Geometry Seminar
Tuesday, November 02, 2010
Room 201 WWH at 6:00 P.M.

Configuration spaces of hard discs

Matthew Kahle
IAS, Princeton.

We study the space of all possible positions of n labeled nonoverlapping discs of radius r in a unit square, Config(n;r). Spaces like this have long been studied as a model of atomic matter in the context of statistical mechanics. A phase transition is known to occur from computer simulations but this is still not well understood mathematically. Here we study the topology of Config(n;r) and discover a few surprising facts.

In particular we find that the configuration space is not connected in the range of parameters where it is generally assumed to be, the number of components is not monotone in the radius, and the "topological complexity" can be quite large. The main tools are various kinds of Morse theory – a computational implementation, known as the "nudged elastic band" method, and a theoretical implementation of Min-type Morse theory, similar to the stratified Morse theory of Goresky and MacPherson. Some of this is joint work with Gunnar Carlsson and Jackson Gorham, and some of it is joint with Yuliy Baryshnikov and Peter Bubenik.

For more information please visit the seminar website at:
`http://www.math.nyu.edu/seminars/geometry_seminar.html`.