MP 11: Quantenmechanik

Time: Thursday 16:30–17:50 Location: SPA SR125

MP 11.1 Thu 16:30 SPA SR125

First-order asymptotic corrections to the meanfield limit — •Matthias Christandl[1], Robert Matjeschk[2], Friederike Trimborn[2,3], and Reinhard Werner[2] — [1]Institute for Theoretical Physics, ETH Zürich, Wolfgang-Pauli-Strasse 27, CH-8093 Zürich, Switzerland — [2]Leibniz Universität Hannover — [3]Bundesministerium für Bildung und Forschung

We derive a complete algebraic theory for treating permutation invariant problems beyond separability to first order in the asymptotics. Our work builds on a C*-algebraic theory for permutation invariant operators on n-particles, with an algebraic description of the limit $n \to \infty$ (the *meanfield limit*). We use the fluctuation ansatz, a version of a non-commutative central limit, and derive a continuous-variable algebra (the *fluctuation algebra*) that asymptotically describes the $1/n$-corrections to this *meanfield* limit. Using the fluctuation algebra, we derive a method for estimating the ground-state energy of meanfield models up to first order, and for estimating the time-evolution of correlations between different particles. Moreover, we show that the meanfield ground-state problem is closely related to the finite de Finetti problem and therefore obtain a lower bound, complementing recent results in this direction.

MP 11.2 Thu 16:50 SPA SR125

Uncertainty relation for simultaneous measurements in a thermal environment — •Raoul Heese and Matthias Freyberger — Institut für Quantenphysik, Universität Ulm, D-89069 Ulm, Germany

Uncertainty relations for simultaneous measurements of conjugate observables date back to the theory of Arthurs and Kelly, who considered a model of two pointer systems, which are coupled to a quantum system to be measured and act as the measurement apparatus. We extend this classic model by including a thermal environment in which the pointers behave as coupled particles under Brownian motion. In this sense the pointers behave like classical measurement devices. This novel approach leads us to a new kind of uncertainty relation for so-called open pointer-based simultaneous measurements of conjugate observables.

MP 11.3 Thu 17:10 SPA SR125

A Nonlinear Schrödinger Wave Equation With Linear Quantum Behavior — •Chris D. Richardson, Peter Schlagheck, John Martin, Nicolas Vandewalle, and Thierry Bastin — Département de Physique, University of Liege, 4000 Liege, Belgium

We show that a nonlinear Schrödinger wave equation can reproduce all the features of linear quantum mechanics. This nonlinear wave equation is obtained by exploring, in a uniform language, the transition from fully classical theory governed by a nonlinear classical wave equation to quantum theory. The classical wave equation includes a nonlinear classicality enforcing potential which when eliminated transforms the wave equation into the linear Schrödinger equation. We show that it is not necessary to completely cancel this nonlinearity to recover the linear behavior of quantum mechanics. Scaling the classicality enforcing potential is sufficient to have quantum-like features appear and is equivalent to scaling Planck's constant.

MP 11.4 Thu 17:30 SPA SR125

Classical trajectories of identical particles — •Stefan Fischer, Clemens Gneiting, and Andreas Buchleitner — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg

The number of permutations required to describe systems of identical particles grows very fast with the number of particles involved. In order to simplify the description of such systems, we resort to an idea put forward by J.M. Leinaas and J. Myrheim in 1977 [1]. They studied the consequences of restricting the configuration space of identical particles to the fundamental domain of the group of permutations of their coordinates. Upon utilizing this concept, we demonstrate for several examples that the quantum mechanical propagator, in this restricted space, can be obtained by a semi-classical treatment. Within this framework, a one-to-one correspondence between the solutions of the associated classical problem and the permutations of the particles arises. Thus, one obtains a clear picture as to whether a certain permutation may be neglected or significantly contributes to the propagation process.

[1] J.M. Leinaas and J. Myrheim, Nuovo Cimento B **37**, 1-23 (1977).