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HELPMI: Helmholtz Laser-Plasma Metadata Initiative

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Metadata is the foremost element in data management strategy when taking account of the F.A.I.R.(findable, accessible, interoperable and reusable) principles, what is becoming increasingly important within the scientific community. Additionally, there is a strong need for better data integration and enrichment in the field of high-intensity laser-plasma physics in an international context: at many laser-plasma (LPA) research labs, experimental data lacks a standardized metadata format and a way to coherently combine and store it.

A reason for this is the various levels of data origins, ranging from calibration data before an experimental campaign, to detector and machine data during the run. In addition, the diagnostic configuration and experimental setup are often subject to changes throughout one campaign, implying consequences on the experimental results and subsequently increasing the complexity of the data. Setting out from this status quo and given their worldwide leading expertise in laser-driven experiments, Helmholtz-Zentrum Dresden –Rossendorf, Helmholtz-Institut Jena and GSI Helmholtzzentrum für Schwerionenforschung have formed HELPMI within HMC to develop a metadata standard for LPA experiment data.

Currently, a standard only exists for LPA simulations, namely the Open Particle Mesh Data (openPMD). openPMD is a hierarchical format, originally developed and mainly used for –but not limited to –laser-plasma simulations. It supports several file formats (HDF5, JSON) as well as streaming techniques (ADIOS) to avoid data rate limitations on high-performance computing systems.

Within the synchrotron radiation and neutron research community, "NeXus is developed as an international standard by scientists and programmers representing major scientific facilities in Europe, Asia, Australia, and North America in order to facilitate greater cooperation in the analysis and visualization of neutron, x-ray, and muon data". NeXus is also a hierarchical data model built on top of HDF5, able to cope with experimental setup geometry description and incrementally adding analysis results to the original (raw) data. In fact, the NeXus base classes form a set of available data structures, whereas the application definitions define rules which classes are mandatory for certain applications. With contributed definitions, further use cases can be defined and tested before review for official implementation.

Thereby it should be possible to make openPMD compatible or interoperable with NeXus, while first maintaining both standards.

Within HELPMI we will examine, based on a real-world data example, how far the NeXus format definitions can carry laser-plasma experimental data, how the standard's structure elements map to domain-specific structures and if there are limitations, requiring an extension of the standard. Additionally, domain-specific terms will be identified and collected into a glossary of laser-plasma experimental data, which will be done in close contact to the LPA community in order to have well-accepted definitions. The resulting glossary or ontology should then be implemented in a both human- and machine-readable fashion.

Therefore, building on analogies to existing standards in similar domains and in close collaboration with the international community, developing a standard within the HELPMI project would enable F.A.I.R. data with easy access, allowing for automated analyses and cross-comparisons in the research field of laser-plasma interaction.

Please assign your contribution to one of the following topics

Technological solutions for findable and machine-readable metadata

Please specify "other" (stakeholder)

In addition please add keywords.

data standard, metadata, Nexus, openPMD

Please assign yourself (presenting author) to one of the stakeholders.

Researchers

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