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Quantum walks and graph isomorphism

A quantum walk is a quantum process on graph, whose transition matrix is a graph invariant. There are many proposals for classes of graphs where some property of the transition matrix is a complete graph invariant. In particular, it is proposed by Emms, Hancock, Severini and Wilson in 2006, that the spectrum of a matrix based on the amplitudes of walks in the quantum walk, distinguishes strongly regular graphs. We will discuss linear algebraic and combinatorial properties of graphs which are distinguished by this invariant and also present strongly regular graphs on which this invariant fails.