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An implementation of hybrid parallel CUDA code for the hyperonic nuclear forces

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We present our recent effort to develop the CUDA code to measure the Nambu-Bethe-Salpeter (NBS) wave function of various baryon-baryon systems on the lattice, which is a primary quantity to make a first-principle calculation of nuclear force and hyperonic-nuclear forces from lattice QCD. Not only the nucleon-nucleon (NN) but also the hyperon-nucleon (YN) and hyperon-hyperon (YY) interactions are fundamental inputs to study the properties of (hyper-)nuclei and the (hyperonic-)matter inside the neutron stars while the present phenomenological YN and YY potentials are not well constrained from experimental data. In the HAL QCD method, which is recently developed to study various interhadron interactions from lattice QCD, the NN, YN and YY potentials can be obtained at the same time by defining the set of interpolating field of baryons. The purpose of this contribution is to present a fast algorithm to calculate a large set of NBS wave functions and its implementation to the heterogeneous system involving GPUs. This is a branched work from the hybrid parallel programming reported in LATTICE 2013 [PoS LATTICE2013 (2014) 426]. A hybrid parallel CUDA code is implemented with utilizing the MPI and OpenMP. The present code works on HA-PACS at University of Tsukuba which comprises 16 CPUs (Intel E5-2670) and 4 GPUs (NVIDIA M2090) per node. We would also like to present preliminary results of YN potentials which is obtained from the 2+1 flavor lattice QCD at almost physical point.

Primary author: Dr NEMURA, Hidekatsu (Center for Computational Sciences, University of Tsukuba)

Co-author: HAL QCD COLLABORATION, for (.)

Presenter: Dr NEMURA, Hidekatsu (Center for Computational Sciences, University of Tsukuba)

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