

Max Wakefield (U.S. Naval Academy)

Coloring Partitions and Configuration Spaces

Abstract for the Colloquium 2014 December 5

There is a deep interplay between the combinatorics (matroid), algebra (cohomology or rational model), and geometry (complement) of a subspace arrangement (finite collection of subspaces in a vector space). For example, if the subspaces are complex with complex codimension 1 (hyperplanes) then the Betti numbers are exactly the (unsigned) Whitney numbers of the first kind on the intersection lattice.

Subspace arrangements of the braid arrangement can be enumerated by partitions. It turns out that the Whitney numbers of these subspace arrangements can be found by looking at a generalized chromatic polynomial of the associated partitions. Unfortunately, these Whitney numbers do not give the Betti numbers of the complement and finding a closed formula for these Betti numbers is not known. However, using tools from rational homotopy theory I can show that certain classes of these arrangements are rationally formal and non-formal.

At the end I will construct a new differential graded algebra which presents a kind of model for the collection of all k -equal arrangements (configuration spaces where $k-1$ points can collide) that gives hints at a nice presentation for the cohomology and the Betti numbers.

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Last update: **2020/01/29 19:03**

