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Bluesky NeXus: a solution for NeXus-compliant data acquisition in Bluesky

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Modern scientific experiments require rich, standardized metadata to ensure data is Findable, Accessible, Interoperable, and Reusable (FAIR). The NeXus format—a hierarchical data standard used in neutron, x-ray, and muon science—provides a structured way to organize such metadata, but integrating it automatically into acquisition workflows remains a challenge. We present Bluesky NeXus, a Python package that enables automated, standards-compliant NeXus data generation within Bluesky—a modular Python-based framework for experiment control and data acquisition widely used at synchrotron and neutron facilities.

Users define the desired NeXus structure—including groups, datasets, and attributes—using human-readable configuration files (YAML schemas), which are validated using models defined with Pydantic, a Python library for data validation, to ensure consistency and adherence to NeXus definitions. This enables flexible, user-defined metadata management while preserving data integrity.

Bluesky NeXus gathers static metadata (e.g., equipment setup) and dynamic data (e.g., measurements), consolidating them into a complete NeXus file automatically archived with each experiment. It integrates with deployment tools like the Bluesky container used at BESSY II and supports diverse experimental configurations.

Developed within the ROCK-IT project, Bluesky NeXus streamlines the creation of standardized metadata, advancing the Interoperability and Reusability goals of the FAIR principles.

Footnotes

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