

Remote Target Handling and Radioactive Isotope Collection and Handling for CERN's MEDICIS Facility

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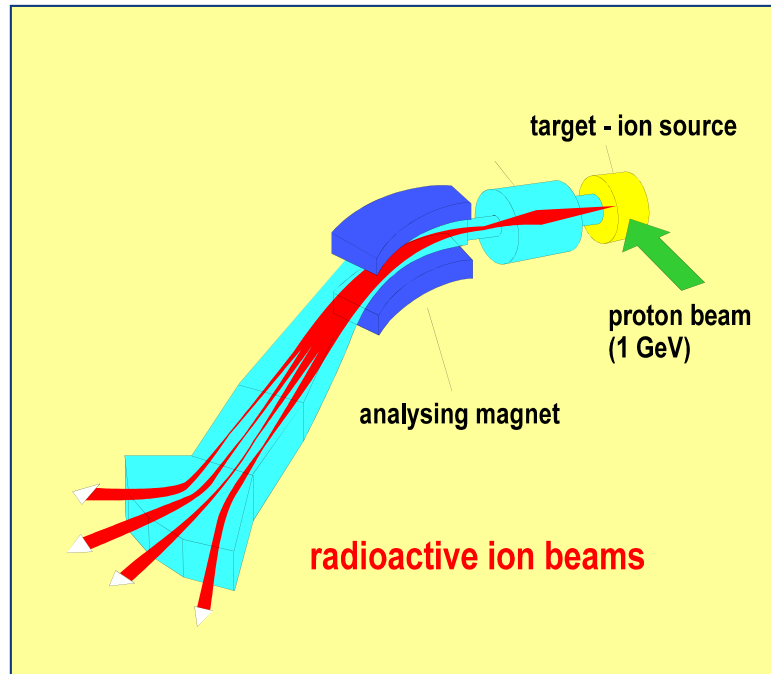
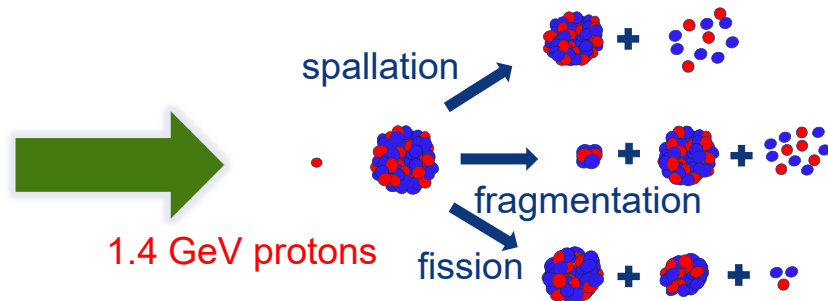
Outline

- Introduction
 - ISOLDE
 - MEDICIS
- Robot
- Monorail shuttle
- Shielding doors and air locks
- Isotope collection and transfer
- Concluding remarks / questions

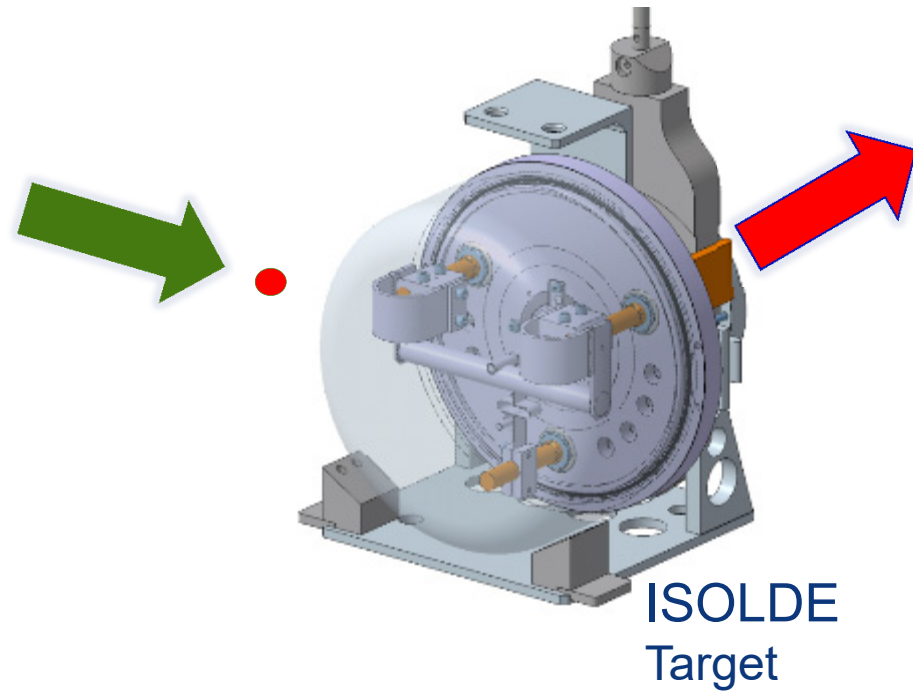
Introduction

- CERN is a particle physics research lab in Switzerland + France (since 1954)
- MEDICIS is a new facility under construction at CERN
- MEDICIS is built next to ISOLDE which produces isotopes for physics research (since 1967)
- MEDICIS will produce a wide range of isotopes for medical research (diagnostics and therapy)
- MEDICIS will use “waste” proton beam from ISOLDE to produce the isotopes

