GQTA 2018 conference 9-13 July
Sandbjerg Estate, Sønderborg

Programme

Monday 9 July

08:00-09:00	Breakfast
09:30-10:30	**Francesco Costantino** *On stated skein modules of surfaces*
11:00-12:00	**Siu Cheong Lau**, *Quantum corrected moduli of immersed Lagrangians*
12:00-13:00	Lunch
13:00-14:00	**Hongbin Sun** *A Characterization on Separable Subgroups of 3-Manifold Groups*
14:30-15:30	**Du Pei** *2D TQFTs labelled by three-manifolds*
16:00-17:00	**William Petersen** *Asymptotics of Quantum Invariants*
18:00	Dinner
20:00	Coffee in the library

Tuesday 10 July

08:00-09:00	Breakfast
09:30-10:30	**Alexis Virelizier** *Generalized Kuperberg invariants of 3-manifolds*
11:00-12:00	**Hai Lin** *Complete Intersection Calabi-Yau and Vanishing Theorems*
12:00-13:00	Lunch
13:00-14:00	**Ramanujan Santharoubane** *Asymptotic of quantum representations of surface groups*
14:30-15:30	**Azat Gainutdinov** *Modified trace, integrals and invariants*
16:00-17:00	**Tian Yang** *Some resent progress on the volume conjecture for the Turaev-Viro invariants*
18:00	Dinner
20:00	Coffee in the library

Wednesday 11 July

08:00-09:00	Breakfast
09:30-10:30	**Christian Blanchet**, *Modified trace and logarithmic Hennings invariants*
11:00-12:00	**Bertrand Patureau-Mirand** *Non semi-simple Hopf algebra and TQFT*
12:00-13:00	Lunch
13:00-14:00	**David Jordan** *A unified quantization of character varieties of surfaces and 3-manifolds*
14:30-15:30	**Alessandro Malusà** *SL(2,C)-Chern-Simons theory and AJ conjecture*
16:00-17:00	**Ben Aribi Fathi** *The Teichmüller TQFT volume conjecture for twist knots*
18:00	Special 3 course dinner
20:00	Coffee in the library

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Thursday 12 July

08:00-09:00	Breakfast
09:30-10:30	**Shahn Majid** *Poisson-Riemannian Geometry*
11:00-12:00	**Tudor Dimofte** *(0,2) dualities and 4-simplices*
12:00-13:00	Lunch
13:00-14:00	**Yang-Hui He** *Sporadic and Exceptional*
14:30-15:15	**Renaud Detcherry** *Quantum representations and monodromies of fibered links*
15:30-16:30	*Poster session*
18:00	Dinner
21:00	Coffee in the library

Friday 13 July (Checkout Friday no later than 10am – return your room key to the staff in the reception)

08:00-09:00	Breakfast
09:30-10:30	**Vladimir Fock** *Tau-function and cluster coordinates*
11:00-12:00	**Qingtao Chen** *Recent progress of various Volume Conjectures for links as well as 3-manifolds*
12:00-13:00	Lunch
13:00-14:00	**Gregor Masbaum** *On the skein module of the product of a surface and a circle*

Posters

Yuta Nozaki, (University of Tokyo)
Ka Ho Wong, (The Chinese University of Hong Kong)
Marco Suen, (The Chinese University of Hong Kong)

Book of abstracts

Francesco Costantino *On stated skein modules of surfaces*
In this talk we will report on a ongoing joint work with Thang Le. After recalling the definition of stated skein module of a surface we will provide some key examples associated to the easiest cases. This will highlight a larger algebraic structure induced by topology which we will detail along this talk.

Siu Cheong Lau, *Quantum corrected moduli of immersed Lagrangians*

Hongbin Sun *A Characterization on Separable Subgroups of 3-Manifold Groups*

Du Pei *2D TQFTs labelled by three-manifolds*
String theory and quantum field theory predicts the existence of a family of two-dimensional topological quantum field theories (2D TQFTs) labelled by 3-manifolds. I will survey what is known about this correspondence and discuss possible ways to explicitly construct such 2D TQFTs.

William Petersen *Asymptotics of Quantum Invariants*
The Witten-Reshetikhin-Turaev (WRT) invariant of a closed oriented three manifold was introduced by Witten as the partition function of Chern-Simons theory with compact gauge group. Moreover; Witten proposed that these invariants extends to topological quantum field theories (TQFT's) in a way that involves geometric quantization of moduli spaces of flat connections. TQFT's were subsequently constructed rigorously from a mathematical point of view through combinatorial means by Reshetikhin and Turaev, and it is now known that these TQFT's can also be realized using quantization of moduli spaces. From the partition function motivation, it is conjectured that the WRT-invariants admits asymptotic expansions. In this talk, I shall present recent results on this conjecture joint with my supervisor J.E. Andersen. Our approach is based on quantization of moduli spaces, and our results are obtained in the more general context of quantization of symplectomorphisms of Kähler manifolds.

