Theoretical Physics

Wednesday, 02.09.2015, Room EI 3

Time	ID	Theoretical Physics I *Chair: Robert Seiringer, IST Austria*
13:30	401	**Superfluid Behavior of a Bose Einstein Condensate in a Random Potential** *Jakob Yngvason, Faculty of Physics, Uni Wien, Boltzmanngasse 5, AT-1090 Vienna* We investigate the relation between Bose-Einstein condensation (BEC) and superfluidity in the ground state of a one-dimensional model of interacting Bosons in a strong random potential. We prove rigorously that in a certain parameter regime the superfluid fraction can be arbitrarily small while complete BEC prevails. In another regime there is both complete BEC and complete superfluidity, despite the strong disorder. In the course of the proof we derive an explicit formula for the superfluid fraction in terms of the wave function of the Bose Einstein condensate. This is joint work with Martin Könenberg, Thomas Moser and Robert Seiringer.
14:00	402	**Large scale structure probes of inflation** *Vincent Desjacques, University of Geneva, 24 Quai Ernest Ansermet, CH-1211 Geneva* Observations of the cosmic microwave background (CMB) furnish to date the tightest constraints on the nature of the primordial fluctuations and, therefore, the physics of inflation. These measurements exploit the fact that different inflationary mechanisms imprint distinct signatures in the non-Gaussianity of the primeval curvature perturbations. Interestingly, independent and competitive constraints can be obtained by measuring the statistical properties of large scale density fluctuations in the low redshift Universe. I will discuss recent theoretical and observational developments, and argue that upcoming galaxy redshift surveys can achieve limits (at least) an order of magnitude better than the CMB Planck mission.
14:30	403	**Rotation of quantum impurities in the presence of a many-body environment** *Mikhail Lemeshko, Inst. of Science and Technology Austria, Am Campus 1, AT-3400 Klosterneuburg* *Richard Schmidt, ITAMP/Harvard University, Garden st. 60, 02138 Cambridge, USA* We present the first systematic treatment of quantum rotation coupled to a many-particle environment. We approach the problem by introducing the quasiparticle concept of an “angulon” – a quantum rotor dressed by a quantum field – and reveal its properties using a combination of variational and diagrammatic techniques. The theory can be applied to a wide range of systems described by the angular momentum algebra, from Rydberg atoms immersed into BEC’s, to cold molecules solvated in helium droplets, to ultracold molecular ions. [1] Richard Schmidt, Mikhail Lemeshko, Phys. Rev. Lett. 114, 203001 (2015)
15:00	404	**Molecular Dynamic simulation of a microscopic Laval nozzle** *Helmut Ortmayer, Robert Zillich, David Haider* *Institute for Theoretical Physics, Johannes Kepler Universität, Altenbergerstrasse 69, AT-4040 Linz* We study the dynamics of supersonic expansion of a Lennard-Jones gas through a microscopic Laval nozzle using a combination of molecular dynamics and Monte Carlo simulations. We investigate the role of thermodynamic fluctuations for the gas dynamics, particularly for defining the sonic horizon, as well as the influence of the nozzle shape and the boundary layer on the expansion. We compare with continuum calculations based on the equation of state of the Lennard-Jones gas.
15:30		
16:00		***Coffee Break***