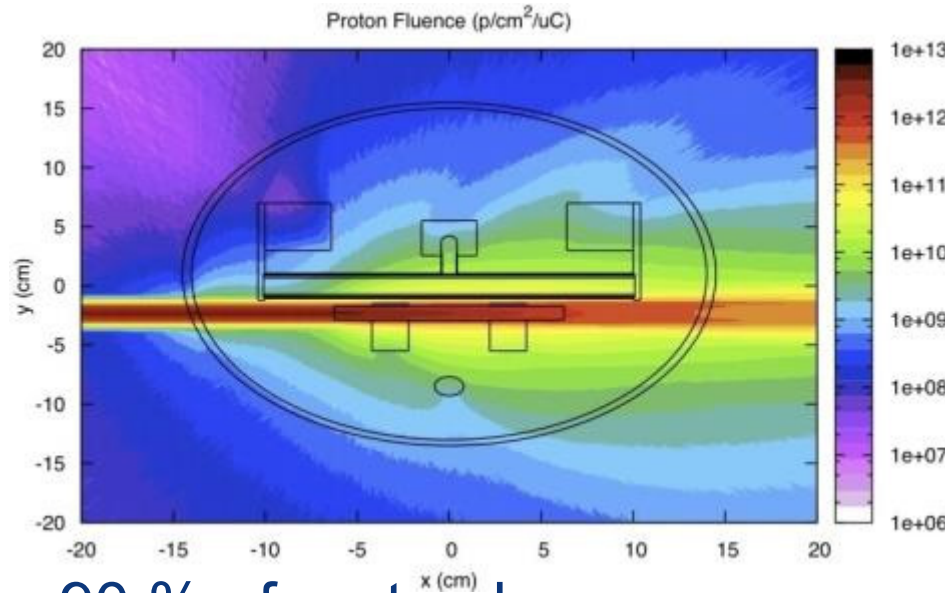
ISOLDE isotope production method



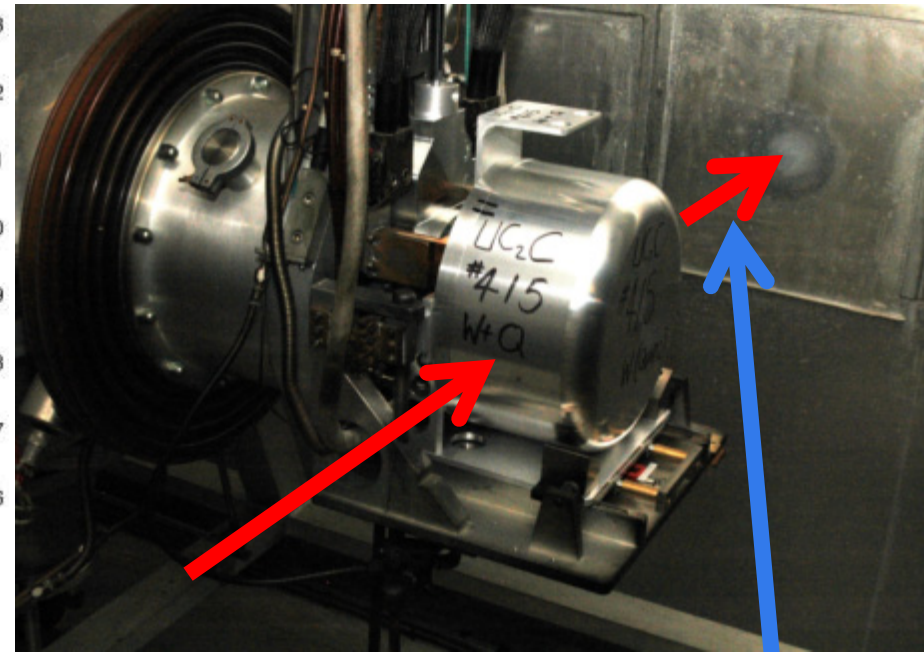
Mass separation



MEDICIS will use ISOLDE waste protons



90 % of proton beam passes through ISOLDE target into beam dump

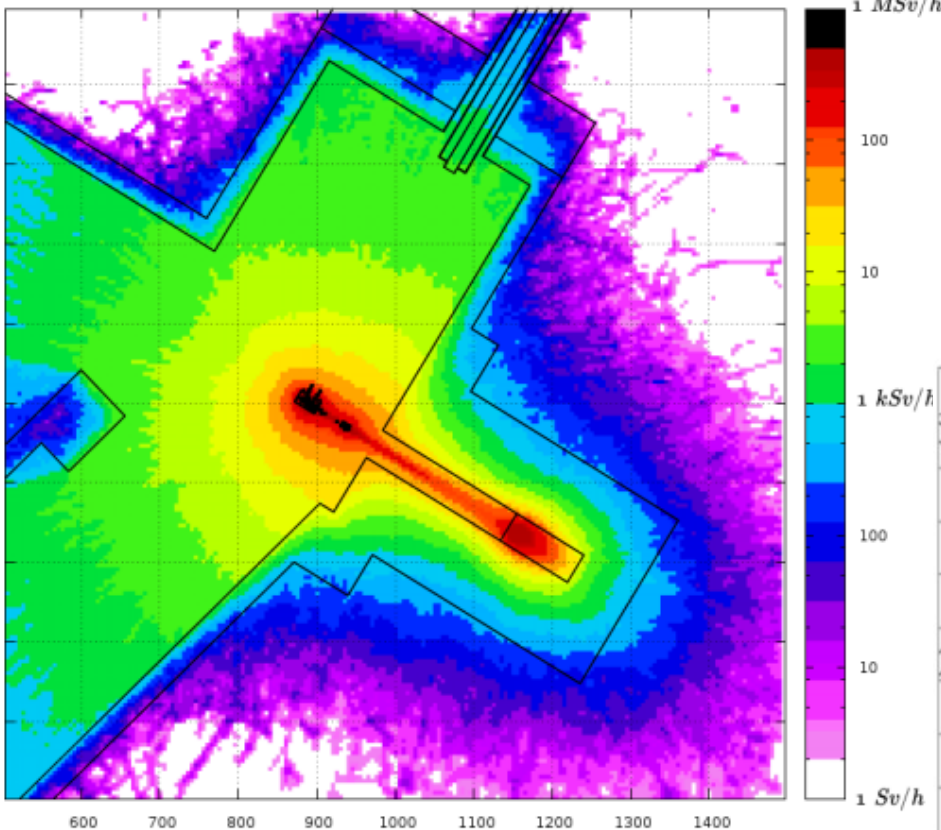


Need to be able to remotely position MEDICIS targets here

Then remotely move targets to a mass separator for collection of isotopes;
Then store the targets.

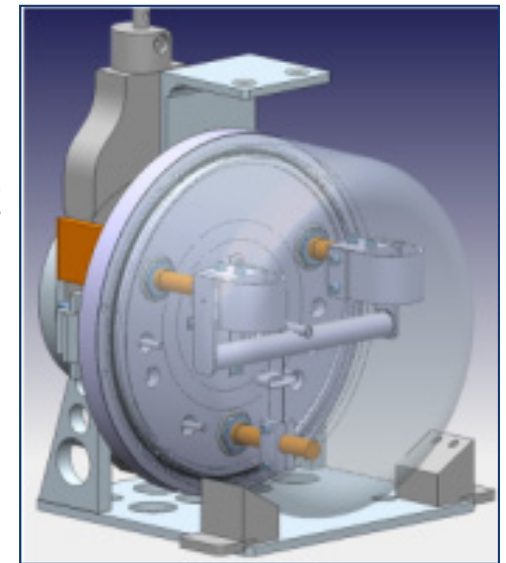
Targets + radiation

Ambient dose equivalent rate as an HIE-ISOLDE beam traverses an UC_x and MEDICIS Ta targets

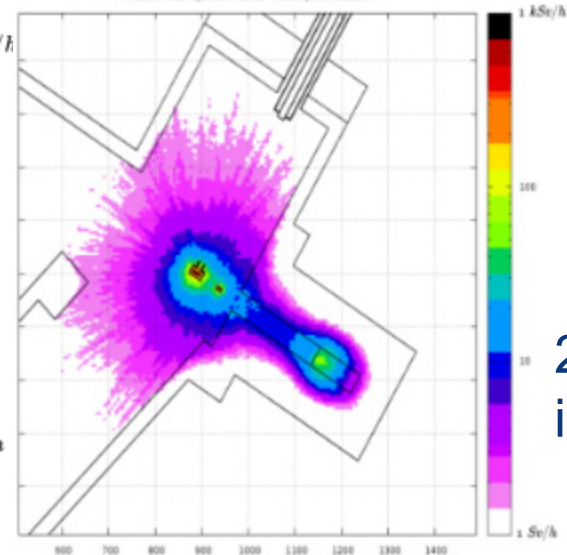


Radiation levels during proton pulse

MEDICIS target
ISOLDE target
(~30 kg)



Ambient dose equivalent rate 2 minutes post irradiation



2 minutes after
irradiation

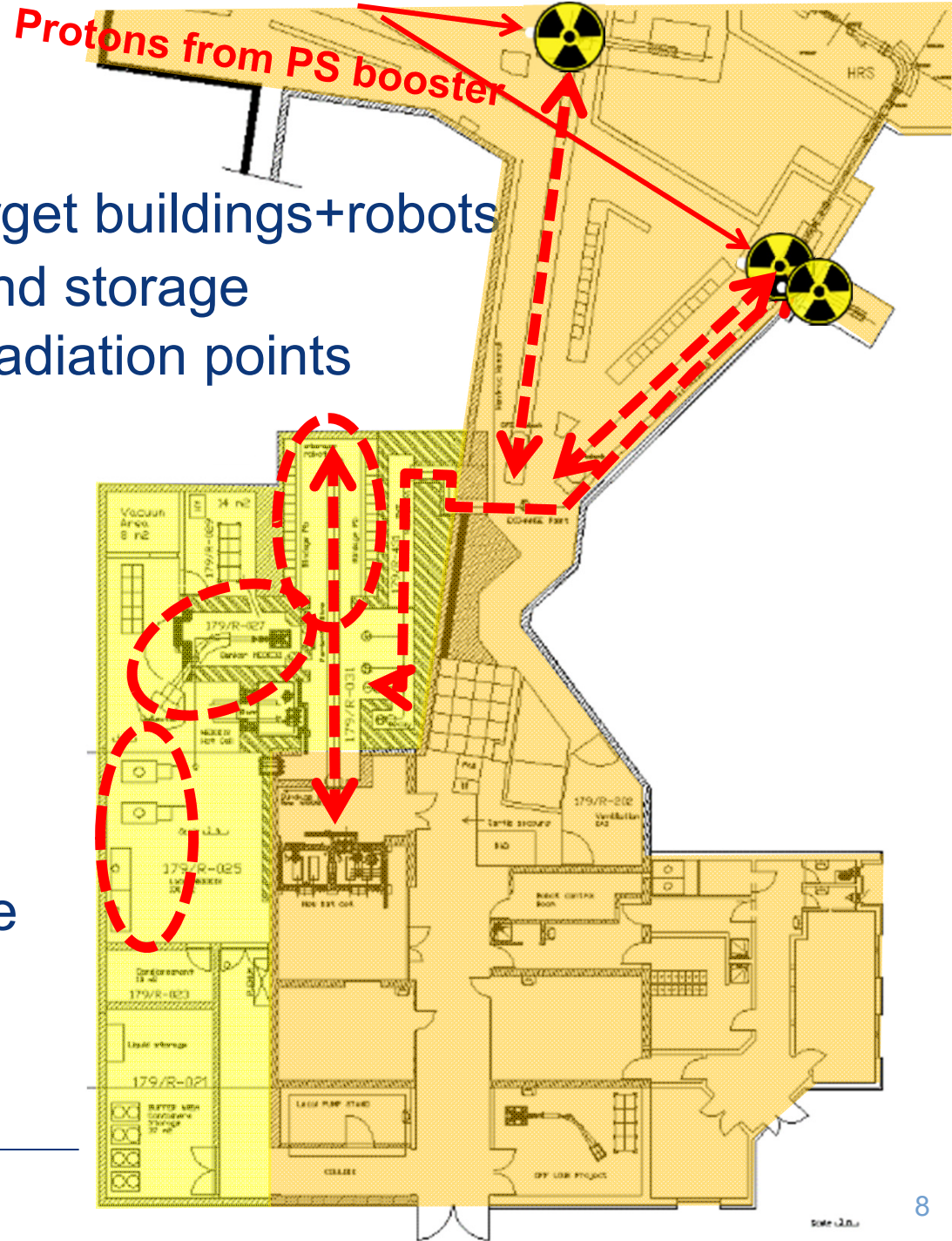
(Black is 1MSv/h)

ISOLDE and MEDICIS Facilities



Facility layout

- Existing ISOLDE lab + target buildings+robots
- Extension for MEDICIS and storage
- ISOLDE and MEDICIS irradiation points
- Target shuttle transfers
- Robot target handling
- MEDICIS mass separator
- MEDICIS chemical lab
- Radioactive target storage



