeler formed his little group of students and postdocs at the University of Texas in the early 1980s. David Deutsch (quantum Turing machines, quantum speed up), Benjamin Schumacher (qubits, quantum channel capacities), William Wootters (no-cloning, quantum teleportation), Wojciech Zurek (no-cloning, decoherence). Even Richard Feynman visited once. Those names now ring out to our field like the names of Bedford, Exeter, Warwick, and Talbot in King Henry's Saint Crispin's Day Speech.

To every student who walked into his office, Wheeler would implore, "Give an information theoretic derivation of quantum theory!" He saw that method as the only sure way to gain a real understanding of the quantum. In this talk, I will outline how Wheeler's old seed is still giving technical fruit in my group at UMass Boston. Particularly, taking his desire seriously leads to the study of a mysterious structure called the Symmetric Information Complete quantum measurement. When these structures exist (and it seems they do for all finite dimensions, though who could prove it!) they give a very clean way of writing the Born rule in purely information-theoretic terms. This gives the hope that all the mathematical structure of quantum theory might be derivable from one very basic physical scenario. It's not the double-slit experiment that Feynman wanted, but one might still chime in with him and say, "In reality, [this scenario] contains the only mystery [of quantum mechanics]."