Progress and Challenges during the Development of the Settings Management System for FAIR

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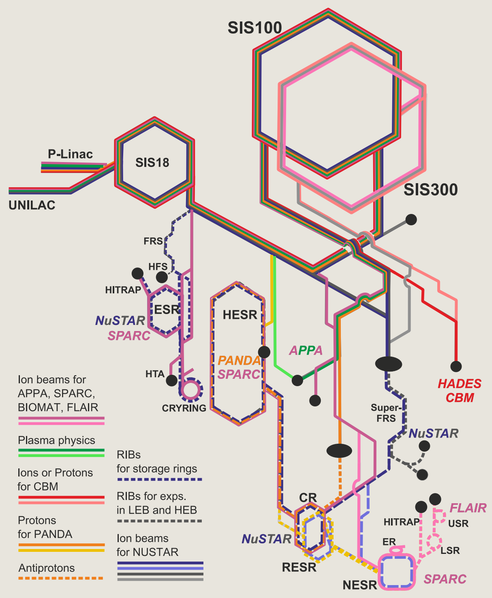
Abstract

A few years into the development of the new control system for FAIR (Facility for Antiproton and Ion Research), a first version of the new settings management system is available. As a basis for the system, the CERN LSA framework (LHC Software Architecture) is being used and enhanced in collaboration between GSI and CERN. New aspects, like flexible cycle lengths, have already been introduced while concepts for other requirements, like parallel beam operation at FAIR, are being developed. At SIS18, the settings management is currently being utilized for testing new machine models with beam and operation modes relevant for FAIR. Based upon this experience, a generic model for ring accelerators has been created that will be used throughout the new facility. This will also be deployed for commissioning and operation of CRYRING by the end of 2014. During development, new challenges came up. To ease collaboration, the LSA code base has been split into common and institute specific modules. An equivalent solution for the database level is still to be found. Another remaining problem is the usage of separate build systems at GSI and CERN that manage dependencies differently. Besides technical issues, a data-driven system like LSA requires high-quality data. To ensure this, organizational processes need to be put in place at GSI.

FAIR Control System Requirements

- **Optimize the number of concurrent research programs**
  - Up to five beams in parallel
  - Pulse-to-pulse switching between different particle types
- **Allow for great flexibility**
  - Change the parallel operation schemes on a daily basis



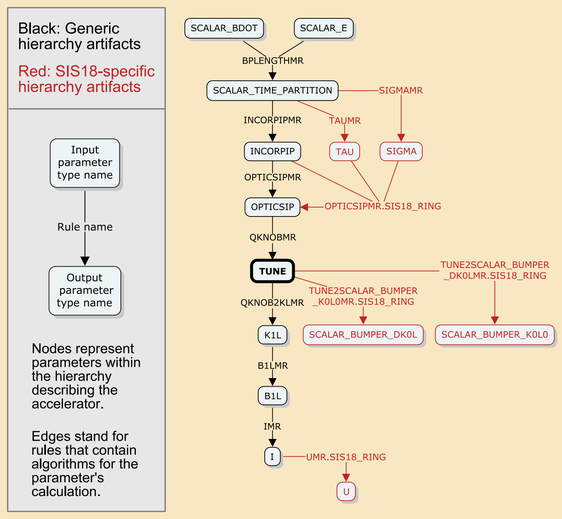
Progress since 2010

- ✓ **LSA framework is now feature-complete for SIS18**
- ✓ **Machine development work carried out for FAIR with SIS18 ring accelerator**
  - Resonance compensation experiments using tune variations at injection and extraction plateaus
  - Commissioning of new H=2 cavity
- ➔ **Several new developments towards FAIR, two major ones described here**

Generic Model for Ring Accelerators

- **Reduce modelling effort**
- **Make machine models and operation processes easier to understand**
- **Modelling accelerators as parameter hierarchies in LSA**
  - Define parameters for accelerator
  - Define relations between parameters
  - “Rule” calculation component associated with each relation

- **A Generic model for ring accelerators as the basis for all synchrotrons and storage rings**
  - Develop a generic hierarchy that is part of each accelerator’s model
  - Reuse rules for calculations in all ring accelerators
  - Add distinctive features of certain accelerators while keeping the generic structure
- ✓ **Less effort for modelling all additional rings**
- ✓ **Increased consistency aids understanding**

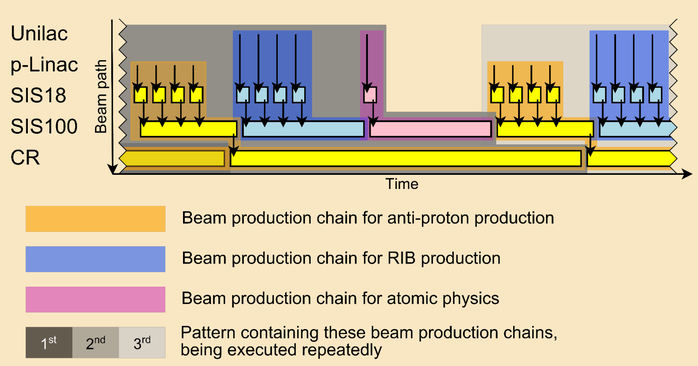


Hierarchy for inputs and outputs of the tune parameter type. Distinctive features of SIS18 added keeping the generic ring accelerator model structure.

Beam Production Chains and Patterns

- **Supply settings for beams across accelerators**
- **Schedule multiple concurrent beams**
- **Accelerator-oriented view in LSA**
  - So far, modelling artefacts were all bound to a specific accelerator
  - Coupling of accelerators is done on a timing system level at CERN

- **Introduce new modelling classes to complement those available in the framework**
  - A beam production chain describes a beam‘s settings for the whole beam path
  - A pattern groups and coordinates beam production chains
- ✓ **Compatible with LSA’s design principles**
  - Beam processes as basic building blocks are also used for beam production chains
  - Choice which modeling classes are used can be taken based upon requirements



Example for parallel beam operation showing aggregation of beam process chains into patterns. HESR accumulating the anti-protons is ommitted.

Collaboration with CERN

- **Enhance LSA for mutual benefit**
- **Use LSA as the core component for settings management @FAIR**
- ➔ **Continues to thrive and mature**
  - Ongoing since 2007
  - Constructive retrospect and good practices extracted (see TCO101)

Remaining difficulties

- ➔ **GSI cannot apply bug fixes to libraries solely owned by CERN**
- ➔ **Use of different build systems causes version numbering inconsistencies**
- ➔ **Institute-specific tables in common database cause issues with queries**

Outlook

- **Use new control system for commissioning of CRYRING in the coming months**
- **Operate CRYRING using beam production chain and pattern concepts**
- **Make operation applications adhere to beam-oriented perspective**
- **Establish processes that ensure data quality**

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