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A Novel Algebraic Approach to Quantum and Classical Dualities

Few non-perturbative tools available to the theoretical physicist are as widely useful as Dualities. These "connections" among diverse models (or one and the same model in different regions of its coupling space) can provide a wealth of qualitative and quantitative information up to exact critical couplings in favorable cases; which explains why dualities have been researched constantly over the last sixty years in fields ranging from Classical Statistical Mechanics to String Theory. In this talk we introduce a completely novel algebraic approach to dualities. By associating a "bond algebra" to any quantum Hamiltonian, dualities can be systematically searched for,
and dual variables computed algorithmically. It follows that that quantum dualities can be characterized as unitary transformations that can be explicitly computed. In this context, the connection between self-dualities and ordinary (Wigner) quantum symmetries is enormously clarified. Furthermore, through Feynman's path integral,
our technique provides also a new approach to classical dualities, thus affording a unified solution to the problem of finding dualities in classical and quantum models:
as an elementary example, the Krammers-Wannied duality of the classical Ising model and the duality of (sourceless) electromagnetism are shown to be the manifestation of one and the same property of these models' quantum renditions.
Quantum Field Theory (QFT) provides a most interesting and challenging scenario for the application of this novel technique. Hence though still under research, applications to dualities in QFTs is stressed.

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