16:30	**405**	**Majorana fermions in atomic-molecular systems at finite temperature and in the presence of a noise.** *Mikhail Baranov, Z. Cai, Y. Hu, P. Zoller, Uni Innsbruck* We discuss the effects of quantum and thermal fluctuations, as well as of global and local noise, on the Majorana edge states in topological atomic-molecular wire networks. we find that, even at finite temperature, the energy of the Majorana states remains exponentially small with the length of the wire. At finite temperature, however, the initial correlations between Majorana states decay to the values which are temperature and wire-length dependent, and vanish in the thermodynamic limit. The effects of the noise are similar to those of temperature but strongly depend on the band-width and the amplitude of the noise, and on the position of a noise sours (for local noise). Remarkably, the life-time of correlations in the case of a fast noise is large enough for quantum manipulations with Majorana fermions, even when the noise causes switching between topological and non-topological phases of the wire.
17:00	**406**	**Chiral low-energy physics from squashed brane solutions in deformed N = 4 Super-Yang-Mills** *Harold Steinacker, Department of Physics, University of Vienna, Boltzmanngasse 5, AT-1090 Vienna* *Jochen Zahn, Department of Physics, University of Leipzig, Brüderstraße 16, DE-04103 Leipzig* We find new vacuum solutions of maximally supersymmetric Yang-Mills theory with a cubic soft SUSY breaking term. We discuss the low-energy physics which arises on stacks of these solutions. A configuration is found which leads to a low-energy physics similar to the standard model, assuming suitable VEV's of the scalar ("Higgs") zero modes. Due to the triple self-intersection of the branes, the matter content includes that of the MSSM with precisely 3 generations. No exotic quantum numbers arise, but some fields are doubled. The chiral low-energy sector is complemented by a heavy mirror sector, and heavy Kaluza-Klein modes.
17:30	**407**	**Conformal gravity holography, canonical charges and asymptotic symmetry algebra** *Iva Lovrekovic [1], Daniel Grumiller [1], Maria Irakleidou [1], Robert McNees [2], Florian Preis [1]* *[1] Institute for Theoretical Physics, TU Wien, Wiedner Hauptstrasse, 8-10/136, AT-1040 Wien* *[2] Loyola University of Chicago, 1032 W. Sheridan Road, 60660 Chicago, USA* We study conformal gravity in four dimensions via canonical analysis and find the charges. The spacetime diffeomorphism charges are shown to agree wight the Noether charges, however there is no charge associated with Weyl transformations. Consequently the asymptotic symmetry algebra is isomorphic to the Lie algebra of the boundary condition preserving diffeomorphisms. One of the examples on which the results can be applied is the Mannheim--Kazanas--Riegert solution of conformal gravity.
18:00	**408**	**New results on glueball decay in the Witten-Sakai-Sugimoto model** *Frederic Brünner, Anton Rebhan, Denis Parganlija* *Institute for Theoretical Physics, TU Wien, Wiedner Hauptstraße 8-10, AT-1040 Vienna* Based on 1504.05815 and 1501.07906, I present results on glueball decay rates in a holographic top-down approach that allows for the calculation of decays into two pions, two vector mesons and four pions, using a range of the 't Hooft coupling which leads to a value for the gluon condensate consistent with QCD sum rules. We also studied the effects of finite quark masses and found that in line with the mechanism of chiral suppression, our approach strongly favours the identification of $f_0(1710)$ as a narrow glueball state in the anticipated mass range.
18:30	**409**	**From holography towards real-world nuclear matter** *Andreas Schmitt, TU Wien, Wiedner Hauptstrasse 8-10, AT-1040 Vienna* QCD is notoriously difficult to solve at nonzero baryon density, and most models or effective theories of dense quark or nuclear matter are restricted to a particular density regime and/or a particular form of matter. I will discuss the question whether holographic methods can provide a realistic strong-coupling description of dense matter. In particular, I will ask the question whether the holographic Sakai-Sugimoto model fulfills two basic requirements of real-world cold and dense matter, a first-order onset of nuclear matter and a chiral phase transition at high density to quark matter. Such a model would be extremely useful for astrophysical applications because it would provide a single equation of state.

