Πανεπιστήμιο Κύπρου

ΤΜΗΜΑ ΦΥΣΙΚΗΣ

Το Τμήμα Φυσικής του Πανεπιστημίου Κύπρου
σας προσκαλεί το

Σάββατο, 1 Ιουνίου 2019, ώρα 10:00
στην αίθουσα B228, στο κτίριο 13 στην Πανεπιστημιούπολη

στην παρουσίαση της Διδακτορικής Διατριβής του Salvatore Cali

" Model study of charm loop effects "

At present, many lattice simulations of Quantum Chromodynamics (QCD) are carried out using $N_f = 2 + 1$ dynamical light quarks (up, down, strange). This setup has so far provided important results and predictions in Particle Physics and can be considered a good approximation of full QCD at energies much below the charm quark mass. However, a more complete setup would include a dynamical charm quark ($N_f = 2 + 1 + 1$ QCD), since it eliminates systematic effects due to the "quenching" of the charm quark in $N_f = 2+1$ QCD simulations and also leads to a better understanding of charm physics.

In this thesis we want to compute the loop effects due to a dynamical charm quark in QCD. For this purpose, instead of working in full QCD we study a simplified setup. We simulate two theories: $N_f = 0$ QCD and QCD with $N_f= 2$ dynamical quarks at the charm mass. The dynamical charm effects are extracted from the comparison of $N_f = 0$ and $N_f = 2$ QCD. For the lattice discretization we use the Wilson plaquette gauge action and twisted mass Wilson fermions at maximal twist including a non-perturbatively determined clover term. The absence of light quarks allows us to reach extremely fine lattice spacings ($0.017 \text{ fm} \lesssim a \lesssim 0.049 \text{ fm}$), which are crucial for reliable continuum extrapolations.

We compute in the continuum both quantities without an explicit charm-quark dependence, like the static quark potential and the strong coupling derived from the static force, and quantities with an explicit charm-quark dependence, like charmonium masses and decay constants, the hyperfine splitting and the renormalization group invariant quark mass.
For example, for the hyperfine splitting $(m_{J/\psi} - m_{\eta c})/m_{\eta c}$, where $m_{\eta c}$ and $m_{J/\psi}$ denote the masses of the pseudoscalar meson η_c and vector meson J/ψ respectively, we find that the relative effects of a dynamical charm quark are around 2%. In the strong coupling determined from the static force we clearly see the effects of a dynamical charm as soon as the distance r between the static quarks becomes smaller than 0.13 fm.

Για περισσότερες πληροφορίες παρακαλώ επικοινωνείτε: Τμήμα Φυσικής, τηλέφωνο: 22892820