Alexis Virelizier *Generalized Kuperberg invariants of 3-manifolds*
In the 90s, Kuperberg defined a scalar invariant of 3-manifolds from each finite-dimensional involutory Hopf algebra over a field. The construction is based on the presentation of 3-manifolds by Heegaard diagrams and involves tensor products of the structure tensors of the Hopf algebra. These tensor products are then contracted using integrals of the Hopf algebra to obtain the scalar invariant. We generalize this construction by contracting the tensor products with other morphisms. Examples of such morphisms are derived from involutory Hopf algebras in symmetric monoidal categories. This is a joint work with R. Kashaev.

Hai Lin *Complete Intersection Calabi-Yau and Vanishing Theorems*

Ramanujan Santharoubane *Asymptotic of quantum representations of surface groups*
In a previous work with Thomas Koberda we defined actions of surface groups on the vector spaces coming from the Witten-Reshetikhin-Turaev TQFT. For l a given loop in a surface we can define the trace of the associated operator. Actually, this is a sequence of invariant depending on a sequence of roots of unity. For any z on the unit circle, we study the asymptotic of this sequence of invariant when the sequence of roots of unity converges to z. The main theorem says that this asymptotic is determined by the evaluation at z of a Laurent polynomial depending only on l. This polynomial can be viewed as a Jones polynomial for surface groups. The main corollary concerns the so-called AMU conjecture which relates TQFT representations of mapping class groups to the Nielsen-Thurston classification. This talk represent a joint work with Julien Marché.

Azat Gainutdinov *Modified trace, integrals and invariants*
A modified trace for a finite k-linear pivotal category is a family of linear forms on endomorphism spaces of projective objects which has cyclicity and so-called partial trace properties. A non-degenerate modified trace defines a compatible with duality Calabi-Yau structure on the subcategory of projective objects. The modified trace provides a meaningful generalisation of the categorical trace for non-semisimple categories and allows to construct interesting topological invariants. I will present our recent results on existence and uniqueness of such traces for categories arising from Hopf algebras, a joint work with A. Beliakova and Ch. Blanchet. Our main theorem says that for any finite-dimensional unimodular pivotal Hopf algebra H over a field, a modified trace is determined by a symmetric linear form on H constructed from an integral: shifting with the pivotal element defines an isomorphism between the space of right integrals, which is known to be 1-dimensional, and the space of modified traces. This result allowed us to compute modified traces for all simply laced restricted quantum groups at roots of unity. I will also discuss applications of modified traces to analysis of mapping class group representations.

Tian Yang *Some resent progress on the volume conjecture for the Turaev-Viro invariants*
In 2015, Qingtao Chen and I conjectured that at an appropriate root of unity the Turaev-Viro invariants of a hyperbolic 3-manifold grow exponentially with growth rate the hyperbolic volume of the manifold. In this talk, I will present a recent joint work with Renaud Detcherry and Effie Kalfagianni on an infinite family of cusped hyperbolic 3-manifolds, including the fundamental shadow link complements, for which the conjecture is true.

Christian Blanchet, *Logarithmic Hennings invariant for restricted quantum sl(2)*
Using a combination of right integral and modified trace on restricted quantum sl(2) we define an invariant of 3-manifold with a link whose components are colored either by central elements or by trace classes. We will compare with the logarithmic invariant constructed by Jun Murakami. This is joined work with Anna Beliakova and Nathan Geer.

Bertrand Patureau-Mirand *Non semi-simple Hopf algebra and TQFT*
Combining the Hennings-Kauffman-Radford invariant associated to a unimodular Hopf algebra H and the modified trace on H-mod lead to the modified Hennings invariant for colored graphes in closed 3-manifolds.
For factorizable Hopf algebras, this invariant is the heart of a TQFT on a not completly rigid category of cobordisms.
This is a common work with Marco De Renzi and Nathan Geer.

David Jordan *A unified quantization of character varieties of surfaces and 3-manifolds*
Character varieties of surfaces carry canonical Poisson brackets, introduced by Atiyah-Bott and Goldman. The three primary methods of their quantization have been: the moduli algebras of Alekseev-Grosse-Schomerus, the quantum cluster varieties of Fock-Goncharov, and the skein algebra approach introduced by Turaev. By now each of these is a booming industry, running largely in parallel rather than in unison. However, each construction leaves out some part of the full structure of the quantized character variety, and each depends on making certain choices on the surface which prevent it from being functorial/invariant, and in particular prevent the development of 3-manifold invariants. I will present a canonical quantization of character varietes using factorization homology, which relies on certain naturality and universality properties of character varieties and the Atiyah-Bott/Goldman bracket, and I will explain how each of the three traditional approaches can be extracted from it and what is lost in the extraction. In addition to giving simplified proofs of numerous difficult structural results in each case, we promote the quantization to a fully local 3-dimensional TFT, thereby quantizing also the Lagrangians associated to 3-manifolds, with relations to quantum A-polynomials, and "analytically continued Chern-Simons".

