HEST upgrade towards beam time 2018

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During the 2-year shutdown from July 2016 till May 2018, GSI machines went through a series of modifications in order to renovate the accelerator chain and prepare it for operation with FAIR machines [1]. The High Energy Transfer Lines (Hochenergie-Strahlführung, HEST) transport the beams from the SIS18 synchrotron to experimental caves and storage rings. The schematic of HEST is shown in Fig. 1. The main shutdown works were: preparation of HADES beam line to high intensity operation [2], modification of HTD beam line and Cave C to accomodate mini-CBM [3], modernisation of ion getter pump controllers with the goal to improve performance of the vacuum system and change of the accelerator control system, which is described here.

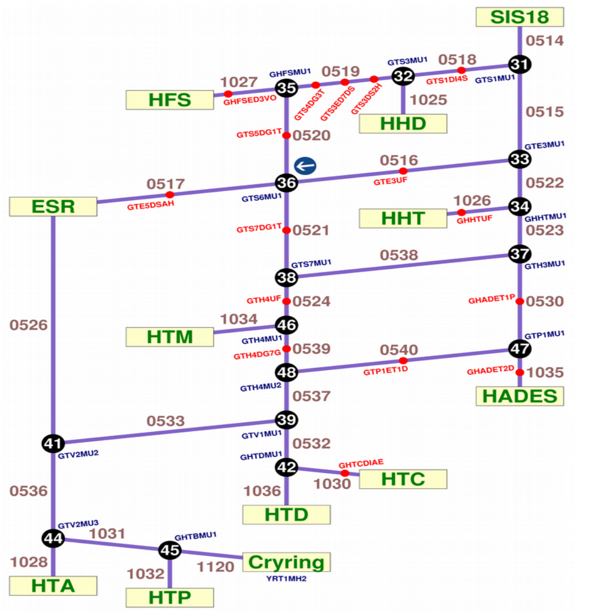

Figure 1: Diagram of HEST "accelerator zones" from control system perspective.

The old accelerator control system contained magnet settings generated by MIRKO beam optics program. For HEST about 20 of such "theory" optics were prepared. During the operation, corrections to those settings are applied in order to optimize beam properties. Those corrected settings were stored in special files (called IBHS files, from the name of the old program). Several thousands of these files were generated over the decades of operation of GSI machines.

The old control system was based on OpenVMS system and suffered from limitations which had to be overcome for FAIR operation. As a successor, the LHC Software Architecture (LSA) setting management system has been chosen [4]. LSA has a hierarchical structure, it is flexible, modular and uses modern technologies (OO, Oracle DB, Java). In addition, also equipment control layer (FESA), timing system and electronic control units have been replaced.

Hierarchy generation is an essential task of the HEST machine modelling. It is realized by generic coding strategies, based both on Python and JSON. The implemented hierarchies allow for propagation of physics parameters (e.g., dipole and/or quadrupole field strengths) to hardware parameters (e.g., currents for power supply units).

LSA stores the setting of device parameters in database tables. In order to reproduce the old system functionality, the information about beam optics setting must be transferred to LSA. The import functions require specific type of text files to be generated. Those files contain integrated strengths of the optical elements as well as Twiss parameters along the beamline.

The strategy adapted to fulfil this task is the following:

1. Execute MIRKO for each optics, generate Twiss files.
2. Convert MIRKO optics to MAD-X, run MAD-X, assure its agreement with MIRKO results.
3. Use Twiss files and information about accelerator zones to generate input for LSA using Python scripts.
4. Import files to LSA verifying consistency of the data.

Resulting LSA setting were tested during Dry Runs.

The second task is to provide data from IBHS files for trimming the optics. A Python script has been prepared which converts the IBHS format to format of the files which can be imported into trim application.

References

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[3] C.Sturm et al. for the CBM Collaboration, CBM Progress Report 2017, DOI 10.15120/GSI-2018-00485
[4] G. Kruk et al.,"LHC Software Architecture LSA – Evolution Toward LHC Beam Commissioning", ICALEPCS'07.

Experiment beamline: SIS18-CaveA / SIS18-CaveM / mCBM@SIS18 / FRS / HADES / R3B / SIS18-other
Accelerator infrastructure: HEST

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