A comprehensive approach to gamma and alpha spectrometry data acquisition and analysis is presented through the integration of the LVis laboratory management system with the newly developed **tRAYcy** Monte Carlo simulation code. LVis supports a modular workflow for laboratory operations, incorporating customizable measurement routines, structured data handling within a unified file format, and advanced quality assurance tools. It facilitates both standard and specialized applications, including whole-body counting, automated sample changers, and GMP-compliant workflows, while offering a simplified interface for routine monitoring tasks.

The tRAYcy code, embedded within the LVis platform, implements a multi-threaded ray-tracing Monte Carlo algorithm to simulate detector response functions with high fidelity. It supports geometry and cascade-related corrections, summing effects, and mathematical efficiency calibration, and enables synthetic spectrum generation based on nuclear decay schemes, including α, β, γ, X-ray, and conversion electron emissions. Spectral components are derived using Bateman solutions for activity evolution, and the simulated data can be directly compared with experimental spectra to support quantitative corrections, method validation, and virtual instrument prototyping.

This integrated software environment aims to improve accuracy, reproducibility, and traceability in spectrometric measurements, particularly in applications requiring complex geometry corrections and high-throughput analytical workflows.