Collider Physics based on e-Science Paradigm of Experiment-Computing-Theory

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Our goal is to study collider physics anytime, anywhere. The current science requires the unified research environment of experiment-computing-theory. Using the 21st century concept of e-Science paradigm, we combine experiment, theory and computing of collider physics for more efficient research process.

Researches in the 21 century are characterized by e-Science. Data centric analysis as a unified concept of experiment-computing-theory has been suggested. However, this concept has not been realized yet. We have realized this e-Science paradigm by constructing the unified research environment of experiment-theory and computing-theory as well as that of experiment-computing performed at KISTI (Korea Institute of Science and Technology Information). We use the fusion concept of collider physics of experiment, theory and computing.

For experiment-theory unified system, we have constructed and utilized the unified research environment of collider physics experiment, phenomenology, and data analysis. We have constructed the Monte Carlo (MC) system used in experimental data analysis and studied phenomenology using the system. We have also designed a future research system applicable to the upcoming collider experiment. We have developed the data handling system for lepton collider experiment (for example, Belle II experiment) using metadata system.

For theory-computing unified system, we have developed a phenomenological analysis technology using supercomputers. We have built up an environment of phenomenological analysis using the fourth generation supercomputer at KISTI. We have developed the parallel and optimization processing of phenomenological analysis codes.

For computing-experiment, we use e-Science research environment. The components of e-Science research environment are data production, data processing and data analysis of collaboration.

As for results, experiment-computing collaboration leads the data handling working group of Belle II experiment at KEK in Japan. As for the Belle II experiment, it is expected that the existing metadata service has problems with performance, scalability, and durability, in particular if it is extended to an event-level metadata searching. Therefore, we have proposed applying AMGA (Arda Metadata catalog for Grid Application) [1] into the metadata service for the Belle II experiment to solve the problems. We have performed the research project with our original and creative ideas at KISTI. Experiment-theory collaboration studies J/ψ polarization measurement by PHENIX international research group and the forward-backward asymmetry of top quark pairs observed at the Tevatron. The one-stop system for data production, processing and analysis increases the research efficiencies. The construction of this kind of new system of experiment, theory and computing of collider physics can provide new research paradigm in other science areas.

In conclusion, we have constructed the e-Science paradigm of experiment, theory and computing of collider physics. Experiment-theory collaborative research provides Higgs search in Tevatron experiment and research on J/ψ in PHENIX and LHC (Large Hadron Collider) experiments. Belle II data handling system utilize it for large collider experiments such as ILC (International Linear Collider). Computing-theory collaborative research provides the extensive use of the KISTI supercomputer in phenomenology calculations of high energy physics and applies the various theoretical models to the Monte Carlo simulation program.

References

[1] AMGA, http://cern.ch/amga .