T 110: Other Theory

Time: Thursday 15:50–17:20 Location: HSZ/0201

T 110.1 Thu 15:50 HSZ/0201

The use of Fierz identities beyond one loop — •Sophie Kollatzsch[1,2], Adrian Signer[1,2], Dominik Stöckinger[3], and Yannick Ulrich[4] — [1]Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland — [2]Physik-Institut, Universität Zürich, Winterthurerstrasse 190, CH-8057 Zürich, Switzerland — [3]Institut für Kern- und Teilchenphysik, TU Dresden, DE-01069 Dresden, Germany — [4]Institute for Particle Physics Phenomenology, University of Durham, South Road, Durham DH1 3LE, United Kingdom

EFTs typically contain dimension-six four-fermion operators. Different basis choices of such operators are possible by applying Fierz identities to rearrange four-fermion expressions. In d dimensions, such Fierz identities are not strictly valid; hence the question arises how such a basis change has to be treated at the (multi-)loop level. We discuss the treatment of so-called Fierz-evanescent operators, resulting in (finite) shifts of Wilson coefficients. Motivated by an abelian toy model, we show how the two-loop QED effects of specific Fierz-evanescent operators are absorbed into the renormalisation. As an example, we demonstrate how those basis changes affect the calculation of $\mu \to e\gamma$ at next-to-leading order.

T 110.2 Thu 16:05 HSZ/0201

Two-loop Treatment of a Simple Chiral Yang–Mills Model using Non-Anticommuting γ_5 — •Baibhab Ray — Deutsches Elektronen-Synchrotron DESY, Platanenallee 6, 15738 Zeuthen — TU Dresden, Institut für Kern- und Teilchenphysik, Zellescher Weg 19, 01069 Dresden

For practical calculations of loop diagrams in perturbative quantum field theory, Dimensional Regularization (DREG) is the most commonly applied regularization scheme. In this context, fields and integrals are transformed to D dimensions and one invariably needs to decide how intrinsically four-dimensional quantities like γ_5 should be treated in $D \neq 4$ dimensions. The original and to date most rigorous and universal HVBM scheme ('t Hooft–Veltman/Breitenlohner–Maison) forfeits anticommutativity of γ_5 with all other γ^μ and breaks BRST symmetry in intermediate steps. The latter can be restored by means of finite, symmetry-restoring counterterms.

In this talk, I shall discuss a simple chiral Yang–Mills model with only one SU(N) gauge group and without scalar fields, and present two-loop results in the HVBM scheme. Besides acquiring the two-loop counterterm structure (involving both singular and finite counterterms), I shall demonstrate methods of cross-checking by considering the Abelian special case (which can be compared with literature), as well as comparing with Ward identities (which are derived from the relevant Slavnov–Taylor identities encoding BRST symmetry). Time permitting, I shall provide insights into the implementation in `Mathematica`.

T 110.3 Thu 16:20 HSZ/0201

The phase structure of neutral three flavor quark matter — •Marco Hofmann, Gholami Hosein, and Buballa Michael — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 2, 64289 Darmstadt

This talk explores the phase structure and equation of state of dense neutral quark matter at zero and finite temperature. As the equation of state and the speed of sound of neutron stars become more and more constrained by observations from gravitational waves and mass-radius measurements, the phenomenology of the quark matter phase structure is pivotal to understand the composition of stars with a quark matter core. We calculate the phase diagram from a three flavor Nambu Jona-Lasinio (NJL)-type model in the mean field approximation. Color superconductivity is included through the attractive scalar diquark channel. A repulsive vector interaction increases the stiffness of the matter. Furthermore, we address the systematic removal of cutoff artefacts within an renormalization group consistent approach.

T 110.4 Thu 16:35 HSZ/0201

Hybrid equation of state and mass radius relation — •Hosein Gholami, Marco Hofmann, and Michael Buballa — Institut für Kernphysik,Technische Universität Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt

With the discovery of gravitational waves from neutron star mergers, investigating the structure of these objects using theoretical models has gained more importance. Matter at the highest densities reached in neutron star remnants is expected to be in a color superconducting state. To constrain the quark matter equation of state at these densities, we compare with constraints on hybrid star equations of state for isolated neutron stars at zero temperature. Here we explore the speed of sound and mass-radius relation for such hybrid equations of state. We also study these properties within a renormalization group consistent approach. Our calculation is based on a mean field approximation of three flavor Nambu Jona-Lasinio (NJL)-type models. A repulsive vector interaction is included to satisfy the 2 solar mass neutron star observations. Color superconducting phases are included through the attractive scalar diquark channel.

T 110.5 Thu 16:50 HSZ/0201

Notational Invariance of the standard model — •Lello Boscoverde — Istituto della Fava Pazza, Garching

We present current investigations into the notational invariance of the standard model as well as an introduction to the principles of notational invariance with pedagogical examples, a history of its study, and algorithms for implementing changes of notation.

T 110.6 Thu 17:05 HSZ/0201

Particle knowledge enhanced by a classical model — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

According to today's understanding, the properties of elementary particles must be treated quantum mechanically - preferably according to the "Copenhagen Interpretation". In contrast, we present a particle model that classically provides the usual parameters; and what is more, it derives parameters that are only postulated by today's quantum mechanics.

This classic model initially refers to Louis de Broglie's approach and takes into account the relativistic behavior of particles. With these ingredients, not only standard properties such as spin and magnetic moment can be derived. In complete contrast to the Higgs model, it is possible to determine the particle mass very precisely; in the case of the electron by 1:300 000 without any adaption of parameters. It also allows the physical quantities h (Planck) and alpha not only to be postulated, but also to be derived from more fundamental elements. The additional understanding gained in this way leads to further properties such as the Pauli principle and the color codes of quarks, which are also only postulated to this day.

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