ICMP Contributed Talks 2
Communications libres ICMP 2

JORGEN ELLEGAARD ANDERSEN, Centre for Quantum Geometry of Moduli Spaces, Aarhus University
Complex Quantum Chern Simons Theory

In the first part of this talk I will present work joint with Gukov and Pei, where we have derived a Verlinde formula for the space of states in complex Quantum Chern Simons theory on surfaces with labeled marked points for general simple Lie groups. Although this state space is infinite dimensional, it has a natural grading in terms of finite dimensional spaces and we give an explicit formula for the generating function for the dimensions of these. In fact we establish that these generating functions gives a one parameter familie of 1-1 dimensional TQFT, which completely determines all these dimensions.

In the second part I will present joint work with Kashaev, where we have given a combinatorial explicit construction of complex Quantum Chern-Simons theory much like Reshetikhin and Turaev gave a combinatorial construction of Quantum Chern-Simons theory in the case of compact groups. We consider the non-compact groups $SL(2,\mathbb{R})$ and $SL(2,\mathbb{C})$ and we use triangulations and charged quantum Teichmüller theory to construct two versions of this TQFT. We verify that the resulting state integrals are indeed convergent and an invariant of the triangulation and thus gives well-defined invariants independent of the triangulation. I shall state our version of the volume conjecture for these invariants for the group $SL(2,\mathbb{R})$, which propose that these invariants decay exponentially in Planck's constant at the rate given by the hyperbolic volume. I will present our proof of this conjecture for a few simple knots.

NOÉ CUNEO, University of Cergy-Pontoise
Non-Equilibrium Steady States for Networks of Oscillators

Non-equilibrium steady states for chains of oscillators interacting with heat baths at different temperatures have been the subject of several studies. In this talk I will discuss how to generalize these results to multidimensional networks of oscillators. I will present conditions on the topology of the network and on the interaction potentials which imply the existence and uniqueness of the non-equilibrium steady state, as well as exponential convergence to it. The two main ingredients of the proof are (1) a controllability argument using Hörmander's bracket criterion and (2) a careful study of the high-energy dynamics which leads to a Lyapunov-type condition. I will also mention cases where the non-equilibrium steady state is not unique, and cases where its existence is an open problem. This is joint work with J.-P. Eckmann, M. Hairer and L. Rey-Bellet (arXiv:1712.09413).

DANILO DIAZ, UNAB, Chile
Listen to the CFT Weyl anomaly with gravity

We propose a recipe - arguably the simplest - to compute the holographic type-B Weyl anomaly for general higher-derivative gravity in asymptotically AdS spacetimes. In 5 and 7 dimensions we identify a suitable basis of curvature invariants that allows to read off easily, without any further computation, the Weyl anomaly coefficients of the dual CFT. We provide few examples, where the anomaly coefficients have been obtained by other means, to illustrate the effectiveness of our prescription. We also examine the implications of these findings in the holographic description of 4D and 6D conformally invariant powers of the Laplacian (GJMS operators) and 4D conformal higher spins (CHS).

YAN GOBEIL, McGill University
Thermal conformal blocks

We will discuss the derivation of the conformal blocks for the thermal one-point function of primary scalar operators in d-dimensional conformal field theories. We will quickly explain how these objects can in theory be computed directly in the CFT by an explicit calculation and with the help of a Casimir differential equation. We will then introduce an auxiliary Anti de Sitter space that allows us to find a closed form for the blocks in terms of Witten diagrams.

HIROHIKO SHIMADA, OIST
Universal asymptotics in one parameter family of OPEs

The unitarity bound plays a key role in the numerical conformal bootstrap. These bounds in the dimensions $d \geq 2$ are often associated with one parameter families of solutions to the crossing symmetry, and as such, revive the interest in non-unitary CFTs with a continuous parameter. An example of the latter arises in the Schramm-Loewner evolution SLE_κ realized in the conformal $O(n)$ loop models, where the OPE for generic non-rational κ does not truncate as in the CFTs in $d > 2$. The CFTs with the Virasoro or W_3 symmetry may have one parameter and are of fundamental importance in statistical physics. When one varies the parameter, the zeros and poles in OPE coefficients form the infinite tree structures of the Stern-Brocot type. The analytic structure is deeply linked to the universal exponential decays and the oscillation of the OPE coefficients for large scaling dimensions.

