Workshop on Moduli Spaces in Geometry and Physics

Sibiu, May 14-16, 2009

ABSTRACTS

Vector bundles on non-Kaehler Calabi-Yau type 3-folds

Vasile Brînzănescu (Bucharest)

We compute the relative Jacobian of a principal elliptic bundle as a coarse moduli space and find out that it is the product of the fiber with the basis. Using the relative Jacobian we adapt the construction of Căldăraru to our case obtaining a twisted Fourier-Mukai transform. Using this transform and the spectral cover we prove that the moduli space of rank n, relatively semi-stable vector bundles is corepresented by the relative Douady space of length n and relative dimension 0 subspaces of the relative Jacobian.

The explicit geometry of the spin moduli space

Gavril Farkas (Berlin)

The moduli space S_g of spin curves parameterizing roots of canonical bundles over curves of genus g is an interesting cover of the moduli space of curves. For instance, its enumerative geometry is highly non-trivial and the generating function of intersection numbers of tautological classes satisfies differential equations coming from KdV type integrable systems (Witten's conjecture, now a theorem). We discuss the birational and enumerative geometry of the spin moduli space S_g and prove among other things that the odd spin moduli space is of general type for $g > 11$ and uniruled for g at most 11. Its even counterpart is of general type for $g > 8$, uniruled for $g < 8$, and has Kodaira dimension zero for genus 8! This is joint work with Alessandro Verra.

On defective manifolds, a unitary approach

Paltin Ionescu (Bucharest)

A special but important class of secant defective manifolds is introduced and studied. Their characteristic property is the presence of a quadric of maximal possible dimension joining two general points. Dual defective manifolds are also defined and related to the previous notion. The unifying point of view is provided by the theory of manifolds covered by lines. The subject combines classical projective geometry with modern deformation theory of families of rational curves, a part of Mori theory. Based on joint work with F. Russo.

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Brill-Noether theory for vector bundles

Herbert Lange (Erlangen)

In the first part of the lecture I will give a short survey on Brill-Noether theory of vector bundles. The focus will be on the differences to classical Brill-Noether theory. The second part is a report an a recent joint work with Peter Newstead on the subject. For smooth projective curves the Clifford index is an important invariant which provides a bound for the dimension of the space of sections of a line bundle. This is the first step in distinguishing curves of the same genus. We generalize this to introduce Clifford indices for semistable vector bundles on curves. We study these invariants, giving some basic properties and carrying out some computations for small ranks and for general and some special curves. For curves whose classical Clifford index is two, we compute all values of our new Clifford indices.

Singular Bott-Chern classes and the arithmetic Grothendieck-Riemann-Roch theorem

Răzvan Lițcanu (Iaşi)

The Grothendieck-Riemann-Roch theorem gives a formula that relates direct images and characteristic classes for vector bundles. In general this formula is not valid for the characteristic forms. The singular Bott-Chern classes measure, in a functorial way, the failure of an exact Grothendieck-Riemann-Roch theorem for closed immersions at the level of characteristic forms. In the same spirit, the analytic torsion forms measure the failure of an exact Grothendieck-Riemann-Roch theorem for submersions at the level of characteristic forms. In this talk I give an axiomatic definition of a theory of singular Bott-Chern classes, classify all possible theories of this kind and formulate a general Grothendieck-Riemann-Roch theorem for closed immersions. I also explain how such a definition can be formulated for generalized analytic torsion classes. Joint work with J. I. Burgos Gil.

Fundamental Groups of Smooth Quasiprojective Varieties

Daniel Matei (Bucharest)

We discuss certain restrictions imposed on a fundamental group of a smooth complex quasiprojective variety by the algebraic structure. We then investigate, using characteristic and resonance varieties, quasiprojectivity of various classes of groups such as the Artin groups, their normal subgroups, and certain generalizations of both. This will lead us to consider the finiteness properties of quasiprojective groups.

On the motive of a conic bundle over a surface

Johannes Nagel (Dijon)

We construct a decomposition of the motive of a conic bundle over a surface in which one of the summands is the 'Prym motive' of the double covering of the discriminant curve. Using this result, we reprove (up to isogeny) a theorem of Beauville on the relation between the intermediate Jacobian of the conic bundle and the Prym variety of the double covering. Joint work with M. Saito.

Laumon Spaces and the Calogero-Sutherland Integrable System

Andrei Neguț (Bucharest)

My aim will be to present a proof of Braverman's conjecture concerning Laumon quasiflag spaces. I consider the generating function of the integrals of the equivariant Chern polynomial of the tangent bundles to the Laumon spaces. I will prove Braverman's conjecture, which states that this generating function coincides with the eigenfunction of the Calogero-Sutherland hamiltonian, up to a simple factor. This conjecture was inspired by the work of Nekrasov in the affine sl_n setting, where a similar conjecture is still open. Joint work with Andrei Okounkov.

Existence results on moduli spaces of coherent systems

Angela Ortega (Berlin)

The Brill-Noether problem for higher rank is concerned with describing the moduli space of stable vector bundles over a curve having a prescribed number of sections. One way of studying this problem is via coherent systems, that is, pairs *(E, V)* consisting of a vector bundle *E* and a subspace *V* of global sections subject to a stability condition. In this talk we will mention some generalities about the moduli space of coherent systems and present results on the nonemptiness of such spaces, including recent joint work with Brambila-Paz in the case when the number of sections is bigger than the rank.

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Deformation theory for flat connections and cohomology jump loci

Ştefan Papadima (Bucharest)

I will discuss a non-commutative analog of Green-Lazarsfeld sets, for finite polyhedra.

On the geometry of stable base loci of adjoint and anti-adjoint divisors

Gianluca Pacienza (Strasbourg)

I will present some results on the local geometry of the stable base loci of adjoint divisors, and concerning the global informations on the geometry of the ambient variety that (in the anti-adjoint case) one can deduce from such loci.

Symmetries in the quantum cohomology of homogeneous spaces

Nicolas Perrin (Bonn)

The classical Schubert calcul is an important tool in enumerative geometry, however there are still several open problems. Quantum cohomology of homogeneous spaces is a generalization of Schubert calculus and involves the enumerative geometry of rational curves. We shall explain that in several ways, quantum cohomology is more symmetric that the classical cohomology.

Replacing the boundary by vector bundles

Günther Trautmann (Kaiserslautern)

Given a moduli space of semistable sheaves, one can try to replace its boundary of non-locally free sheaves by a variety of classes of locally free sheaves. This wil be discussed for Gieseker-Maruyma moduli spaces $M_S(P)$ of semistable sheaves with Hilbert polynomial P on a projective surface S and for the Simpson moduli space M of semistable sheaves on the projective plane with Hilbert polynomial $P(m) = 3m+1$ as an example for 1-dimensional sheaves with varying supports.

http://www.imar.ro/~aprodu/ms2009/abstracts.pdf