T 38: Quantenfeldtheorie (nicht-perturbativ)

Convenor: C. Bogner, P. Maierhöfer

Zeit: Dienstag 11:00–12:15 Raum: VSH 11

T 38.1 Di 11:00 VSH 11

Dynamically assisted Sauter-Schwinger effect—from nonperturbative to perturbative — Greger Torgrimsson, •Christian Schneider, and Ralf Schützhold — Fakultät für Physik, Universität Duisburg-Essen

The dynamically assisted Sauter-Schwinger effect is a tremendous increase in the probability of nonperturbative pair creation by the combination of a strong electric field and a weak, time dependent one. Especially the very sensitive dependence on the exact field profile of the weak pulse has not yet been fully understood. We present both detailed numerical data and new analytical results that agree remarkably well, allowing us to explain how these differences arise.

T 38.2 Di 11:15 VSH 11

Doubly assisted Sauter-Schwinger effect — Greger Torgrimsson, •Johannes Oertel, and Ralf Schützhold — Fakultät für Physik, Universität Duisburg-Essen

We study electron-positron pair creation by a strong and slowly varying electric field, assisted by a weaker and more rapidly changing field (e.g., in the keV regime) plus an additional high-energy (say MeV) photon. It turns out that this combination can yield a pair creation probability which is exponentially larger than in the case where one (or more) of the three ingredients is missing. Apart from a deeper understanding of these nonperturbative phenomena, this double enhancement may pave the way for an experimental verification of this fundamental prediction.

T 38.3 Di 11:30 VSH 11

Semiconductor analog of the Dirac equation and Sauter–Schwinger pair creation — •Malte F. Linder and Ralf Schützhold — Fakultät für Physik, Universität Duisburg-Essen, Lotharstr. 1, 47057 Duisburg, Germany

There is an analogy between E-field-induced tunneling of Dirac-sea electrons to the upper energy continuum in Dirac theory (Sauter–Schwinger effect) and electron–hole pair creation in direct-gap semiconductors via interband (Landau–Zener) tunneling due to external E fields. In this talk, we show that in 1+1 spacetime dimensions, the Bloch electrons in the vicinity of the band gap obey a Dirac equation with effective physical constants in arbitrary external fields $E(t,x)$, provided the fields predominantly stimulate tunneling-type excitations (low photon energies, large wavelengths). Condensed-matter analogs of relativistic quantum physics could be useful to study high-energy effects in the laboratory.

T 38.4 Di 11:45 VSH 11

Soliton-like solution in quantum electrodynamics — •Oleg D. Skoromnik[1], Ilya D. Feranchuk[2,3,4], and Christoph H. Keitel[1] — [1]Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Atomic Molecular and Optical Physics Research Group, Ton Duc Thang University, 19 Nguyen Huu Tho Str., Tan Phong Ward, District 7, Ho Chi Minh City, Vietnam — [3]Faculty of Applied Sciences, Ton Duc Thang University, 19 Nguyen Huu Tho Str., Tan Phong Ward, District 7, Ho Chi Minh City, Vietnam — [4]Belarusian State University, 4 Nezavisimosty Ave., 220030, Minsk, Belarus

A novel soliton-like solution [1] in quantum electrodynamics is obtained via a self-consistent field method. By writing the Hamiltonian of quantum electrodynamics in the Coulomb gauge, we separate out a classical component in the density operator of the electron-positron field. Then, by modeling the state vector in analogy with the theory of superconductivity, we minimize the functional for the energy of the system. This results in the equations of the self-consistent field, where the solutions are associated with the collective excitation of the electron-positron field—the soliton-like solution. In addition, the canonical transformation of the variables allowed us to separate out the total momentum of the system and, consequently, to find the relativistic energy dispersion relation for the moving soliton.

[1] arXiv:1608.01245

T 38.5 Di 12:00 VSH 11

Renormalization group flow of the Higgs sector — •René Sondenheimer — Theoretisch-Physkalisches Institut, FSU Jena, Germany

We investigate the nonperturbative renormalization flow of the Higgs potential and reanalyze the conventional arguments that relate a lower bound for the Higgs mass with vacuum stability in the framework of the FRG. Especially, we discuss the impact of generalized bare Higgs potentials from an effective field theory point of view on the lower mass bound and identify a renormalization group mechanism to diminish this bound whithout introducing a metastability in the effective Higgs potential.