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Bridging Domain-Specific Data Center and Cross-Domain Metadata Frameworks

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Bridging Domain-Specific Data Center and Cross-Domain Metadata Frameworks
Abstract The KASCADE Cosmic-Ray Data Centre (KCDC) is a domain-specific data provider for high-energy astroparticle physics. Established in 2013, it was among the first platforms to provide full open access to data from the KASCADE and KASCADE-Grande experiments. Over time, KCDC has expanded beyond experimental event data to include simulations, software, documentation, tutorials, and derived data products, reflecting the full digital research lifecycle typical for modern astroparticle physics. Operating KCDC over more than a decade required addressing a broad range of data curation challenges, including the management of heterogeneous digital objects, preservation of experiment-specific knowledge, and provision of sufficient contextual metadata to enable reuse beyond the original collaboration. These experiences have positioned KCDC as an active participant in the FAIR data community within fundamental physics. As a data provider, KCDC contributes to the PUNCH4NFDI (Particles, Universe, NuClei and Hadrons for Nationale Forschungsdaten Infrastruktur), which aims to federate data providers across astro-, astroparticle-, particle-, and nuclear-physics communities within a common Science Data Platform. Within this framework, we work on integrating KCDC digital resources into the PUNCH4NFDI infrastructure, addressing practical challenges related to metadata harmonisation, exposure of diverse data products, and alignment with infrastructure-level discovery and access services. In parallel, lessons learned from KCDC feed into the NAPMIX project, which develops a cross-domain metadata framework for nuclear, particle, and astroparticle physics. NAPMIX focuses on identifying shared metadata layers across disciplines and enabling FAIR data management at a cross-domain level while preserving necessary domain specificity. This contribution illustrates how lessons learned from operating a domain-specific astroparticle physics data centre support both infrastructure-level integration and cross-domain metadata development, highlighting transferable approaches to FAIR data publication.

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