SOFTWARE APPLICATIONS FOR BEAM TRACEABILITY AND MACHINE DOCUMENTATION

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Abstract

The ISOLDE facility at CERN, requires a wide variety of software applications to ensure maximum productivity. It will be further enforced by two new applications; Automatic Save After set uP (ASAP) and Fast Beam Investigation (FBI). ASAP saves crucial time for the Engineers In Charge (EIC) during the physics campaign. It automatizes and standardizes a repetitive process.
FBI will be serving two different needs. First, it will be used as a beam traceability tool. The settings of every element of ISOLDE that could obstruct, stop or affect the beam will be tracked by the application. The second functionality will allow real time monitoring of the machine status during a physics run. Finally, an application has been developed to automatize with flexibility a sequence of pre-defined assignments, such as performing a measurement and setting a value to a device.

Introduction

ISOLDE is one of the leading research facilities in the field of nuclear physics. The latest addition, HIE-ISOLDE increased the demand for beam time to conduct experiments. In such a demanding environment time is crucial. Even a few minutes gained from a repetitive task can account for hours gained within a year. These hours could be allocated in any other more productive manner. The three applications presented in this paper were conceived mainly with this achievement in mind. How to gain time and be more efficient. ASAP reduces the time the EIC is required to perform the task mentioned above, that takes place a minimum of once a week. FBI will contribute in efficiently resolving issues that hinder the users from receiving beam. The principle and assignment possibilities of the Automation application will also be described.

Automatic Save After Set-up

For each new set up, the EIC is required to document the settings of all important elements, before delivering beam to the users. The reasons behind this are: a) to ensure that the facility can be restored to an known and approved state, in the case of an unexpected event (e.g. power cut). b) Having stored the state of the machine, allows more easily to discover possible drifts in parts of the machine, which would lead in loss in transmission efficiency.

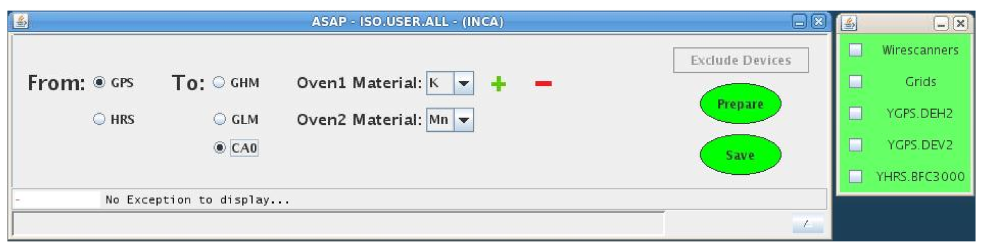

Figure 1: ASAP main panel with the excluded devices window open.

Once the beam set up is concluded, the path of the beam needs to be selected and the "prepare" button as seen in Figure 1, should be pressed. ASAP then retrieves the current values for all devices and automatically creates a csv file which can be utilised for the two points mentioned above. ASAP will also calculate the transmission between Faraday cups and assist in taking screenshots of every relevant beam diagnostics device. An automated entry in the logbook will be created following a template. For the next phase of the project, ASAP will include the remaining parts of the facility (REX-TRAP, REX-EBIS, REX/Hie-linac)

Automated Processes

This application as seen on Figure 2, serves the purpose of automatizing sequences of actions with flexibility. An input text file describes the scripting of the tasks or assignments to achieve. The list of possible tasks can be grouped in three categories: simple tasks of communication to a device for setting or getting a value, more complex tasks requiring several iterations or graphic representations and tasks related to the algorithmic of the scripting.

Table 1: Basic Tasks

Tasks	Description
FC	Inserts and measures or retracts a Faraday Cup
QP	Quadrupole set value or get data
STEERER	Steerer set value or acquire data
SET	Set value of specified device URL
GET	Get value of specified device URL

The first category of basic tasks, as seen in Table 1, includes several predefined communication modes with quadrupoles, Faraday cups and steerers.

Table 2: Complex tasks

Tasks	Description
SLITSCAN	Beam profile using a moving slit and Faraday cup or Silicon detector
MAGNET	HIE magnets scan with Faraday cup or Silicon detector acquisition
MASSSCAN	REX separator magnet mass scan with Faraday cup acquisition
OPTICS	Measurement of all the optics elements values of HIE/REX-ISOLDE

The second category as seen on Table 2, includes more complex operations. As an example the task called "SLITSCAN" performs a transverse profiling of the beam with a chosen slit and a selected Faraday cup or a Silicon detector.

