Higher Structures in Holomorphic and Topological Field Theory

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Abstracts

- **David AYALA**
  - **Title**: Factorization Homology
  - **Abstract**: The talk will begin with a statement concerning factorization homology of n-categories with adjoints. We'll compare this articulation of factorization homology to the perturbative version, concerning E_n-algebras. I'll state a non-perturbative version of non-abelian Poincare' duality concerning this articulation of factorization homology. We'll relate this version of factorization homology to other known manifold invariants. Then we'll see a description, and definition, of factorization homology.

- **Claudia SCHEIMBAUER**
  - **Title**: Relative field theories from relative dualizability
  - **Abstract**: I will first explain a relative version of functorial field theories and give a classification thereof. This will allow to constructs simple examples using dualizability results. The main tool is that of a factorization algebra and the pictures which appear strongly resemble string diagrams and correspond to algebraic manipulations. Moreover, I will compare to previous results by Douglas-Schommer-Pries-Snyder and Brochier-Jordan-Snyder on Turaev-Viro and Reshetikin-Turaev theories. The final goal is to showcase low-dimensional field theories which are "relative" to their observables.

- **Owen GWILLIAM**
  - **Title**: Symmetries of holomorphic QFT and the higher dimensional Kac-Moody algebras
  - **Abstract**: In symplectic geometry the notion of a moment map encodes beautifully the idea of a symmetry of a mechanical system. In the Batalin-Vilkovisky formalism there is a parallel notion to the moment map that encodes a homological version of Noether's theorem. BV quantization of this moment map encodes the current algebras of QFT, and it provides a useful perspective on some familiar anomalies, including the Adler-Bardeen-Jackiw anomaly. This talk will discuss these ideas and introduce some examples from the setting of holomorphic field theories, recently developed with B. Williams. In particular, we will describe a systematic generalization of the affine Lie algebras and connect with work of Faonte-Hennion-Kapranov.

- **Brian WILLIAMS**
  - **Title**: A relationship between higher chiral algebras and gauge theory
  - **Abstract**: There is a renewed interest in the theory of chiral algebras due to recently discovered relations to supersymmetric gauge theory. A well-studied example of such a correspondence is between the operators of the chiral Wess-Zumino-Witten model and Chern-Simons theory. We will discuss two directions of current work that provide a systematic formulation of this correspondence. The first is the realization of a wide class of vertex algebras as boundary conditions to 3d topological field theories labeled by Courant algebroids, which is joint work with P. Safronov. The second direction proposes a connection of higher dimensional chiral algebras, which were introduced in O. Gwilliam's lecture, and gauge theories in 5 and 7 dimensions.

- **Emily CLIFF**
  - **Title**: Chiral algebras, factorization algebras and Borcherds' "singular commutative rings" approach to vertex algebras
  - **Abstract**: In the late 1990s, Borcherds gave an alternate definition of some vertex algebras as "singular commutative rings" in a category of functors depending on some input data (A, H, S). He proved that for a certain choice of A, H, and S, the singular commutative rings he defines are indeed examples of vertex algebras. In this talk I will explain how we can vary this input data to produce categories of chiral algebras and factorization algebras (in the sense of Beilinson-Drinfeld) over certain complex curves X. We'll discuss the failure of these constructions to give equivalences of categories and obstructions to extending this approach to more general varieties X.

- **Miroslav RAPČAK**
  - **Title**: Vertex Algebras for Divisors in Toric 3-folds
  - **Abstract**: Conjecturally, one can associate a vertex operator algebra to any divisor inside a Calabi-Yau 3-fold. First, I will discuss a three-parameter family of algebras associated to a general toric divisor inside $\mathds{C}^3$. Secondly, I will sketch a gluing construction that associates an algebra to any toric divisor inside a Calabi-Yau 3-fold. The proposed algebras are expected to act naturally on the equivariant cohomology of the moduli space of Nerkasov's "spiked instantons" associated to such divisors, generalizing the famous AGT correspondence.

- **Jie REN**
  - **Title**: 2 Calabi-Yau categories and motivic Donaldson-Thomas series
  - **Abstract**: The motivic Donaldson-Thomas invariants for 3 Calabi-Yau categories were introduced by Kontsevich and Soibelman. In this talk, I will give a brief introduction to the 2 Calabi-Yau case, mainly via motivic Hall algebras.

- **Alexander BRAVERMAN**
  - **Title**: Local geometric Langlands correspondence and Lie superalgebras
  - **Abstract**: In this talk, I am going to present certain conjectures (due to D. Gaiotto) which provide explicit examples of quantum local geometric Langlands duality for the group GL(n)\times GL(m). These conjectures lead to some interesting equivalences of categories involving representation theory of the Lie superalgebra GL(m|n). I will present some evidence for these conjectures and discuss proofs in some special cases.

- **Philsang YOO and Justin HILBURN**
  - **Title**: Symplectic Duality and Geometric Langlands Duality
  - **Abstract**: It is believed that certain physical dualities of 3d N=4 theory and 4d N=4 gauge theory underlie symplectic duality and geometric Langlands duality, respectively. By setting up a mathematical model for those physical theories and studying their physical relationship as studied by Gaiotto and Witten in our framework, we suggest a program that finds new relationships between symplectic duality and geometric Langlands theory. In this series of talks, we aim to provide a global overview of our program in progress.