ISOLDE Target Robots

Kuka robots suspended
from rail on ceiling

Operational for 3 years

Preparation:

Electronics removed (60m
cables)

Motors and resolvers
replaced

Cables replaced

Some plastic components
replaced

**MEDICIS uses the same
robot and rail etc**



Kuka robots during installation in ISOLDE

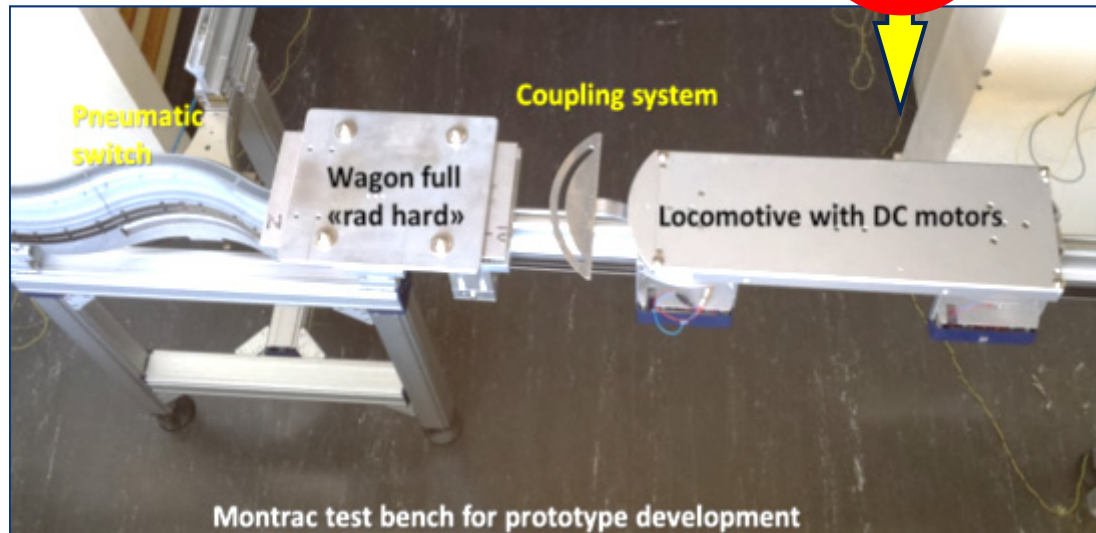
Monorail shuttle system

Main requirements:

- Radiation tolerant
- Reliable
- Simple remote control
- Fail safe
- Recovery possible
(redundant locomotive
+ redundant power rails)

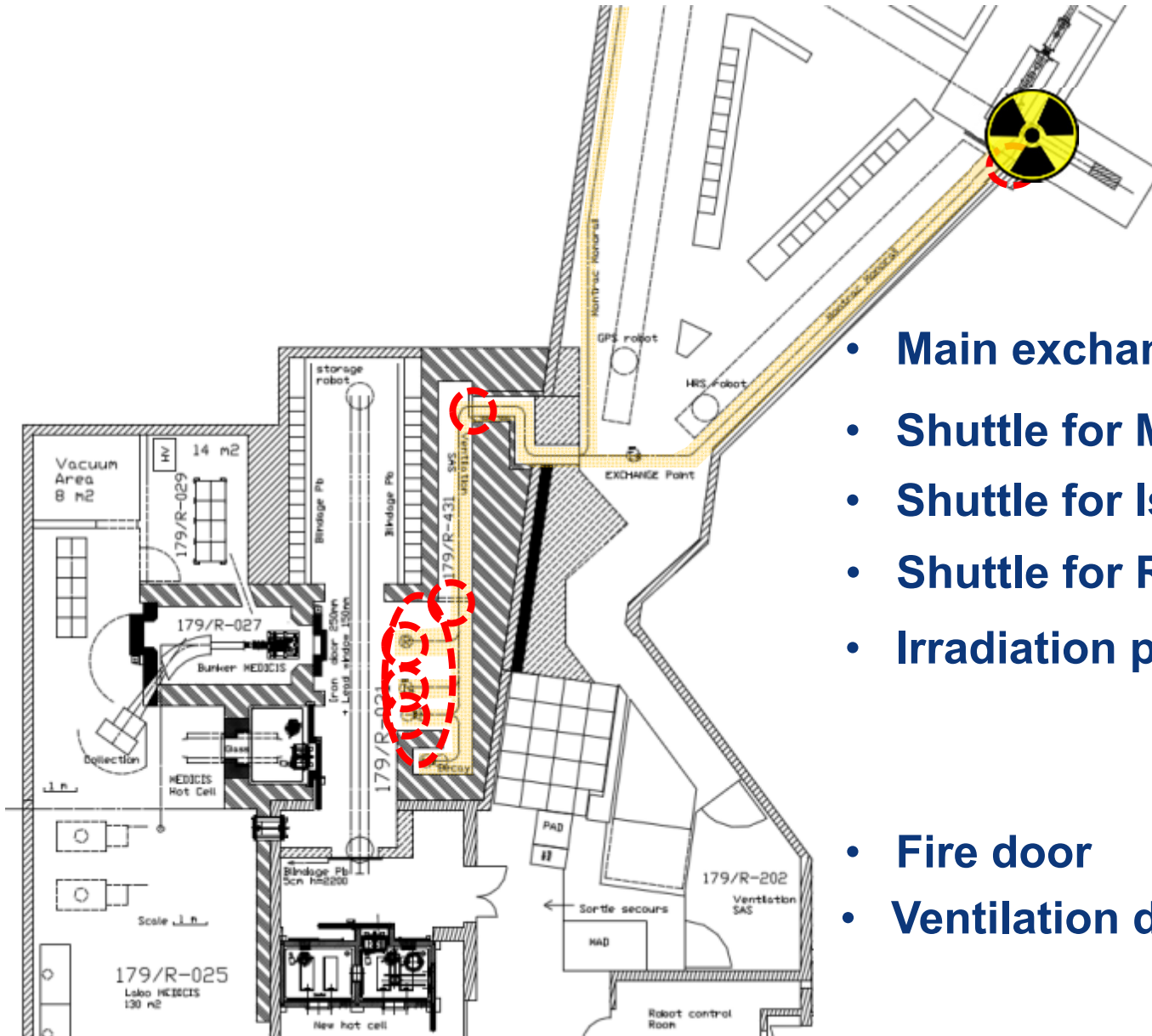


Based on industrial product (Montrac)



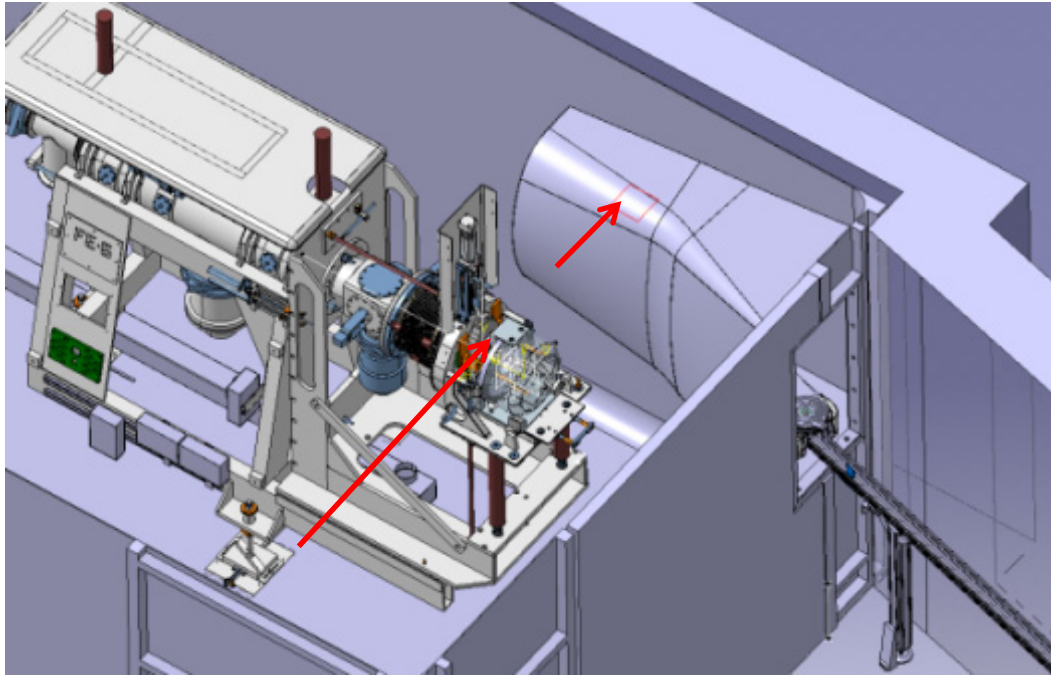
Mock up tests with DC motors

Target shuttle transfer system

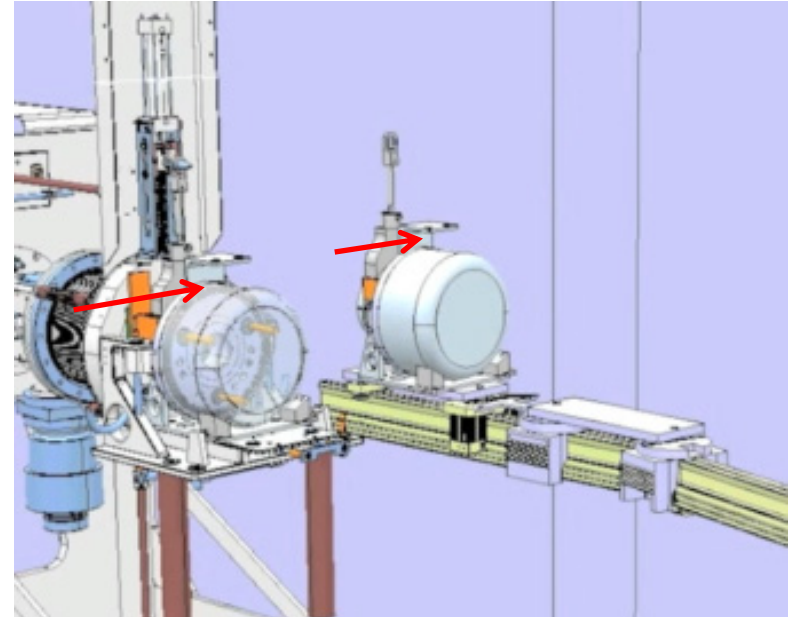


- Main exchange station
- Shuttle for Medicis
- Shuttle for Isolde
- Shuttle for Rescue & inspection
- Irradiation point for Medicis
- Fire door
- Ventilation door

