Titles and abstracts

School lectures

Paolo Cascini

Title: On the Minimal Model Program for Foliations

Abstract: We present an introduction to the birational geometry of foliations, focusing on the interaction between algebraic geometry and the dynamics of algebraic vector fields. After recalling the basic notions and explaining how foliations fit into the framework of the Minimal Model Program, we discuss adjunction and the Cone Theorem in the rank-one case, highlighting both analogies and key differences with the classical setting. We then turn to algebraically integrable foliations, describing their birational structure and some applications towards the canonical bundle formula. Finally, we outline recent developments in the Minimal Model Program for foliations on threefolds, including the main ideas, techniques, and remaining challenges.

Stéphane Druel

Title: Introduction to (regular) holomorphic foliations

Abstract: Our lectures will review classical facts about regular foliations on complex manifolds (Reeb local stability theorem, Bott's vanishing theorem, etc) as well as recent developments in the topic (special cases of Beauville's conjecture, normal bundle of codimension one foliations, etc). Time permitting, we will explain the structure of regular holomorphic foliations with numerically flat tangent bundles on compact Kähler manifolds.

Jorge Pereira

Title: Codimension one foliations on projective manifolds

Abstract: This series of lectures is intended as a gentle introduction to the study of singular holomorphic foliations of codimension one on projective manifolds. It will begin with foundational results, including index theorems for invariant hypersurfaces and the existence of separatrices for foliations on surfaces, following the perspective developed in the chapter "Closed Meromorphic 1-Forms" in the Handbook of Geometry and Topology of Singularities V: Foliations (see also arXiv:2206.09745). It will then turn to some of the ideas and techniques currently being explored in the area. Possible topics include criteria for the algebraicity of leaves, deformation of rational curves along foliations, and reduction of foliations to positive characteristic.

Jarosław Włodarczyk

Title: Resolution of Foliations and Varieties via Weighted Centers

Abstract: In this lecture series, I will present a comprehensive framework for the resolution of singularities, highlighting its applications to foliations. The core of this approach relies on blow-ups with weighted centers - a natural and powerful tool that utilizes simple geometric invariants derived from the weighted normal cone to approximate singularities and guide resolution through successive improvements.

While this machinery is fundamentally rooted in the resolution of algebraic varieties in characteristic zero (and, in some cases, positive characteristic), this framework extends naturally to the setting of foliated varieties, and some classes of foliations. The method integrates torus actions and Rees algebras, working within smooth ambient spaces with simple normal crossings divisors to achieve embedded resolution, principalization of ideals, and the resolution of foliations.

These results stem from a series of joint projects with D. Abramovich and M. Temkin, as well as joint work with Abramovich, Belotto, and Temkin.

Workshop lectures

Stefano Filipazzi

Title: Deformations of fibered Calabi-Yau varieties

Abstract: Work of Kollár shows that small deformations of an elliptically fibered strict Calabi-Yau variety remain elliptically fibered. In this talk, we show that small deformations of an arbitrary fibered strict Calabi-Yau variety remain fibered. More generally, if we consider a smooth K-trivial variety X and a semiample line bundle L on X, any small deformation (X', L') of (X, L) admits a fibration, which is numerically induced by L'. This is joint work with Ben Bakker, Kristin DeVleming, Radu Laza, Jennifer Li, Roberto Svaldi, Chengxi Wang, and Junyan Zhao.

Jihao Liu

Title: Boundedness of algebraically integrable foliations and fibrations

Abstract: I will discuss my recent joint work with Paolo Cascini, Calum Spicer, and Roberto Svaldi on the boundedness of algebraically integrable foliations and McKernan's ACC conjecture for interpolated lc thresholds for algebraically integrable foliations. As a consequence we prove a birational boundedness result for locally stable families of maximal variation.

James McKernan

Title: Equivalence of Grothendieck-Katz and a conjecture of Ekedahl-Shepherd-Barron-Taylor

Abstract: We give an account of a recent result due to Yujie Xu on the equivalence of the Grothendieck-Katz conjecture, which concerns algebraic solutions to systems of linear differential equations and a conjecture of Ekedahl-Shepherd-Barron-Taylor, which concerns when the leaves of a foliation are algebraic.

Wenhao Ou

Title: Orbifold modifications of complex analytic spaces

Abstract: For a compact complex analytic space, we construct a proper bimeromorphic modification, which is an isomorphism over the locally trivial orbifold locus. This is based on a joint work with János Kollár.

Mihai Păun

Title: A few techniques and results around positivity of direct images

Abstract: I will survey some results concerning the positivity of direct images from an analytic point of view. To begin with, I intend to discuss in detail a basic theorem in this direction, due to Bo Berndtsson. The main ingredients in the proof are the L^2 estimates and basic properties of Bergman kernels. Then I will survey some recent results obtained in joint work with Junyan Cao.

Quentin Posva

Title: Linear α_p actions

Abstract: In positive characteristic p, linear actions of the finite group $\mathbb{Z}/p$ are simple to classify, but the singularities of the associated quotients are significantly more difficult to describe. In 2013, T. Yasuda used motivic integration to compute invariants of these singularities; some years later, he and F. Tonini conjectured that the same formula also gives the motivic invariants of the quotients associated to a series of actions by the infinitesimal additive group α_p. Their conjecture was based on an explicit bijection between these actions of α_p and linear actions of $\mathbb{Z}/p$. In this talk, I will explain how to realize this correspondence in an algebraic way; then I will present a proof of the Tonini-Yasuda conjecture based on techniques of foliation theory, and mention some natural questions raised by this method. This is a joint work with T. Yasuda and L. Rösler.

Calum Spicer

Title: Classification and MMP for some smooth foliations

Abstract: Smooth holomorphic foliations on projective algebraic varieties are quite rare and so it seems plausible that a classification for these foliations can be achieved. For surfaces, this was done in the late 90s by work of Brunella. I will explain some work in progress on the problem of classifying smooth foliations on threefolds (joint with J. V. Pereira and R. Svaldi). I will also explain some work in progress on this problem in higher dimensions by explaining how one can run the MMP for smooth co-rank one foliations in arbitrary dimension (joint with P. Cascini).

Stefania Vassiliadis

Title: Explicit bounds on foliated surfaces and the Poincaré problem

Abstract: Extending the approaches of Spicer-Svaldi and Pereira-Svaldi, we study the set of pseudo-effective thresholds of adjoint foliated structures on surfaces. We establish an explicit positive lower bound for the pseudo-effective threshold, which in turn yields effective birationality results for adjoint divisors of the form $K_{\mathcal{F}} + \tau K_X$. As an application, we refine a bound on the degree of general leaves of foliations of general type, obtaining a bound that is linear in the genus of the general leaf.

Lingyao Xie

Title: On the base point free theorem of algebraically integrable foliations

Abstract: Algebraically integrable foliations are the foliations that are induced by dominant rational maps, where the leaves correspond to the general fibers. We established the corresponding minimal model program to show that the base point free theorem holds for log canonical algebraically integrable foliations in some interesting cases (eg. when the ambient variety is klt). As an application, we showed that every $\mathbb{Q}$-factorial klt variety with an lc algebraically integrable Fano foliation structure is a Mori dream space. This talk is mainly based on a joint work with J. Liu and F. Meng.