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A study of dark photon at e+ e- colliders using KISTI-5 supercomputer

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Dark matter is one of the most important challenges of particle physics. One of the ways to research dark matter is to identify dark matter signals in particle collision experiments. However, a large amount of simulation is required due to the very small cross-section and broad parameter space of dark matter. Therefore, it is important to reduce the Central Processing Unit (CPU) time. In order to reduce the CPU time, we have studied CPU time of simulation used for dark matter research using machines.
We have studied a few signal channels of dark photon including A^'⟶μ^+ μ^- at electron-positron colliders using High Energy Physics (HEP) simulations. We have conducted this study in the stand-alone frame using KISTI-5 supercomputer (Nurion) and a local Linux machine. We have included the electron-positron collision experimental energies of Belle II, FCC-ee, CEPC, and ILC. We have generated signal events using MadGraph5 based on the Simplified Model. And the detector simulation of each experiment has been performed through Delphes. Next, physics analysis has been performed using MadAnalysis5. As a result, we have compared the physical quantities of dark photon at the generation level and the reconstruction level. Finally, the detector acceptance for each experiments have been calculated. The CEPC have showed the highest detector acceptance for the signal channel.
We have compared CPU time of simulation using the Nurion and the local machine. Nurion is composed of the KNL, a computational node, and the SKL, a CPU-only node, and both the KNL and the SKL were used in this study. We have compared how much CPU time is reduced when using one node (multiple cores) compared to when using one core by machines. When using multiple cores, CPU time decreased in the order of the KNL, the SKL, and the local Linux machine. In addition, we have compared the CPU time for each machines as the number of jobs increase on one node. As a result, the parallel processing efficiency according to the number of jobs of the Nurion have shown much better performance than that of the local Linux machine.

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