



The HIE-ISOLDE Design Study

Richard Catherall
ISOLDE Technical Coordinator
CATHI Final Review Meeting
Marina H10 Hotel, Barcelona
22nd – 26th September 2014



The Report

- A detailed account of the approaches to address:
 - the issues associated with an upgrade of primary beam intensity and energy
 - the necessary upgrades required for an improvement in secondary beam quality
- A description of the most appropriate solution
- Approximate cost estimate and eventual timeline for its implementation



Overall Layout

- Title page
- *Foreword*
- *Participating members*
 - *Associated partners*
 - *Collaborating institutes etc*
- *Steering committee*
- *International Advisory Panel*
- *Management Board*
- *Design Study Members*
- *Preface*
- Contents
- Executive Summary
- Introduction and Objectives
- Section 1 Infrastructure
- Section 2 Beam Quality Upgrade
- Section 3 Target Issues
- Section 4 Operations
- Section 5 Radioprotection and Safety Summary
- Section 6 cost and planning summary
- Conclusion
- *List of publications associated with DS*





Section 1: Infrastructure Upgrade Section

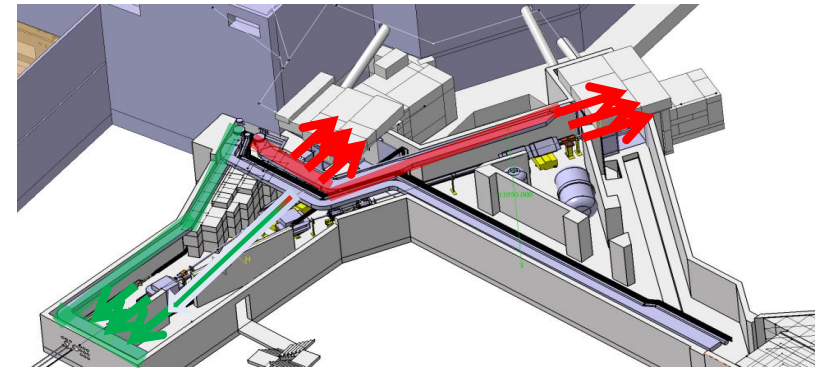


- Cooling and Ventilation
 - **Andrea Polato**, Michele Battestin
- Vacuum
 - **Mario Hermann**, Giovanna Vandoni, Maddalena Maietta, Tim Giles, Irina Graur
- Beam dumps
 - Valentina Venturi, Antonio Perillo Marcone
- Fluka simulations and radiation protection
 - **Leonel Morejon**, Vasilis Vlachoudis, Joachim Vollaire
- Interfaces
 - Robots, MEDICIS, infrastructure
 - Richard

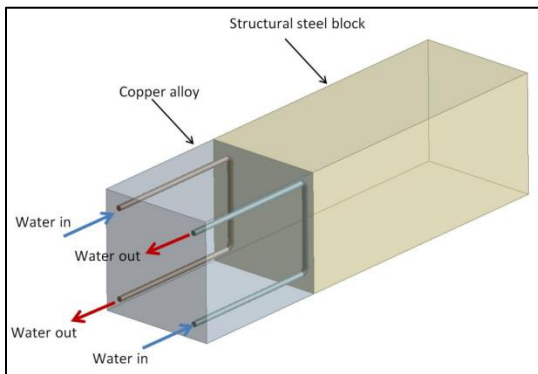
Section 1: Ventilation

See presentation by Andrea Polato

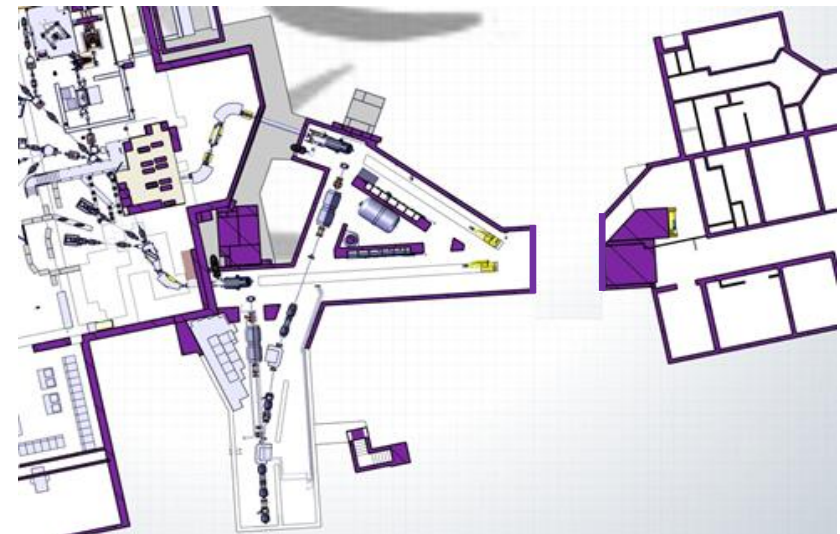
- ISOLDE tunnel vs Class A laboratories
- ISOLDE tunnel confinement
- Water Cooling System
- Targets
- Beam dumps



