TUPV047

CONTROLLING THE CERN EXPERIMENTAL AREA BEAMS

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Introduction

Abstract

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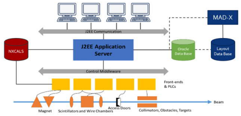
CESAR is based on Java and constructed around an ORACLE database. It acquires and sets so-called equipment knobs, mainly by subscribing to the Front-End Software Architecture FESA device. In addition, it receives information from other services such as from the access system database (Access-DB) , via DIP (Data Interchange Protocol), and the data logging system NXCALS. All devices are identified in the CESAR database together with their parameters, such as FESA name, element type, beam line, and others. This allows flexible modifications as often needed in secondary beam lines



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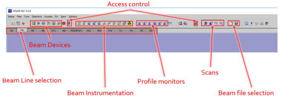

CESAR Interface

Interface

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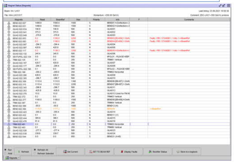
CESAR Device Control

Magnets

In the magnets status panel, all magnets of the selected beam line are displayed together with their main parameters. There is the possibility to set and read the ap-plied current values for each of the magnets and reference values can be defined in addition. This reference allows to go back to previous configurations, e.g. when steering the beam. CESAR also displays magnet faults together with the specific fault type, e.g. overheating



Magnets Status (You can see the display of faults in red colour)

Collimator

For collimator settings, each of the motors moving individual jaws is controlled. Collimators with four jaws are considered as two different entities, one vertical and one horizontal, for a better overview. They are used for changing intensity, shape, and energy spread of a beam. Similar to the magnet settings, one can set reference values for each of them, as can be seen

Collimators Status

Obstacles

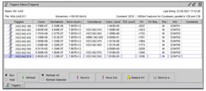
In order to create and absorb different particles types as well as for creating tertiary beams, different materials (``obstacles'') can be placed in the beam. The Obstacles Command allows the users to control the position of each device and to add or remove different kinds of material automatically as these devices are motorised. The positions are all entered in the CESAR DB, so one can directly select the desired obstacle to be placed and keep a reference, as well.

Obstacles Status

Beam Instrumentation and Scan

Scintillators

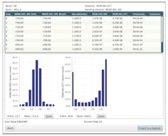
The trigger status displays counts from each scintillator along the selected beam line. In addition, it calculates 'normalised counts', which are normalised to the beam intensity on the upstream primary target in order to avoid fluctuations coming from the primary beam. As they are motorised, scintillators can be moved out of beam on demand, e.g. to reduce absorption for low-momentum electrons. Furthermore, in each control room, users can connect their discriminated NIM detector signals to scaler units, which are then displayed on CESAR and allow beam operators to scan and set the beam position for a maximum number of counts



Scintillators Status

Scan

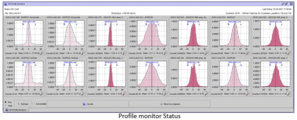
CESAR offers the possibility to perform scans on any beam device and instrumentation. One can select the control element (e.g. magnet or collimator) and the instrumentation to perform a scan between certain values in selected steps. The scan will go through all preset values and plot the detector reading as a function of scanned parameter, e.g. a magnet current as depicted below. This needed allows to maximise transmission through a beam line or to find the position of a user detector without the need of survey in the zone. FISC scans can be performed in different modes, i.e. one position per extraction or in a fast mode for a complete scan during one extraction. There are different expert modes in addition, for instance to scan the beam divergence between two FISC monitors



Scan Result

Profile Monitor

CESAR displays beam profiles along the beam lines independent of the type of monitors that are used. Typical monitor types are analogue MWPCs, delay wire chambers and scintillating fibre monitors (XBPF). CESAR provides count rates from each monitor as well as calculated mean values of the profile distribution. As for the scintillators, some of the monitors can be moved out of the beam. Voltage settings can be adjusted by the operators for an optimal dynamic range.



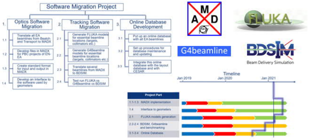
Profile monitor Status

Software Migration Update and CESAR Future

Software Migration Project

The Software Migration project has been instated with the goal of modernisation of the offline software used for the description and design of the secondary beamlines at CERN, employed by the BE-EA-LE Section. A migration of the complete software chain used for the design of the secondary beamlines in both CERN North and East Areas has been performed. The new baseline consists of MADX for beam optics and survey calculations, the in-house developed software AppLE.py for graphical output and matching as well as FLUKA, BDSIM and Geant4 for beam-matter interactions. The solution has been validated with the help of benchmark studies and a test of the complete software chain. It is planned to use the software in a highly integrated way, utilising the modern online database tools available at CERN, such as Layout Database and GitLab.

The new software has become the baseline for Run 3 (2021-2025), which is expected to allow the final validation of its practicability and to reveal some aspects requiring improvement. While the major migration work has been completed according to the initial project plan, the work on the adaptation of the software chain to the evolving software infrastructure at CERN as well as the integration of the beamlines into the Layout Database, the benchmarking studies and work on further automatisation are foreseen to continue during Run 3 and beyond.