- **Caroline BREMBILLA**
  - **Title**: An abstract extension of higher Chern-Simons action in supergeometry
  - **Abstract**: We describe an analogue of higher Chern-Simons actions on certain divisorial "supergeometric" neighbourhoods, that we will define in the process. This relies on invariant sheaves functorial description, homotopy Lie algebra operadic structure, and classical L-\infty interpretation of infinitesimal neighbourhoods in formal geometry. As a consequence of M-theory reduction techniques, we apply the dimensional reduction from maximally superconformal field theory in six dimensions to obtain $L\infty$ Chern-Simons solutions written in terms of these divisorial neighbourhoods.

- **Tim WEELINCK**
  - **Title**: Equivariant factorization homology and quantum groups
  - **Abstract**: We briefly describe how to extend the theory of factorization homology equivariantly, which results in a homology theory of manifolds equipped with finite group actions. The theory satisfies, and is characterised by, an excision property. The rest of the talk is devoted to an extended example. We explain how quantum groups, and associated quantum symmetric pairs, define the coefficients for Z/2Z-equivariant factorization homology of framed surfaces. We then discuss the invariant associated to the torus with certain fixed involution, which is the category of equivariant quantum D-modules on a symmetric space.

- **Kursat SOZER**
  - **Title**: Extended HFTs in dimension 2
  - **Abstract**: For any discrete group G, homotopy field theories (HFTs), introduced by V. Turaev, are G-equivariant versions of topological field theories (TFTs). Developing techniques in differential topology and in the theory of symmetric monoidal bicategories C. Schommer-Pries classified 2-dimensional extended TFTs in 2009. In this talk, generalizing Schommer-Pries' methods we define and classify 2-dimensional extended HFTs.

- **Satoshi NAWATA**
  - **Title**: Geometric representation theory of double affine Hecke algebra
  - **Abstract**: I will talk about physics approach to understand representation theory of double affine Hecke algebra (DAHA). DAHA can be realized as an algebra of line operators in 4d N=2* theory and therefore it appears as quantization of coordinate ring of Hitchin moduli space over once-punctured torus. Using 2d A-model on the Hitchin moduli space, I will explain relationship between representation category of DAHA and Fukaya category of the Hitchin moduli space.

- **Junya YAGI**
  - **Title**: String theory, gauge theories and integrable systems
  - **Abstract**: I will discuss recent developments in the study of connections between string theory, gauge theory and integrable systems. One can construct quantum integrable systems using line operators in partially topological quantum field theories. I will explain how string theory provides such structures, and how string dualities unify various phenomena in which integrable systems arise from gauge theories.

- **David JORDAN**
  - **Title**: Quantum cluster algebras via factorization homology
  - **Abstract**: Given a surface S, the moduli space of G-local systems on S equipped with a B-reduction and a T-framing at the boundary carries the structure of a cluster variety, by classic results of Fock and Goncharov. In essence, this means that there is a system of toric charts, and a compatible Poisson bracket, quadratic in each chart. Fock and Goncharov moreover quantized this structure by hand, giving rise to what they called a "quantum cluster ensemble".

- **Damien CALAQUE**
  - **Title**: Vertex models and n-algebras
  - **Abstract**: I will explain and state a conjecture of Kontsevich, that relates vertex models from statistical mechanics to n-algebras. I will also give the main ingredients of the proof of Kontsevich's conjecture, which is a joint work in progress with Damien Lejay.

- **Olivier SCHIFFMANN**
  - **Title**: Cohomological Hall algebras associated to curves
  - **Abstract**: We will define and give some algebraic properties of cohomological Hall algebras of the stacks of coherent, resp. Higgs sheaves on a compacts Riemann surface X. We will in particular show how these are related to the structure of the cohomology rings of the moduli spaces of semistable vector bundles, resp. Higgs bundles on X.

- **Pavel SAFRONOV**
  - **Title**: Courant sigma-models and representations of chiral Lie algebroids
  - **Abstract**: Courant sigma-models are examples of 3-dimensional topological field theories which in particular contain the Chern-Simons theory. I will describe the ribbon category of line operators in these models in terms of representations of certain chiral Lie algebroids. Assuming a certain anomaly cancellation, this theory admits a pair of interesting conformal boundary conditions. In the case of Chern-Simons theory, one of the boundary conditions is given by the chiral WZW model. In the other extreme of exact Courant algebroids, the two boundary conditions are described by chiral differential operators and the chiral de Rham complex. This is joint work with Brian Williams.

- **Nikita NEKRASOV**
  - **Title**: Some applications of defects in supersymmetric gauge theory
  - **Abstract**: I will explain the formula of Gamayun, Iorgov and Lysovyy relating Painleve VI tau-function to c=1 conformal blocks and some of generalizations, using the blowup formulas for N_f=2N_c supersymmetric N=2 d=4 theory. If time permits I will talk about the eigenvalue problem for the elliptic Calogero-Moser system.