Quantum Physics

Computations in Finite Groups and Quantum Physics

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Mathematical core of quantum mechanics is the theory of unitary representations of symmetries of physical systems. We argue that quantum behavior is a natural result of extraction of "observable" information about systems containing "unobservable" elements in their descriptions. Since our aim is physics where the choice between finite and infinite descriptions can not have any empirical consequences, we consider the problem in the finite background. Besides, there are many indications from observations - from the lepton mixing data, for example - that finite groups underly phenomena in particle physics at the deep level. The "finite" approach allows to reduce any quantum dynamics to the simple permutation dynamics, and thus to express quantum observables in terms of permutation invariants of symmetry groups and their integer characteristics such as sizes of conjugate classes, sizes of group orbits, class coefficients, dimensions of representations. Our study has been accompanied by computations with finite groups, their representations and invariants. We have used both our C implementation of algorithms for working with groups and computer algebra system GAP.

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