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## Hypergraph framework for Spekkens contextuality applied to Kochen-Specker scenarios

I will introduce some recent work [1, 2] on formulating contextuality within the Spekkens framework [3] for scenarios that are traditionally considered in Kochen-Specker (KS) contextuality [4, 5]. I will follow Ref. [1] in motivating the discussion and then present a hypergraph framework that applies to KS-colourable contextuality scenarios, obtaining noise-robust noncontextuality inequalities that generalize the KS-noncontextuality bounds from Ref. [4]. The framework for Ref. [1] relies on the introduction of a new hypergraph invariant in obtaining the noncontextuality inequalities. We will see that this hypergraph invariant is, in fact, the only relevant invariant when it comes to obtaining noncontextuality inequalities for KS-uncolourable scenarios and we will outline a complementary framework for the latter following Ref. [2]. Taken together, Refs. [1, 2] complete the project of turning proofs of Kochen-Specker theorem – whether statistical or logical – into noise-robust noncontextuality inequalities following the Spekkens framework. Along the way, time permitting, we will also comment on the status of Specker’s principle [6] in these considerations and outline applications of the framework to quantum information protocols.

### References:

- [1] R. Kunjwal, “Beyond the Cabello-Severini-Winter framework: Making sense of contextuality without sharpness of measurements”, arXiv:1709.01098 [quant-ph] (2018).
- [2] R. Kunjwal, “Hypergraph framework for irreducible noncontextuality inequalities from logical proofs of the Kochen-Specker theorem”, arXiv:1805.02083 [quant-ph] (2018).
- [3] R. W. Spekkens, “Contextuality for preparations, transformations, and unsharp measurements”, Phys. Rev. A 71, 052108 (2005).
- [4] A. Cabello, S. Severini, and A. Winter, “Graph-Theoretic Approach to Quantum Correlations”, Phys. Rev. Lett. 112, 040401 (2014).
- [5] A. Acín, T. Fritz, A. Leverrier, and A. B. Sainz, A Combinatorial Approach to Nonlocality and Contextuality, Comm. Math. Phys. 334(2), 533-628 (2015).
- [6] A. Cabello, “Specker’s fundamental principle of quantum mechanics”, arXiv:1212.1756 [quant-ph] (2012).