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A study of dark photon simulation at e+e- colliders based on high performance computing

Because the cross section of dark matter is very small compared to that of the Standard Model (SM), huge amount of simulation is required [1]. Hence, to optimize Central Processing Unit (CPU) time is crucial to increase the efficiency of dark matter research in HEP. In this work, the CPU time was studied using the MadGraph5 as a simulation toolkit for dark matter study at e+e- colliders. The signal process is $e+e- \rightarrow \mu+\mu-A'$ where dark photon (A') decays to dimuon [2]. The results show cross-section depending on center of mass (CM) energy and dark photon mass. We generated the signal MC using MadGraph5 with simplified model which includes dark matter and dark photon as well as the SM particles [3]. For comparison of CPU time of simulation, we used the KISTI-5 supercomputer (Nurion KNL, SKL) and the local Linux machine. Nurion KNL is equipped with processor Intel Xeon Phi 7250 and 68 cores per node. Nurion SKL is equipped with Intel Xeon 6148 and 40 cores per node. The local Linux machine has 32 cores. The theoretical peak performance for the KISTI-5 supercomputer is 25.7 PFLOPS (with the KNL and the SKL corresponding to 25.3 and 0.4 PFLOPS, respectively). We compared wall-clock time with one core or more cores on machines. The results show that the KNL's speed up was the highest speed-up among the three machines on multi jobs. We also examined wall-clock time as the number of jobs increases and compared the efficiency of parallel processing for different machines [4]. The results help to optimize HEP software using high performance computing. This will also provide users with the concept of parallel processing.

References:

- [1] Kihyeon Cho, J. Astron. Space Sci. 34(2) (2017) 153-159.
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- [3] Daniele, et al., Alves, Journal of Physics G: Nuclear and Particle Physics, 39(10) (2012) 105005.
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Significance

Dark matter, which is one of the most important research topic in HEP, requires huge amount of simulation due to the small cross-section of dark matter. Therefore, to optimize the CPU time is important to increase the efficiency of dark matter research in HEP. In this work, we showed the comparison of CPU time between KISTI-5 supercomputer and local machine using specific HEP software. The results of the study will help to optimize HEP software using HPC.

References

- Kihong Park and Kihyeon Cho, J. Astron. Space Sci.35, (2021) 55-63.

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