Titles & Abstracts

Wednesday, July 5

Marcello Porta

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Robin Reuvers

Ground state energy of dilute Bose and Fermi gases in 1D

I will discuss dilute, repulsive Bose and Fermi gases in one dimension. For the case without spin, I will mention some aspects of the ground state energy expansion obtained with Johannes Agerskov and Jan Philip Solovej. For the case with spin, I will explain how to think about the ground state, and I will discuss the upper bound obtained with the same co-authors.

Morris Brooks

The Fröhlich Polaron at strong coupling

In this talk we will discuss recent results of Robert Seiringer and myself, concerning the ground state energy and the energy-momentum relation of the Fröhlich polaron, which is a model describing the interactions between a charged particle and a polarized medium. We especially verify a conjecture by Landau and Pekar from 1948, claiming that the energy-momentum relation asymptotically coincides with the one of a free particle having an increased mass $M = \alpha^4 m$, where m is an explicit constant, in the regime of large couplings alpha between the particle and the medium, and suitably small momenta.

Marie Fialova

Asymptotics of weakly coupled eigenvalues of the Pauli operator:

We are interested in the magnetic Pauli operator perturbed by a potential ϵV, where ϵ is a small parameter. In particular, we want to find the asymptotics of the eigenvalues as ϵ tends to zero. We consider the Aharonov-Bohm magnetic field and show that both components of the Pauli operator are critical in the sense of not satisfying a Hardy-type inequality. Consequently the small potential perturbation results in emergence of two

eigenvalues compared to the usual result of only one eigenvalue for non-singular magnetic fields. This is a joint project in progress with David Krejcirik.

Thursday, July 6

Julian Fischer

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Jinyeop Lee

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Martin Ravn Christiansen

Emergent Quasi-Bosonicity in Interacting Fermi Gases

We consider the correlation energy of a Fermi gas on a torus as the particle number N goes to infinity, with the interaction potential scaled by a factor proportional to $N^{-1/3}$.

In the second-quantized picture, the Hamiltonian of such a system can be written in the form of a quadratic Hamiltonian with respect to certain "quasi-bosonic" operators. By applying the theory of bosonic Bogolubov transformations, this Hamiltonian can be approximately diagonalized to yield a "bosonic contribution" to the correlation energy.

In this talk we will see how this quasi-bosonic behavior emerges, and how to efficiently carry out such a diagonalization procedure in the non-exact setting.

Giulia Basti

Upper bounds on the ground state energy of dilute hard core bosons

In this talk we discuss some recent estimates on the energy of dilute gases of hard core bosons. We present an upper bound for hard core bosons in the thermodynamic limit

resolving the ground state energy up to an error of the order of the so-called Lee-Huang-Yang correction. We also discuss the Gross-Pitaevskii regime, in which N hard spheres with radius of order $1/N$ move on the unit torus; in this setting, we show an upper bound for the ground state energy up to an error vanishing as N diverges.
Based on joint works with S. Cenatiempo, A. Giuliani, A. Olgiati, G. Pasqualetti, B. Schlein.

Toan Nguyen

Plasma oscillations

Charged particles in a non-equilibrium state can experience complex behavior at large times, including trapped trajectories, oscillations, phase mixing, and Landau damping. This talk is to identify the survival threshold for oscillations of an electron modeled by Hartree or Vlasov equations.

Lea Boßmann

Focusing NLS and Bogoliubov correction for dilute Bose gases in the instability regime

We consider the dynamics of a $2d$ Bose gas with singular attractive interactions in the instability regime, where the corresponding focusing nonlinear Schrödinger equation (NLS) has a blow-up. We show that the evolution of the condensate is effectively described by this NLS for all times before the blow-up. Moreover, we prove the validity of the Bogoliubov approximation for the dynamics of the fluctuations, resulting in a norm approximation of the many-body dynamics. This is joint work with Charlotte Dietze and Phan Thành Nam.

Asbjørn Bækgaard Lauritsen

Dilute Fermi gases: Upper bounds via cluster expansion

Recently the study of dilute quantum gases have received much interest, in particular regarding their ground state energies. I will present recent work on two such problems: that of a spin-polarized Fermi gas and a spin-$1/2$ Fermi gas. In the spin-polarized setting the ground state energy is bounded from above by the kinetic energy plus a term of order $a^3\rho^{8/3}$ with a the p-wave scattering length of the repulsive interaction. In the spin-$1/2$ setting the correction is of order $a_s\rho_\uparrow\rho_\downarrow$ with a_s the s-wave scattering length. One of the main ingredients in the proofs is a rigorous version of a formal cluster expansion of Gaudin, Gillespie and Ripka (Nucl. Phys. A, 176.2 (1971), pp. 237-260). I will discuss this expansion and the analysis of its absolute convergence.

Joint work with Robert Seiringer. Based on arXiv:2301.04894 and 2301.08005.

Luca Fresta

Fermionic Stochastic Quantization

Stochastic quantization is the study of measures via the push-forward from Gaussian measures. The goal of my talk is to survey some recent results on the application of stochastic quantization in the context of Grassmann measures, e.g., fermionic euclidean quantum field theories, which are an important example of non-commutative measures. Based on joint works with F. De Vecchi, M. Gordina and M. Gubinelli.

Friday, July 7

Nguyen Viet Dang

The ϕ_3^4 measure on compact Riemannian 3-manifolds

Stochastic quantization is the study of measures via the push-forward from Gaussian measures. The goal of my talk is to survey some recent results on the application of stochastic quantization in the context of Grassmann measures, e.g., fermionic euclidean quantum field theories, which are an important example of non-commutative measures. Based on joint works with F. De Vecchi, M. Gordina and M. Gubinelli.

Charlotte Dietze

Spectral estimates for Schrödinger operators with Neumann boundary conditions on Hölder domains

We prove a universal bound for the number of negative eigenvalues of Schrödinger operators with Neumann boundary conditions on bounded Hölder domains, under suitable assumptions on the Hölder exponent and the external potential. Our bound yields the same semiclassical behaviour as the Weyl asymptotics for smooth domains. We also discuss different cases where Weyl's law holds and fails.

Ngoc-Nhi Nguyen

Weyl laws for interacting particles

The known Weyl laws of Schrödinger operators $-\hbar^2\Delta + V$ provide asymptotics the ground state density of systems of several non-interacting fermions submitted to an

external potential V. We will discuss the corresponding version in the case of interactions between these particles.

Torben Krüger

Merging singularities in two-dimensional Coulomb gases

The two-dimensional one-component plasma is a particle system in the plane with long-range logarithmic interactions. At a specific temperature the system is equivalent to the eigenvalue ensemble of a normal random matrix model. In equilibrium the particles form distinct droplets when placed in an external potential. Using the Riemann-Hilbert approach we determine the local statistical behaviour of the particles at the point where two droplets merge and observe an anisotropic scaling behaviour with particles being much further apart in the direction of merging than the perpendicular direction.

This is joint work with Meng Yang and Seung-Yeop Lee.
