VBAC 2019

Sandbjerg Gods, Denmark 23-28 June 2019

Program

Meals:	Breakfast	08:00-09:00	Coffee breaks: (by the Lecture hall)
	Lunch	12:00-13:00	10:20-10:50
	Dinner	18:00-19:00	15:30-16:00 (except Friday)
	Coffee & Wine 20:00-22:00 (in the Library)		

Sunday 23 June 2019 - Afternoon-evening arrivals – Keys are available in the reception

18:00 Dinner
20:00 Coffee/tea and cake in the Library (through the dining room and into the original building)

Monday 24 June 2019

09:20-10:20 **Richard Wentworth** *Degenerations of HYM connections and wall-crossing*
10:50-11:50 **Jesse Huang** *Grade restriction rule for G_m actions under mirror symmetry*
13:00-13:15 Group photo (outside) – Meeting point by the main entrance
13:15-14:15 **Dylan Alegretti** *Relating stability conditions and cluster varieties*
14:30-15:30 **Diletta Martinelli** *On the geometry of contractions of the Moduli Space of sheaves of a K3 surface*
16:00-17:00 **Mario Maican** *Moduli of sheaves supported on curves of low genus contained in a quadric surface*

Tuesday 25 June 2019

09:20-10:20 **Carlos Simpson** *Stability on Fukaya-Seidel categories with coefficients*
10:50-11:50 **Anne-Sophie Kaloghiros** *Threefold Calabi-Yau pairs*
13:15-14:15 **Alastair Craw** *Birational geometry of symplectic quotient singularities*
14:30-16:00 Poster session

Wednesday 26 June 2019 – In honour of Frances Kirwan's 60'th birthday

09:20-10:20 **Constantin Teleman** *Abelianization of Coulomb branches*
10:50-11:50 **Lisa Jeffrey** *Spectral curves for the triple reduced product of coadjoint orbits*
13:15-14:15 **Dan Halpern-Leistner** *Harder-Narasimhan theory for gauged maps*
14:30-15:30 **Eloise Hamilton** *Stratifications and moduli spaces for Higgs bundles via Non-Reductive GIT*
16:00-17:00 **Frances Kirwan** *Moment maps and non-reductive geometric invariant theory*
18:30 Special dinner *(three course meal)*

Thursday 27 June 2019

09:20-10:20 **Margherita Lelli-Chiesa** *Genus two curves on abelian surfaces*
10:50-11:50 **Magarida Melo** *Tropicalizing the moduli space of stable spin curves and applications*
13:15-14:15 **Aurelio Carlucci** *Moduli spaces of stable pairs on the resolved conifold: the degree-2 case.*
14:30-15:30 **Camilla Felisetti** *The intersection cohomology of the moduli space of Higgs bundles on a smooth projective curve.*
16:00-17:00 **Claudio Meneses** *A geometric model for genus 0 moduli spaces of parabolic Higgs bundles, parabolic weight variations, and wall-crossing*

Friday 28 June 2019

09:00 Check out of your room
09:20-10:20 **Leonardo Leguizamon** *Segre Invariant and A Stratification of the Moduli Space of Coherent*
10:50-11:50 **Orsola Tommasi** *On the cohomology of fine compactified Jacobians in genus 1*

VBAC 2019

Sandbjerg Gods, Denmark 23-28 June 2019

Abstracts

Richard Wentworth ***Degenerations of HYM connections and wall-crossing***
I will discuss relationships between semistable coherent sheaves and the behavior of Hermitian-Yang-Mills connections on projective manifolds under deformations of the polarization.

Dylan Alegretti ***Relating stability conditions and cluster varieties***
Associated to a quiver with potential are two interesting spaces. The first is a complex manifold parametrizing Bridgeland stability conditions on a triangulated category, and the second is a cluster variety with a natural Poisson structure. The structure of each space is controlled by the combinatorics of quiver mutations, but the combinatorics is used quite differently in the two cases. Whereas the space of stability conditions has a wall-and-chamber decompose-tion, the cluster variety is defined as a union of algebraic tori glued by birational maps. In this talk, I will describe the relationship between these two spaces for quivers of Dynkin type A. Using ideas from the theory of differential equa-tions, I will construct a local biholomorphism from the space of stability conditions to the cluster variety and explain how this map relates the structures of the two spaces.