Stop supply of air into zone during operation



Proposal for future beam dump cooling



Separation of zones in terms of ventilation

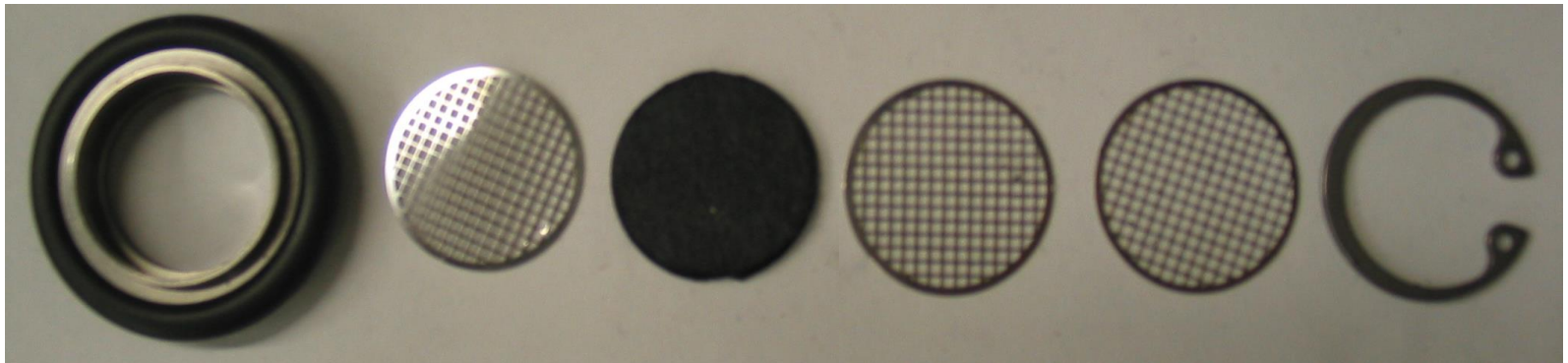


Study of propagation of radioactive contamination



Monte-Carlo modelling of the whole Isolde beam-line, to determine the propagation of radioactive neutral isotopes and the distribution profile

Sampling and measuring along the line



Sampling via carbon filters as done in TRIUMF

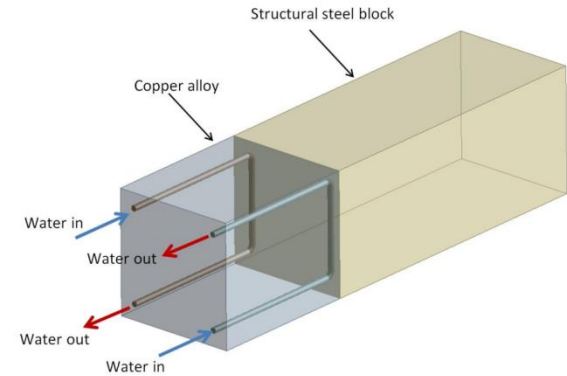


Section 1: Infrastructure HRS and GPS dumps



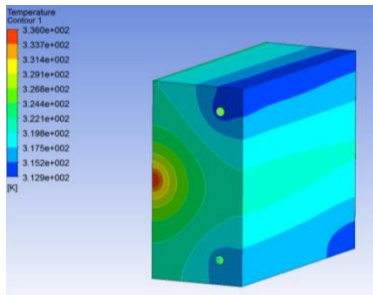
Present design study → beam upgrade will damage the dump
 Design proposed → active cooled CuCrZr block in front of old dump
 Max temperatures and stresses are below the material limits
 for a 2.0 GeV beam

New dump design

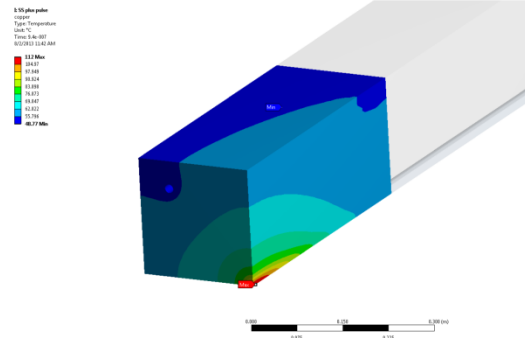


Calculations

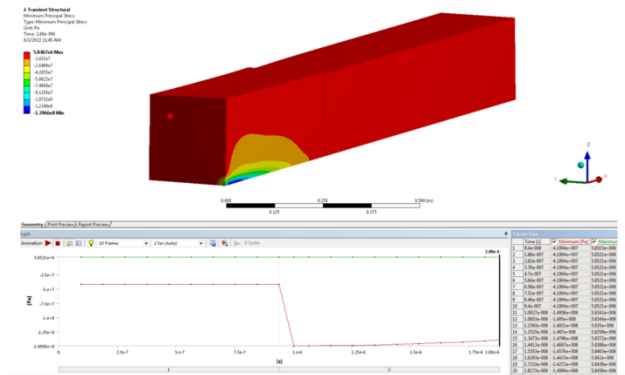
CFD (computational fluid dynamic analysis) analysis



