MP 7: Quantum field theory

Time: Wednesday 16:45–18:45 Location: MP-H5

MP 7.1 Wed 16:45 MP-H5

Fermionic integrable models and graded Borchers triples — •Henning Bostelmann[1] and Daniela Cadamuro[2] — [1]University of York, Department of Mathematics, York YO10 5DD, United Kingdom — [2]Universität Leipzig, Institut für Theoretische Physik, Brüderstraße 16, 04103 Leipzig, Germany

The operator-algebraic construction of 1+1-dimensional integrable quantum field theories has received substantial attention over the past decade. These models are characterized by their asymptotic particle spectrum and their two-particle S-matrix; so far, those particles have been bosonic. By contrast, we consider the case of asymptotic fermions. Abstractly, they arise from a grading of the underlying operator algebraic structures (Borchers triples). Many of the technical methods required can be carried over from the bosonic case, *mutatis mutandis;* most importantly, existing results on the technically hard part of the construction (i.e., establishing the modular nuclearity condition) do not require modification.

Thus we are lead to a new family of rigorously constructed quantum field theories which are physically distinct from the bosonic case (with a different net of local algebras and a different scattering theory). Their local operators fulfill modified form factor axioms, consistent with the physics literature.

MP 7.2 Wed 17:05 MP-H5

Interacting massless infraparticles in 1+1 dimensions — •Wojciech Dybalski[1] and Jens Mund[2] — [1]AMU Poznań — [2]Universidade Federal de Juiz de Fora - UFJF

The Buchholz' scattering theory of waves in two dimensional massless models suggests a natural definition of a scattering amplitude. We computed such a scattering amplitude for charged infraparticles that live in the GNS representation of the 2d massless scalar free field and obtained a non-trivial result. It turns out that these excitations exchange phases, depending on their charges, when they collide. Perspectives for obtaining a similar effect in higher dimensions will also be discussed.

MP 7.3 Wed 17:25 MP-H5

Quantum energy inequalities in integrable QFT models — •Jan Mandrysch — Institut für theoretische Physik, Leipzig

Many results in general relativity rely crucially on classical energy conditions imposed on the stress-energy tensor. Quantum matter, however, violates these conditions since its energy density can become arbitrarily negative at a point. Nonetheless quantum matter should have some reminiscent notion of stability, which can be captured by the so-called quantum (weak) energy inequalities (QEIs), lower bounds of the smeared quantum-stress-energy tensor. QEIs could be proven in many free quantum field theory (QFT) models on both flat and curved spacetimes. In interacting theories only few results exist. We are here presenting numerical and analytical results on QEIs in interacting integrable QFT models in 1+1 dimension, in particular the O(N)-nonlinear-sigma model at 1-particle level.

MP 7.4 Wed 17:45 MP-H5

Dyson-Schwinger Equations in Tensorial Φ^4 Theory — •Johannes Thürigen — Mathematisches Institut der Westfälischen Wilhelms-Universität, Münster, Deutschland

In quantum field theory, the Connes-Kreimer Hopf algebra captures not only the structure of perturbative renormalization but allows also to describe the non-perturbative regime in terms of "combinatorial" Dyson-Schwinger equations. This algebra generalizes from usual Feynman diagrams to "strand graphs", the combinatorial objects underlying a broad class of non-local theories, in particular tensorial field theory. Here we show how this can be used to derive Dyson-Schwinger equations in the case of Φ^4 theory with tensorial interactions.

MP 7.5 Wed 18:05 MP-H5

Dyson series approach for understanding quadratic interactions — •Ayush Paliwal[1] and Karl Henning Rehren[2] — [1]Institut für Theoretische Physik, Universität Göttingen — [2]Institut für Theoretische Physik, Universität Göttingen

We analyze for general quadratic interactions whether, and in which sense, the two point function of the perturbed field, written in terms of the unperturbed field as a Dyson expansion, taken in the vacuum state of the unperturbed field, converges to the vacuum state of the perturbed field when the adiabatic limit is taken. The answer is affirmative in a number of simple cases, where the perturbed field is explicitly known. The result is not in conflict with Haag's theorem. It suggests to use the same method to compute the two-point function in some cases of interest where the perturbed field is not known.

MP 7.6 Wed 18:25 MP-H5

A C^*-algebraic approach to the classical limit of quantum systems — •Christiaan van de Ven[1] and Valter Moretti[2] — [1]Max Planck Institute for Mathematics in the Sciences, Leipzig,Germany — [2]Università di Trento, Trento, Italy

Quantization refers to the passage from a classical to a corresponding quantum theory. The converse problem, called the classical limit of quantum theories, is considered as a much more difficult issue and poses an important question for various areas of modern mathematical physics.

In this talk I will present this notion, first by introducing a natural framework based on the theory of deformation quantization. Subsequently, I will show that this setting is perfectly suitable to model the classical limit of quantum theories. More precisely, the corresponding quantization maps allow us to take the limit for $\hbar \to 0$ of a suitable sequence of algebraic states induced by $\hbar$-dependent eigenvectors of several quantum models, in which the sequence converges to a probability measure on the pertinent phase space.

In addition, since this C^*-algebraic approach allows for both quantum and classical theories, it provides a convenient way to study the theoretical concept of spontaneous symmetry breaking (SSB) as an emergent phenomenon when passing from the quantum realm to the classical world by switching off the semi-classical parameter $\hbar$. This is illustrated for several physical models, e.g. Schrödinger operators and mean-field quantum spin systems.