Jesse Huang ***Grade restriction rule for G_m actions under mirror symmetry***
It is wellknown that derived categories of GIT quotients can be understood through grade restriction windows. In fact, the story can be realized in the mirror picture by studying partially wrapped Fukaya categories of the mirrors of various loci in the GIT construction. I will discuss how mirror symmetry preserves the windows in a collection of examples.

Diletta Martinelli ***On the geometry of contractions of the Moduli Space of sheaves of a K3 surface***
I will describe how recent advances have made possible to study the birational geometry of hyperkaehler varieties of K3-type using the machinery of wall-crossing and stability conditions on derived categories as developed by Tom Bridgeland. In particular Bayer and Macrì relate birational transformations of the moduli space M of sheaves of a K3 surface X to wall-crossing in the space of Bridgeland stability conditions Stab(X). I will explain how it is possible to refine their analysis to give a precise description of the geometry of the exceptional locus of any birational contraction of M.

Mario Maican ***Moduli of sheaves supported on curves of low genus contained in a quadric surface***
We compute the Betti numbers of some moduli spaces of sheaves supported on curves of genus 2, 3 or 4 that are contained in a smooth quadric surface. The sheaves are assumed to be Gieseker semi-stable relative to the usual polarization of the quadric surface. Our technique (which is not new) is to relate the moduli spaces to certain flag Hilbert schemes whose Betti numbers are easy to compute, via the notion of alpha-semistability for coherent systems introduced by Le Potier. In our case, the parameter alpha is just a positive real number. A familiar wall-crossing phenomenon occurs when alpha transits through definitely many so-called 'singular values'.

Carlos Simpson ***Stability on Fukaya-Seidel categories with coefficients***
This is joint work with F. Haiden, L. Katzarkov and P. Pandit. We define Fukaya-Seidel categories with constant coefficients on a disk with boundary points. This allows us to consider a conjecture of Kontsevich, related to a folklore conjecture about stability conditions and special Lagrangians, saying that semistable objects are those represented by Gaiotto-Moore-Neitzke spectral networks. Our idea for the proof in a first case involves mirror symmetry with stability conditions on the B-side category of equivariant coherent sheaves on an elliptic curve.

VBAC 2019

Sandbjerg Gods, Denmark 23-28 June 2019

Anne-Sophie Kaloghiros ***Threefold Calabi-Yau pairs***

A Calabi-Yau (CY) pair (X,D) consists of a normal projective variety and a reduced anti-canonical integral divisor on it. Such pairs arise in a number of contexts; for example, cluster varieties are obtained by gluing CY pairs by volume preserving or crepant birational maps. A CY pair has maximal intersection if its dual complex has maximal dimension. Such pairs are degenerate objects and their geometry has a "Fano" flavor. Toric and cluster varieties have maximal intersection, and while in dimension 2 these are essentially the only maximal intersection CY pairs, this does not hold in higher dimensions. In this talk, I will discuss the birational geometry of CY pairs and give examples in dimension 3. If time permits, I will present some results specific to the geometry of maximal intersection CY pairs.

Alastair Craw ***Birational geometry of symplectic quotient singularities***

For a finite subgroup G of SL(2,C) and for n \geq 1, the Hilbert scheme X=Hilb^[n](S) of n points on the minimal resolution S of the Kleinian singularity C^2/G provides a crepant resolution of the symplectic quotient C^{2n}/G_n, where G_n is the wreath product of G with S_n. I'll explain why every projective, crepant resolution of C^{2n}/G_n is a quiver variety, and why the movable cone of X can be described in terms of an extended Catalan hyperplane arrangement of the root system associated to G by John McKay. These results extend the algebro-geometric aspects of Kronheimer's hyperkahler description of S to higher dimensions. This is recent joint work with Gwyn Bellamy.

Constantin Teleman ***Abelianization of Coulomb branches***

I will recall the construction of Coulomb branches for 4D gauge theory (reduced to 3D) for a compact Lie group and a quaternionic representation, and the relation to Gromov-Witten theory when the representation is polarizable.