Monorail positioning MEDICIS target in ISOLDE proton beam



MEDICIS Target will be outside faraday cage



MEDICIS Target (on right)
in position before
locomotive disconnects

Automated shielding doors in front of target storage shelves



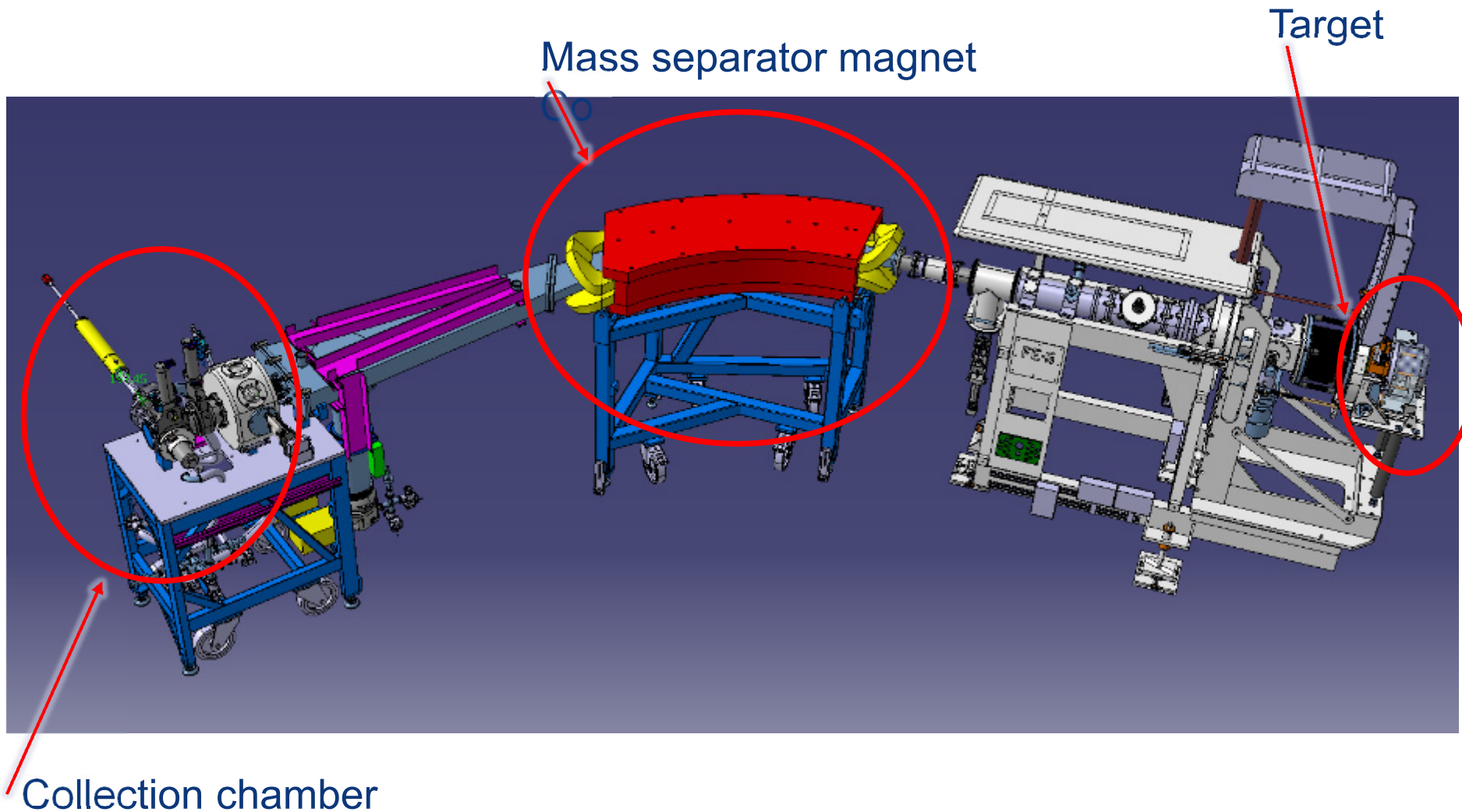
ISOLDE Target area
Pneumatically operated



MEDICIS Target area
doors – same principle

Video...

