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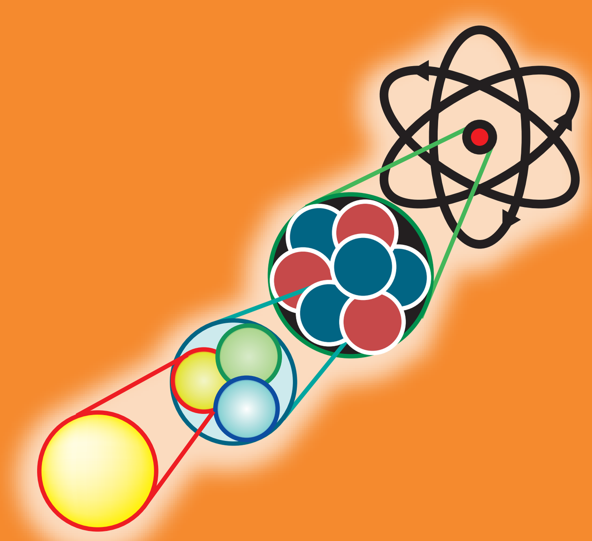
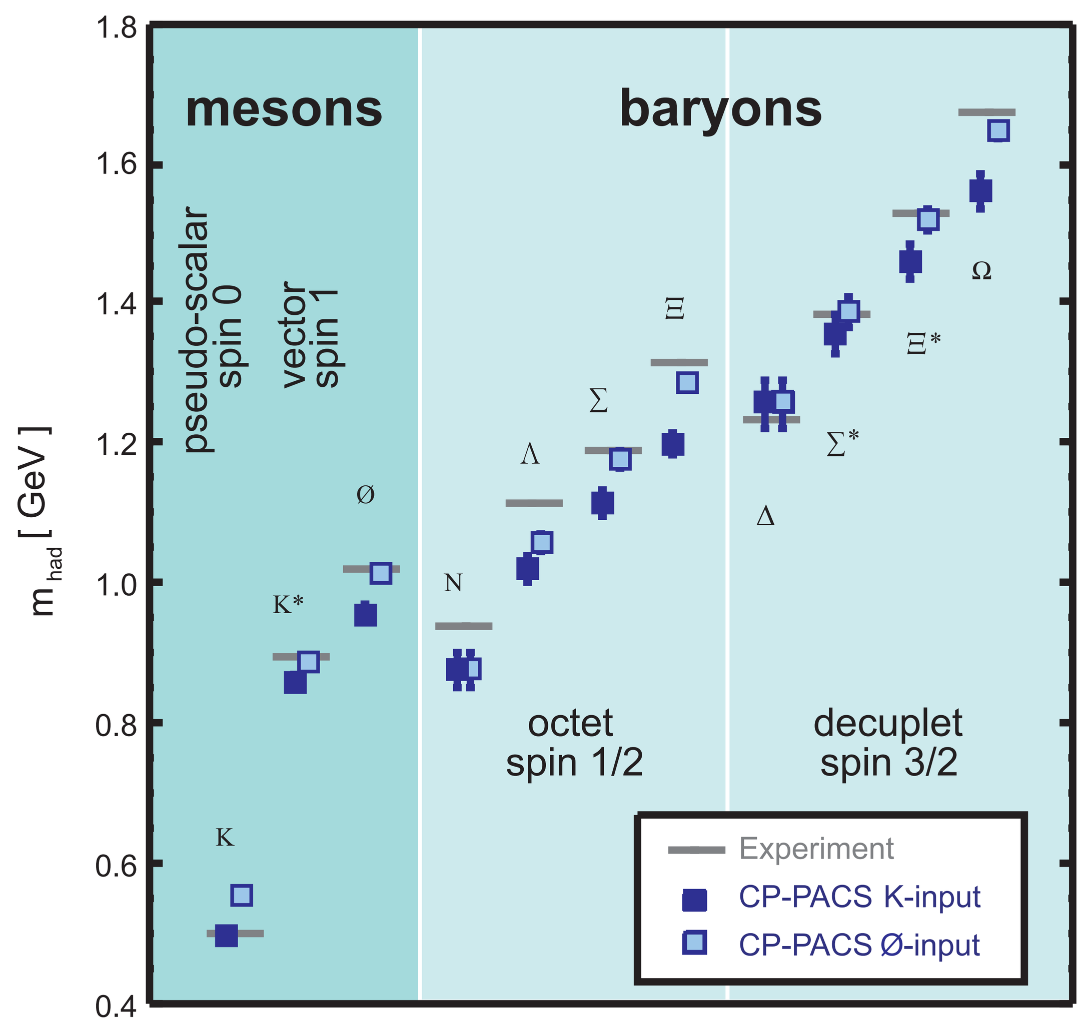


