Monday 1/14	Tuesday 1/15	Wednesday 1/16	Thursday 1/17	Friday 1/18
Registration 8:30 – 9:00				
Mike Hopkins 9:00 – 10:00	**Nati Seiberg** 9:00 – 10:00	**Rafe Mazzeo** 9:00 – 10:00	**Nigel Hitchin** 9:00 – 10:00	**Kevin Costello** 9:00 – 10:00
Emily Riehl 10:20 – 11:20	**Zohar Komargodski** 10:20 – 11:20	**Karen Uhlenbeck** 10:20 – 11:20	**Marco Gualtieri** 10:20 – 11:20	**Si Li** 10:20 – 11:20
Constantin Teleman 11:30 – 12:30	**Mina Aganagic** 11:30 – 12:30	**Tamás Hausel** 11:30 – 12:30	**Frances Kirwan** 11:30 – 12:30	**Alexei Kitaev** 11:30 – 12:30
Lauren Williams 2:30 – 3:30	**Greg Moore** 2:30 – 3:30		**John Lott** 2:30 – 3:30	
Graeme Segal 4:00 – 5:00	**Anton Kapustin** 4:00 – 5:00		**Ulrike Tillmann** 4:00 – 5:00	

Mina Aganagic, Knot Categorification from Geometry, via String Theory. Tuesday, 11:30-12:30.

I will describe how two geometric approaches to categorification of RTW invariants of knots emerge from string theory. The first approach is based on a category of B type branes on resolutions of slices in affine Grassmannians. The second is based on a category of A-branes in a Landau-Ginzburg theory. The relation between them is two dimensional (equivariant) mirror symmetry. I will also explain why string theory predicts that a third approach to categorification, which is based on counting solutions to five dimensional Haydys-Witten equations, is equivalent to the first two. (Works with Andrei Okounkov, and with Dimitrii Galakhov.)

Kevin Costello, Topological holography. Friday, 9:00-10:00.

I will discuss my joint work with Davide Gaiotto, in which we study holography for a vertex algebra associated to $\mathcal{N} = 4$ Yang-Mills theory. I will explain how this vertex algebra, in the planar limit, can be reconstructed holographically from the topological B model on the variety $\mathrm{SL}_2(\mathbb{C})$.

Marco Gualtieri, Morita equivalence and the generalized Kähler potential. Thursday, 10:20-11:20.

Since the introduction of generalized Kähler geometry in 1984 by Gates, Hull, and Roček in the context of two-dimensional supersymmetric sigma models, we have lacked a general understanding of the degrees of freedom inherent in the geometry. In particular, the description of a usual Kähler structure in terms of a complex manifold together with a local Kähler potential function is not available for generalized Kähler structures, despite many positive indications in the literature over the last decade. I will explain how holomorphic Poisson geometry may be used to solve this problem and to obtain new constructions of generalized Kähler metrics.

Tamás Hausel, $P = W$. Wednesday, 11:30-12:30.

I will survey developments on the $P = W$ conjecture claiming the agreement of the weight filtration on the cohomology of the character variety and the perverse filtration on the cohomology of the corresponding Hitchin integrable system via non-abelian Hodge theory.

Nigel Hitchin, Integrable systems and special Kähler geometry. Thursday, 9:00-10:00.

Associated to any algebraic completely integrable system is a special Kähler structure on its base. A particularly important example is the case of the moduli space of Higgs bundles where it contributes the leading term in an asymptotic expansion for the natural hyperkähler metric over the regular locus. The talk will focus on the subintegrable systems and the corresponding special Kähler structures arising from the nondegenerate critical loci, in particular where the base consists of the Severi variety of nodal spectral curves.

Mike Hopkins, Moduli spaces of field theories and condensed matter physics. Monday, 9:00-10:00.

This talk will concern ongoing joint work with Dan Freed (and many others) about a proposed classification of invertible, gapped phases of matter in terms of moduli spaces of "topological" quantum field theories.

Anton Kapustin, Bosonization in higher dimensions. Tuesday, 4:00-5:00.

Frances Kirwan, Moment maps and non-reductive geometric invariant theory. Thursday, 11:30-12:30.

When a complex reductive group acts linearly on a projective variety the GIT quotient can be identified with an appropriate symplectic quotient. The aim of this talk is to discuss an analogue of this description for GIT quotients by suitable non-reductive actions. In general GIT for non-reductive linear algebraic group actions is much less well behaved than for reductive actions. However when a

linear algebraic group has 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, then GIT for a linear action of the group on a projective variety 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 a moment map description of the quotient.

Alexei Kitaev, Differential forms on the space of statistical mechanics models. Friday, 11:30-12:30.

