Online Data Analysis and Visualization for Large-Scale Nuclear Spectroscopy Studies

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In large-scale nuclear spectroscopy experiments, real-time access to meaningful, conditionally filtered spectra is crucial for monitoring detector performance, adjusting parameters, and guiding experimental decisions. **GREWARE** is an event-by-event data analysis framework designed specifically for this purpose. It supports online, offline, and near-line processing modes, enabling both live feedback during data taking and full-resolution post-run analysis.

The **GREWARE** system consists of two independent but cooperating components:

- Spy: a dedicated event analysis engine that processes incoming data blocks from the DAQ system, applies detector-specific calibration algorithms, and produces one- and two-dimensional spectra.
- **GREWARE GUI**: a graphical interface used to configure analysis parameters, define and manage user spectra and conditions, and visualize results in real time.

A key innovation is the **incrementer** abstraction - a mapping of internal variables (e.g., calibrated energy, time, position) to user-friendly names, enabling physicists to build custom spectra and logical conditions without coding. Spectra and conditions are described via text files with readable syntax, and are interpreted dynamically by the Spy, eliminating the need for recompilation.

GREWARE has been deployed in numerous international campaigns, including **RISING, PreSPEC** (GSI), **AGATA, GALILEO** (LNL), **EAGLE** (Warsaw University) and **PARIS-KRATTA** (IFJ PAN), where it demonstrated robustness, flexibility, and usability in high-rate, multi-detector environments. This presentation will detail the architecture, workflow, and capabilities of GREWARE, illustrating how its modular design supports advanced visualization and fast, iterative analysis in complex nuclear physics experiments.