Tests and Validation

The aforementioned tools have been tested individually. In order to assure smooth interfaces between the tools, a major part of the new software chain has been tested on a hardware modification on the North Area beamline K12. This modification consisted of moving several bending magnets and installing new detectors for the NA62 experiment. The following steps have been undertaken for the test:

(1) BEATCH files for the configurations of 2018 and 2021 have been forwarded to the EA configuration managers.
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Many of the use cases for the new software chain will be tested now thanks to the restart of beams after LS2. A large share of the North Area beamlines has still to be implemented into the Layout Database, which is planned to be completed by the end of 2021.

CESAR Future

The most important aspect from the configuration management point-of-view will be the connection of CESAR to the newly commissioned beam software. The project is on a good track and several new features for CESAR have been already developed, such as the Apple.py-to-CESAR conversion and the automatic layout update with the Layout Data Base. We are thankful for the plenitude of ideas reaching us from the user community and from the recently established North Area Consolidation Project, which are evaluated at the moment. A frequently wished for item is establishing an Application Programming Interface (API) for CESAR, permitting Super Users to access the CESAR functionality from within scripts. This would allow to automatise even complicated steps for beam tuning with direct feedback from the beam instrumentation. In addition, connecting CESAR to the NXCALS logging service will allow users to retrieve recorded values of any device in convenient way. Thinking further ahead, integrating fault reporting into CESAR, e.g. with the already existing Automatic Fault System AFT, will improve reliability analyses and save time of the operators.

In addition, the new CERN GUI Strategy working group currently reviews the existing GUI systems with the aim of streamlining and easier maintainability. This is a good opportunity to improve the graphical interface and to explore possible synergies with the other control systems of CERN, for instance by adding some useful features that have been developed for accelerator controls.

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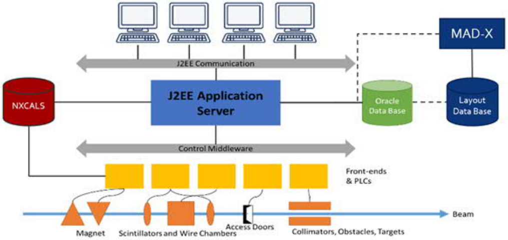

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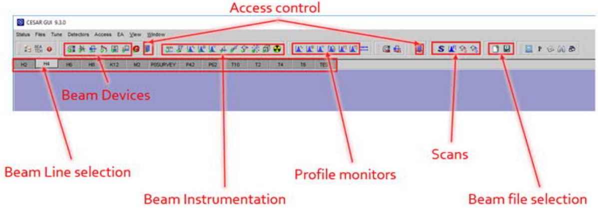

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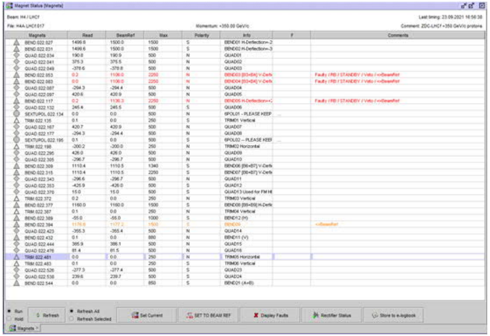

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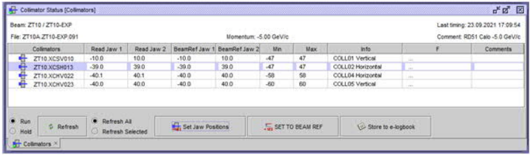

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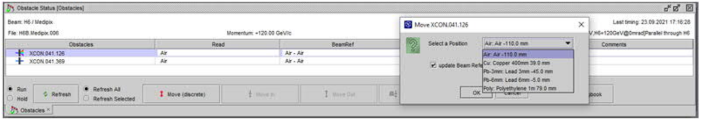

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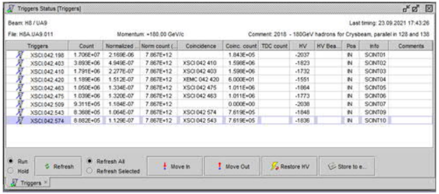

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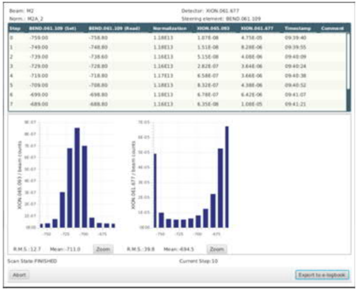

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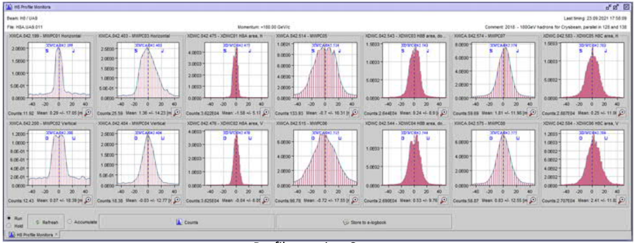

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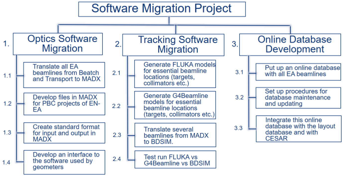
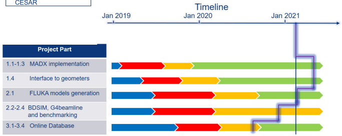


G4beamline

Beam Delivery Simulation



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