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Cyclic Hamiltonian (Near-)Decompositions of the Complete Graph

It has been proven that the complete graph on n vertices can be decomposed into Hamiltonian cycles, whenever n is odd. Similarly, if we remove a 1-factor (perfect matching) from the complete graph on an even number of vertices, the remaining graph can always be decomposed into Hamiltonian cycles; this is what is referred to as a near-decomposition. To make the problem interesting again, we put constraints on the Hamiltonian cycles that we allow to be in the decomposition. A cyclic Hamiltonian decomposition of the complete graph is a decomposition of the complete graph into Hamiltonian cycles, in such a way as to ensure that rotating any cycle in the decomposition gives us a (possibly different) cycle in the decomposition. It has been proven that a cyclic Hamiltonian decomposition of the complete graph on n vertices always exists when n is odd, as long as $n \neq 15$ and $n \neq p^\alpha$, where p is prime and $\alpha > 1$, and that these constraints are necessary. We prove that when n is even, cyclic Hamiltonian near-decompositions of the complete graph on n vertices exist if and only if $n \neq 2p^\alpha$ where p is prime, and n is either 2 or 4 (mod 8).