Zohar Komargodski, From Topology to Baryons. Tuesday, 10:20-11:20.

We propose a model for baryons, where the baryons are interpreted as quantum Hall droplets. An important element in our construction is an extended, 2+1 dimensional, meta-stable configuration of the η' particle. Baryon number is identified with a magnetic symmetry on the 2+1 dimensional sheet. If the sheet has a boundary, there are finite energy chiral excitations which carry baryon number. These chiral excitations are analogous to the electron in the fractional quantum Hall effect. Studying the chiral vertex operators we are able to determine the spin, isospin, and certain excitations of the droplet. The mass, size, spin, isospin, and excitations that we find agree with phenomenological expectations.

Si Li, Singularities: from L^2 Hodge theory to Seiberg-Witten geometry. Friday, 10:20-11:20.

Let X be a non-compact Calabi-Yau manifold and f be a holomorphic function on X with compact critical locus, satisfying a general asymptotic condition. We establish a version of twisted L^2 Hodge theory for the pair (X, f) and prove the corresponding Hodge-to-de Rham degeneration property. It can be viewed as a generalization of Kyoji Saito's higher residue theory and primitive forms for isolated singularities, putting Landau-Ginzburg B-model of the pair (X, f) into the same setting as compact Calabi-Yau manifolds. In the second part of the talk, I will explain a connection between primitive forms and 4d $\mathcal{N} = 2$ Seiberg-Witten geometry.

John Lott, A Hilbert bundle description of differential K-theory. Thursday, 2:30-3:30.

We give an infinite-dimensional description of the differential K-theory of a manifold. The construction uses superconnections on Hilbert bundles and eta forms. We describe the pushforward of a finite-dimensional cycle under a proper submersion with a Riemannian structure. Finally, we give a model for twisted differential K-theory. This is joint work with Alexander Gorokhovsky.

Rafe Mazzeo, From KW to Extended Bogomolny to Hitchin. Wednesday, 9:00-10:00.

I will discuss a sequence of results which go some distance toward a proposal by Gaiotto and Witten regarding the Kapustin-Witten equations on $X^3 \times \mathbb{R}^+$, where X is the product of a Riemann surface and S^1. This is joint work with Siqi He. If time permits, I will also discuss some connections with Taubes' compactness results and his theory of $\mathbb{Z}_2$ harmonic spinors.

Greg Moore, K3 surfaces, Mathieu Moonshine, And (Quantum) Error Correcting Codes. Tuesday, 2:30-3:30.

The Mathieu Moonshine phenomenon, discovered by Eguchi, Ooguri, and Tachikawa (EOT) in 2010 has, amazingly, remained a mystery despite concerted efforts to find a conceptual explanation. After reviewing this phenomenon I will review the Quantum Mukai Theorem of Gaberdiel, Hohenegger, and Volpato (GHV). This theorem lists the possible symmetry groups of K3 sigma models. I will then review work of Gaberdiel, Taormina, Volpato, and Wendland (GTVW) showing that the biggest of the GHV groups is realized by a $\mathbb{Z}_2$-orbifold of the Cartan torus of Spin(8). Remarkably, this GTVW conformal field theory is isomorphic to the product of six bosonic SU(2) level $k = 1$ WZW models! I will then describe on-going work with Jeff Harvey: The supercurrents in the $SU(2)^6$ WZW model are not obvious, and are governed by a quantum code, which turns out to be closely

related to the CSS code associated to the classical hexacode. The $\mathcal{N} = 1$ superconformal algebra and the error-correcting properties of the code turn out to be closely related. Since the EOT observation really only requires $(4, 1)$ supersymmetry we are motivated to study the symmetry groups of the GTVW model that preserve $(4, 1)$ supersymmetry. Again, thanks to the error-correcting properties of the code it is clear that the stabilizer of the $\mathcal{N} = 1$ current within the continuous $\mathrm{SU}(2)^6$ global symmetry of the model is a finite group. I will say some words about our – as yet quite imperfect – knowledge of this symmetry group and explain that, when acting on the RR sector in a distinguished basis, the Golay code naturally emerges in the form presented by the Curtis-Conway Miracle Octad Generator. Time permitting, I will explain how the Conway Moonshine module discussed by Frenkel, Lepowsky, Meurman, and Duncan also fits within the quantum code paradigm. Please note: If you have actually read this far there is really no need to go to the talk, since that is all the information I will attempt to convey.

Emily Riehl, The complicial sets model of higher ∞-categories. Monday, 10:20-11:20.