MEDICIS Isotope Collection and Transfer



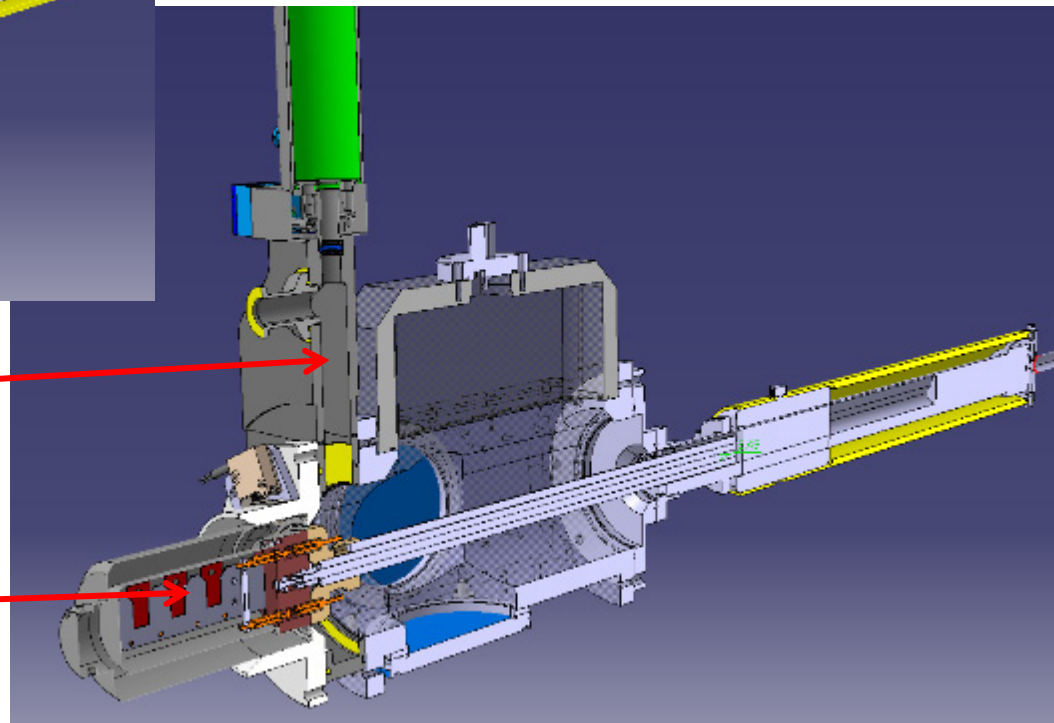
Collection chamber + mechanism

Collection on small plates aligned with beam of isotopes

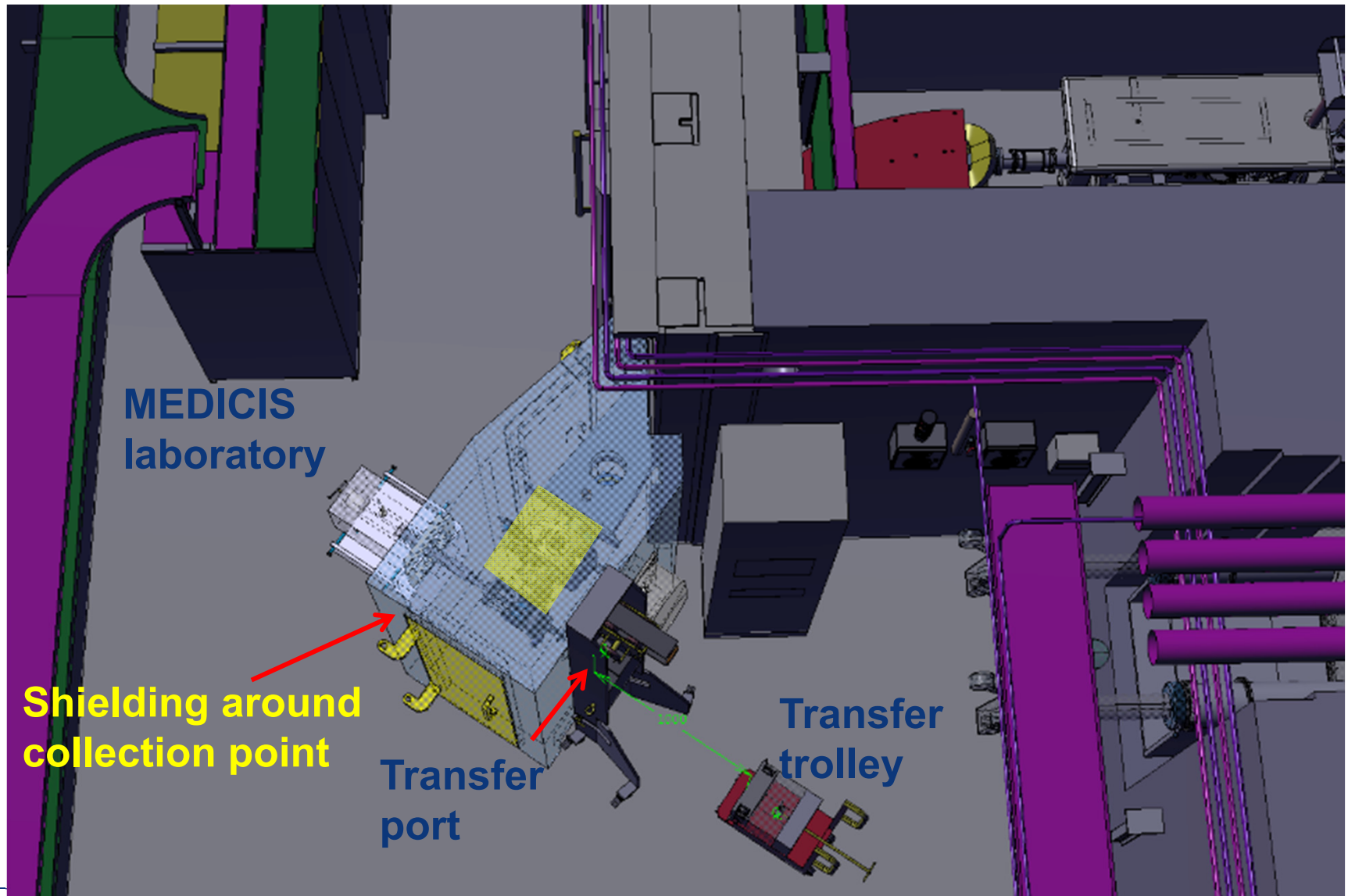
In-vacuum sample transfer arm holds plates (UHV design)

Vacuum valve

Collection plates moved in to sealed container (manual operation of arm)



