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論文審査の要旨及び審査員

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論文審査の要旨（2000 字程度）

Composite nature of hadrons, such as the proton and the pion, can be probed by applying external electromagnetic field and measuring the form factors. Studying the electromagnetic form factors will reveal information about charge and magnetic distributions inside the hadron. Most of the experimental and theoretical efforts on baryon electromagnetic form factors have been focused on the nucleon while the data on charmed sectors is limited to its spectroscopy. Forthcoming experiments with a heavy-hadron physics program at major experimental facilities, e.g. J-PARC, SuperKEKB, BES-III etc., are expected to provide a wealth of information on charmed baryons, which calls for a better understanding of the heavy- sector dynamics from theoretical grounds. In this Thesis, Can, Kadir Utku has applied the numerical simulation method of lattice Quantum Chromodynamics (QCD) and evaluated the electromagnetic form factors and masses of charmed baryons

The thesis, “Electromagnetic Form Factors of Charmed Baryons in Lattice QCD”, consists of 5 chapters. After Chap.1, Introduction, Chap.2 reviews the general formulation of QCD and its properties at low energy. Then lattice QCD formulation is introduced. Lattice QCD requires heavy numerical computations on supercomputers. Basic techniques of lattice QCD, such as discretizing space-time and introducing the gauge field and the other variables, are explained. In particular, the fermions require special treatment on the lattice and the derivation of the quark action in this calculation is explained.

In Chap.3, technical details of the calculation are presented. The author focuses on the baryon masses and the electric and magnetic form factors. Methods for the numerical lattice computation, such as lattice parameter setups, statistical analysis methods, error evaluations, and various improvement techniques, are explained in detail.

Chap.4 is devoted to the results of the calculation and their physical interpretations. The singly-, doubly- and triply-charmed baryons with spin 1/2 and 3/2 are analyzed. The author has found that the masses of charmed baryons are reasonably well reproduced and are in good agreement with the observed masses, when data are available. In the analyses of the electromagnetic form factors, he has, for the first time, resolved the contributions from individual species of quarks, and found that the charm quark has in general smaller spatial distributions compared to the lighter quarks. This results in the conclusion that the charmed baryons are compact objects. The magnetic moments are extracted from the magnetic form factors at the static limit. The results are found to agree qualitatively to the model calculations, such as quark models, while they are significantly underestimated as compared to the model predictions. The electric quadrupole moments revealed a deformation of heavy baryons with spin 3/2, although their absolute values are small. Summary and Conclusions are given in Chap.5.

In all, Can, Kadir Utku has achieved an important development in the study of hadron spectroscopy and structure and has shown his high ability in conducting most advanced scientific researches. The examiners agree unanimously that this thesis fulfills the requirement for the degree Doctor of Science.