ABSTRACTS

1. Lea Bossmann (Ludwig Maximilian University Munich)

Title: Edgeworth expansion for the weakly interacting Bose gas

Abstract: We consider the ground state and the low-energy excited states of a system of weakly interacting bosons. We derive an Edgeworth expansion for the fluctuations of bounded one-body operators around the condensate, which yields corrections to a central limit theorem. This is a joint work with Sören Petrat.

2. Marco Falconi (Politecnico di Milano)

Title: Renormalization of the Bogoliubov Theory in the Nelson Model

Abstract: In this talk - based on a joint work with J. Lampart, N. Leopold, and D. Mitrouskas - I will talk about the mean field limit of the renormalized Nelson model, in which a large number of bosonic particles is weakly coupled with a large number of coherent excitations of the scalar field. We prove quantitative bounds on the convergence both for reduced density matrices and in norm, with the effective theory being the Schrödinger-Klein-Gordon system with Yukawa-type coupling. A crucial ingredient of the proof is the construction of a renormalized Bogoliubov evolution for the quantum fluctuations.

3. Shahnaz Farhat (University of Rennes)

Title: Classical-Quantum motion of charged particles in interaction with scalar field

Abstract: This talk explores the quantum-classical transition in particle-field dynamics where a finite and fixed number of non-relativistic or semi-relativistic quantum particles interact with a quantized scalar field in the scaling limit of small value of Planck constant $\hbar \to 0$. Such a topic aims to rigorously derive effective equations from fundamental first principles of quantum mechanics. In other words, we establish Bohr's correspondence principle. Moreover in our case, the interactions between the wave and the particles are sufficiently singular to prevent us from using a standard fixed point argument. Therefore, when analyzing the quantum-classical transition, we crucially use the transferring of some a priori quantum regularizing effects to the classical equation in such a way that we are able to establish the global well-posedness for the particle-field equation while studying the transition by means of Wigner measures.

4. Daniele Ferretti (Gran Sasso Science Institute)

Title: Zero-Range Hamiltonians for Many-Particle Quantum Bosonic Systems in Dimension Three

Abstract: We discuss a class of regularized zero-range Hamiltonians for different problems satisfying a bosonic symmetry in dimension three, corresponding to the investigation of suitable self-adjoint extensions of the free Laplacian restricted on the space of regular functions vanishing along the coincidence hyperplane (i.e. the hyperplanes where the contact interaction occurs). Following the standard procedure in defining such operators, one comes up with the so-called Ter-Martirosyan Skornyakov Hamiltonian that turns out to be unbounded from below in three dimensions (Thomas collapse takes place in case of usual two-body point interactions since zero-range forces become too singular when three or more particles get close to each other). In order to avoid this energetical instability, we consider a many-body repulsion meant to weaken the strength of the interaction when more than two particles coincide. More precisely, following a suggestion coming from the early '60s by Minlos and Faddeev, we introduce an effective scattering length depending on the positions of the particles. In case of a three-boson problem (or a Bose gas of non-interacting particles interacting only with an impurity) such a function vanishes as a third particle gets closer to the couple of interacting particles. Similarly, dealing with an interacting Bose gas, we also take into account a four-body repulsion in order to handle the ultraviolet singularity associated with the collapse of two distinct couples of interacting particles. We show that the Hamiltonians corresponding to these regularizations are self-adjoint and lower-bounded, provided that the strength of the many-body force is large enough.

5. Christian Hainzl (Ludwig Maximilian University Munich)

Title: TBA

Abstract: TBA

6. Sebastian Herr (University of Bielefeld)

Title: Well-posedness of the Zakharov system

Abstract: The Zakharov system is a quadratically coupled system of a Schrödinger and a wave equation, which is related to the focusing cubic Schrödinger equation. We consider the associated Cauchy problem in the energy-critical dimension d=4 and prove that it is globally well-posed in the full (non-radial) energy space for any initial data with energy and wave mass below the ground state threshold. The result is based on a uniform Strichartz estimate for the Schrödinger equation with potentials solving the wave equation. A key ingredient in the non-radial setting is a bilinear Fourier extension estimate. This is joint work with Timothy Candy and Kenji Nakanishi. In addition, we present a well-posedness result of the stochastic Zakharov system in the 3d energy space, which is joint work with Martin Spitz, Michael Röckner and Deng Zhang.