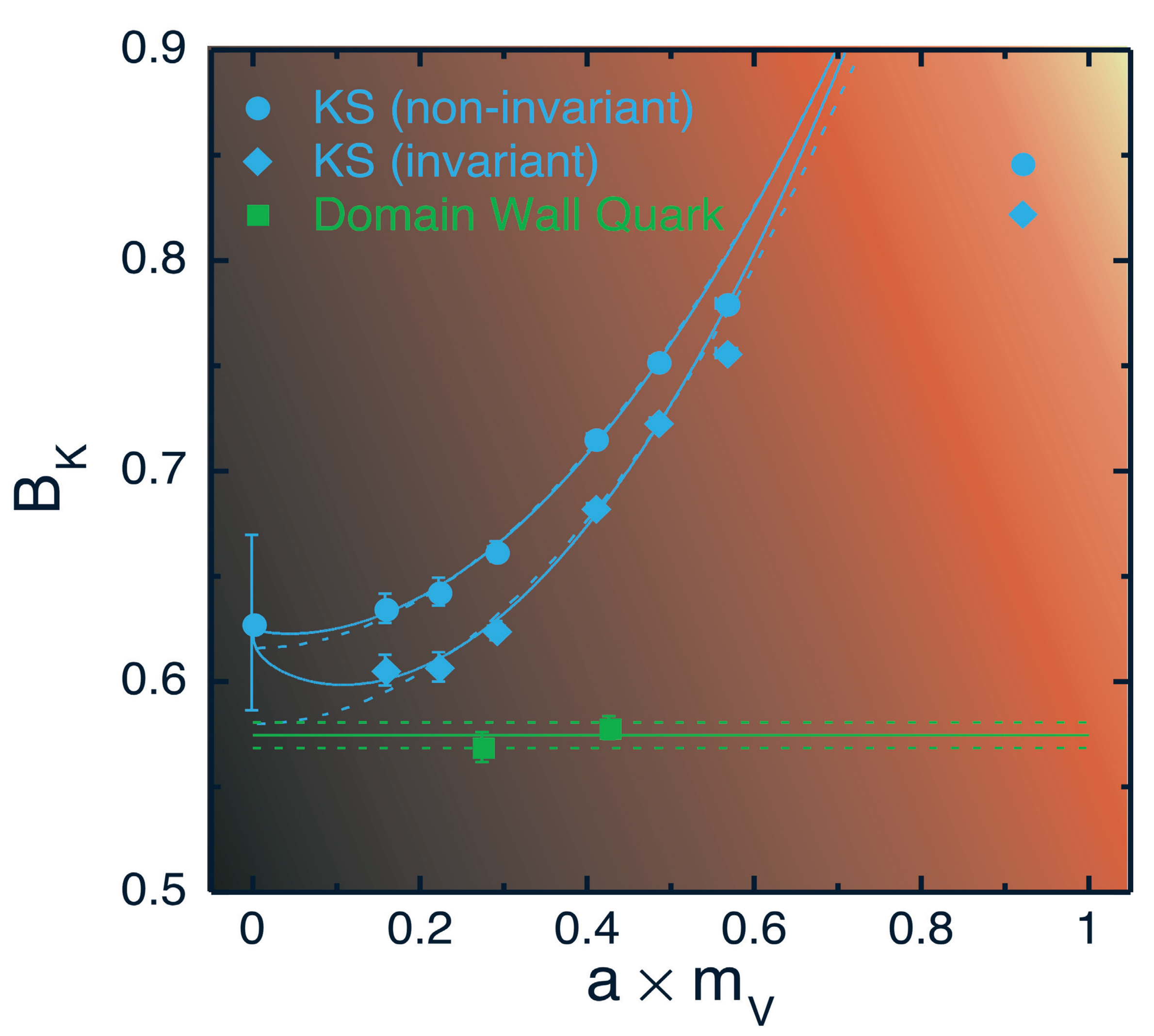
Research in Particle Physics (1)

Prediction of hadron spectrum from QCD

Hadrons are the constituents of atomic nuclei. The computation of their mass spectrum from the quantum chromodynamics (QCD), the fundamental theory of quarks and gluons, has been a principal subject in particle physics. In this figure, our results are compared with experiment. Experimental results are reproduced within about 5-10%, critically proving the validity of QCD. At the same time, with the precision first acheved by the CP-PACS, a limitation of the widely accepted "quenched" approximation, in which dynamical quarks are neglected, was made clear, answering a question since 1981 about the effects of quenching.



CP violation of weak interactions



The asymmetry between matter and anti-matter in the universe is believed to have its origin in the CP violation of weak interactions. On CP-PACS we have investigated several quantities relevant for CP violating weak interactions. This figure shows the B-parameter in the K meson mixing. The CP-PACS result obtained with domain-wall lattice quarks show a much weaker lattice-spacing dependence than the previous results using KS lattice quarks by JLQCD Collab., and hence are expected to give a more precise prediction in the continuum limit.

Quark matter in extreme conditions

At extremely high temperatures and densities, quarks are expected to be liberated from their confinement, to form a new state of matter, quark-gluon plasma (QGP). Clarification of the nature of QGP is important for understanding nucleosynthesis in the early universe and for detecting QGP through heavy ion collision experiments. This figure shows the temperature dependence of the energy density. Results for N_t (lattice size in the temperature direction) of 6 are believed to be close to the values in the continuum limit.