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A development of an accelerator board dedicated for multi-precision arithmetic operations and its application to Feynman loop integrals II

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Evaluation of a wide variety of Feynman diagrams with multi-loop integrals and physical parameters, and its comparison with high energy experiments are expected to investigate new physics beyond the Standard Model. We have been developing a direct computation method (DCM) of multi-loop integrals of Feynman diagrams. One of the features of our method is that we adopt double exponential (DE) rule for numerical integrations which enables us to evaluate the loop integral with boundary singularities. Other feature is that in order to accelerate the numerical integrations with multi-precision calculations, we develop an accelerator system with Field Programmable Gate Array (FPGA) boards on which processing elements (PE) with dedicated logic for quadruple/hexuple/octuple precision arithmetic operations are implemented. We presented in ACAT 2014 performance results of the small system consists of 4 FPGA boards, and its usability by performing numerical integration of two-loop planar box diagrams. Here we present details of implementation of the dedicated logic on FPGA, our development environment designed for easy use of the system, and the current system consists of 64 FPGA boards. We also present numerical results of higher-loop diagrams performed on our system.

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