MP 9: Poster Session: Many-body Theory

Time: Wednesday 16:15–18:15 Location: ZHG Foyer 1. OG

MP 9.1 Wed 16:15 ZHG Foyer 1. OG

Exact solutions of interacting spinor Bose gases — •Hannes Köper[1] and Thomas Gasenzer[1,2] — [1]Kirchhoff-Institut für Physik, Universität Heidelberg, Im Neuenheimer Feld 227, D-69120 Heidelberg, Germany — [2]Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, D-69120 Heidelberg, Germany

The quantum matrix non-linear Schrödinger equation in one spatial dimension describes an integrable model of two non-relativistic SU(2) multiplets with quartic interaction between their coupled states. Due to the matrix structure of the field operators involved, the non-linear term includes spin-changing processes not captured by a plain density-density interaction. In spite of the complexity of these spin changing terms for the general $m \times n$ matrix field, symmetry analysis reveals a very simple picture in terms of Casimir operators of an associated Jordan-Schwinger representation of $\mathfrak{su}(n)$. We solve the model explicitly for the case where both multiplets are spin-1/2 giving rise to a 2×2 matrix field theory. The model is expected to describe e.g. the interactions between different hyperfine states in a Bose gas of hydrogen-like atoms. From its solution we derive exact thermodynamic quantities for the few- and many-body systems.

MP 9.2 Wed 16:15 ZHG Foyer 1. OG

Exploring Strong Correlations and Strong Disorder in Fermionic Systems: Independent Investigations — •Saurabh Kumar — Institute for Theoretical Physics, University of Cologne, Zülpicher Straße 77, D-50937, Köln, Germany

This work addresses the challenges of analyzing strongly interacting and disordered fermionic systems, focusing on two independent projects. Both projects utilize the superbosonization formula as a key analytical tool.

The first project develops a general analytical framework for studying strongly interacting systems, with a specific focus on the one-dimensional Hubbard model at half-filling. The approach utilizes bosonization within the functional integral framework, but challenges arise in defining the continuum limit in time. To overcome this, we integrate renormalization techniques into the bosonization scheme. A full implementation of these ideas is planned for future research.

The second project examines strongly disordered fermion systems in symmetry class D. Motivated by recent proposals of novel spontaneous symmetry breaking (SSB) phenomena in class A, we explore similar phenomena in class D systems. Starting with a general formulation of supersymmetric field theory applied to disordered class D systems, we focus on the strong disorder limit. We also analyze a specific system of monitored free fermions, which exhibits measurement-induced phase transitions. While we propose a reformulation of the theory to offer a fresh perspective, a comprehensive exploration of novel SSB phenomena in class D remains an open question for future investigation.

MP 9.3 Wed 16:15 ZHG Foyer 1. OG

Wegner model in high dimension: Self-consistent approximation — •Julian Arenz — Cologne University, Zülpicher Straße 77, 50937 Köln

Assuming the self-consistent theory of localization due to Abou-Chacra, Anderson and Thouless (AAT), we study the $N = 1$ Wegner model in the regime of strong disorder and high dimension.

While it is traditionally believed that the Wegner model possesses only two phases (metallic and insulating), we investigate the existence of a third phase with spontaneously broken U(1) symmetry. We do so by using a supersymmetric integral equation which follows from the AAT self-consistency equation for the advanced and retarded Green's function.

In the process, we uncover solutions that are neither of metallic nor of insulating type (they break a U(1) symmetry but have a non-compact symmetry). We propose that these solutions correspond to the novel phase and describe fractal eigenstates and singular continuous spectrum.

MP 9.4 Wed 16:15 ZHG Foyer 1. OG

An analogue of the Meissner effect for a SU(2)-Yang-Mills field — •Philipp Wagner[1] and Martin Zirnbauer[2] — [1]Hahnenstraße 23, 50354 Hürth-Efferen — [2]Institut für Theoretische Physik, Zülpicher Straße 77a, 50937 Köln

The decay of the electromagnetic field in a superconducting material, described by the Meissner-Ochsenfeld effect, is a well-known phenomenon of solid state physics. Here we consider an analogous situation for the weak interaction in the presence of a Higgs condensate. Mathematical foundations from Yang-Mills theory are used to set up the Lagrangians for both the Yang-Mills field and the Higgs field. Based upon these structures, an adapted London equation with an adapted London penetration depth is derived for a SU(2)-Yang-Mills field interacting with a spacetime-independent Higgs condensate. It is shown that all gauge bosons of the weak interaction individually exhibit the same phenomenological behavior as the electromagnetic field in a superconductor.