ISOLDE's latest upgrades

E. Fadakis et al., CERN, Switzerland

Abstract

The Isotope Separator On Line (ISOLDE) in 2017, celebrated 50 years of delivering beam to users. In the ISOLDE collaboration there are 15 countries and 500 users from 100 institutes. More than 50 experiments per year take place which translates to approximately 430 shifts of radioactive ions beam. The facility has the capability of delivering beam to multiple experimental stations at the same time. 6 machine supervisors are responsible for the facility and to set-up and provide un-interrupted beam to users. Responsibility of the facility is in weekly rotation, from beam commissioning until the end of the physics campaign. Outside working hours the machine supervisor is on call. During low energy set up, one machine supervisor is sufficient to promptly provide beam. When a REX/HIE-ISOLDE experiment is being prepared a minimum of two people are required.

Introduction

ISOLDE is one of the leading research facilities in the field of nuclear physics. Radioactive Ion Beams (RIBs) are produced when 1.4 GeV protons impact in a target.
The RIB of interest is extracted and transported to different experimental stations either directly or after being accelerated in the post-accelerator. In the latter, RIBs are transported to the REX-TRAP, charge-bred in the REX-EBIS and accelerated to 2.85 MeV/u in the REX normal conducting section of the linac before being accelerated further (7.3 MeV/u for beams with A/q = 4.5 and to 11 MeV/u for A/q = 2.5) in the HIE-ISOLDE superconducting section of the linac. With more demanding physics schedule, the need to even faster diagnose potential issues becomes more important. At ISOLDE a new tool has been developed to augment the diagnostics capabilities of machine supervisors and users in order to maximize physics time.

REX/HIE-ISOLDE 3D layout

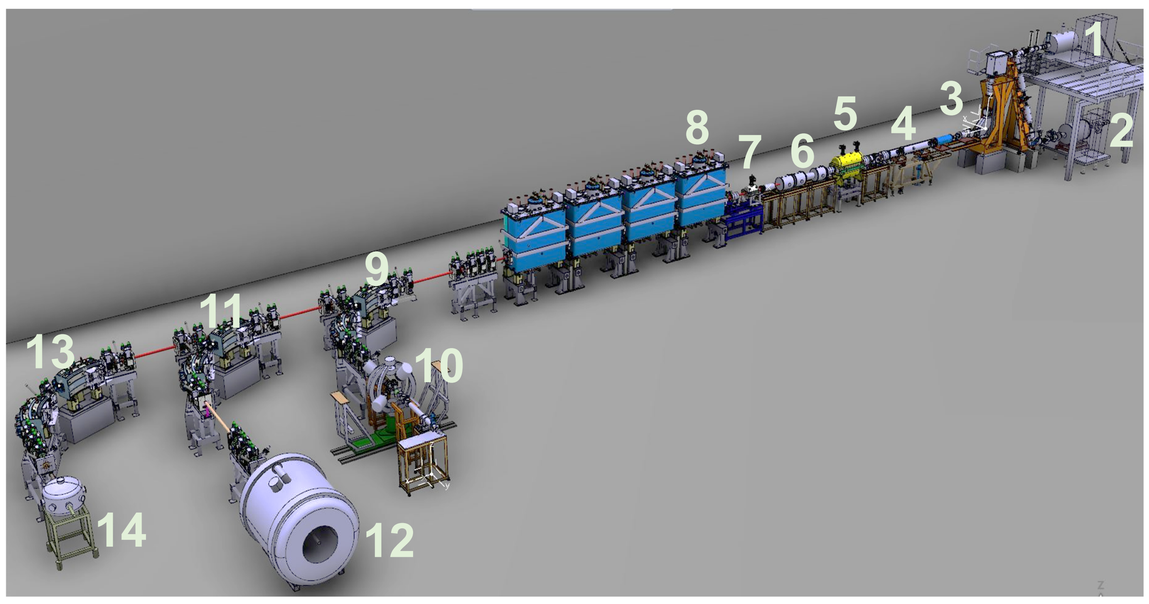


Figure 1: The REX/HIE-ISOLDE post accelerator and HEBT lines.

Picture 1: The view inside the HIE tunnel.

In the 3D drawing on the left (figure 1), one can see from right to left the REX normal conducting accelerator and following the HIE-ISOLDE superconducting accelerator with the 3 high energy beam transfer lines. The individual devices as numerated are:

1) REX-EBIS
2) REX-TRAP
3) REX Separator
4) RFQ
5) IHS
6) 7-GAP Resonator
7) 9-GAP Resonator
8) The first out of 4 in a row superconducting cryomodules. Real view in Picture 1
9) A dipole which either allows the beam further into the transfer line or bents it towards the 1st experimental station
10) The Miniball experiment
11) A dipole which either allows the beam further into the transfer line or bents it towards the 2nd experimental station
12) The ISOLDE Solenoid Spectrometer (ISS)
13) A dipole bending the beam to the 3rd and final experimental station
14) Scattering experiments

