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QUANTUM ALGEBRA FOR QUANTUM COMPUTERS

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Summary

Quantum logic which should be developed into a machine language for quantum computers is a small algebraic core of the full probabilistic descriptions of a quantum measurement, i.e., the Hilbert space probability theory. In order to handle a superposition of states, which are the starting point of any quantum computer, the computer cannot be given the present quantum (orthomodular) logic. It can be shown that only a variety of quantum logic (quantum logic with new additional independent axioms) can be used for a description of even the simplest superposition of states if we want that a mapping from an obtained final proposition to the interval [0,1] be direct and represent a calculated result of the computer. On this mapping rather complicated conditions (*read off* from the Hilbert space structure) must be imposed although just recently a significant advance has been made when M. P. Solèr proved that an orthomodular form that has an infinite orthonormal sequence *is* a Hilbert space. The reason for that is that within standard formulations of quantum logics additional axioms become rather complicated even for automated theorem proving and that the problem of inferring new theorems has not been properly solved.

My coworker Norman Megill and I investigated properties of the structures underlying a machine computation of the results of quantum measurements. In particular, we considered the algebra $\mathcal{A}$ of all relations between the obtained data. We first investigated mapping of $\mathcal{A}$ to an ortholattice under the usual unary valuation. We obtained a collection of expressions in the ortholattice. It turns out that such an algebraic mapping of the axioms of any standard quantum logic is not a quantum orthomodular structure but a proper non-orthomodular variety of an ortholattice. We therefore formulated a new binary quantum logic approach which does map into a quantum structure. In this talk, I am going to present the approach.