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ROOT RNTuple and EOS: The Next Generation of Event Data I/O

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For several years, the ROOT team is developing the new RNTuple I/O subsystem in preparation of the next generation of collider experiments. Both HL-LHC and DUNE are expected to start data taking by the end of this decade. They pose unprecedented challenges to event data I/O in terms of data rates, event sizes and event complexity. At the same time, the I/O landscape is getting more diverse. HPC cluster file systems and object stores, NVMe disk cache layers in analysis facilities, and S3 storage on cloud resources are mixing with traditional XRootD-managed spinning disk pools.

The ROOT team will finalize a first production version of the RNTuple binary format by the end of the year. After this point, ROOT will provide backwards compatibility for RNTuple data. This contribution provides an overview of the RNTuple feature set, the related R&D activities, and the long-term vision for RNTuple. We report on performance, interface design, tooling, robustness, integration with experiment frameworks, and validation results as well as recent R&D on parallel reading and writing and exploitation of modern hardware and storage systems. We will give an outlook on possible future features after a first production release.

Collaboratively, the IT and EP departments have launched a formal project within the Research and Computing sector to evaluate the novel data format for physics analysis data utilized in LHC experiments and other fields. This aspect of the project focuses on verifying the scalability of the storage back-end EOS during the migration from TTree to RNTuple, utilizing replicated and erasure coded profiles.

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