ICMP Contributed Talks 4
Communications libres ICMP 4

GIOVANNI ANTINUCCI, Universität Zürich
Universal edge transport in interacting Hall systems

We study the edge transport properties of 2d interacting Hall systems, displaying single-mode chiral edge currents. For this class of many-body lattice models, including for instance the interacting Haldane model, we prove the quantization of the edge charge conductance and the bulk-edge correspondence. Instead, the edge Drude weight and the edge susceptibility are interaction-dependent; nevertheless, they satisfy exact universal scaling relations, in agreement with the chiral Luttinger liquid theory. Moreover, charge and spin excitations differ in their velocities, giving rise to the spin-charge separation phenomenon. The analysis is based on exact renormalization group methods, and on a combination of lattice and emergent Ward identities. The non-renormalization of the emergent chiral anomaly plays a crucial role in the proof.

IVAN AVRAMIDI, New Mexico Tech
Quantum Heat Traces

We study new invariants of elliptic partial differential operators acting on sections of a vector bundle over a closed Riemannian manifold that we call the relativistic heat trace and the quantum heat traces. We obtain some reduction formulas expressing these new invariants in terms of some integral transforms of the usual classical heat trace and compute the asymptotics of these invariants. The coefficients of these asymptotic expansion are determined by the usual heat trace coefficients (which are locally computable) as well as by some new global invariants.

RAM BAND, Technion
Neumann Domains

The nodal set of a Laplacian eigenfunction forms a partition of the underlying manifold or graph. An alternative partition, based on the gradient field of the eigenfunction, is via the so called Neumann domains. We introduce this subject for manifolds and metric graphs and point out the similarities and differences between nodal domains and Neumann domains. The talk is based on joint works with Lior Alon, Michael Bersudsky, Sebastian Egger, David Fajman and Alexander Taylor.

HADEWIJCH DE CLERCQ, Ghent University
The higher rank Askey-Wilson algebra and the q-Dirac-Dunkl model

The Askey-Wilson algebra is the q-deformed algebra that underlies the Askey-Wilson polynomials. It is strongly connected with the graded quantum superalgebra $\mathfrak{osp}_q(1|2)$: it arises as its covariance algebra and can be embedded in its threefold tensor product. In this talk I will exploit this connection to generalize the Askey-Wilson algebra to higher rank. This will be done in a slightly different presentation, called the q-Bannai-Ito algebra. I will propose a general extension procedure in the tensor product of n copies of $\mathfrak{osp}_q(1|2)$. The resulting higher rank algebra will have more generators and q-commutation relations and contains the original rank one algebra as its subalgebra. I will present an integrable model as a realization of this algebra, which we will call the $\mathbb{Z}_2^n$ q-Dirac-Dunkl model. We will study the central operator in this model through modules of its null-solutions.

This talk is based on joint work with Hendrik De Bie and Wouter van de Vijver.

MANUELA GIROTTI, Colorado State University / Concordia University
Rigorous asymptotics of the soliton gas

We analytically study the long time and large space asymptotics of a KdV soliton gas. A soliton gas can be thought as an infinite collection of interacting solitons randomly distributed on the line. The concept was originally introduced by Zakharov (1971). From a 2×2 Riemann-Hilbert problem and via non-linear steepest descent techniques, we are able to extract meaningful information for the solution of the KdV equation in such (random) setting. This is a joint work with Ken McLaughlin (CSU).

BORIS KONOPELCHENKO, University of Salento and INFN, Lecce, Italy
Universal parabolic regularization of the gradient catastrophes for the Burgers-Hopf equation and Jordan systems

Non-standard parabolic regularization of gradient catastrophes for the Burgers-Hopf equation and integrable hydrodynamic-type systems with the most degenerate Jordan blocks is proposed. It is based on the analysis of the generic and all higher order gradient catastrophes and their step by step regularization by embedding the Burgers-Hopf equation and Jordan systems into integrable multi-component parabolic systems of quasi-linear PDEs with the most degenerate Jordan blocks. Probabilistic realization of such procedure is discussed. The complete regularization is achived by embedding into infinite Jordan chain. It is shown that the Burgers equation, Korteweg-de Vries equation and other regularized PDEs are particular reductions of the Jordan chain.

KONSTANTIN MATVEEV, Brandeis University
Gibbs measures on the Young graph with the Macdonald multiplicities and Kerov's conjecture.

