Quantum Geometry: MUB's and SIC-POVM's

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Abstract: Work on quantum computers leads to many interesting combinatorial problems. In particular there has been considerable interest in questions concerning nice arrangements of lines in finite-dimensional complex space. One question is, for which values of d can we find a set of d^2 equiangular lines in d-dimensional complex space? (Physicists call such a line set a SIC-POVM.) Another asks ,in which dimensions we can find $d+1$ orthogonal bases such that any two lines in different bases lie at the same angle? (Physicists refer to such a set of bases as MUB's.) For combinatorialists, the analog of the first question leads to regular two-graphs, which were extensively studied by Seidel and his collaborators. The second question appears to have little to do with combinatorics, but all known examples of sets of size $d+1$ can be obtained by a single construction from finite geometry, and it may be that sets of size $d+1$ exist only if d is a prime power.

My talk will provide a general introduction to these problems; no knowledge of physics is necessary.