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Hadron spectroscopy in lattice QCD: basics and some recent developments

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Lattice Quantum Chromodynamics (QCD) provides a non-perturbative approach to QCD from first principles which has proven successful for the study of several physical quantities of interest, for example the energy spectrum of mesons and baryons. It is a crossroads of particle physics, applied mathematics and high performance computing: the numerical simulations performed often require solving several linear systems to compute the quark propagator involving sparse yet extremely large matrices which depend on random variables that need to be efficiently sampled from a non-trivial distribution dictated by the action of the theory of interest. Significant research has been focused on fast solvers for such linear systems to be used in supercomputers, efficient sampling of the distributions and improved actions that define the theory on a lattice, among many other topics of interest. State-of-the-art methods are being used to study exotic states of great theoretical and experimental interest, such as glueballs, hybrid mesons with gluonic excitations or states with quantum numbers not allowed in the conventional quark model. To understand how this is done, this talk will focus on a particular area of lattice QCD: hadron spectroscopy. Here we calculate the spectrum of the energy eigenstates of the theory (mesons, baryons, etc...) by means of Monte Carlo averages over random variables which represent the gluon background. Starting with a short introduction to some widely used methods, including how to build creation operators for the different states, we will see how we can use and improve them to map out the low-lying meson spectrum while at the same time look for the predicted-but-not-yet-found scalar glueball.

Session Classification: Hadron and Flavour Physics