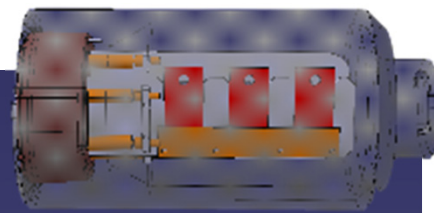
Shielding around collection equipment



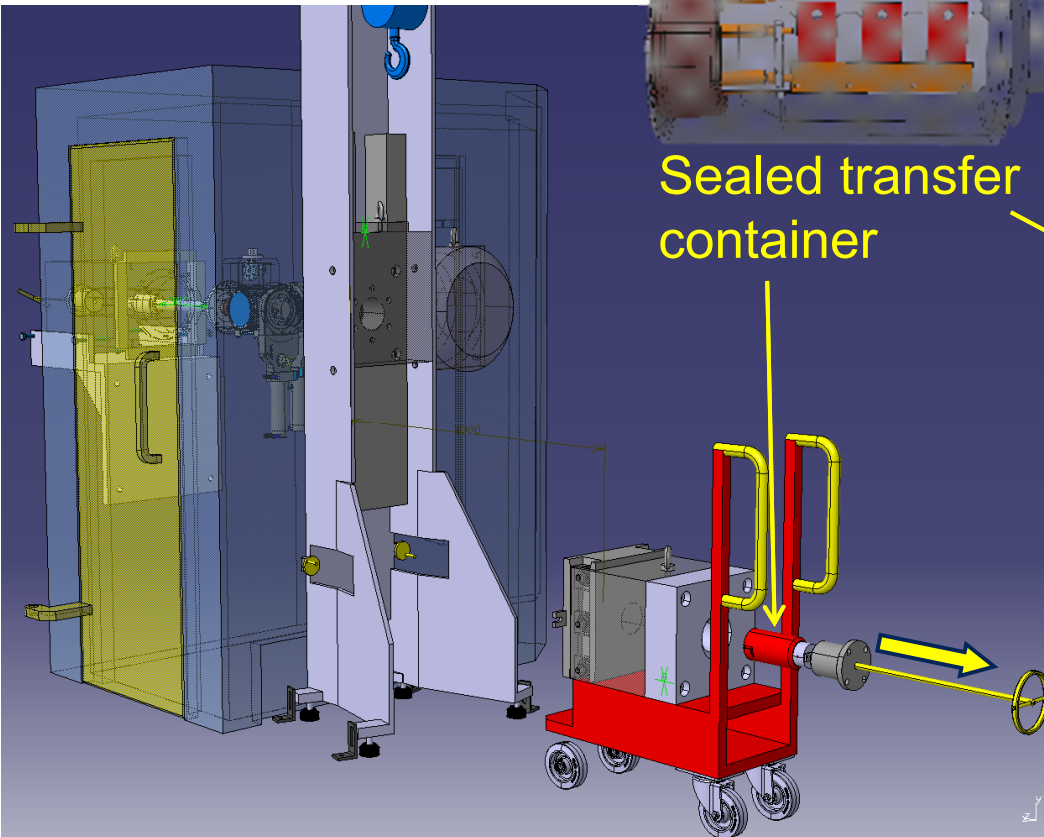
Conceptual design of transfer system

Transfer step a) insert new container

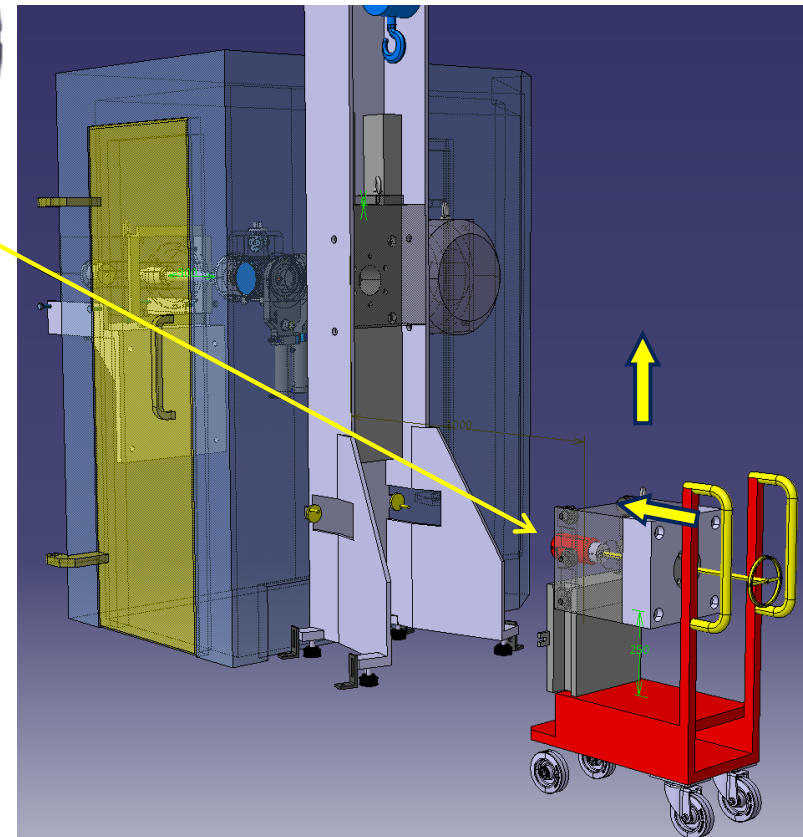
From rear



Sealed transfer container

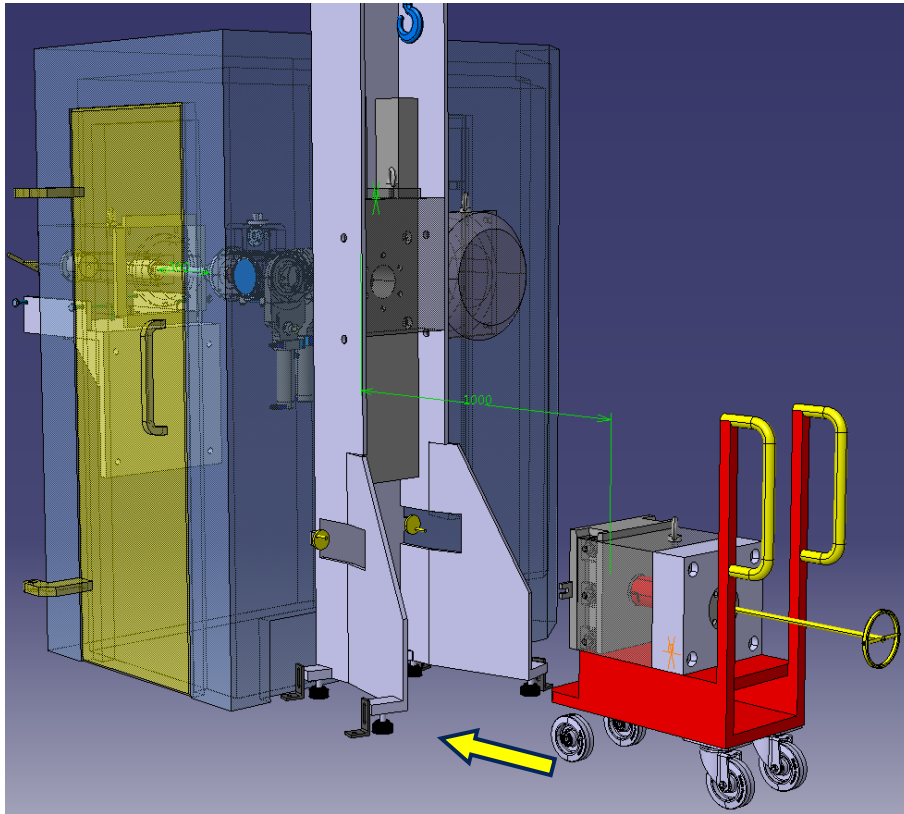


Or from front

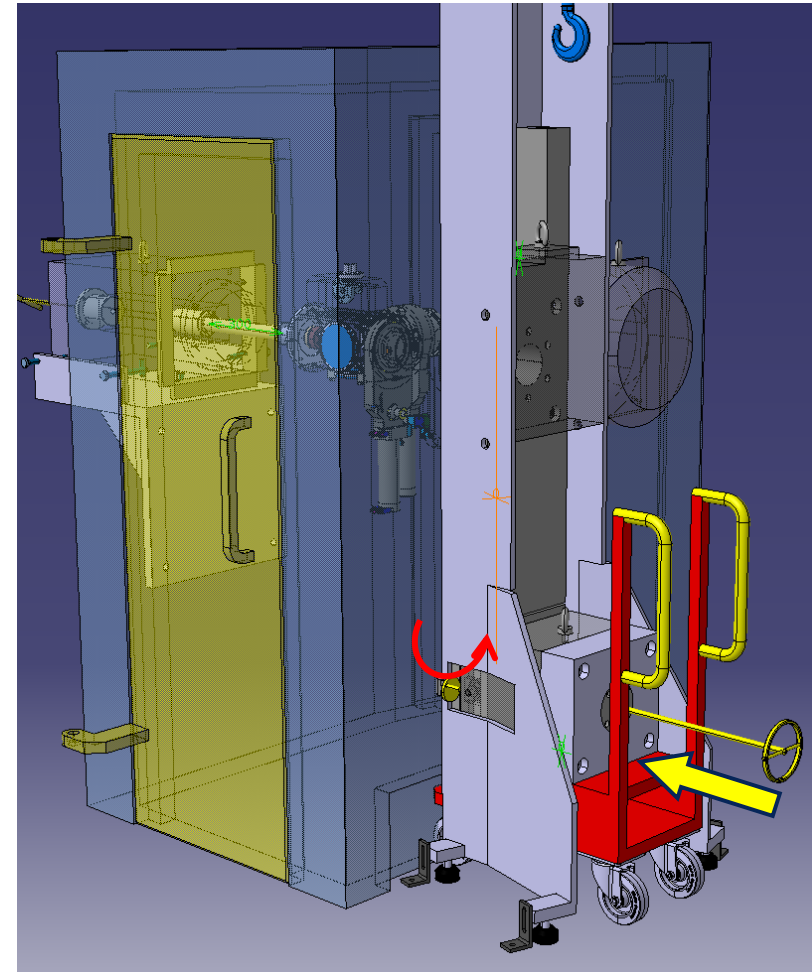


Transfer step b) - dock trolley to port

Move into place

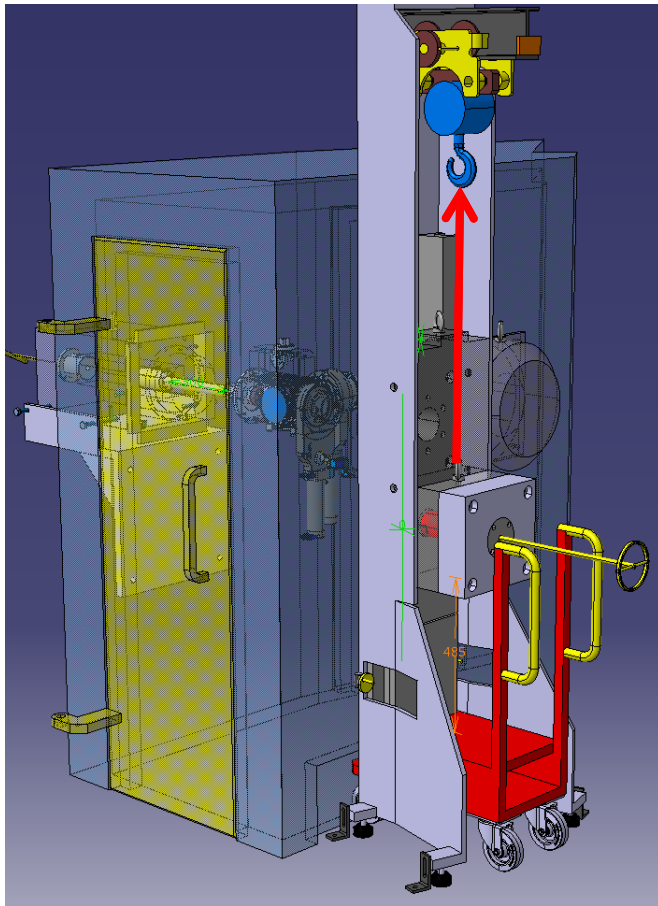


Dock and lock

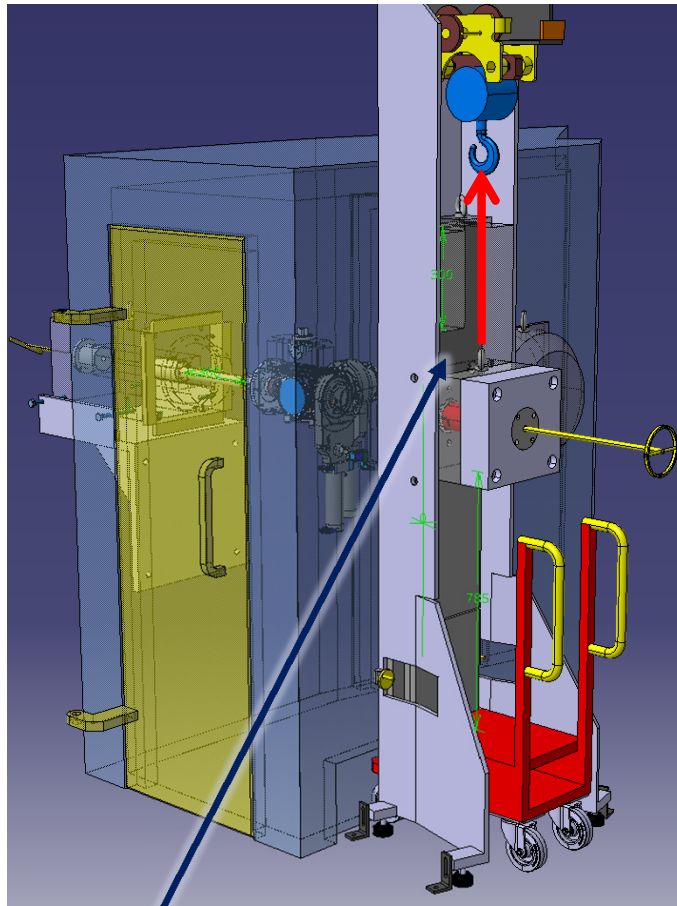


Transfer step c) lift box up to port

