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The Spekkens toy model Revisited

The Spekkens toy model is an interesting example of how to augment classical physics in order to perform several quantum informational tasks using limited resources. We revisit the Spekkens toy model and look at the different representations for the group of operations on a single toy bit. We show that in the representation of the operators as Euler rotations, there exist rotations that obey the knowledge balance principle, yet are not present in Spekkens' original group. We demonstrate that this expanded group of single toy bit operations, which includes Spekkens' original operations as a subgroup, is isomorphic to the extended Clifford group for one qubit (modulo scalar multiples of the identity). We also investigate the case for two toy bits again expanding the group of toy operations to include some, but not all, of the extended operations.