19:00		
19:15		***Transfer to Dinner***
20:00		***Conference Dinner***

Thursday, 03.09.2015, Room EI 3

Time	ID	**Theoretical Physics II** *Chair: Gian Michele Graf, ETH Zürich*
14:00	**411**	**Projective symmetry group classification of chiral spin liquids** *Samuel Bieri, Claire Lhuillier, Laura Messio* *LPTMC, UPMC - Paris 6 / Sorbonne Universités, UPMC, Tour 12/13, FR-75252 Paris* Recent progress in material science has lead to novel quantum magnets described by frustrated spin S=1/2 Heisenberg models on the Kagome lattice with farther-neighbor exchange interactions. Motivated by these advances and by experimental indications for quantum spin liquid phases, we perform a projective symmetry group classification of chiral spin liquids with fermionic spinons on this lattice. We discuss general properties of these exotic spin states, such as emergent SU(2) gauge structure, fluxes, and order parameter. We present a variational phase diagram of the physically relevant Heisenberg model.
14:30	**412**	**Holography with higher spins in flatland** *Jan Rosseel, Institute for Theoretical Physics, TU Wien* Higher spin theories in anti-de Sitter space-times have recently attracted a lot of attention in the context of holography. In this talk, I will argue that non-trivial higher spin theories can also be formulated in three-dimensional asymptotically flat space-times and that they can be used to explore aspects of holography around such space-times. I will give a concrete example of such a flat space higher spin theory and comment on the structure of the putative conformal field theory dual. The theory has non-trivial cosmological solutions and I will show how their thermodynamical properties can be studied.
15:00	**413**	**Exotic Bound States in Low Dimensions: Majorana Fermions.** *Jelena Klinovaja, University of Basel, Klingelbergstrasse 82, CH-4056 Basel* I will present results on exotic bound states in one-dimensional condensed matter systems that have attracted wide attention due to their promise of non-Abelian statistics. Majorana fermions can emerge in a variety of setups in which either standard or synthetic spin-orbit interaction is present. Here, I willdiscuss candidate materials such as semiconducting Rashba nanowires, graphene nanoribbons, atomic magnetic chains or magnetic semiconductors [1,2]. [1] J. Klinovaja and D. Loss, Phys. Rev. B 86, 085408 (2012). [2] J. Klinovaja, P. Stano, A. Yazdani, and D. Loss, Phys. Rev. Lett. 111, 186805 (2013).
15:30	**414**	**Quantum enhanced measurement of an alternating signal** *Andrey Lebedev, ETH Zürich* We discuss several measurement schemes of a time alternating electromagnetic field with a noisy stochastic component. These schemes involve a Ramsey measurement of a single qubit (two level system) continuously interacting with the field. Depending on the amount of a prior information about the field i.e. the noise level, its spectral function, we suggest several measurement protocols which an increasing accuracy.
16:00		
16:30		***Coffee Break***

17:00	**415**	**Generalizations of coherent states and continuous frames** *Michael Speckbacher, Institut für Schallforschung, Österreichische Akademie der Wissenschaften, Wohllebengasse 12-14, AT-1040 Vienna* Coherent states play an important role in nearly all branches of quantum mechanics and its relation to classical mechanics. This talk aims at presenting concepts beyond the classical coherent states approach from a mathematical perspective. First, advantages and limitations of generalized coherent states and continuous frames will be highlighted. Subsequently, two concepts to overcome these obstacles will be presented, namely semi-frames and reproducing pairs. A semi-frame Ψ is a complete system in a Hilbert space that satisfies only one frame bound, whereas a reproducing pair (Ψ,Φ) generates a bounded and invertible analysis/synthesis process under the omission of frame bounds.
17:30	**416**	**Holographic Entanglement Entropy from Numerical Relativity** *Christian Ecker, Institute for Theoretical Physics, TU Wien, Wiedner Hauptstr. 8-10, AT-1040 Wien* *(talk will be given by Stefan Stricker)* Entanglement entropy, a measure for entanglement in quantum systems, attracts a lot of attention in seemingly unrelated branches of physics like quantum information, condensed matter and conformal field theories. While computing entanglement entropy in quantum field theories turns out to be notoriously hard, the holographic principle maps the problem to the much easier task of finding minimal (hyper)surfaces in a higher dimensional gravity theory. In this talk I will present recent results from our numerical relativity computations of the holographic entanglement entropy in an anisotropic system relevant for the early stage of heavy ion collisions.
18:00	**417**	**Phase transitions and criticality of the Hubbard model in two and three dimensions** *Thomas Schäfer [1], Faruk Geles [2], Daniel Rost [3], Georg Rohringer [1], Andrey A. Katanin [4], Enrico Arrigoni [2], Karsten Held [1], Nils Blümer [3], Markus Aichhorn [2], Alessandro Toschi [1]* *[1] Institute of Solid State Physics, TU Wien, Wiedner Haupstraße 8-10, AT-1040 Vienna* *[2] Institute of Theoretical and Computational Physics, TU Graz, Rechbauerstraße 12, AT-8010 Graz* *[3] Institute of Physics, Johannes Gutenberg University, Saarstraße 21, DE-55122 Mainz* *[4] Inst. of Metal Physics, University of Ekaterinburg, Kovalevskaya st. 18, RU-620990 Ekaterinburg* One of the hallmarks of strong electronic correlations, is the Mott-Hubbard metal-insulator transition (MIT). Our analysis of the two-dimensional Hubbard model on a square lattice demonstrates that at low temperatures the critical interaction for the onset of an insulator is reduced towards zero by the inclusion of long-range spatial correlations, so that the MIT completely disappears in this case. Also, magnetic ordering is only possible at zero temperature, but by increasing the dimensionality we explore the physics of magnetic transitions at finite temperatures. T. Schäfer et al., Phys. Rev. B 91, 125109 (2015) and in preparation.
18:30		***END***
19:45		***Public Lecture***

