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Galois-unitary symmetry of mutually unbiased bases as a toy model for SIC-POVMs

Besides applications in quantum information, symmetric informationally-complete (SIC) POVMs have deeply interesting mathematical properties due to their high degree of symmetry. Here we focus on g -unitary symmetry, which is a generalized notion of anti-unitary symmetry. G -unitary operators are defined with respect to a number field extension. For the case of mutually unbiased bases (MUB) where the relevant field extension is simple, we find that g -unitaries help us to solve problems such as MUB-cycling and finding MUB-balanced states.