Hoist lifts box

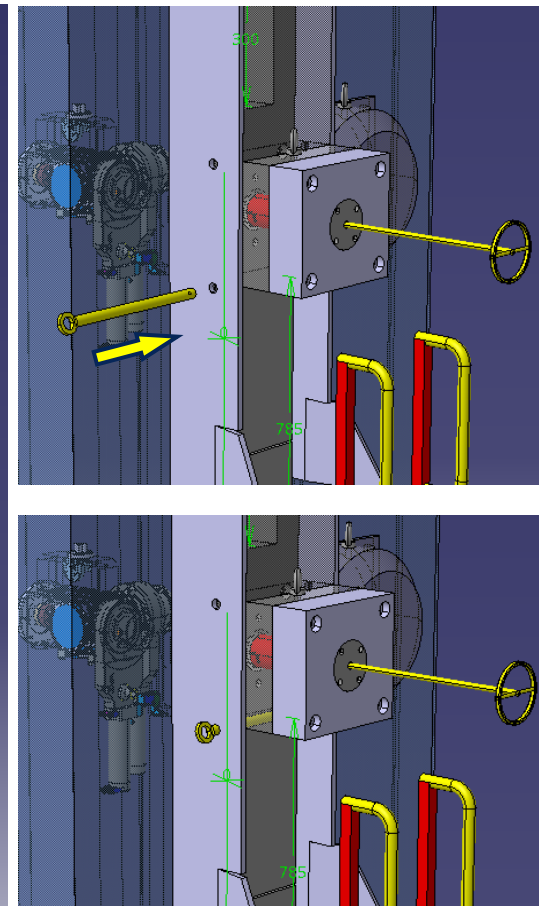


Box lifts port door



Port door

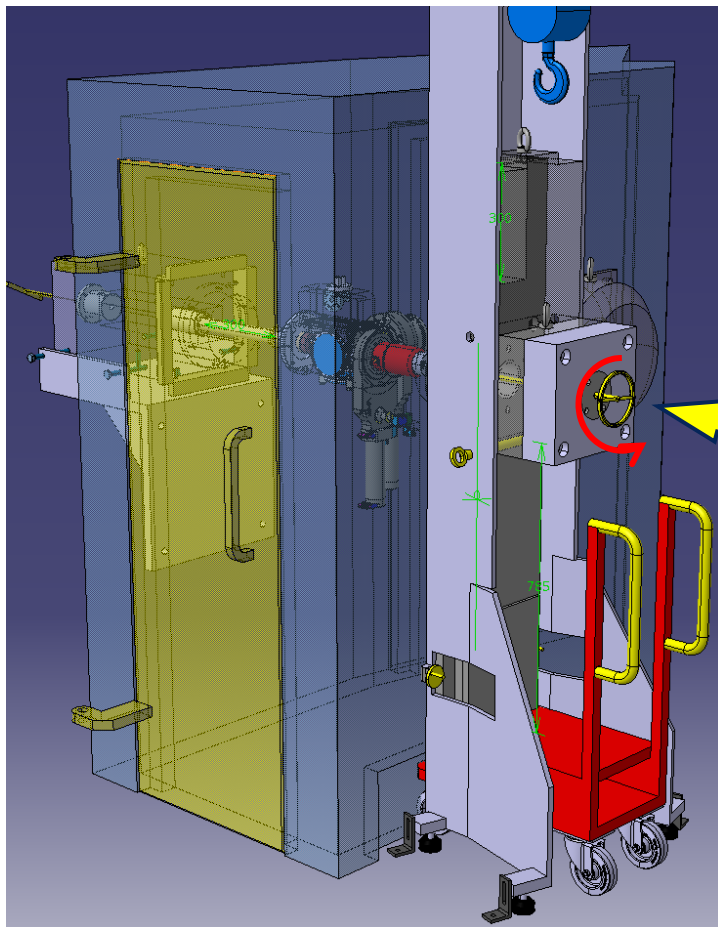
Align and secure



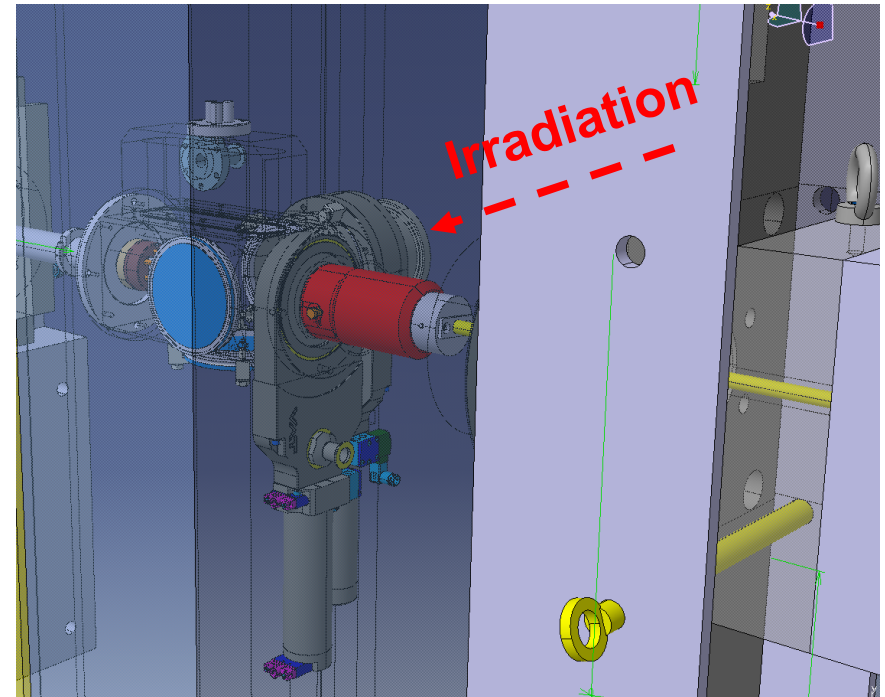
Transfer step d) connection to collection point

Connect the container to collection point

Transfer arm pulls the collection plates out of the container and holds them for irradiation



Push then Twist to lock



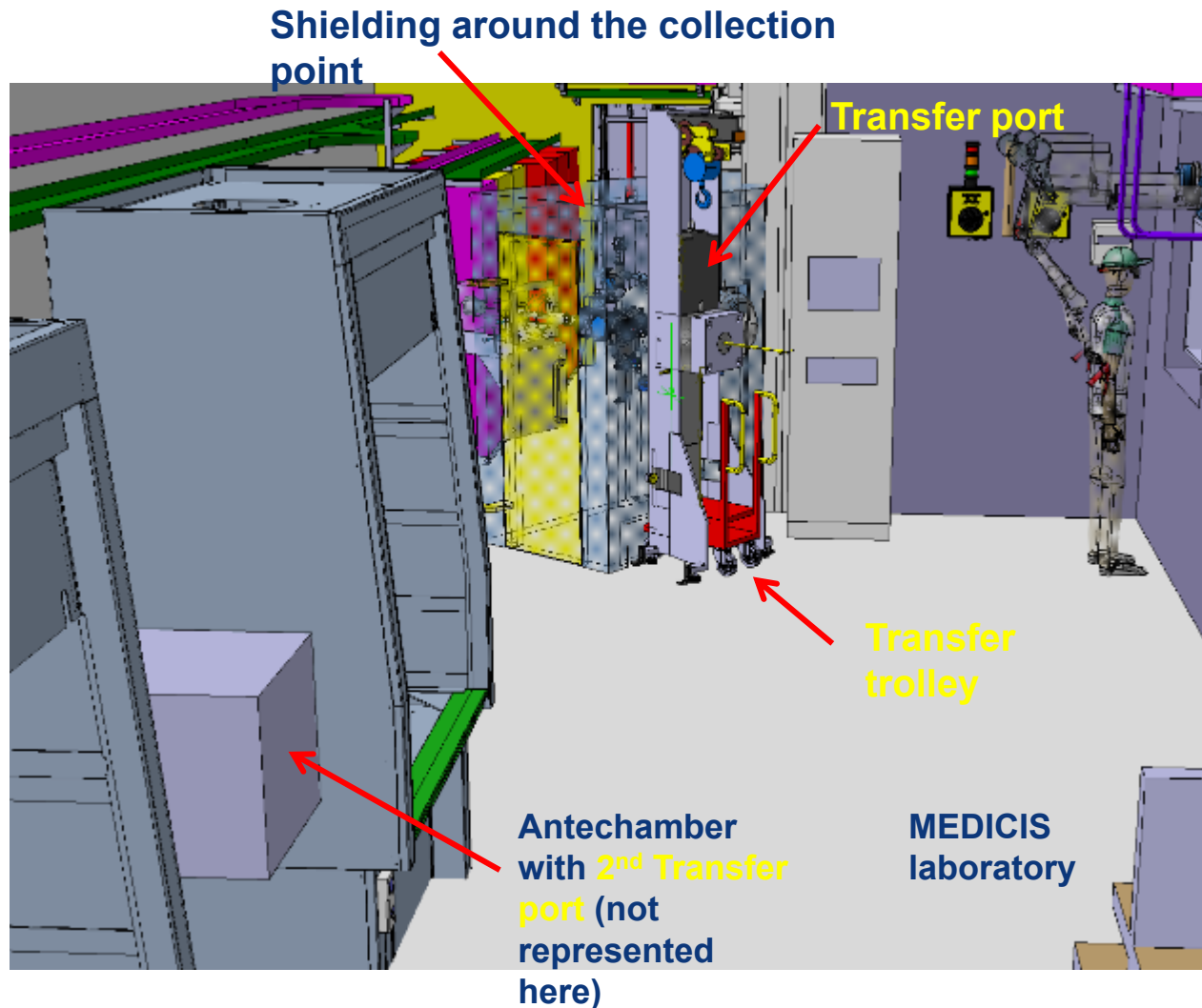
Decoupling and transfer follow same basic steps – transfer to antechamber on shielded fume cupboard

