



## The Mathematics of Transformers: From Particle Systems to Control Theory"

**SPEAKER/LECTURER:** Cyril Letrouit - (CNRS, Laboratoire de Mathématiques d'Orsay) <https://www.imo.universite-paris-saclay.fr/~cyril.letrouit/>

**Period and schedule:**

**May 12 - 13 - 14 from 11:00 to 12:30**

**(Lectures)**

**Conference Room:** 1201 Aula Dal Passo,

Dipartimento di Matematica - Tor Vergata:

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### ABSTRACT

Since their introduction in 2017, Transformers have profoundly transformed large language models and, more generally, deep learning. This success largely relies on the mechanism known as "self-attention". In this course, I will introduce a mathematical framework that allows self-attention to be viewed as a system of interacting particles. I will explain certain remarkable properties of the associated dynamics in the space of probability measures, with particular emphasis on cluster formation, the preservation of Gaussian distributions, the subtleties of the associated mean-field limit, and the great "expressivity" of these neural networks, proved thanks to control theory.