Geometry and Physics of Higgs Bundles
Géométrie et physique des fibrés de Higgs
(Org: **Florent Schaffhauser** (Universidad de los Andes), **Laura P. Schaposnik** (University of Illinois-Chicago) and/et **Richard Wentworth** (University of Maryland))

LARA ANDERSON, Virginia Tech
Elliptically Fibered CY Geometries and Emergent Hitchin Systems

I provide a brief overview of the way that Higgs bundles arise in string compactifications (particularly F-theory). Further, I will describe recent progress in describing the moduli spaces of singular Calabi-Yau manifolds and the surprising relationships only recently discovered between Calabi-Yau and Hitchin integrable systems, providing a kind of transition function to relate open and closed string degrees of freedom in F-theory.

STEVE BRADLOW, University of Illinois
Fiber products and spectral data for Higgs bundles

I will discuss some interesting relations among Higgs bundles, especially from the point of view of spectral data, that result from isogenies between low dimensional complex Lie groups and their real forms.

LETICIA BRAMBILA-PAZ, CIMAT
Coherent Higgs Systems

Let X be a Riemman surface and K the canonical bundle. An $L-$pair of type (n, d, k) is a pair (E, V) where E is a vector bundle over X of rank n and degree d, and V a linear subspace of $H^0(EndE \otimes L)$ of dimension k. A coherent Higgs system is a $K-$pair. In this talk the moduli space of $K-$pairs of type $(n, d, 1)$ are related to the moduli spaces of Hitchin pairs of type (L, P).

LAURA FREDRICKSON, Stanford University
Constructing solutions of Hitchin's equations near the ends of the moduli space

Hitchin's equations are a system of gauge theoretic equations on a Riemann surface that are of interest in many areas including representation theory, Teichmüller theory, and the geometric Langlands correspondence. In this talk, I'll describe what solutions of $SL(n, \mathbb{C})$-Hitchin's equations "near the ends" of the moduli space look like, and the resulting compactification of the Hitchin moduli space. Wild Hitchin moduli spaces are an important ingredient in this construction. This construction generalizes Mazzeo-Swoboda-Weiss-Witt's construction of $SL(2, \mathbb{C})$-solutions of Hitchin's equations where the Higgs field is "simple."

MICHAEL GROECHENIG, FU Berlin
p-adic integration for the Hitchin system

I will report on joint work with D. Wyss and P. Ziegler. We prove a conjecture by Hausel-Thaddeus which predicts an agreement of appropriately defined Hodge numbers for moduli spaces of Higgs bundles for the structure groups SL(n) and PGL(n) over the complex numbers. Despite the complex-analytic nature of the statement our proof is entirely arithmetic.

SERGEI GUKOV, California Institute of Technology
Equivariant invariants of the Hitchin moduli space

This talk will be a fairly broad review of exploring geometry and topology of the moduli space of Higgs bundles through the equivariant circle action (which acts by a phase on the Higgs field). This approach leads to new invariants of the moduli space of Higgs bundles, the so-called equivariant Verlinde formula, the real and wild versions of the Hitchin character, and the equivariant elliptic genus. The real reason, though, for studying these new invariants is not so much that they contain wealth of useful information about Higgs bundles (they actually do!) but that they have surprising new connections to other problems in math and mathematical physics.

VICTORIA HOSKINS, Freie Universität Berlin
Group actions on quiver moduli spaces and branes

We consider two types of actions on moduli spaces of quiver representations over a field k and we decompose their fixed loci using group cohomology. First, for a perfect field k, we study the action of the absolute Galois group of k on the points of this quiver moduli space valued in an algebraic closure of k; the fixed locus is the set of k-rational points and we obtain a decomposition of this fixed locus indexed by the Brauer group of k and give a modular interpretation of this decomposition. Second, we study algebraic actions of finite groups of quiver automorphisms on these moduli spaces; the fixed locus is decomposed using group cohomology and each component has a modular interpretation. Finally, we describe the symplectic and holomorphic geometry of these fixed loci in hyperkaehler quiver varieties in the language of branes. This is joint work with Florent Schaffhauser.