RONALDO THIBES, Universidade Estadual do Sudoeste da Bahia
Quantization Aspects of the Gauge Invariant Conic Constrained Particle

We consider the recently proposed model of a gauge invariant description of the general conic constrained particle. Starting from an originally second class system we obtain the general classical solution and perform the Faddeev-Jackiw (FJ) symplectic quantization. The FJ brackets are obtained and the symplectic structure in the phase space of the model is described in detail. The last iteration step of the FJ procedure gives rise to a final symplectic potential which is used to obtain gauge invariance. We show how the mentioned symplectic potential can be used in a first-order Lagrangian to produce a new gauge invariant model and pursue its canonical and functional quantization. After introducing the ghost and Nakanishi-Lautrup variables, an explicit BRST symmetry is obtained for the quantum version of the model. The quantum BRST charge and extended Hamiltonian are computed. The symmetries obtained are shown to broadly and neatly generalize previous known particular models. We compare our work with different uses of first-order Lagrangias to obtain gauge invariance in the context of other quantum field theory prototypical systems such as electrodynamics. Compared to previous ones, our approach constitutes a new method which can be used to generate a gauge invariant system from a second-class one.

MARCUS A. C. TORRES, IMPA
Searching for the geometry of the moduli of SU(2) YMH k-monopoles using Gauss-Manin connection in disguise

We will present the work written in arXiv:1709.01545 where we showed that the curvature equations of the reduced moduli of Yang-Mills-Higgs 2-monopoles resumes to, up to a homomorphism, a vector field in the moduli of the enhanced spectral curve as described by the method Gauss-Manin connection in disguise. We will also discuss recent progress for symmetric monopoles.

BRUCE TURKINGTON, University of Massachusetts Amherst
Optimal closure for nonequilibrium statistical models

This talk outlines an unconventional approach to nonequilibrium statistical mechanics that relies on statistical modeling and information theory. Given a deterministic microscopic dynamics, taken to be a Hamiltonian system with many degrees of freedom, and a macroscopic description, defined by a vector of relevant observables, the goal is to derive reduced equations for the mean macrostate from the microdynamics. To do so, this approach avoids the usual projection operator technique, or Mori-Zwanzig method. Instead, one constructs a parametric statistical model (or nonequilibrium ensemble) whose parameter vector is in one-to-one correspondence with the macrostate, and one chooses that path in the model's parameter space along which the rate of information loss is minimized. This optimal path is the best fit to the underlying dynamics within the imposed statistical model, as quantified by relative entropy (Kullback-Leibler divergence). The equations governing the optimal path are deduced by applying Hamilton-Jacobi theory to this classical optimization problem. These reduced equations have a nonequilibrium thermodynamic structure – they are "GENERIC" (=General Equations of NonEquilibrium Reversible Irreversible Coupling) in the sense of Grmela and Öttinger, or "metriplectic" in the terminology of Morrison.

This optimal closure has been applied to several test problems motivated by coarse-graining questions in hydrodynamics. Specifically, it has been implemented in a shell model, the spectrally-truncated Burgers equation, and two-dimensional inviscid flow. These tests show that it is capable of predicting relaxation rates toward statistical equilibrium without introducing tuned constants, and approximating linear response kernels without recourse to full auto-correlation data.

JORIS VAN DER JEUGT, Ghent University

Combining parabosons and parafermions in a new graded superalgebra

When a system of m parafermions and n parabosons are combined, there are two choices for the relative commutation relations. One choice (referred to as "of relative parafermion type") gives rise to the classical orthosymplectic Lie superalgebra $\mathfrak{osp}(2m+1|2n)$. For the other choice (of "relative paraboson type"), the underlying algebraic structure is no longer an ordinary Lie superalgebra, but a $\mathbb{Z}_2 \times \mathbb{Z}_2$-graded Lie superalgebra, denoted here by $\mathfrak{pso}(2m+1|2n)$. Analysing the subalgebra structure of $\mathfrak{pso}(2m+1|2n)$ allows the investigation of the parastatistics Fock spaces for this new set of $m+n$ para-operators, as they correspond to lowest weight representations of $\mathfrak{pso}(2m+1|2n)$. Our main result is the construction of these Fock spaces, with a complete labeling of the basis vectors and an explicit action of the para-operators on these basis vectors. This is the first example of whole class of representations for a $\mathbb{Z}_2 \times \mathbb{Z}_2$-graded Lie superalgebra.

WILLIAM WITCZAK-KREMPA, Université de Montréal

Gapless quantum spin chains: multiple dynamics and conformal wavefunctions

We study gapless quantum spin chains with spin $1/2$ and 1: the Fredkin and Motzkin models. Their entangled groundstates are known exactly but not their excitation spectra. We first express the groundstates in the continuum which allows for the calculation of spin and entanglement properties in a unified fashion. Doing so, we uncover an emergent conformal-type symmetry, thus consolidating the connection to a widely studied family of quantum critical points in 2 spatial dimensions. We then obtain the low lying excited states via large-scale Density Matrix Renormalization Group simulations and find that the dynamical exponent is $z = 3.2$ in both cases. Other excited states show a different z, indicating that these models have multiple dynamics. Finally, we exploit an exact map from the quantum Hamiltonian to the non-equilibrium dynamics of a classical spin chain to shed light on the quantum dynamics.