Status of XAL at FRIB

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Michigan State University designs and establishes FRIB as a DOE Office of Science National User Facility in support of the mission of the Office of Nuclear Physics.

Outline

- Usual setup procedure
- Modifications to XAL and Online Model
- XAL configuration files and database
- Benchmark online model
- Lattice/Model database
- ReA3 Tuning Application
- Summary

Set up XAL at FRIB

- Prepared XAL XDXF files from IMPACT file via Matlab
- XAL source code
  - "xal4frib" package in FRIB local CVS repository
  - Branch off xal4lcls
  - Same source code also in SourceForge (xal_frib project)
- XAL source code, compiled JAR files and configuration files saved on shared folder (accessible from both Windows and Linux)
  - Examples/simple scripts for MATLAB and JYTHON

Modifications to XAL/Online Model

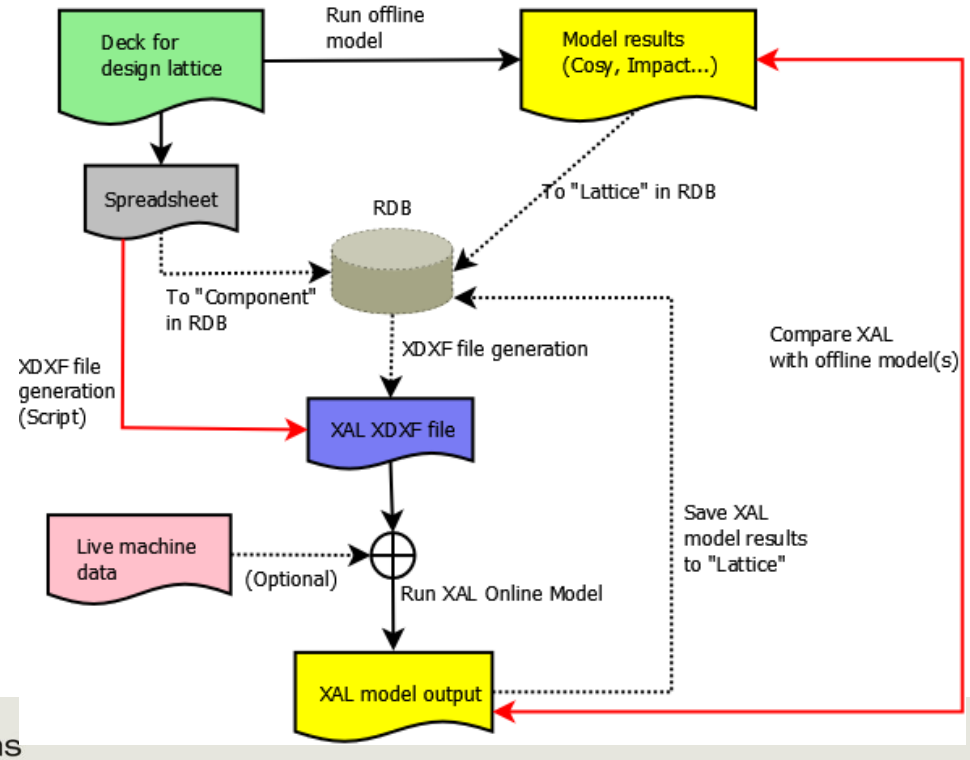
- New device types added:
  - Cylindrical bend
  - Spherical bend
  - Electrostatic dipole
  - Electrostatic quadrupole
- Transfer matrix longitudinal elements modified due to different coordinate system units and reference particle frame

XAL Configuration Files and Database

- XAL initialization files for FRIB linac and ReA3
  - A temporary set generated from physicists' spreadsheets
  - Only design lattice for FRIB, ReA3 file has EPICS PV names
  - Unit conversion such as field vs. integrated field, power supply current vs. field
- Master spreadsheet
- Java program upload the master spreadsheet to RDB
- Java program to generate XAL files from database via RDB data access API (aka "DB2XAL")

Online Model Benchmark [1]

- Join effort with ReA3 and Accelerator Physics Department (thanks to C. Benatti, D. Leitner, M. Syphers, W. Wittmer, X. Wu, Y. Yamazaki, Y. Zhang, Q. Zhao)
- Compare with other codes
  - COSY (matrix based)
  - IMPACT (multi-particle tracking)
- Comparison
  - Scripts to extract model data
  - Same initial beam conditions
  - Compare individual device types
  - Compare beamlines