Lisa Jeffrey ***Spectral curves for the triple reduced product of coadjoint orbits***

We give an identification of the triple reduced product of three coadjoint orbits in SU(3) with a space of Hitchin pairs over a genus 0 curve with three punctures, where the res idues of the Higgs field at the punctures are constrained to lie in fixed coadjoint orbits. Using spectral curves for the corresponding Hitchin system, we identify the moment map for a Hamiltonian circle action on the reduced product. Finally, we make use of results of Adams, Harnad, and Hurtubise to find Darboux coordinates and a differential equation for the Hamiltonian. This is joint work with Jacques Hurtubise, Steven Rayan, Paul Selick and Jonathan Weitsman.

Dan Halpern-Leistner - ***Harder-Narasimhan theory for gauged maps***

Harder-Narasimhan (HN) theory gives a structure theorem for principal G bundles on a smooth projective curve. A bundle is either “semistable”, or it admits a canonical “filtration” whose associated graded bundle is semistable in a graded sense. I will review recent advances in extending HN theory to arbitrary algebraic stacks. Then I will discuss work in progress with Pablo Solis and Eduardo Gonzalez to apply this general machinery to the stack of gauged maps from a curve C to X/G (this stack is closely related to the stack of decorated principal bundles). In addition to being an interesting proof of concept for how to apply this theory to infinite type stacks, the HN stratification has interesting applications to enumerative geometry.

Eloise Hamilton ***Stratifications and moduli spaces for Higgs bundles via Non-Reductive GIT***

The stack of Higgs bundles of a given rank and degree over a curve can be stratified according to Higgs Harder-Narasimhan type. The semistable stratum admits a coarse moduli space, namely the moduli space of semistable Higgs bundles, which can be constructed using Geometric Invariant Theory. In this talk I will explain how recent advances in Non-Reductive GIT can be used to further stratify the unstable strata in such a way that each refined stratum admits a coarse moduli space. I will explicitly describe the refined

stratification in the case of rank 2 Higgs bundles, and discuss the topology and geometry of the corresponding moduli spaces.

Frances Kirwan ***Moment maps and non-reductive geometric invariant theory***

When a complex reductive group acts linearly on a projective variety the quotient in the sense of geometric invariant theory (GIT) can be identified with an appropriate symplectic quotient. In general GIT for non-reductive linear algebraic group actions is much less well behaved than for reductive actions. However GIT for a linear algebraic group with internally graded unipotent radical U (in the sense that a Levi subgroup has a central one-parameter subgroup which acts by conjugation on U with all weights strictly positive) is almost as well behaved as in the reductive setting, provided that we are willing to multiply the linearisation by an appropriate rational character. In this situation we can ask for moment map descriptions of the quotient. This is related to the symplectic implosion construction (introduced in a 2002 paper of Guillemin, Jeffrey and Sjamaar) and recent work by Greb and Miebach on Hamiltonian actions of unipotent groups on compact Kähler manifolds.

Margherita Lelli-Chiesa ***Genus two curves on abelian surfaces***

Let (S,L) be a general (d_1,d_2)-polarized abelian surfaces. The minimal geometric genus of any curve in the linear system |L| is two and there are finitely many curves of such genus. In analogy with Chen's results concerning rational curves on K3 surfaces, it is natural to ask whether all such curves are nodal. In the seminar I will prove that this holds true if and only if d_2 is not divisible by 4. In the cases where d_2 is a multiple of 4, I will construct curves in |L| having a triple, 4-tuple or 6-tuple point, and show that these are the only types of unnodal singularities a genus 2 curve in |L| may acquire.

Magarida Melo ***Tropicalizing the moduli space of stable spin curves and applications***

In recent years, the combinatorial systematic treatment of degenerations of classical linear series within the theory of tropical linear series has seen spectacular developments and has led to many important results on algebraic curves. On the other hand, the introduction and study of a number of tropical moduli spaces of curves along with its realiza-tion as skeletons of their classical (compactified) counterparts allows for a deeper understanding of combinatorial aspects of moduli spaces and in particular of their compactifications. In this talk, which is based on joint work with Lucia Caporaso and Marco Pacini, I will explore this principle for Cornalba's moduli space of spin spin curves. In particular, I will describe a stratification of this moduli space and introduce a tropical interpretation for the skeleton of its analytification. Time permitting, I will mention a number of interesting connections and applications of our work.

