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Quantum Field Theory at the Predictive Limits

Abstract

For decades, theorists have advanced the understanding of quantum electrodynamics (QED) and other quantum, and statistical, field theories, by ever increasing precision, through higher-order loop calculations. Based, in part, on the monograph (With G. S. Adkins) on "Quantum Electrodynamics: Atoms, Lasers and Gravity" (World Scientific, 2022), the talk will give an overview of the field-theoretical techniques used in the challenging calculations, where additional difficulties arise due to the bound-state formalism. The search for New Physics beyond the Standard Model, on the basis of low-energy precision experiments, will be discussed, and a few recently obtained results will be mentioned. Finally, a project will be briefly mentioned which is being pursued in collaboration with Jean Zinn-Justin (CEA, Saclay) and Giorgio Parisi (Rome), which aims to understand better the behavior of perturbation theory at the infinite-loop order, where perturbative techniques naturally are bound to fail.