UCCS Department of Mathematics

Math Colloquium Series

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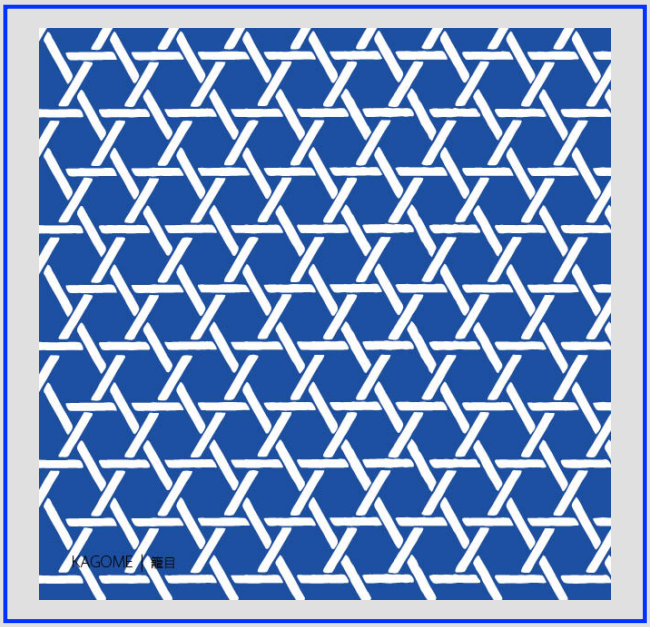

DATE:
NOVEMBER 5, 2015

TIME:
12:30PM-1:30PM
(REFRESHMENTS AT 12:15PM)

LOCATION:
OSBORNE CENTER
ROOM# A327

A disproof of Tsallis' conjecture for the exact bond percolation threshold of the kagome lattice

The kagome lattice is the line graph of the hexagonal lattice. The exact value of the bond percolation threshold of the kagome lattice has been a long-standing open problem, and cannot be determined by currently available methods. Tsallis (Journal of Physics C, 1982) predicted that the bond percolation threshold of the kagome lattice satisfies the equation

$$1 + p^3 - p^2 - p = 2 \sin(\pi/18),$$

yielding $p_c \approx 0.522372$. However, as simulations have improved over the years, the numerical estimates of p_c now cluster around 0.5244, which indicates that the value predicted by Tsallis is lower than the true value. In joint research with students Gaoran Yu and Theo Huang, we applied the substitution method, which is based on stochastic ordering, to compare the behavior of the homogeneous bond percolation model on the kagome lattice to that of an exactly-solved inhomogeneous bond percolation model on the martini lattice. The required computations can only be reduced to a manageable level by using symmetry reductions, non-crossing partitions, "graph-welding", and identifying "desirable classes" of partitions in a relevant partition lattice. We obtained a lower bound for p_c of 0.522394, which is slightly larger than Tsallis' conjectured value.