7. Herbert Koch (University of Bonn)

Title: The Korteweg-de Vries hierarchy at regularity H^{-1}

Abstract: The Hamiltonians of the hierarchy are defined by a generating function which in turn is related to the spectral analysis of the Lax operator. A central object will be a modified Miura map which relates the spectrum and the integral kernel of the resolvent.

I will explain the proof of wellposedness of the Korteweg-de Vries equation in H^{-1} by Killip and Visan using the diagonal Green's function. Inverting the Miura map we can relate the Gardner and the Miura hierarchy and prove wellposedness at the Gardner level for the whole hierarchy.

This is joint work with Baoping Liu and Friedrich Klaus.

8. Giuseppe Lipardi (Gran Sasso Science Institute)

Title: TBA

Abstract: TBA

9. Renato Lucà (Basque Centre for Applied Mathematics)

Title: Phase blow up for the cubic NLS and connections with the binormal flow

Abstract: In this talk, we will discuss a suitable family of borderline regularity solutions of the 1d cubic Schrodinger equation exhibiting a phase blow-up. We will also discuss the connection between these solutions and the evolution of curves under the binormal curvature equation. This is a joint work with V. Banica, N. Tzvetkov and L. Vega.

10. Andrea Nahmod (University of Massachusetts, Amherst)

Title: TBA

Abstract: TBA

11. Alessandro Pizzo (University of Rome Tor Vergata)

Title: TBA

Abstract: TBA

12. Andrew Rout (University of Warwick)

Title: Microscopic derivations of Gibbs measures for the 1D focusing nonlinear Schrödinger equation

Abstract: Gibbs measures for the nonlinear Schrödinger equation are important objects used to study low-regularity almost sure well-posedness. On the other hand, the NLS can be viewed as a limit of many-body quantum mechanics. In this talk we describe the derivation of Gibbs measures from their many-body quantum analogues.

In particular, we consider the dimension $d = 1$ with a non-positive interaction potential. The proof is based off a perturbative expansion of the Hamiltonian and a diagrammatic representation of the interaction.

This is based on joint work with Vedran Sohinger.

13. Manfred Salmhofer (University of Heidelberg)

Title: TBA

Abstract: TBA

14. Vedran Sohinger (University of Warwick)

Title: The Euclidean Φ^4_2 theory as the limit of an interacting Bose gas

Abstract: Gibbs measures of nonlinear Schrödinger equations are a fundamental object used to study low-regularity solutions with random initial data. In the dispersive PDE community, this point of view was pioneered by Bourgain in the 1990s. On the other hand, the nonlinear Schrödinger equation can be viewed a classical limit of many-body quantum theory. We are interested in the problem of the derivation of Gibbs measures as mean-field limits of Gibbs states in many-body quantum mechanics.

The particular case we consider is when the dimension d=2 and when the interaction potential is the delta function, which corresponds to the Euclidean Φ^4_2 theory. The limit that we consider corresponds to taking the density to be large and the range of the interaction to be small in a controlled way. Our proof is based on two main ingredients.

(a) An infinite-dimensional stationary phase argument, based on a functional integral representation.
(b) A Nelson-type estimate for a nonlocal field theory in two dimensions.

This is joint work with Jürg Fröhlich, Antti Knowles, and Benjamin Schlein.

15. Daniel Ueltschi (University of Warwick)

Title: Quantum spin chains, loop representations, dimerisation

Abstract: In contrast to their classical counterparts, one-dimensional quantum spin systems are interesting, they have intriguing behaviour, and they are difficult to study. I will describe a family of systems with nearest-neighbour interactions and $O(n)$ symmetry. Its ground state phase diagram is expected to have a rich structure. For large spins it is possible to prove the occurrence of dimerisation in an open domain. The proof involves a loop representation and the method of cluster expansions.

This is joint work with Jakob Bjornberg, Peter Muhlbacher, and Bruno Nachtergaele.

16. Quirin Vogel (Technical University Munich)

Title: The Feynman-Representation and the Gibbs variational problem

Abstract: We introduce the Feynman representation for the Bose gas. We briefly review the connection between long loops, interlacements and off-diagonal long range order in free, mean field and HYL models. We then discuss how we can use Gibbs theory to solve the variational problem for low densities in the case of repulsive interaction. Joint work with Tianyi Bai.