ID	Theoretical Physics Poster
431	**Protected state Ramsey spectroscopy** *Laurin Ostermann, David Plankensteiner, Helmut Ritsch, Claudiu Genes* *Institute for Theoretical Physics, University of Innsbruck, Technikerstraße 21/3, AT-6020 Innsbruck* The present poster introduces the concept of asymmetric Ramsey spectroscopy, where collective dipole-dipole interaction is exploited to increase the sensitivity of a Ramsey experiment instead of being an unwanted source of noise. Employing two extra (local) operations on the individual atoms, one before and one after the period of free evolution, allows for the collective state to exhibit a minimal total dipole, thus protecting it from environmental decoherence and decay. The poster will focus on recent results in extended 2D- and 3D-systems and provide examples as to how such a technique could be implemented using today's experimental methods.

432 **Time-dependent Hypernetted-Chain Euler-Lagrange Method for Nonlinear Response**

Robert Zillich, Michael Kobler
Institut für Theoretische Physik, Johannes Kepler Universität, Altenbergerstrasse 69, AT-4040 Linz

We use the well-established hypernetted-chain Euler-Lagrange many-body method, and generalize it to time-dependent interactions. Particularly in the field of ultracold atoms, the effective interaction between particles can be varied quickly over a very wide range, for example using Feshbach resonances. Another possibility is the manipulation of the dipole strength and/or orientation in dipolar quantum gases. As first applications we study the nonlinear dynamics of correlations caused by a sudden change of the repulsion strength in homogeneous systems, and by the rotation of the anisotropic dipole-dipole interaction, with the aim to study how a nontrivial phase in the pair correlations may be generated.

433 **Atomistic Fluid Dynamics: 2-dimensional turbulence and cavitation around an obstacle**

Robert Zillich, David Haider, Helmut Ortmayer
Institute for Theoretical Physics, Johannes Kepler Universität, Altenbergerstr. 69, AT-4040 Linz

We present results of nonequilibrium molecular dynamics simulations of two fluid dynamic phenomena: two-dimensional turbulence by random forcing and cavitation in flow around an obstacle. The atomistic results confirm the inverse energy cascade known to occur in 2D turbulent flow, where small scale eddies create larger eddies, and we test the validity of the Kolmogorov scaling. The formation of a gas bubble (cavitation) around a fast-moving microscopic object is studied for the Lennard-Jones fluid close and far from the liquid-gas phase transition, and we compare against continuum models for cavitation.

434 **Data Presentation of the Michelson-type-II Apexmeter measurement of the Solar motion in space, and Restoration of the Michelson-type-I device (interferometer) on Euclidean Grounds.**

Karl Mocnik, Austrian Academy of Sciences, Schmiedlstrasse 6, AT-8042 Graz

The Michelson-type-II-principle proposed in his historical paper on Ether-drift (1887) lead to construct a "n-Whorl-Light-Whirl", which determines both the motion velocity and Apex-direction of the absolute motion of our Sun in space. Surveyor's instruments demonstrate that the null-result observed in the 'Michelson-type-I-device' (interferometer) is perfectly in accord with both the principles of Classical Optics and Euclidean description of Maxwells Ether. Both 'Aether-drift prediction' in the "M-type-I-device" (interferometer) and the 'length-contraction' as being mere hypotheses aren't elements of physical reality.

Karl Mocnik: „Ein verkapptes Geometrieproblem u. seine sieben Syllogismen“.45.Tagung Didaktik d. Math., Freiburg 2011