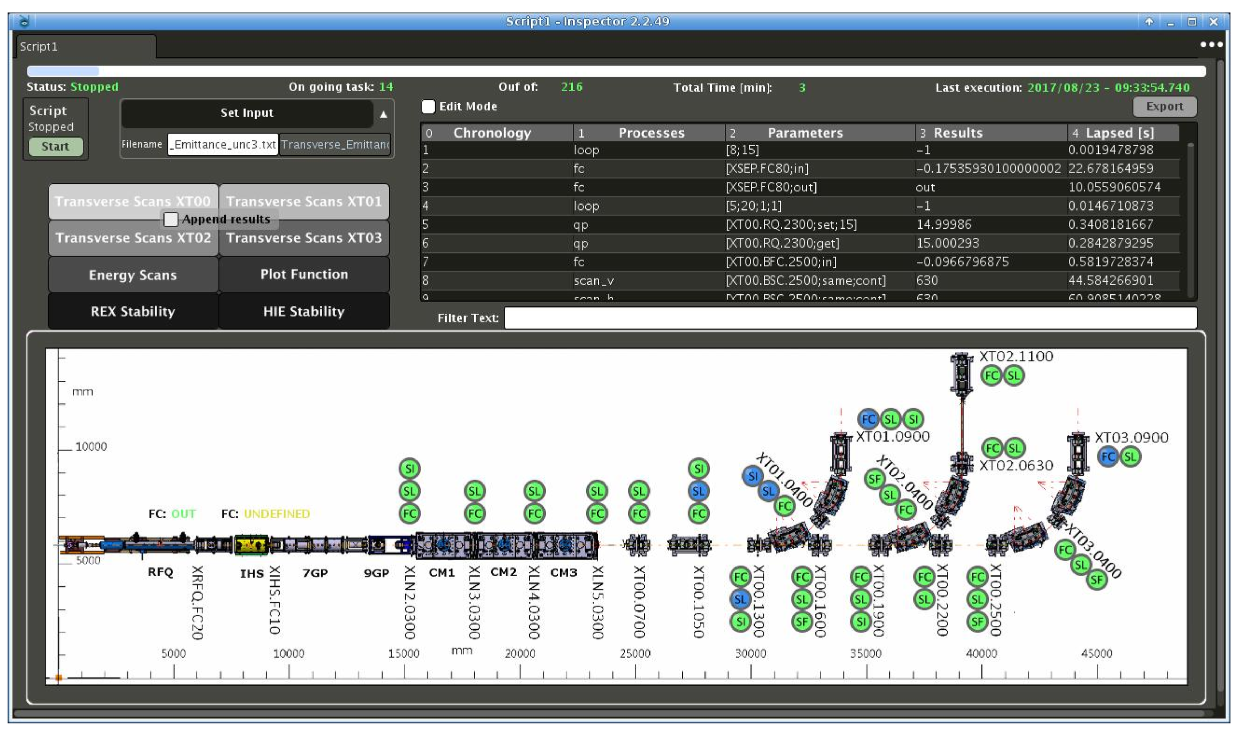

Figure 2: Automation process application main panel, showing the REX/HIE-ISOLDE linac and High Energy Beam Transfer(HEBT) Lines.

Fast Beam Investigation

The beam accounting functionality of the FBI, will allow to understand better the presence of radioactive contaminants after each experiment at critical points in the facility. The second functionality, beam traceability, will be the most efficient way to visualize the status of the machine and realise the reason that prevents the beam from reaching the experimental station.

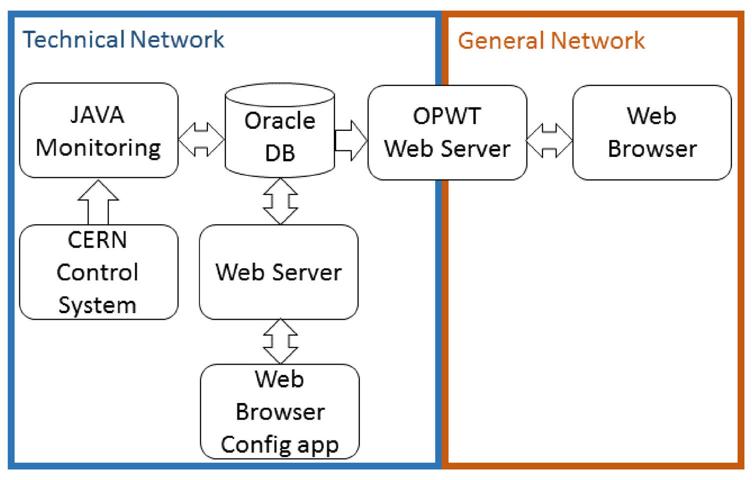

Figure 3: Each component of the FBI project and their connections.

A JAVA application running on a Linux machine on the Technical Network(TN) will monitor a defined list of parameters and log their values in a table in an ORACLE database. The list of parameters to be monitored together with their reference and some extra information is also stored in a configuration table in the same database. The JAVA application is notified every time a parameter is added or removed from the configuration table and is able to start and stop subscriptions without the necessity to interrupt and restart the monitoring process. A diagram showing the respective parts and their communication can be seen in Figure 3.

The front-end client is based on the Vue.js framework. The user interface has one view per section of the machine, each containing a simplified layout as an SVG file, that can easily be acted on (change colour of element to match its status) with javascript. The status of each element is computed on the server side, based on the reference value stored in the database and a series of logical conditions, configurable via the configuration application.

