

Computational particle physics with massively parallel cluster PACS-CS

Akira Ukawa

(University of Tsukuba, Center for Computational Sciences, Professor)

【Outline of survey】

We aim to advance studies with full lattice QCD simulation including the vacuum polarization effects of all three light quarks, i.e., up, down, and strange, using the massively parallel cluster computer PACS-CS whose development started in 2005 and is scheduled to go into operation in 2006. Combining the increased computing power provided by PACS-CS with the recent algorithmic advances, we aim to achieve significant progress in the three major issues of lattice QCD, i.e., elucidation of the properties of hadrons and their structure, establishment of the Standard Model including CP violation, and understanding quark gluon plasma at high temperatures and/or densities, thus placing a landmark in the effort toward clarification and establishment of the theory of the strong interactions based on the first principles of QCD which have been pursued since early 1980's.

【Expected results】

We hope to achieve definitive results on the single particle properties of hadrons which include a precision verification of QCD at low energies via detailed calculations of the hadron spectrum, determinations of the light quark masses and the strong coupling constant, which are the fundamental constants of nature, and calculation of hadron matrix elements for precisely constraining the Cabibbo-Kobayashi-Maskawa quark mixing matrix for understanding CP violation in the Standard Model. We also hope to achieve progress in the determination of thermodynamic properties of quark gluon plasma including the transition temperature and the equation of state.

【References by the principal researcher】

- The PACS-CS Project, PACS-CS Collaboration, S. Aoki et al, PoS LAT2005 (2005) 111
- Light hadron spectroscopy with two flavors of dynamical quarks on the lattice, CP-PACS Collaboration, A. Ali Khan et al, Phys. Rev. D65(2002), 054505

【Term of project】 FY2006 - 2010

【Budget allocation】 11,000,000 yen

【Homepage address】

<http://www.ccs.tsukuba.ac.jp/PACS-CS/LQCD/>