HPQCD highlights

Getting to the bottom of things – work on the b quark

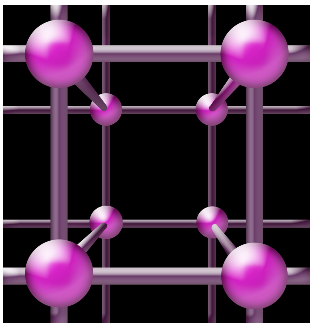

Figure 1. Lattice QCD uses a 4-d grid of space-time

Members of UKQCD, in several different international collaborations, perform calculations with the theory of the strong force, Quantum Chromodynamics or QCD, using a numerical technique known as lattice QCD. These results are of relevance to the ATLAS, CMS and LHCb experiments running at the Large Hadron Collider at CERN. We aim to test results from lattice QCD against experiment so accurately that flaws in our Standard Model of particle physics, which we know must be there, can be found. This will improve our understanding of the substructure of matter at the smallest distance scales, a key aim of the global particle physics programme.

The bottom (b) quark is important here since particles known as B mesons containing b quarks provide the best window into new physics. The b quark is roughly 5 times heavier than a proton and this presents particular problems for including it in lattice QCD calculations.

Last year members of HPQCD improved significantly our method for b quarks [UKQCD.2,3,4,5]. As a result we have been able to calculate the masses of Υ and B, Bs and Bc mesons containing b quarks with much improved accuracy. We have also predicted the masses of some mesons not yet seen in experiment (see Fig. 2).

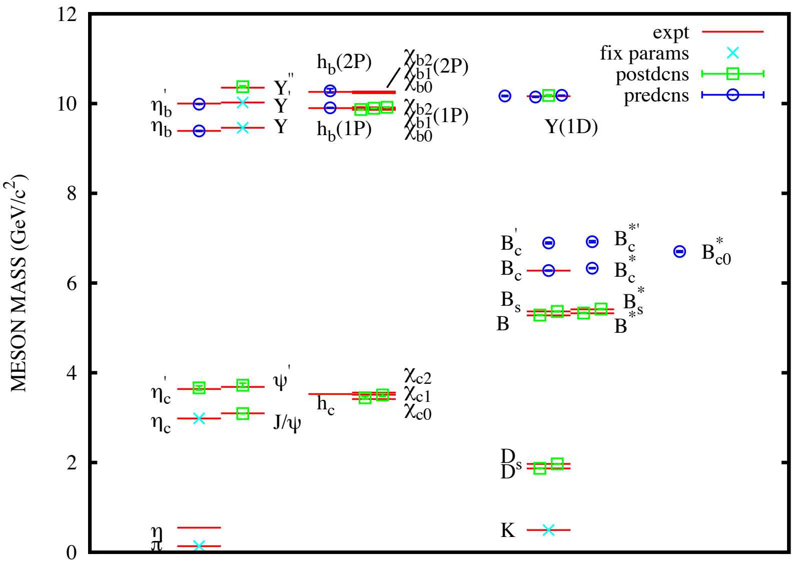

Figure 2. HPQCD collaboration results for the masses of particles known as mesons containing combinations of u, d, s, c and b quarks. Predictions of masses ahead of experiment are shown in dark blue.

The results for masses provide a stringent test of our calculations as we now move on to decay rates which might be sensitive to new physics. DiRAC is enabling us to tackle bigger numerical challenges than hitherto. In particular DiRAC 2 will enable us to make B mesons out of b quarks and u or d quarks at their physically very light masses for the first time, removing a significant source of systematic error.