Geometry Seminar
May 9, 2006, Tuesday, 6:00 p.m.
Room 613, Courant Institute
251 Mercer Street, New York

Random polytopes and isoperimetric inequalities

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Abstract

A random tessellation of d-dimensional Euclidean space with translation invariant distribution gives rise to different types of random polytopes: one may consider the cell containing a fixed point, say the origin (the *zero cell*) or, roughly speaking, pick out a randomly chosen cell (the *typical cell*). We study these random polytopes for two types of tessellations, generated either by a stationary Poisson hyperplane process, or as the Voronoi tessellation corresponding to a stationary Poisson point process. Generalizing and extending a problem of D.G. Kendall, we ask for possible asymptotic shapes of the considered random polytopes under the condition that their size (in some sense) is large. The main result implies that the asymptotic shapes of large cells are completely determined by the extremal bodies of an inequality of isoperimetric type, which connects the functional measuring the size with the expected number of hyperplanes of the generating process that hit a given convex body. Stability results for the employed isoperimetric inequalities lead to exponential estimates for the conditional probability of large deviations of zero cells from asymptotic or limit shapes, under the condition that the cells have large size. (Joint work with Daniel Hug)

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