Thermal analysis

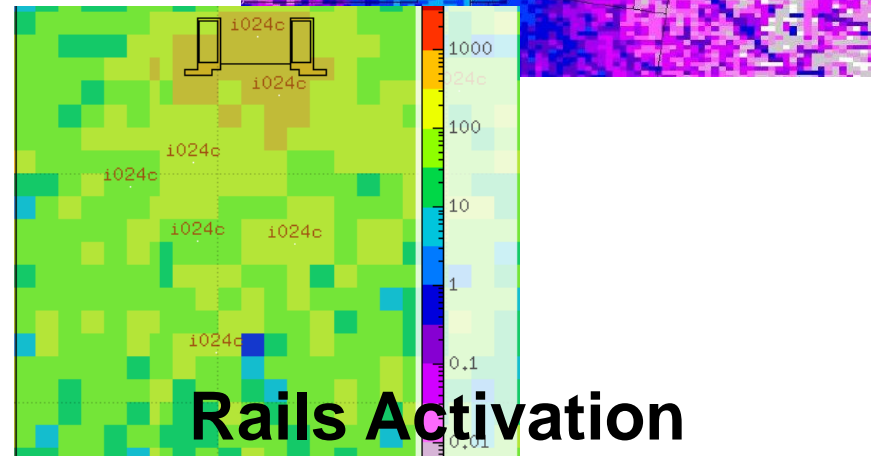
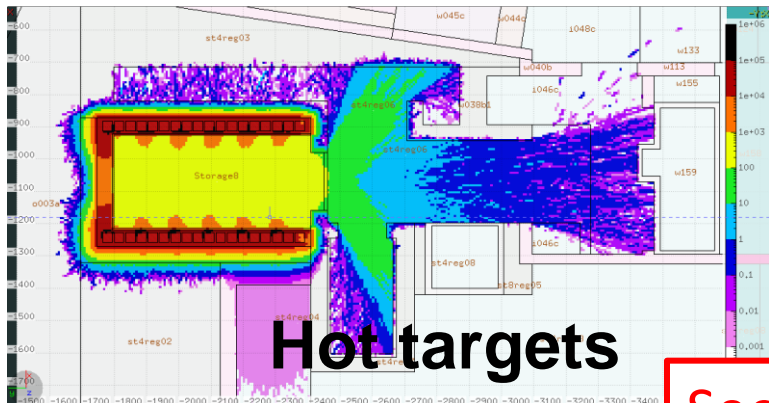
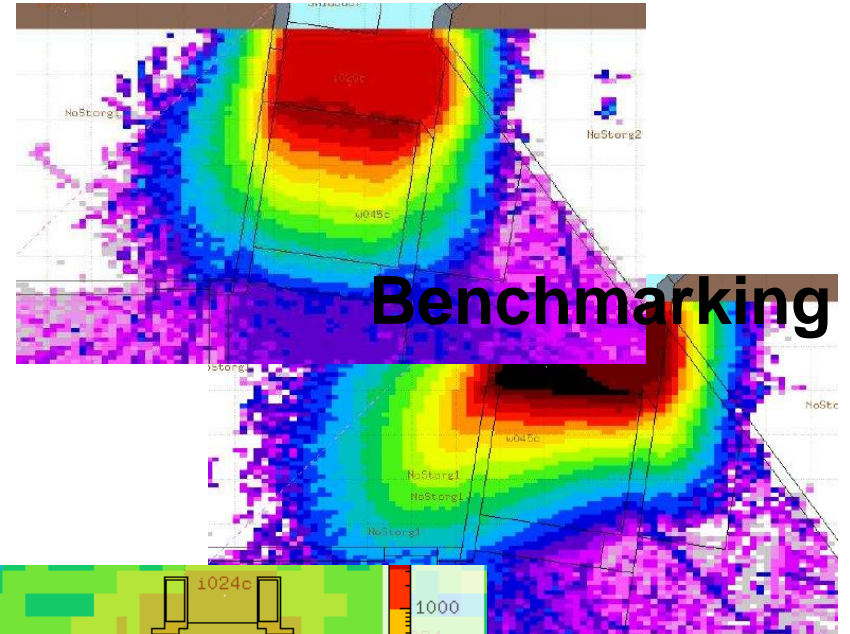
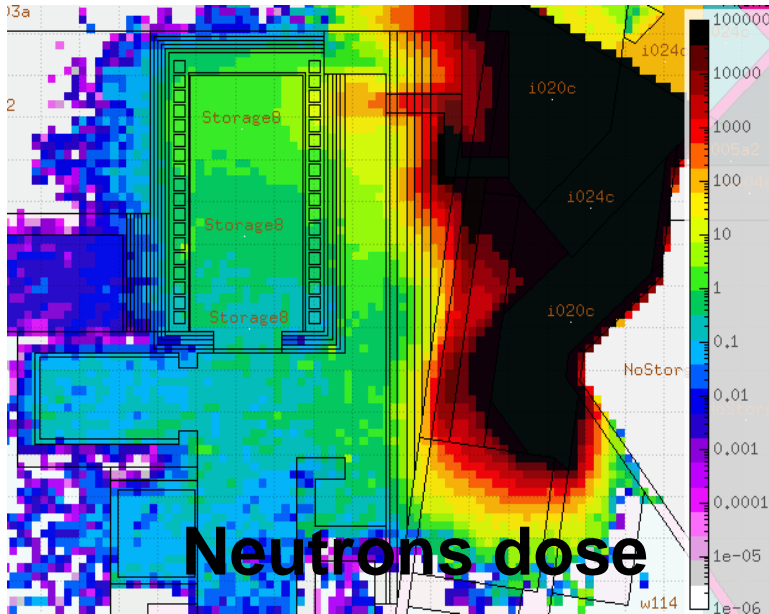