I would like to briefly talk about the recent proof of the Kerov's conjecture (1992) classifying the homomorphisms from the algebra of symmetric functions to reals with non-negative values on the Macdonald functions. This allows to classify Gibbs measures on the Young branching graph with the Macdonald multiplicities. For the special case of the Schur functions this is equivalent to classifying totally non-negative infinite Toeplitz matrices, and the result was first proved by Schoenberg, Edrei, et.al. in the beginning of the 1950s. Their motivation came from Analysis, but in the 1960s Thoma has discovered a connection with the representation theory of the infinite symmetric group. Some other special cases of the Kerov's conjecture are also connected to asymptotic representation theory. Our proof is a combination of two methods. 1). Developing in the Macdonald generality the "pole elimination" argument developed for the Schur case by Schoenberg. 2). A new method based on showing certain diffusivity in the branching graph of the Macdonald functions.

TIM RAEYMAEKERS, Ghent University
Higher spin Laplace operator in several vector variables

This presentation deals with the construction of so-called higher spin Laplace operators. These are conformally invariant differential operators which generalise the Laplace, Maxwell and Fronsdal equations known in theoretical physics to arbitrary dimension and for higher spin fields. We do this using harmonic analysis and representation theory of some classical Lie algebras. The classical Laplace operator maps complex valued functions to complex valued functions, and we can see the space of complex numbers as a representation of the rotation group. In order to generalise this operator, we use Branson's result on second-order conformally invariant operators to switch out the space of complex numbers by another irreducible representation of the orthogonal group. These representations can be modelled as spaces of polynomials in several vector variables, whence our operator can be written down as a second order differential operator acting on functions of several variables.
Next, we want to determine all polynomial solutions to these operators. Therefore, we impose some gauge fixings and consider a special kind of solutions of these higher spin Laplace operators, which we will be able to determine completely. This will make it possible to construct all other solutions from these special ones.

This is joint work with D. Eelbode and M. Roels (University of Antwerp)

ADRIAN MAURICIO ESCOBAR RUIZ, CRM Université de Montréal
General Nth order superintegrable systems separating in polar coordinates

The general description of superintegrable systems, with one polynomial integral of second order in the momenta and one more of N order, in a two-dimensional Euclidean space is presented. We consider Hamiltonian systems allowing separation of variables in polar coordinates. Both the classical and the quantum cases are discussed. The main properties of *standard* and *exotic* potentials are established as well. In particular, unlike the *exotic* potentials the general form of the *standard* ones satisfies a linear ODE. In the quantum case, we conjecture that a new infinite family of *exotic* potentials written in terms of the sixth Painlevé transcendent occurs.

YIBING SHEN, The University of Queensland
Ground-state energies of the open and closed $p+ip$-pairing models from the Bethe Ansatz

We first study the $p+ip$ Hamiltonian isolated from its environment and consider the case of large particle number. A continuum limit approximation is applied to compute the ground-state energy. We discuss the evolution of the solution curve, and the limitations of this approach. We then consider an alternative approach which generalises to accommodate interaction with the environment.

VAN DE VIJVER WOUTER, Ghent University
The higher rank Racah algebra

A higher rank generalization of the (rank one) Racah algebra is obtained by considering the tensorproduct of n copies of $\mathfrak{su}(1,1)$. It also arises as symmetry algebra of the $\mathbb{Z}_2^n$ Dunkl-Laplacian. This leads to a superintegrable system on the n-sphere. We highlight a number of interesting properties of this algebra and focus on the role of the labelling Abelian subalgebras. Connection coefficients between bases diagonalized by these Abelian algebras are multivariate Racah polynomials as defined by M. V. Tratnik. The link with the discrete model of the Racah algebra will be explained.

This is joint work with Hendrik De Bie, Vincent X. Genest and Luc Vinet.

ISMET YURDUSEN, Hacettepe University and CRM (UdeM)
Holomorphic solutions of the supersymmetric Grassmannian sigma model

We study the gauge invariance of the supersymmetric (susy) Grassmannian sigma model $G(M,N)$. It is richer than its purely bosonic submodel and we show how to use it in order to reduce some constant curvature holomorphic solutions of the model into simpler expressions. In particular, the constant curvature holomorphic solutions of the susy $G(2,4)$ σ-model are analyzed in detail. These solutions have constant curvature $\kappa_0 = \frac{2}{r}$, $r = 1,2,3,4$, inherited from their bosonic part. For the solutions corresponding to $r = 3$ and $r = 4$, we obtain a criterion for getting the general susy solution. The cases of $r = 1$ and $r = 2$ do not satisfy this criterion and we give some of the solutions involving a polynomial behavior.