REX/HIE-ISOLDE as a Fast Beam Investigation view

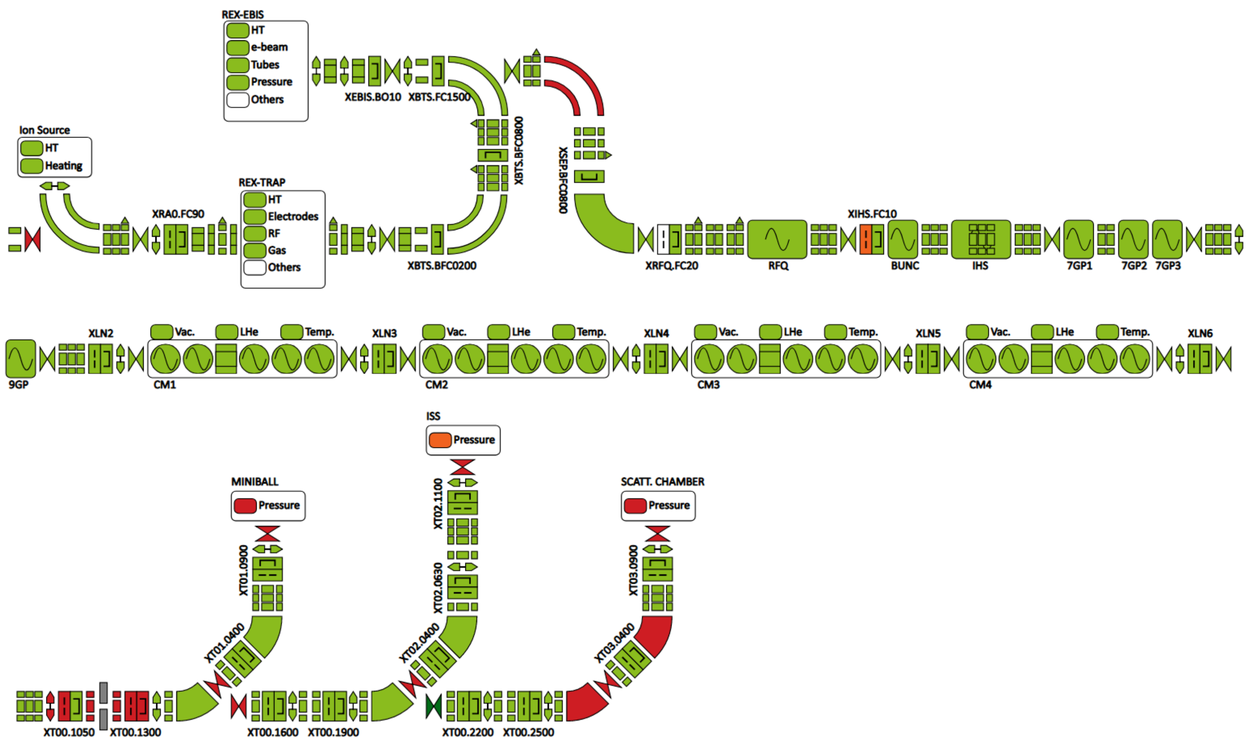


Figure 2: The "view" from a web browser depicting the state of the REX/HIE-ISOLDE post accelerator.

The Fast Beam Investigation(FBI) is a new project created to satisfy two different requests. One to simplify the monitoring of the facility. Second, to provide beam accountability for the radio protection group. The project consists of a number of applications, all interacting with an Oracle database.

The project functions by storing and updating every few seconds, values of all devices within the facility, as well as the reference (expected) value for each device. The values are then compared based on predefined equations and displayed in a web application providing users with an overview of the entire beamline. Devices that can even slightly stop or deviate the beam are being monitored.
As an example, if a Faraday cup is inserted, it will appear in red on the view in Figure 2. The tool stores these information to keep track of the history of each of those devices. One can perform post mortem analysis and retrieve information about any device that blocked the beam and for how long. Information about the type of the beam are also provided.

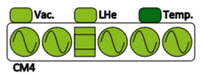
The FBI tool was created with expandability in mind. Users can configure the tool to monitor any amount of devices and provide the comparison equations in order to calculate the status. All information are inserted into a dedicated database using a JSON format text file. The icons themselves are created with information inserted into the same file. Users can create their own set of icons.

Providing these information in the web application means that they are accessible on any browser on the internet, even from a mobile phone.

REX/HIE-ISOLDE Linac view icons explanation

REX Separator(in fault)

REX Amplifiers



HIE Cryomodule with 5 SRF cavities, 1 SC Solenoid and on the top 3 boxes for Vacuum, Lhe and Temperature levels.

Dipole(in fault)

Bender

Quadrupole

Beam diagnostics box with a scanning slit and a Faraday cup .

Vacuum valve

Conclusion

ISOLDE remains one of the leading ISOL facilities in the world. A great part of this successful and long running operation is due to the infrastructure upgrades that enable it to expand the physics possibilities. Upgrades are mostly hardware based which also requires new software to be developed. HIE-ISOLDE will not be the last upgrade ISOLDE will profit from.

The operations team of ISOLDE is responsible not only to set-up and provide beam but also to understand, diagnose and solve any potential issues. The Fast Beam Investigation will make more evident any issue that might occur within the facility. This will minimise the response time and even proactively diagnose and solve issues in segments of the machine that are not part of the current beam delivery path to an experimental station.