Structural analysis analysis



See presentation by Valentina Venturi

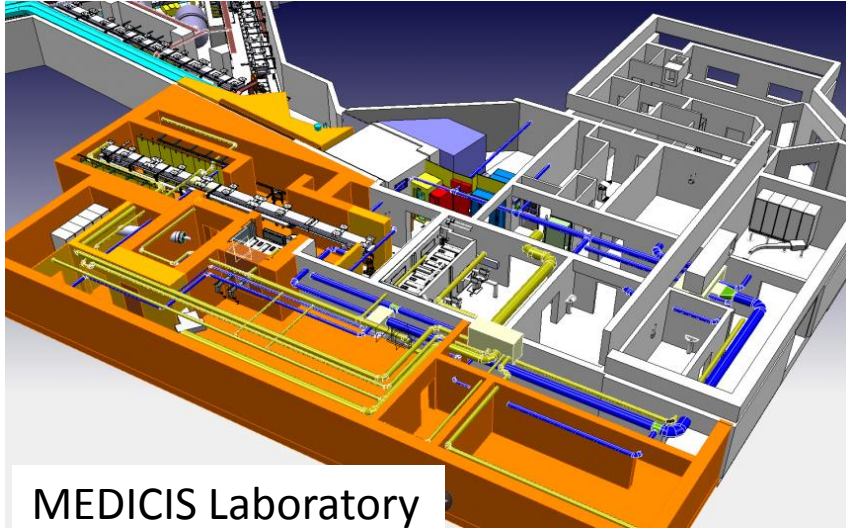
Radiation studies near ISOLDE tunnel



See presentation by Leonel Morejon



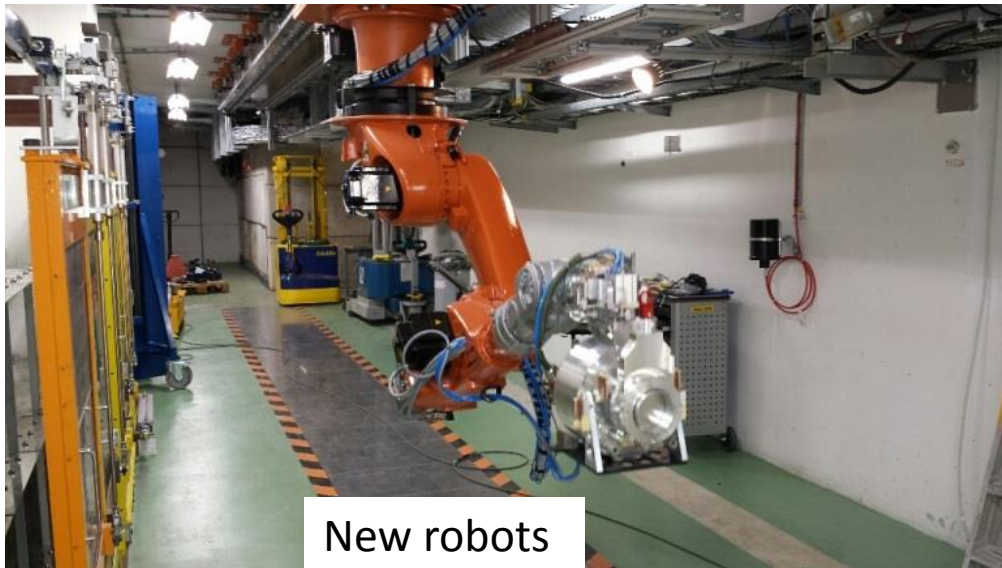
Interfaces



MEDICIS Laboratory



High voltage cover



New robots



Montrac rail for MEDICIS irradiation point



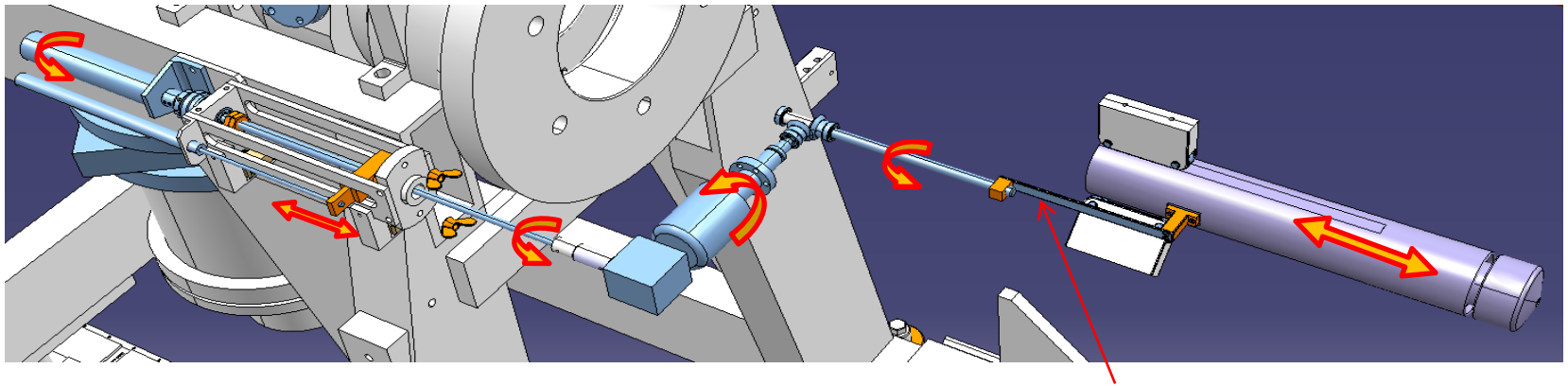
Section 2



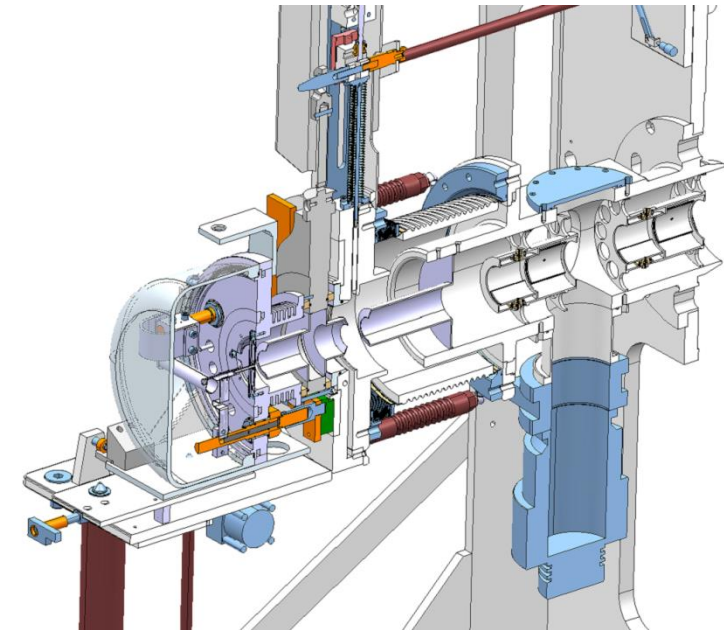
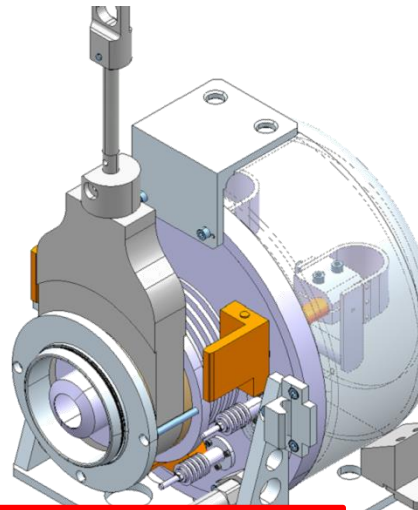
Beam Quality Upgrade Section

- Neutron converter
 - **Serena Cimmino**, Thierry Stora, Stefano Marzari
- Front end modifications towards beam improvement?
 - **Jacobo Montano**, Tim Giles
- HRS separator Magnet design
 - **Mathieu Augustin**, Tim Giles, Martin Breitenfeld,
- MRToF as a tool for High resolution – evaluation
 - Martin Breitenfeld
- HRS separator controls
 - **Martino Colciago**, Alessandro Masi, Mark Butcher
- RFQ Cooler Design
 - **Carla Babcock**, Tim Giles
- HRS Separator integration
 - **Mathieu Augustin**, Tim Giles, **Carla Babcock**, **Jacobo Montano**, Martin Breitenfeld
- REXEBIS Upgrade
 - **Andrej Shornikov**, Fredrik Wenander

