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GELATIO - The GERDA framework for digital signal analysis

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We present the concept, the implementation and the performance of a new software framework developed to provide a flexible and user-friendly environment for advanced analysis and processing of digital signals. The software has been designed to handle the full data analysis flow of GERDA, a low-background experiment which searches for the neutrinoless double beta decay of Ge-76 by using high-purity germanium detectors at the INFN Gran Sasso underground Laboratory. The framework organizes the data into a multi-tier structure, from the raw traces of the Ge detectors up to the condensed analysis parameters, and includes tools and utilities to handle the data stream between the different tiers. It supports a multi-channel modular and flexible analysis, widely customizable by the user either via human-readable initialization files or via a graphical interface. The framework is designed to be solid, maintainable over a long lifetime and scalable to the future phases of the experiment. To ensure flexibility and good computational performances, the framework includes both compiled and interpreted code (C++, Python and Bash). It relies upon ROOT and its extension TAM, which provides compatibility with PROOF, enabling the software to run in parallel on clusters of computers or multi-core machines. The software was tested on different platforms and benchmarked in several GERDA-related applications. A stable version is presently available for the collaboration and it is used to provide the reference analysis of the GERDA data. A few applications of the framework to real GERDA data are presented and discussed.

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