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Quantum mechanics over sets DAVID ELLERMAN, Retired — In models of QM over finite fields (e.g., Schumacher's "modal quantum theory" MQT), one finite field stands out, Z_2, since Z_2 vectors represent sets. QM (finite-dimensional) mathematics can be transported to sets resulting in quantum mechanics over sets or QM/sets. This gives a full probability calculus (unlike MQT with only zero-one modalities) that leads to a fulsome theory of QM/sets including "logical" models of the double-slit experiment, Bell's Theorem, QIT, and QC. In QC over Z_2 (where gates are non-singular matrices as in MQT), a simple quantum algorithm (one gate plus one function evaluation) solves the Parity SAT problem (finding the parity of the sum of all values of an n-ary Boolean function). Classically, the Parity SAT problem requires 2^n function evaluations in contrast to the one function evaluation required in the quantum algorithm. This is quantum speedup but with all the calculations over Z_2 *just like classical computing*. This shows definitively that the source of quantum speedup is *not* in the greater power of computing over the complex numbers, and confirms the idea that the source is in superposition.

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