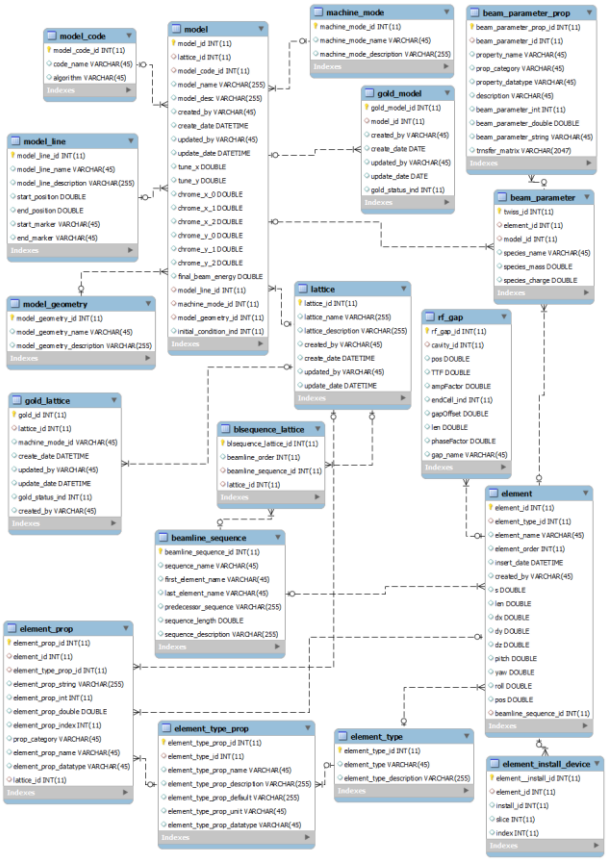


Online Model Benchmark [2]

- Compare individual devices
  - Focus
    - » Quad – magnetic, electrostatic
    - » Solenoid
    - » Sextupole
  - Bend
    - » Spherical Bend
    - » Cylindrical Bend
  - Accelerate
    - » Cavity – single-gap, multi-gap
  - All 6x6 matrices agreed between XAL and COSY
- Beam parameters to compare
  - Energy
  - 6x6 Transfer Matrix
  - Phase space coordinates, Twiss parameters (α,β,ε)
  - Phase advance, Dispersion, Chromaticity

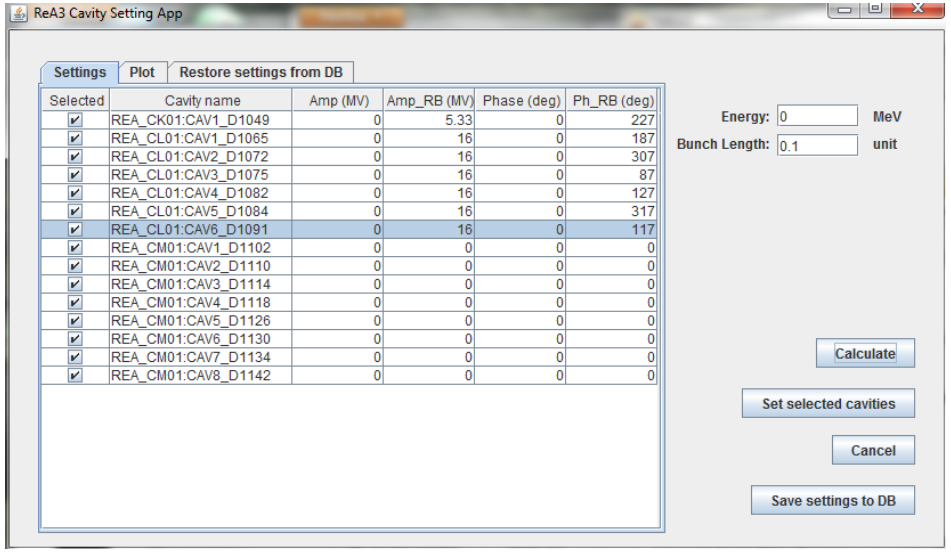
Lattice/Model Database Design

- Model database for storing model run input and output data
- Based on SLAC/LCLS XAL Machine_Model and IRMIS 3 Schemas
- Loosely coupled to rest of global DB
- General lattice/model data holder
  - Prototype with FRIB official expanded lattice
- Modes support:
  - Design
  - Live machine
  - User-defined
  - Other
- Code independent
- Collaboration with BNL



ReA3 Physics Applications

- Cavity Setting App
  - Based on desired energy, calculate cavity amplitude (all cavities set to the same amplitude)
  - Based on TOF, calculate cavity phases
  - Testing with Virtual Accelerator
    - » Read-only mode with real machine
  - Unable to fully test due to low-level issues
- ReA3 model fitting
  - Solenoid strengths in doubt
  - Need beam time for further tests



Summary

- XAL deployed at FRIB
  - Site specific patches added
  - Initialization files for FRIB, ReA3
- XAL Online Model benchmarked with IMPACT, COSY
  - Online model certified and ready for ReA3 machine
- ReA3 applications prototyped
  - Preliminary program with GUI developed
  - Further algorithms will be added in the future
- Related database schemas prototyped
  - Device/Component (Lattice), and Model data
  - Database access API near completion
- Near future plan
  - Validate FRIB Linac data with XAL files generated from RDB