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\* UCLA Combinatorics Seminar \*

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**Richard Wilson**

**Caltech**

## **Decompositions of Complete Graphs**

### **Abstract**

An old result of the speaker is that, given a graph  $G$ , necessary and asymptotically sufficient conditions on  $n$  for the existence of a decomposition of the edges of the complete graph  $K_n$  into copies of  $G$  are that

- (1) the number of edges of  $G$  divides  $n(n-1)/2$ , and
- (2) the greatest common divisor of the degrees of vertices of  $G$  divides  $n-1$ .

For applications, it is desirable to consider decompositions into members of families of graphs or digraphs whose edges have been assigned colors from a fixed set of  $r$  colors; the complete graphs to be decomposed have  $r$  edges joining any pair of vertices, one of each color.

We speak about recent results (with Anna Draganova and Yukiyasu Mutoh) about decompositions into edge-colored multigraphs. New complications arise in describing the necessary conditions. A large part of the proof of asymptotic sufficiency involves showing that the conditions are sufficient for the existence of a solution in integers to a complicated system of linear equations.