

**Michael Chapman**

***Subgroup Tests and the Aldous-Lyons conjecture***

**Abstract:**

The Aldous-Lyons conjecture from probability theory states that every (unimodular random) infinite graph can be (Benjamini-Schramm) approximated by finite graphs. This conjecture is an analogue of other influential conjectures in mathematics concerning how well certain infinite objects can be approximated by finite ones; examples include Connes' embedding problem (CEP) in functional analysis and the soficity problem of Gromov-Weiss in group theory. These became major open problems in their respective fields, as many other long standing open problems, that seem unrelated to any approximation property, were shown to be true for the class of finitely-approximated objects. For example, Gottschalk's conjecture and Kaplansky's direct finiteness conjecture are known to be true for sofic groups, but are still wide open for general groups.

In 2019, Ji, Natarajan, Vidick, Wright and Yuen resolved CEP in the negative. Quite remarkably, their result is deduced from complexity theory, and specifically from undecidability in certain quantum interactive proof systems. Inspired by their work, we suggest a novel interactive proof system which is related to the Aldous-Lyons conjecture in the following way: If the Aldous-Lyons conjecture was true, then every language in this interactive proof system is decidable. A key concept we introduce for this purpose is that of a Subgroup Test, which is our analogue of a Non-local Game. By providing a reduction from the Halting Problem to this new proof system, we refute the Aldous-Lyons conjecture. These talks are based on joint work with Lewis Bowen, Alex Lubotzky, and Thomas Vidick.

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**Jean Raimbault**

***Invariant Random Subgroups and Locally Symmetric Spaces***

**Abstract:**

The goal of these lectures is to introduce invariant random subgroups (IRS) in Lie groups and present some applications to the geometry and topology of locally symmetric spaces. I will start with a short discussion of IRS in discrete groups, then a short survey of discrete subgroups semisimple Lie groups with emphasis on lattices. The rest of the lectures will be devoted to IRS in semisimple Lie groups and the Benjamini-Schramm topology.

**Pierre Py**

***Kähler groups and geometric group theory***

**Abstract:**

The purpose of this course is to give an introduction to the study of fundamental groups of compact Kähler manifolds (also known as Kähler groups) from the geometric group theory perspective.

A Kähler manifold is a complex manifold carrying a hermitian metric compatible with its complex structure: one way to formulate this compatibility condition is to say that the imaginary part of the metric is a closed 2-form, another way is to say that the parallel transport with respect to the metric is complex linear. Closed Kähler manifolds, which include smooth projective varieties, satisfy many strong topological restrictions. In other words, their homotopy types are very constrained. In this course we shall focus on their fundamental groups.

After describing a number of interesting examples of such groups, and a few classical restrictions coming from Hodge theory, we shall notably discuss the following three topics: the description of actions of Kähler groups on trees, following Gromov and Schoen, the description of the Bieri--Neumann--Strebel invariant of Kähler groups, following Delzant, and the proof of the fact that solvable Kähler groups are virtually nilpotent (following works by Arapura, Beauville, Campana, Delzant, Nori).

**Andy Putman**

***The cohomology of the mapping class group and Torelli group***

**Abstract:**

I will give a survey about what is known about the homology of the mapping class group and its subgroups.