

PhD course
*Topics on the Minimal Model Program and the
Kähler-Ricci flow*

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The goal of this class is to discuss aspects of higher dimensional algebraic, or more general Kähler, varieties from both algebraic and differential analytic points of view. From the purely algebro-geometric perspective, the Minimal Model Program (MMP) provides a way to classify varieties up to birational equivalence, showing (partially still conjecturally) that all projective varieties are basically built from Fano varieties, Calabi-Yaus and varieties with ample canonical class. The Kähler-Ricci flow (KRF) instead aims to replace certain algebraic operations in the MMP with metric degenerations (along the parabolic PDE given by the Ricci flow), hoping to serve as a replacement of the algebro-geometric techniques when they are not fully available (e.g., on general Kähler manifolds) and to produce more refined informations.

The precise topics discussed in the lectures are going to be adapted to the audience's interest, but they should include more algebraic results such as the foundational Mori's cone theorem, the description of MMP singularities and the more recent BCHM finite generation of the canonical ring, as well as more analytic results related to the behavior of the evolving metrics near the maximal existence time of the KRF.

Some familiarity with complex/algebraic geometry, and a bit of PDE theory, is expected from the participants to the class.

Some basic references:

- J. Kollár, S. Mori, *Birational Geometry of Algebraic Varieties*.
- C. Birkar, *Lectures on Birational Geometry*.
- V. Tosatti, *KAWA lectures notes on the Kähler-Ricci flow*.