MARCOS JARDIM, Unicamp
Branes on moduli spaces of sheaves

Branes are special submanifolds of hyperkähler manifolds that play an important role in string theory, particularly in the Kapustin–Witten approach to the geometric Langlands program, but which also are of intrinsic geometric interest. More precisely, a brane is a submanifold of a hyperkähler manifold which is either complex or Lagrangian with respect to each of the three complex structures or Kähler forms composing the hyperkahler structure. Branes on moduli spaces of Higgs bundles have been largely studied by many authors; in this talk, I will summarize recent work done in collaboration with Franco, Marchesi, and Menet on the construction of different types of branes on moduli spaces of Higgs bundles via Nahm transform, of framed sheaves on the projective plane, and on moduli spaces of sheaves on K3 and abelian surfaces.

QIONLING LI, Caltech and QGM (Aarhus)
Metric domination for Higgs bundles of quiver type

Given a G-Higgs bundle over a Riemann surface, there is a unique equivariant harmonic map into the associated symmetric space G/K through solving Hitchin equation to Higgs bundles. We find a maximal principle for a type of coupled elliptic systems and apply it to analyze the Hitchin equations associated to the Higgs bundles of quiver type. In particular, we find several domination results of the pullback metrics of the associated branched harmonic maps into the symmetric space. This is joint work with Song Dai.

SARA MALONI, University of Virginia
The geometry of quasi-Hitchin symplectic Anosov representations.

After revising the background theory of symplectic Anosov representations and their domains of discontinuity, we will focus on our joint work in progress with Daniele Alessandrini and Anna Wienhard. In particular, we will describe partial results about the homeomorphism type of the quotient of the domain of discontinuity for quasi-Hitchin representations in $\mathrm{Sp}(4,\mathbb{C})$ acting on the Lagrangian space $\mathrm{Lag}(\mathbb{C}^4)$.

ALESSIA MANDINI, PUC-Rio
Hyperpolygon spaces and parabolic Higgs bundles

Hyperpolygons spaces are a family of (finite dimensional, non-compact) hyperkähler spaces, that can be obtained from coadjoint orbits by hyperkaehler reduction. In joint work with L. Godinho, we show that these space are diffeomorphic (in fact, symplectomorphic) to certain families of parabolic Higgs bundles. In this talk I will describe this relation and use it to analyse the fixed points locus of a natural involution on the moduli space of parabolic Higgs bundles. The fixed point locus of this involution is identified with the moduli spaces of polygons in Minkowski 3-space and the identification yields information on the connected components of the fixed point locus.

This is based on joint works with Leonor Godinho and with Indranil Biswas, Carlos Florentino and Leonor Godinho

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CLAUDIO MENESES, Centro de Investigación en Matemáticas, A. C.
On the Narasimhan-Atiyah-Bott metrics on moduli of parabolic bundles

I will discuss my current work regarding the canonical Kähler structure on moduli spaces of stable parabolic bundles. If time permits, I will also discuss a conjectural relation with the geometry of the nilpotent cone locus and the abelianization of logarithmic connections in genus 0. This talk is based on ongoing projects with Leon Takhtajan, Marco Spinaci and Sebastian Heller.

ANDY NEITZKE, University of Texas at Austin
Abelianization in classical complex Chern-Simons theory

I will describe an approach to classical complex Chern-Simons theory via "abelianization," relating flat $GL(N)$-connections over a manifold of dimension $d \leq 3$ to flat $GL(1)$-connections over a branched N-fold cover. This is joint work with Dan Freed.

STEVE RAYAN, University of Saskatchewan
Asymptotics of hyperpolygons

As discovered in the work of Godinho-Mandini and Biswas-Florentino-Godinho-Mandini, the moduli space of n-sided hyperpolygons in the Lie algebra $\mathfrak{su}(2)^*$ is naturally a subvariety of the moduli space of rank-2 parabolic Higgs bundles on the projective line punctured n times, and the integrable system structure pulls back to one on hyperpolygon space. These results were extended to higher rank in recent work by J. Fisher and myself. In this talk, I will report on joint work with H. Weiss regarding the asymptotic geometry of hyperpolygon space and its ambient space of parabolic Higgs bundles. The former has a hyperkaehler metric arising from a finite-dimensional quotient and the latter has one arising from an infinite-dimensional quotient. We use properties of the hyperkaehler moment map for hyperpolygon space to construct a limiting sequence of hyperpolygons that terminates in a moduli space of degenerate hyperpolygons. In the spirit of the work of Mazzeo-Swoboda-Weiss-Witt on ordinary Higgs bundles, we use this partial compactification to show that hyperpolygon space is an ALE manifold, as expected for Nakajima quiver varieties. Finally, I will use this analysis to speculate on differences between the metric on hyperpolygon space and the one on the ambient parabolic Higgs moduli space.