FE Modifications: Extraction Electrode

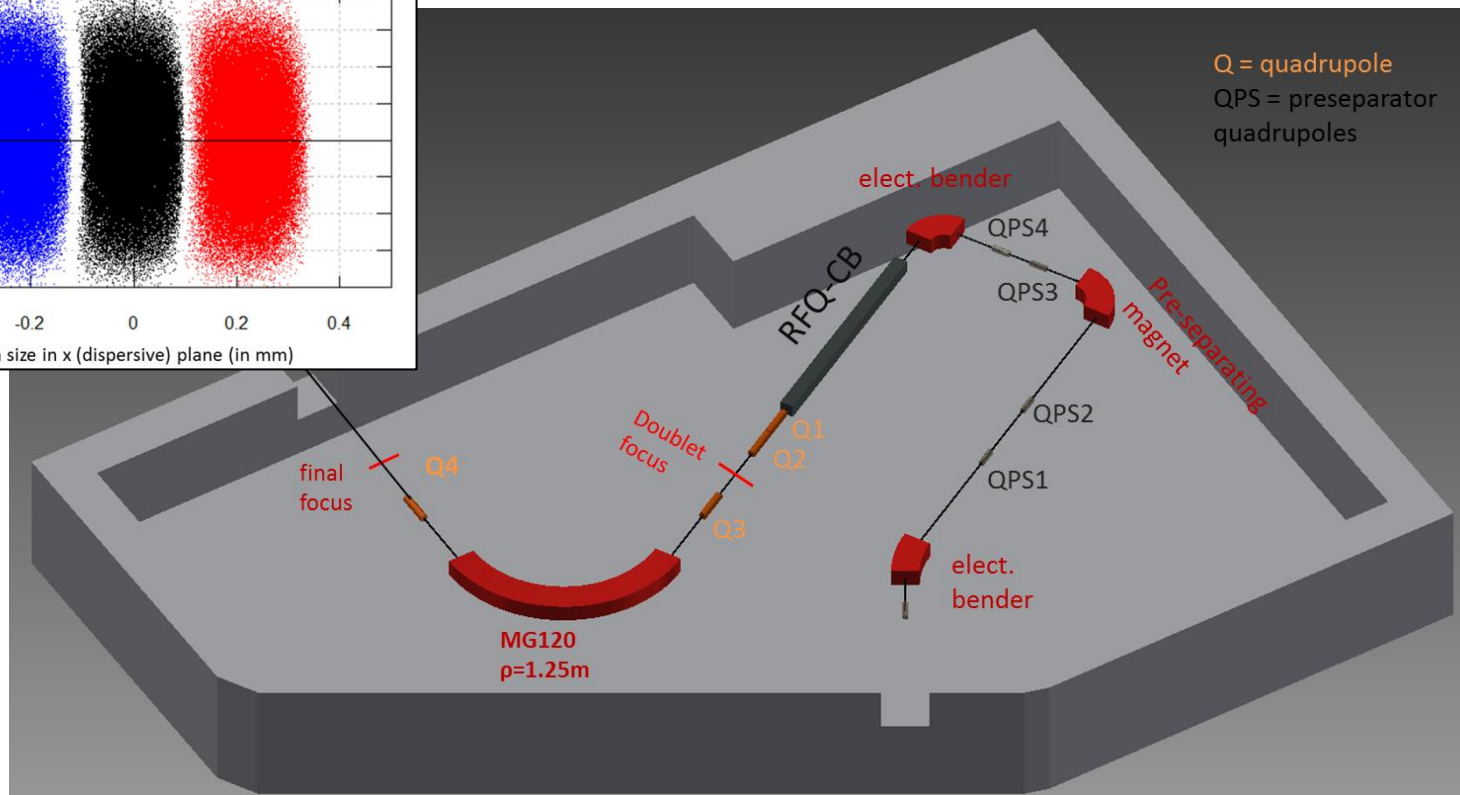
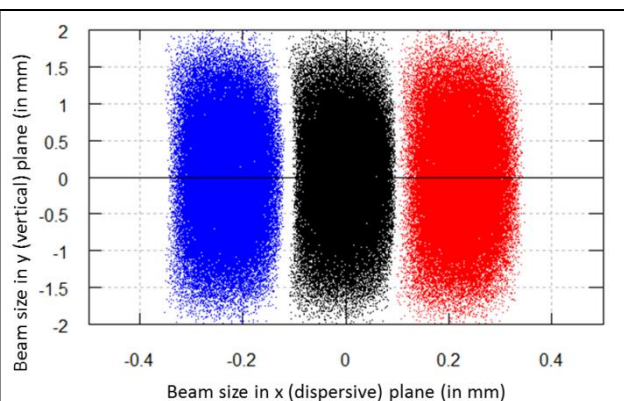


- Remove moving parts subject to failure
- Eliminate the need to exchange the extraction electrode tip
 - Highly contaminated
 - High Dose rate



