
Plenary Lectures
Conférences plénières

HENRI DARMON, McGill

The unreasonable effectiveness of p -adic methods in number theory

In a non-archimedean world, two subjects who walk away from each other, eager perhaps to observe current social distancing guidelines, might never succeed in coming more than one meter apart. Even worse, each successive step risks bringing them closer to each other than they ever were before, in a sequence of regularly spaced but increasingly egregious violations of sanitary rules. In spite of its paradoxical properties, the p -adic distance in such a world is well suited to number theory questions based on studying congruences, and forms the basis for an analysis that is just as rich and subtle as its real and complex counterparts. Some of the most central open problems in number theory, such as the Riemann hypothesis, the Birch and Swinnerton-Dyer conjecture, and the Stark conjecture admit p -adic variants which, far from being variants of concern, are significantly more tractable than their archimedean precursors. This lecture will describe the notable progress that has been achieved on these variants in the last decades, and attempt to explain what makes the progress possible.

MOON DUCHIN, Tufts University

Political Geometry

The field of *political geography* is centered on questions of how nations, states, and districts are bounded and more broadly studies the spatialization of political processes. I'll discuss some active mathematical research areas—spanning combinatorics, probability, and geometry—inspired by questions of current interest in voting and civil rights.

This lecture is dedicated to the memory of Alfonso Gracia-Saz, an incomparable educator and human.

MATILDE MARCOLLI, Caltech and University of Toronto

Entropy, holography, and p -adic geometry

In the 1980s, Manin suggested that physics has " p -adic shadows" and that these p -adic counterparts can be used to better understand the ordinary formulation in terms of real and complex variables. This talk will illustrate how this idea can be applied to AdS/CFT holography, which relates gravity on a bulk space and conformal field theory on its boundary. In particular, holography predicts that information theoretic quantities like entanglement entropy on the boundary can be expressed in terms of geometric properties of the bulk. Instances of this relation can be established in terms of p -adic geometry.

AARON NABER, Northwestern University

Connections between Geometry and Analysis on Manifolds and Path Spaces

In the last decades there have been many connections made between the analysis of a manifold M and the geometry of M . Said correctly, there are now many ways to make precise that well-behaved analysis on M is 'equivalent' to the existence of lower bounds on Ricci curvature. Such ideas are the starting point for regularity theories and more abstract settings for analysis, including analysis on metric-measure spaces. We will begin this talk with an elementary review of these ideas.

More recently it has become apparent analysis on the path space PM of a manifold is closely connected to two sided bounds on Ricci curvature. Again, said correctly one can make an equivalence that the analysis on PM is well behaved iff M has a two sided Ricci curvature bound. As a general phenomena, one sees that analytic estimates on M lift to estimates on PM in the presence of two sided Ricci bounds. Our talk will mainly focus on explaining all the words in this abstract and giving some rough understanding of the broad ideas involved. Time allowing, we will briefly explain newer results with Haslhofer/Kopfer on differential harnack inequalities on path space.

IAN PUTNAM, University of Victoria
Translation flows and operator algebras

There has been a long history of important interactions between dynamical systems and operator algebras. The construction of operator algebras from dynamical systems has provided many enlightening examples. At the same time, operator algebra techniques have brought new ideas to the study of dynamics.

This talk will focus on a construction of certain dynamical systems on surfaces given by K. Lindsey and R. Trevino. Their starting data is a Bratteli diagram, a combinatorial object first used in the 1970's to describe a rich class of C^* -algebras. The first goal is to relate these C^* -algebras with those of the dynamics on the surface. The more ambitious goal is to exploit this relation to better understand the dynamics. The essence of this relation is the under-appreciated subtleties of decimal expansion (and some of its generalizations). This is joint work, in progress, with Rodrigo Trevino (Maryland).