

How to deduce a physical dynamical model from expectation values

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In this talk, we will provide an answer to the question: “What kind of observations (i.e., expectation values) and assumptions are minimally needed to formulate a physical model?” Our answer to this question leads to the new systematic approach of Operational Dynamical Modeling (ODM), which allows deducing equations of motions from time evolution of observables. Using ODM, we are not only able to re-derive well-known physical theories, but also solve open problems in quantum non-equilibrium statistical dynamics. Furthermore, ODM has revealed unexplored flexibility of nonlinear optics: A shaped laser pulse can drive a quantum system to emit light as if it were a different system (e.g., making lead look like gold).