See presentation by Jacobo Montano

HRS Separator Design #3



Schematic 3D view of the layout #3

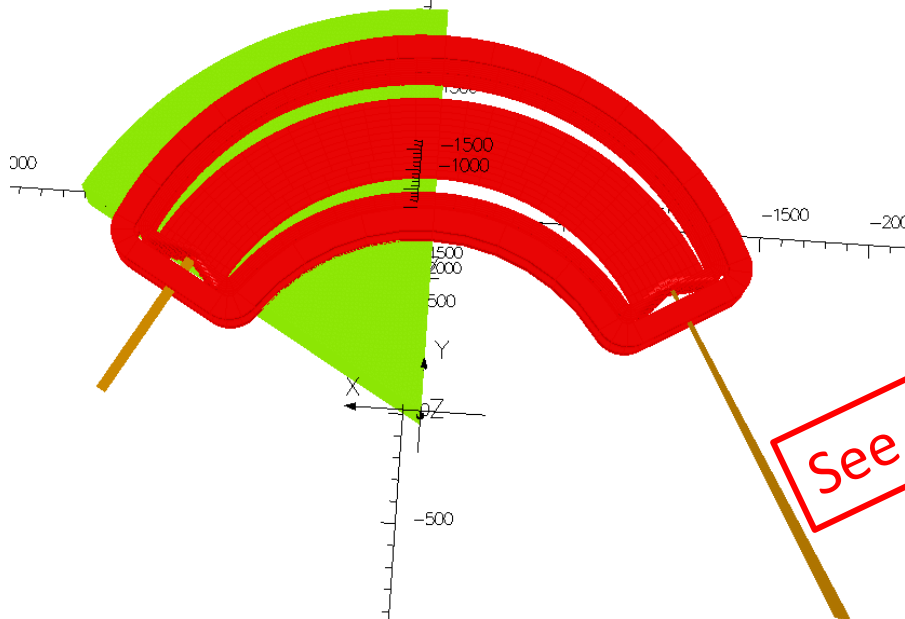
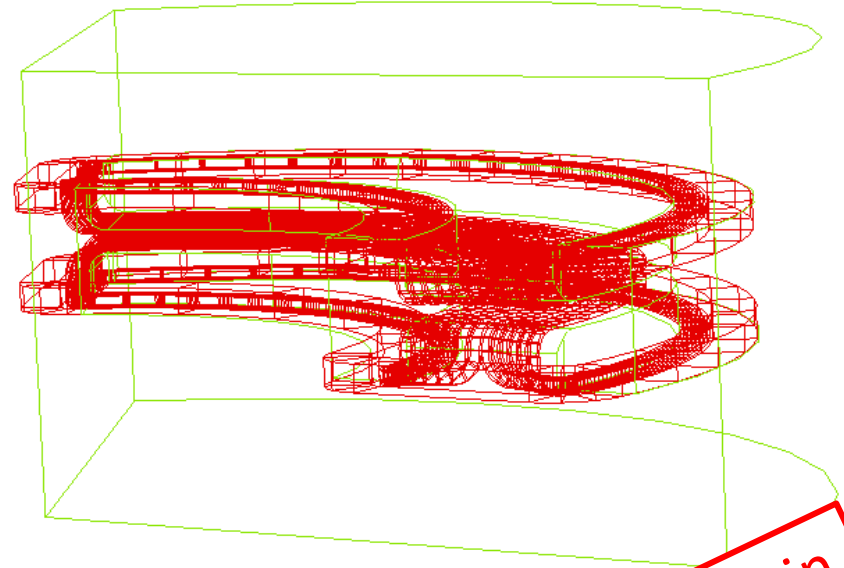
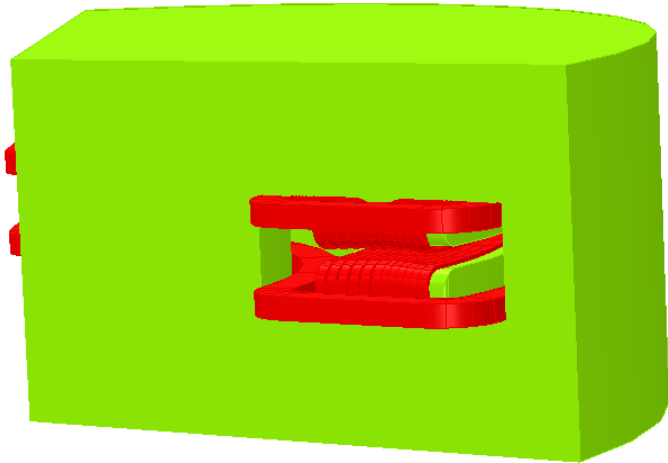
Beam emittance $\varepsilon = 3\pi \text{ mm.mrad}$

$R = 20\ 000$ for more than 99% transmission of pure beam

$R \sim 23\ 000$ for 90% transmission of pure beam



Design & OPERA 3D Simulations for a 120 degree magnet



See presentation by Mathieu Augustin

Electron Beam Ion Source (EBIS) for HIE-ISOLDE

New EBIS – High Energy Compression and Current (HEC²) EBIS
R&D in cooperation with BNL Advanced Ion Source group



EBIS parameters	REXEBIS (Now)	HEC ² for HIE-ISOLDE	HEC ² II for TSR@ISOLDE	Demonstrated (Nov 2013)
Electron energy [kV]	5	60	150	30
Electron current [A]	0.2	3-4	4-5	1.54
Electron current density [A/cm ²]	100	1-2x10 ⁴	1-2x10 ⁴	NA

- HEC² gun built at CERN, shipped to BNL and installed on Test EBIS
- HEC² gun first operated at BNL in Nov 2013 on the real EBIS
- Energy up to 30 keV and current up to 1.54 A were achieved in ~ 10 ms pulses
- Diagnostic tools to measure the current density were set up for the next visit
- The test stand is upgraded to enable higher current
- Extended set of diagnostic tools is in production at CERN

See presentation by Andrej Shornikov



Section 3:

