Contextual qubit models from Wigner functions

Dan Browne

Wigner functions, and other quasi-probability distributions, have been an important tool in quantum optics for a long time. A quasi-probability distribution is a representation of a quantum state with certain properties. In particular it is a real-valued representation of the state. Of particular interest are states for which a Wigner function is non-negative. Spekkens showed such sets of states (and their transformations and measurements) possess a non-contextual hidden variable model that can be defined in terms of the Wigner function itself, showing a tight link between the negativity of quasi-probability distributions and contextuality. I will show how, Spekkens toy model notwithstanding, Wigner functions can be used to define contextual hidden variable models. I will apply this to the qubit case and derive a contextual hidden variable model for stabilizer quantum mechanics based on Wigner functions. I will compare the derived model with Spekkens toy model, a non-contextual hidden variable model known to be closely-related but different to stabilizer quantum mechanics. This is unpublished work-in-progress, in collaboration with Nicolas Delfosse, Juan Bermejo-Vega, Cihan Okay and Robert Raussendorf.