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Qutrits under a microscope[1] GELO NOEL TABIA, University of Waterloo, Perimeter Institute for Theoretical Physics, Institute for Quantum Computing — Gleason's theorem states that the set of quantum states is complete, in the sense that density operators specify the unique probability measure definable on the lattice of Hilbert space of projection operators according to the Born Rule. Particularly, Gleason showed that the theorem holds in all finite dimensions if and only if it holds in dimension 3. This suggests that the essential features defining the probability structure of quantum theory can already be found in 3-dimensional quantum systems. Hence, we establish key geometric properties of qutrit state space as they are expressed in terms of symmetric, informationally-complete (SIC) measurements. We provide a variety of important results, which include an elegant formula for describing pure qutrits, affine plane symmetries and the Hesse configuration in qutrit SICs derived from algebraic structure constants for $\mathrm{GL}(3, \mathrm{C})$, and a comparison of the SIC and generalized Bloch representations by analyzing plane cross-sections of qutrit state space. In addition, we present a new way of implementing SIC-POVMs using multi-port devices built from waveguide-based micro-optics, in particular, by proposing experimental circuits for qubits and qutrits.

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Gelo Noel Tabia
University of Waterloo, Perimeter Institute for Theoretical Physics,
Institute for Quantum Computing

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