Alessandro Malusà *SL(2,C)-Chern-Simons theory and AJ conjecture*
The AJ conjecture was originally formulated in the context of the SU(n) Chern-Simons theory, aiming to propose a quantisation of the A-polynomial of a knot annihilating its coloured Jones polynomial. The same problem can be considered for the SL(2,C)-theory, with the partition function of the Teichmüller TQFT by Andersen and Kashaev in place of the coloured Jones polynomial. In a joint work with Andersen, we use methods of geometric quantisation to obtain a representation of the quantum torus analogous to the one used by Garoufalidis to state the original conjecture in its algebraic formulation. We then use this to phrase an analogous conjecture, which can be checked explicitly for the first two hyperbolic knots in S^3.

Ben Aribi Fathi *The Teichmüller TQFT volume conjecture for twist knots*
In 2014, Andersen and Kashaev defined an infinite-dimensional TQFT from the Quantum Teichmüller theory. This Teichmüller TQFT is an invariant of triangulated 3-manifolds, in particular knot complements.
The associated volume conjecture stated that the Teichmüller TQFT of an hyperbolic knot complement contains the volume of the knot as a certain asymptotical coefficient, and Andersen-Kashaev proved this conjecture for the first two hyperbolic knots. In this talk I will present the construction of the Teichmüller TQFT and how we approached this volume conjecture for the infinite family of twist knots : in particular, we proved the conjecture for several new examples of knots, up to 14 crossings. (joint work with E. Piguet-Nakazawa).

Shahn Majid *Poisson-Riemannian Geometry*
We analyse the moduli space of quantum Riemannian geometries at the semiclassical level of a Poisson bracket, metric and Poisson-connection subject to certain field equations (work with E. Beggs). We present some classes of solutions and a uniqueness theorem with spherical symmetry (including for the Schwarzschild black hole). If time, we will also describe some discrete moduli such as the quantum Riemannian geometry of a triangle.

Tudor Dimofte *(0,2) dualities and 4-simplices*

Yang-Hui He *Sporadic and Exceptional*
We study the web of correspondences linking the exceptional Lie algebras E8,7,6 and the sporadic simple groups Monster, Baby and the largest Fischer group. We will survey some old observations from the perspective of Moonshine and representation theory and present some new ones from that of congruence groups and enumerative geometry. Based on joint work with John McKay.

Renaud Detcherry *Quantum representations and monodromies of fibered links*
A conjecture of Andersen, Masbaum and Ueno asserts that the quantum representations eventually send pseudo-Anosov maps to elements of infinite order. We will show a link between this conjecture and the growth of Turaev-Viro invariants. As a result, we produce infinite families of mapping classes satisfying the AMU conjecture, in all surfaces with n>=2 boundary components and genus g>n. We get our examples as monodromies of some well-chosen fibered links.

Vladimir Fock *Tau-function and cluster coordinates*
Tau-function is known first of all to be a generating function for solution of certain integrable systems and is defined as a certain determinant in an infinite dimensional vector space. We will give a equivalent purely bosonic definition of a tau-function as a (certain limiting case) of generating function of flat (Abelian) connections on a Riemann surface and show that A-coordinates of cluster (Goncharov-Kenyon) integrable systems are special values of this function.

Qingtao Chen *Recent progress of various Volume Conjectures for links as well as 3-manifolds*
The original Volume Conjecture of Kashaev-Murakami-Murakami predicts a precise relation between the asymptotics of the colored Jones polynomials of a knot in S^3 and the hyperbolic volume of its complement. I will discuss two different directions that lead to generalizations of this conjecture. The first direction concerns different quantum invariants of knots, arising from the colored SU(n) (with the colored Jones polynomial corresponding to the case n= 2). I will first display subtle relations between congruence relations, cyclotomic expansions and the original Volume Conjecture for colored Jones polynomials of knots. I will then generalize this point of view to the colored SU(n) invariant of knots. Certain congruence relations for colored SU(n) invariants, discovered in joint work with K. Liu, P. Peng and S. Zhu, lead us to formulate cyclotomic expansions and a Volume Conjecture for these colored SU(n) invariants. I will also discuss similar ideas for the superpolynomials that arise in HOMFLY-PT homology. In fact, I proposed cyclotomic expansion conjectures and Volume conjectures for superpolynomials. If time permits, I will briefly discuss my work with Joergen Andersen following this direction, which is an ongoing project. Another direction for generalization involves the Witten-Reshetikhin-Turaev and (modified) Turaev-Viro quantum invariants of 3-manifolds. In a joint work with T. Yang, we formulated a new Volume Conjecture for the asymptotics of these 3-manifolds invariants evaluated at certain roots of unit, and numerically checked it for many examples. Interestingly, this conjecture uses roots of unity that are different from the one usually considered in literature. This may indicate that the understanding of this new phenomenon requires new physical and geometric interpretations that go beyond the usual quantum Chern-Simons theory. I will also introduce a work on Krillov-Reshetikhin quantum 6j-symbols done by J. Murakami & me.

Gregor Masbaum *On the skein module of the product of a surface and a circle*
Let Sigma be a closed oriented surface of genus g. We use growth properties of Witten-Reshetikhin-Turaev invariants to show that the Kauffman bracket skein module of Sigma x S^1 over the field of rational functions in A has dimension at least 2^{2g+1}+2g-1. This is joint work with P. Gilmer.