While it's undeniably sexy to work with infinite-dimensional categories "model-independently," we contend there is a categorical imperative to familiarize oneself with at least one concrete model in order to check that proposed model-independent constructions interpret correctly. With this aim in mind, we recount the n-complicial sets model of (∞, n)-categories for $0 \leq n \leq \infty$, the combinatorics of which are quite similar to its low-dimensional special cases: quasi-categories ($n = 1$) and Kan complexes ($n = 0$). We conclude by reporting on an encounter with 2-complicial sets in the wild, where a suitably-defined fibration of 2-complicial sets enables the comprehension construction introduced in joint work with Verity. Special cases of the comprehension construction can be used to "straighten" a co/cartesian fibration of $(\infty, 1)$-categories into a homotopy coherent functor, exhibit a quasi-categorical version of the "unstraightening" construction, and define an internal model of the Yoneda embedding for $(\infty, 1)$-categories.

Graeme Segal, The smooth homotopy category. Monday, 4:00-5:00.

There are suggestions from physics that space is an "emergent" concept. Two of its features that must emerge are a global homotopy type and a local smooth manifold structure, expressing its "infrared" and "ultraviolet" aspects. The smooth homotopy category provides a perspective on this question: it is an enlargement of the usual homotopy category which contains the category of smooth manifolds as a subcategory. It belongs to a genre of "derived" constructions now prominent on the mathematical stage, but has been studied in a variety of mathematical languages since the 1950s: among its objects are classifying spaces for Lie groups and Lie algebras, as well as various moduli spaces and spaces of deformations and of foliations. I shall describe a kind of structure theorem for its objects, focussing especially on the map – regarded as a fibration – from a smooth manifold to its homotopy type, and also on the local structure of a non-smooth point of the moduli space of bundles on a surface.

Nati Seiberg, Confinement, de-confinement, and 3d topological quantum field theory. Tuesday, 9:00-10:00.

Motivated by the study of 4d strong dynamics, we will consider interfaces in 4d Yang-Mills theory. Specifically, we will start with an $\mathrm{SU}(N)$ theory and let its theta parameter vary in space. The two sides of the interface are (conjectured to be) confining, gapped, and invertible. But anomaly considerations show that the interface supports a nontrivial 3d topological quantum field theory (TQFT) and the full 4d theory does not confine there. A more detailed analysis of this topological theory leads us to find some surprising phenomena in general TQFTs with symmetries. In our case they are connected to the strong dynamics of the 4d theory in the bulk. We will also discuss a 4d $\mathrm{PSU}(N)$ theory, whose low energy theory is in general not invertible, and the interfaces in that theory.

Constantin Teleman, A biased survey of topological gauge theory in low dimensions. Monday, 11:30-12:30.

Ulrike Tillmann, Moduli spaces of manifolds and TQFTs. Thursday, 4:00-5:00.

There has been a rich and fruitful interplay between quantum field theory and the study of topological moduli spaces of manifolds. We will explore some of these interactions emphasising the role of homological stability.

Karen Uhlenbeck, Morrey Spaces and Regularity for Yang-Mills-Higgs Equations. Wednesday, 10:20-11:20.

We start with background on regularity theory for the equations of gauge theory. Morrey spaces arise naturally from monotonicity theorems in dimensions greater than 4. Our main technical result is that functions in a Morrey space which satisfy an elliptic inequality off a singular set of Hausdorff codimension 4 can be bounded in a much better Morrey space in the interior. This can be used to show that when the curvature is small in the relevant Morrey space, solutions of a Yang-Mills-Higgs equation off a singular set of codimension 4 are in interior domains gauge equivalent to a connection which is smooth. This simplifies a classic paper of Tao-Tian.

Lauren Williams, Cluster duality and mirror symmetry for Grassmannians and Schubert varieties. Monday, 2:30-3:30.

In joint work with Konstanze Rietsch, we use the $\mathcal{A}$- and $\mathcal{X}$-cluster structure on the Grassmannian to exhibit a new aspect of mirror symmetry for Grassmannians in terms of polytopes. From a given cluster seed we have both an $\mathcal{X}$-cluster chart and an $\mathcal{A}$-cluster chart. We use the $\mathcal{X}$-cluster chart to associate a corresponding Newton-Okounkov polytope, which arises as a convex hull of points. Meanwhile we use the corresponding $\mathcal{A}$-cluster chart to express the Marsh-Rietsch superpotential as a Laurent polynomial, and by tropicalizing this expression, we obtain another polytope, defined via inequalities. We prove that these two polytopes coincide. In work-in-progress, we use this paradigm to produce conjectural LG-model mirrors for Schubert varieties in Grassmannians, which are in general singular.