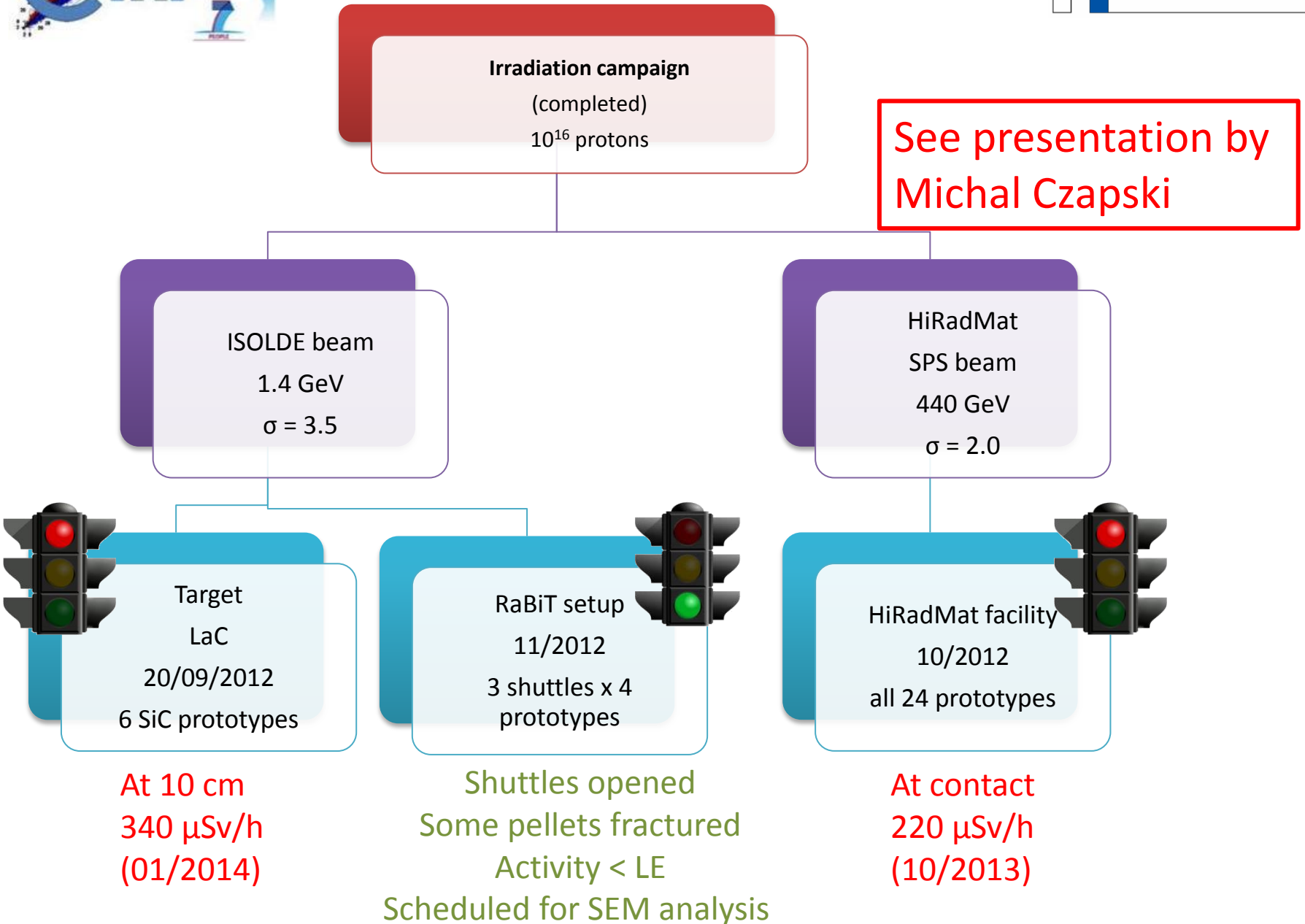


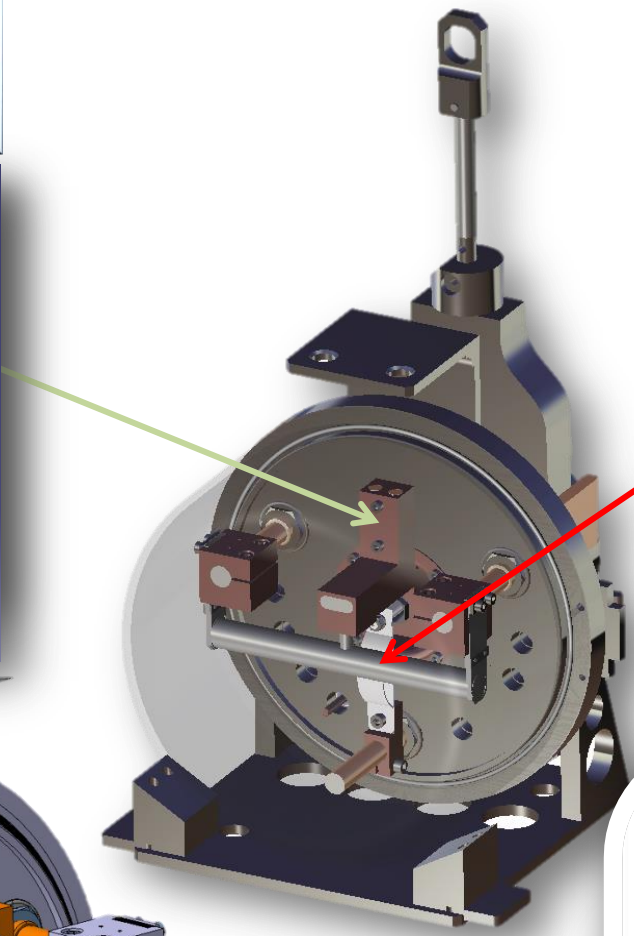
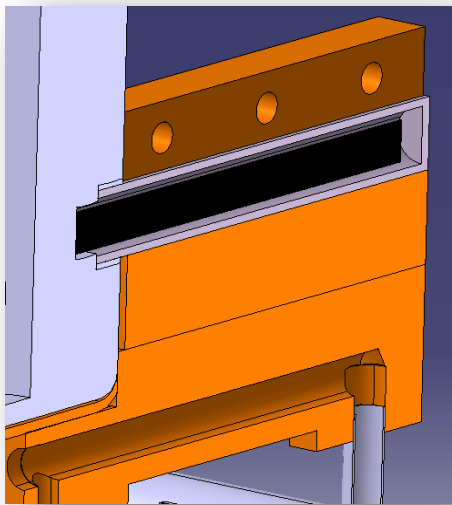
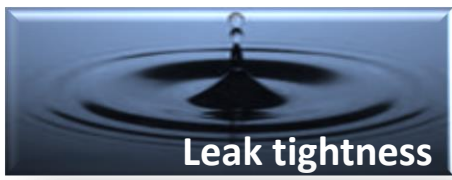
Target and Front End Upgrade