A draft version of the user interface is depicted in Figure 4. As an example, in the REX/HIE-ISOLDE tab one can see: REX-TRAP, REX-EBIS, and the REX/HIE-ISOLDE linac with the HEBT lines. Information about the type beam will be provided as well. The evolution of the value of a device can be shown on the graph.

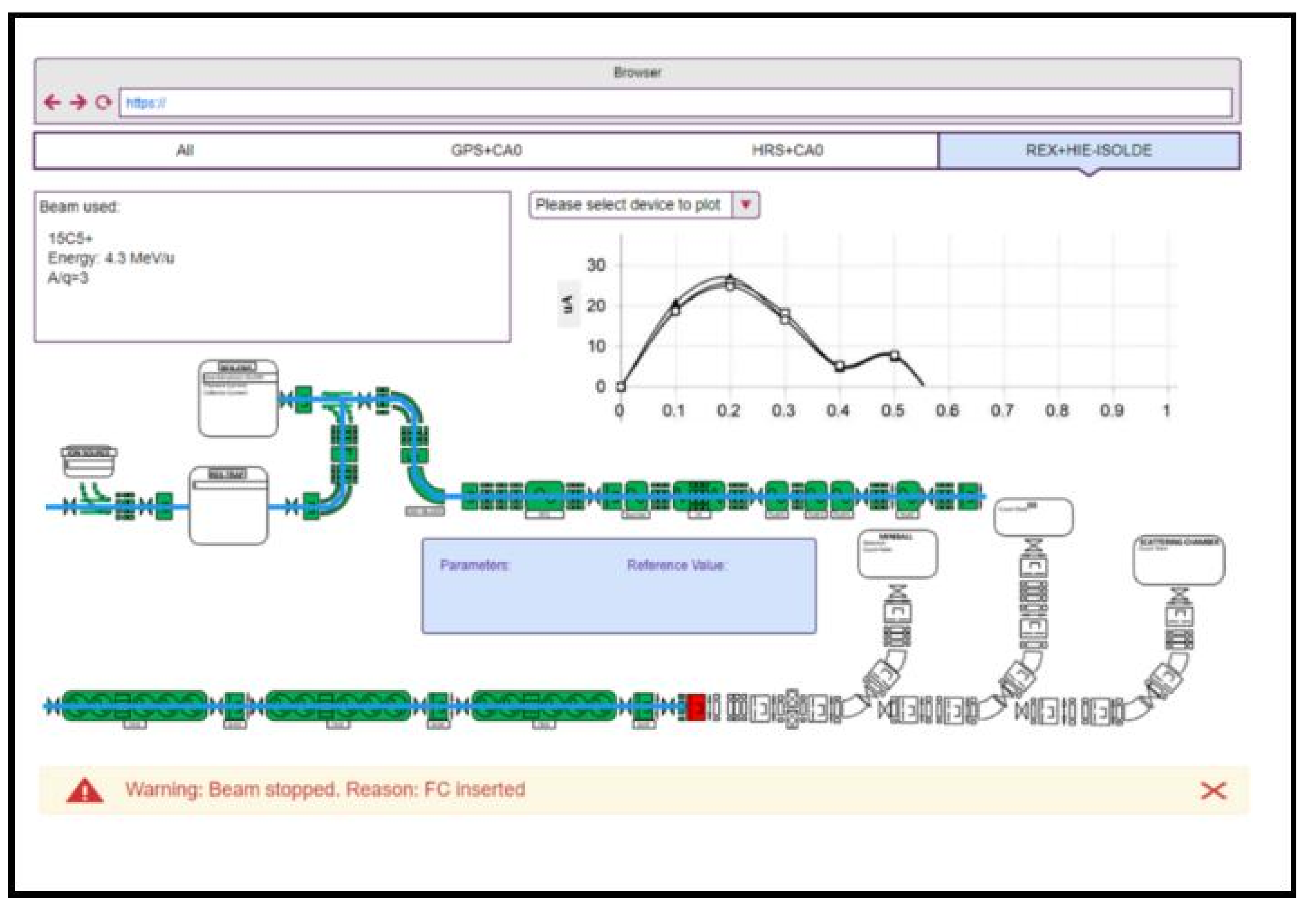

Figure 4: A draft design of the web application of FBI.

Conclusion

ISOLDE in 2017 celebrates 50 years of experiments at CERN. A great part of this continuous operation is the fact that the facility is constantly upgrading its infrastructure. The last example is the addition of HIE-ISOLDE. Part of the infrastructure is the software used to operate the facility. With the applications described in this paper, operations will be reinforced with additional tools. ASAP and automation application, will standardise a repetitive procedure. FBI will make more evident any issue that might occur with the facility. This will potentially minimise the response time and even proactively diagnose and solve issues in parts of the machine that are not part of the current path to deliver beam to an experimental station.