

## Physics analysis workflows and pipelines for the HL-LHC

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High Energy Physics analysis workflows commonly used at LHC experiments do not scale to the data volumes expected from the HL-LHC. A rich program of research and development is ongoing to address this challenge, proposing new tools and techniques for user-friendly analysis. The IRIS-HEP Analysis Grand Challenge (AGC) provides an environment for prototyping, studying and improving workflows in the context of a realistic physics analysis. The AGC defines an analysis task, based on publicly available Open Data, which captures the relevant technical requirements and features that physicists need. It furthermore provides a reference implementation that addresses this task.

The IRIS-HEP AGC reference implementation makes use of novel pieces of cyberinfrastructure from the HEP Python ecosystem and is executed on modern analysis facilities (e.g. coffea-casa and others). A coffea-casa analysis facility prototype is used as a testbed for the AGC, offering the possibility for end-users to execute analysis at HL-LHC-scale data volumes. This facility adopts an approach that allows transforming existing facilities (e.g. LHC Tier-2 and Tier-3 sites) into modular systems, using Kubernetes as the enabling technology. Multiple data delivery mechanisms and caching strategies are available for fast and efficient data reduction. This contribution provides an overview of ongoing R&D work, describes the status of the AGC project, and showcases the envisioned analysis workflows and pipelines on analysis facilities.

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