Partial wave analysis with OpenAcc
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INTRODUCTION

The generally accepted theory for the strong interaction, quantum chromodynamics (QCD), remains a challenging part of the standard model in the low energy regime. Hadron spectroscopy provide a validation of and valuable input to the quantitative understanding of QCD. Partial wave analysis (PWA) is an important tool in hadron spectroscopy. In PWA, the full kinematic information is used and fitted to a model of the amplitude in a partial wave decomposition. The resonance’s spin-parity, mass, width and decay properties are accurately measured. [1]

The Beijing Spectrometer III (BES-III) is an important particle physics experiment at the Beijing Electron–Positron Collider II (BEPC-II) at the Institute of High Energy Physics (IHEP). The pioneer approach of harnessing GPU parallel acceleration in PWA was performed in the framework of BES-III [2] BES-III developed GPUPWA software framework based on OpenCL. GPUPWA uses the programming language of C++, and its functions of fitting and drawing are realized by ROOT [3]. IHEP has established a GPU High Performance Computing Cluster.

OpenAcc is a programming model that uses high-level compiler directives to expose parallelism in the code and parallelizing compilers to build the code for a variety of parallel accelerators. [4]

OpenACC allows parallel programmers to provide simple hints to the compiler identifying which areas of code to accelerate, without requiring programmers to modify or adapt the underlying code itself. It reinforces the ability of code transplant.

OpenAcc compiler can generate parallel code on different platforms through this high-level programming model, so that the application written by OpenAcc has excellent cross platform performance. It is more convenient to use supercomputing resources. On the other hand, covariant tensor amplitudes of baryon spectroscopy are very complicated. The corresponding performance I

Parameters to be fitted = likelihood fit. In a fit, a maximum of the logarithm of the likelihood, $\ln L = \sum_{i=1}^{N} \ln \left(\text{Prob}(x_i, \theta)\right) = \sum_{i=1}^{N} \ln \left(\frac{d\sigma(E)}{dt} \cdot \Delta \sigma(E)\right)$

$\sum_{i=1}^{N} \left( \sum_{\text{mctcs}} P_{ij} \cdot r_{ij} \right) \cdot \ln \left( \sum_{\text{mctcs}} P_{ij} \cdot r_{ij} \right)$

$\sum_{i=1}^{N} \left( \sum_{\text{mctcs}} P_{ij} \cdot r_{ij} \right)$

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$\sigma$ : total cross section

Conclusions

We have implement the parallelization of OpenAccPWA based on GPUPWA. OpenAccPWA will be further improved:

- Optimize performance and improve program reliability
- Develop a friendly user environment to meet different PWA needs
- To deploy OpenAccPWA on Sunway TaihuLight, another version out of ROOT environment is under development

REFERENCES


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