- Target Materials
 - **Michal Czapski**, Thierry Stora
- Target Design
 - **Serena Cimmino**, Stefano Marzari
- Front End Design
 - **Jacobo Montano**, Stefano Marzari, Tim Giles
- New High Voltage Modulator
 - Roger Barlow, Jan Schipper, Tony Fowler



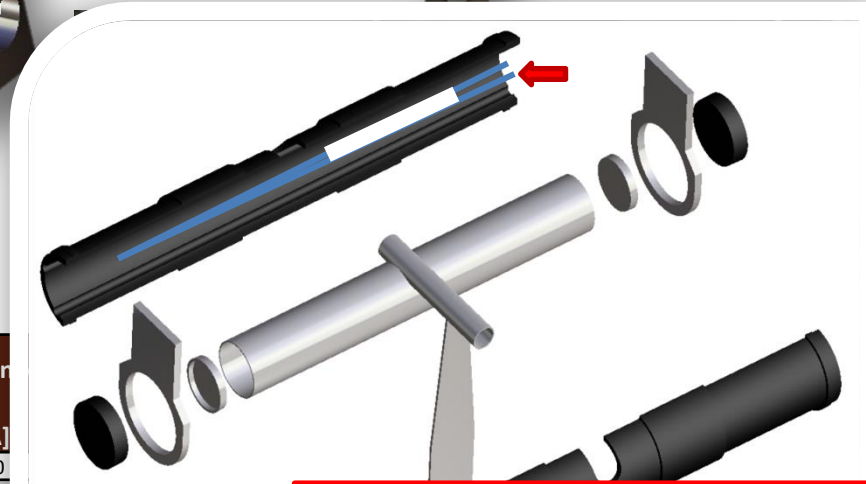
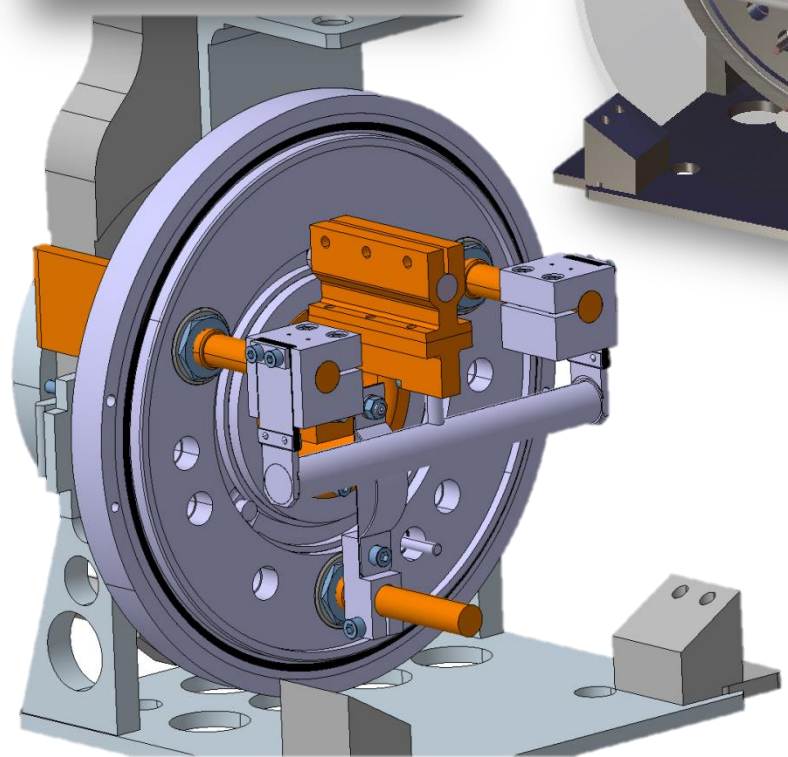
Target Material Studies





Uniform Thermal Field

Release Efficiency Increase



Voltage measured [v]	Current [A]
2.3698	50
3.74	100
4.8	150
5.571	200
6.71	250
8.13	300
9.107	350

Ohmic Heat / Containment
Thermocouple

See presentation by Stefano Marzari

Section 4 Operations

- Boundary Conditions for operations
 - Radioactive waste and target dismantling





Section 5

Safety and Radiation Protection Summary



- Review of safety and radiation protection issues addressed throughout the report
- Identification of further issues to be addressed
 - ALARA
 - Dose rates etc etc
- Ana-Paula Bernardes, Joachim Vollaire



Water leak tests in ISOLDE target

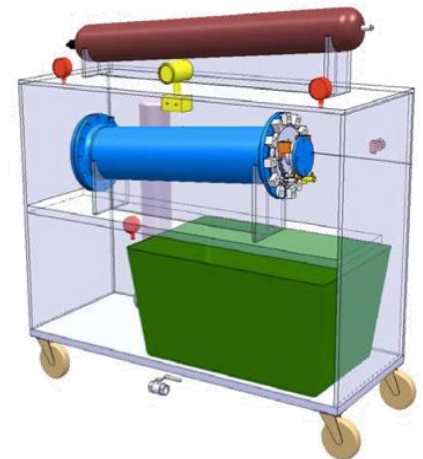
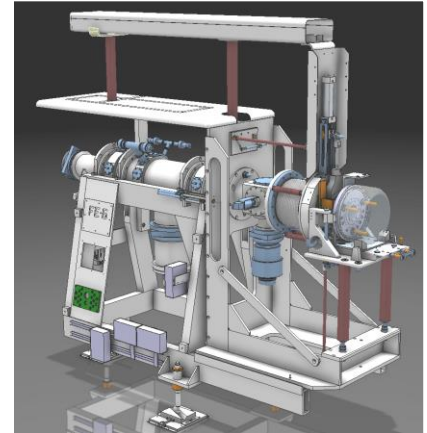


Assess the consequences of a water leak in the target at nominal operational temperatures

A model of the Frontend was built representing volume and heating

4 tests of simulated water leak were performed in the bunker (b. 125) in collaboration with DGS-SEE on the workbench

See presentation by Ana-Paula Bernardes



- On behalf of ISOLDE community, I would like to say a big thank you to all the Marie Curie Fellows for their excellent contributions towards the HIE-ISOLDE project.
- But before you go....just a kind reminder to file your reports!!