Семинар «Геометрические структуры на многообразиях»

Семинар состоится 23 января 2025 года в 18.30

Семинар пройдет **в аудитории 306, Усачева 6.**

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«Cayley–Bacharach: Generalizations and conjectures»

Abstract:
The original Cayley–Bacharach theorem states that if 3 plane cubics intersect in 8 points, then they also intersect in a 9th point. The radical axis theorem, Pascal's theorem, associativity of addition on elliptic curves, are all special cases of Cayley–Bacharach. In 1978, Griffiths and Harris generalized Cayley–Bacharach to arbitrary varieties in the language of line bundles and vector bundles:
"For a projective variety X, let E be a vector bundle of rank dim(X). Let s be a global section of E which vanishes on a finite set of points Z of X. If h is a global section of O_X(K_X + det E) which vanishes on all but one point of Z, then it must vanish on the last point as well."
This theorem is not only very useful, it also naturally leads to the following question: "When does a set of points (or subschemes) fail to impose linearly independent conditions on a linear system?"
Eisenbud, Green, and Harris pursued this question in one direction by collecting inequalities on the Hilbert polynomial of subschemes of complete intersections. On the other hand, Mu-Lin proposed a generalization of Cayley–Bacharach in 2018, extending the theorem to cases when the linear system vanishes on subschemes of dimension greater than 0.
During this talk, we explore how the Cayley–Bacharach problem has evolved over the last decades. We will discuss several applications and conjectures which remain open and seem approachable.