Aurelio Carlucci ***Moduli spaces of stable pairs on the resolved conifold: the degree-2 case.***

Moduli space of Pandharipande-Thomas (PT) stable pairs provide an example of moduli spaces of objects in the derived category whose scheme-theoretic geometry can be described to a reasonable level of details. I would like to present a new example of such moduli scheme, parametrising PT-pairs supported at the double of the zero-section inside a particular bundle over the projective line, called resolved conifold. Their geometry can be probed in two ways. The first is sheaf-theoretic, and consists in looking at the non-reduced structures with which we can endow a reduced curve: this relies on a procedure by Ferrand, reducing the study to line bundles. Degenerations of those line bundles are relevant, as they carry information about the corresponding PT-pairs. The second way involves representation theory. Thanks to a result by Nagao-Nakajima, PT-pairs on the resolved conifold correspond to stable representations of a particular quiver with potential, for a suitable stability condition. By finding an appropriate basis, we can read off the equations for the moduli scheme and recognise the same geometry observed through the first approach.

VBAC 2019

Sandbjerg Gods, Denmark 23-28 June 2019

Camilla Felisetti ***The intersection cohomology of the moduli space of Higgs bundles on a smooth projective curve.***

Let X be a smooth projective curve of genus g over $\mathbb{C}$. The character variety $\mathcal{M}_B$ parametrizing conjugacy classes of representations from the fundamental group of X into $SL(2,\mathbb{C})$ is an affine irreducible singular projective variety. The Non Abelian Hodge theorem states that there is a real analytic isomorphism between $\mathcal{M}_B$ and the quasi projective singular variety $\mathcal{M}_{Dol}$ which parametrizes semistable Higgs bundles of rank 2 and degree 0 on X. During the seminar I will present a desingularization of these moduli spaces and I will compute the intersection cohomology of $\mathcal{M}_{Dol}$ using the famous Decomposition theorem by Beilinson, Bernstein, Deligne and Gabber. Moreover I will show that the mixed Hodge structure on the intersection cohomology is pure, showing evidence that an analogue of the P=W conjecture might hold for singular moduli spaces.

Claudio Meneses ***A geometric model for genus 0 moduli spaces of parabolic Higgs bundles, parabolic weight variations, and wall-crossing***

In this talk I will describe recent work on the geometry of moduli spaces of parabolic Higgs bundles over the Riemann sphere. The genus 0 case is exceptional in that it allows a construction of explicit geometric models, which elucidates the moduli spaces' wall-crossing behavior under variations of parabolic weights, and is structurally analogous to a variation of nonreductive GIT-quotients introduced by Bérczi-Jackson-Kirwan. This work was motivated by results on the cohomology of natural Kähler forms on the moduli spaces and their relation to the computation of certain symplectic volumes.

Leonardo Leguizamon ***Segre Invariant and A Stratification of the Moduli Space of Coherent Systems***

In this talk, I generalize the m−Segre invariant for vector bundles to coherent systems. Let X be a non-singular irreducible complex projective curve of genus g over C and (E,V) be a coherent system on X of type (n,d,k). For any pair of integers m,t, $0 < m < n$, $0 \leq t \leq k$ we define the (m, t)−Segre invariant, denoted by $S\alpha$ and show that it m,t induces a semicontinuous function on the families of coherent systems. Thus, $S\alpha$ gives m,t a stratification of the moduli space $G(\alpha;n,d,k)$ of α−stable coherent systems of type (n, d, k) on X into locally closed subvarieties $G(\alpha; n, d, k; m, t; s)$ according to the value s of $S\alpha$. We study the stratification, determine conditions under which the different strata m,t are non-empty and compute their dimension.

Orsola Tommasi ***On the cohomology of fine compactified Jacobians in genus 1***

The degree d universal Jacobian parametrizes degree d line bundles on smooth curves. There are several approaches on how it can be extended on a family over the moduli space of stable curves. In this talk, we will discuss an approach by Kass and Pagani on how to construct a universal Jacobian which is proper over \bar M_{g.n}. We will discuss some details of the construction in the case g=1, including a formula for the rational cohomology of this compactified space. This is joint work with Nicola Pagani (Liverpool).