Concluding remarks

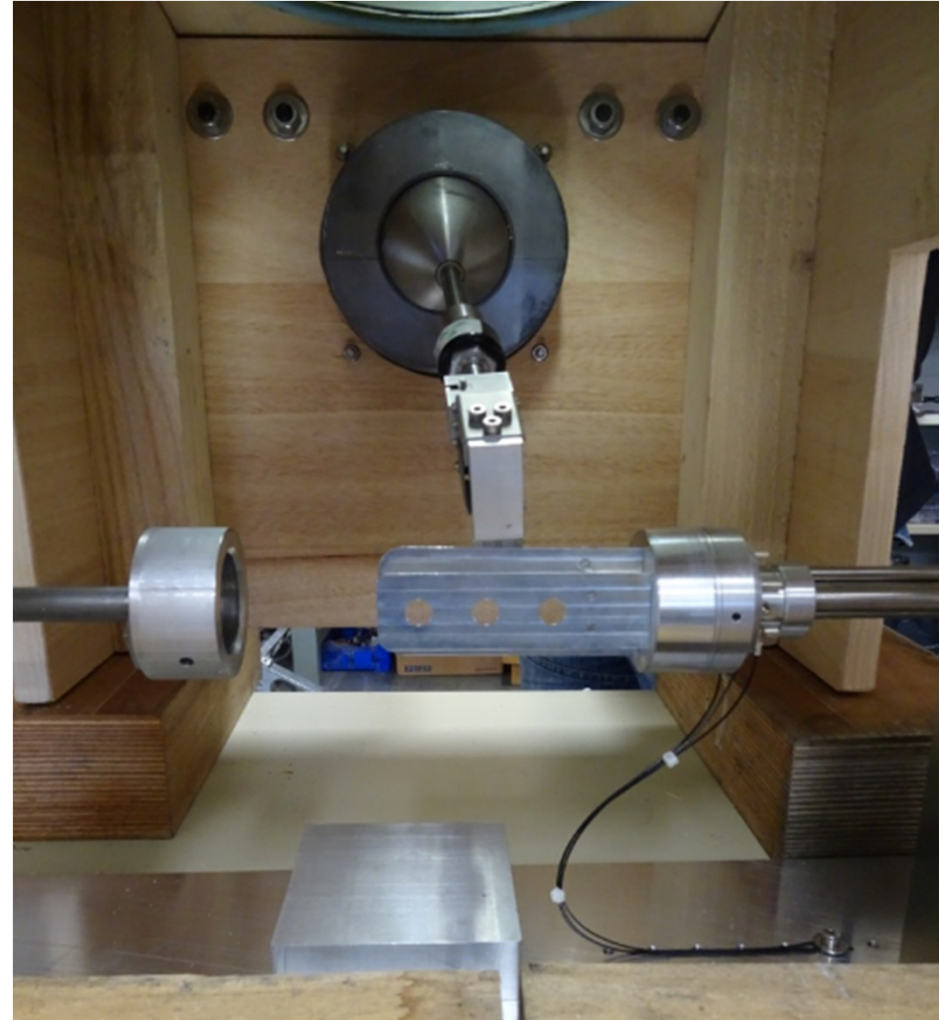
- The robot, monorail and doors have been tested together
- The MEDICIS beam line is currently being installed
- The isotope collection and transfer system is under design – installation early 2018
- Work is underway on the next stages of the process – chemical purification onwards...

SPARE SLIDES

Conceptual design for transfer...



Antechamber mock up trials



Abstract

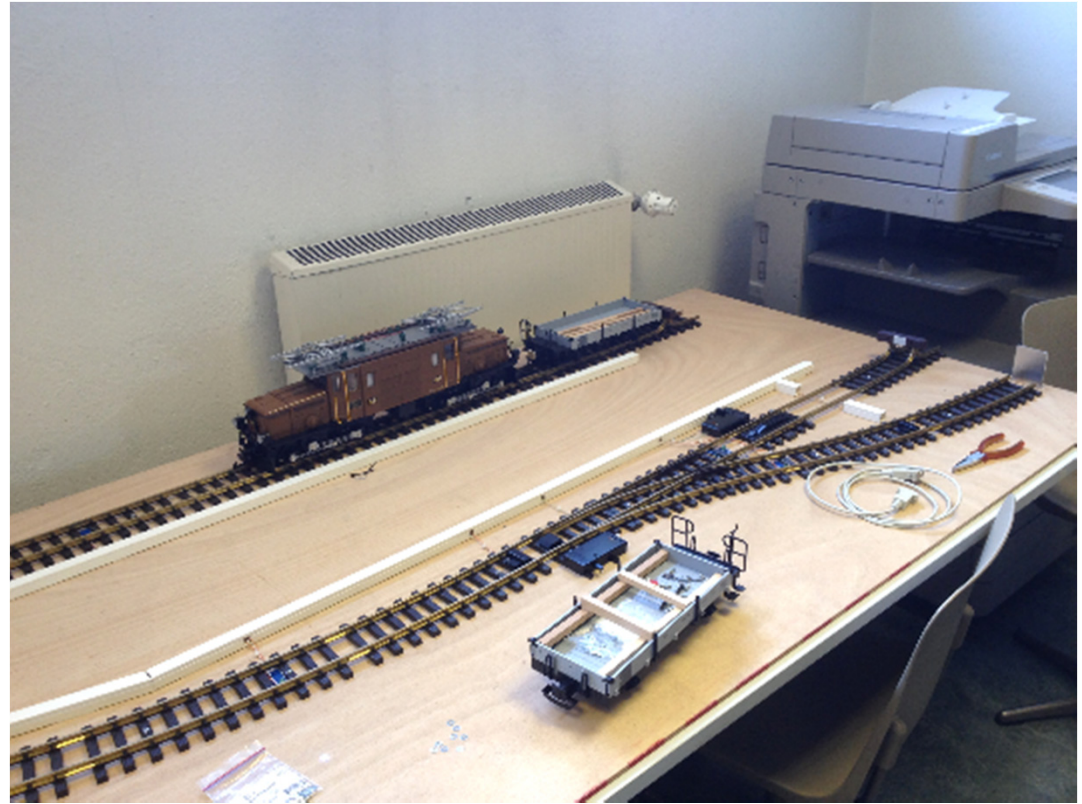
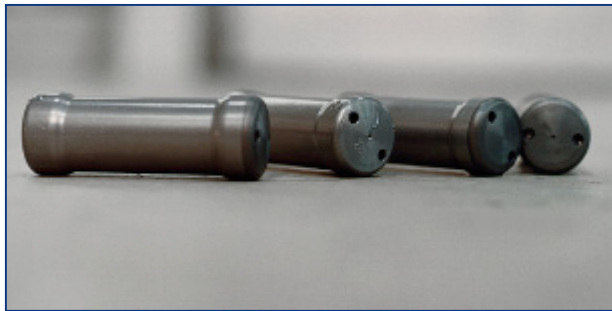
A new medical research isotope production facility, “MEDICIS,” is currently under construction at CERN. The new facility will use the leftover particle beam of the ISOLDE facility - after it has passed through ISOLDE targets - to irradiate additional targets to produce isotopes for medical research work.

In order to transfer, precisely position and store these additional targets, the isotope production process will use a new remote target handling and storage system. To ensure compatibility with radiation levels, which preclude the presence of electronics in the target handling and storage areas, the remote target handling system integrates modified versions of an industrial robot suspended from a linear axis mounted on the ceiling and industrial monorail transfer system working with custom-designed automated shielding doors, an air lock and remote handling cell.

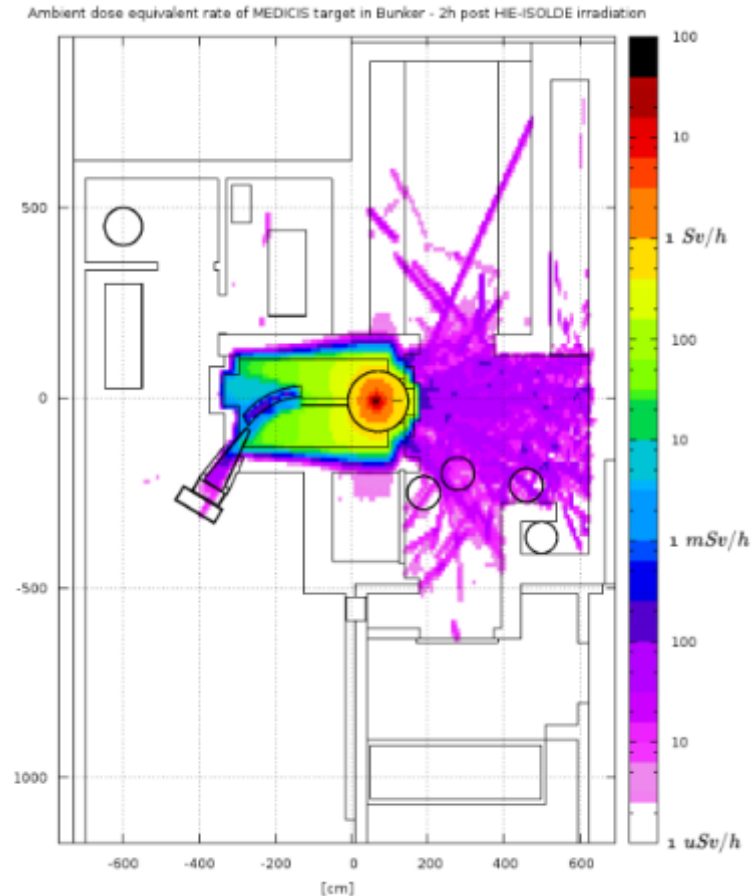
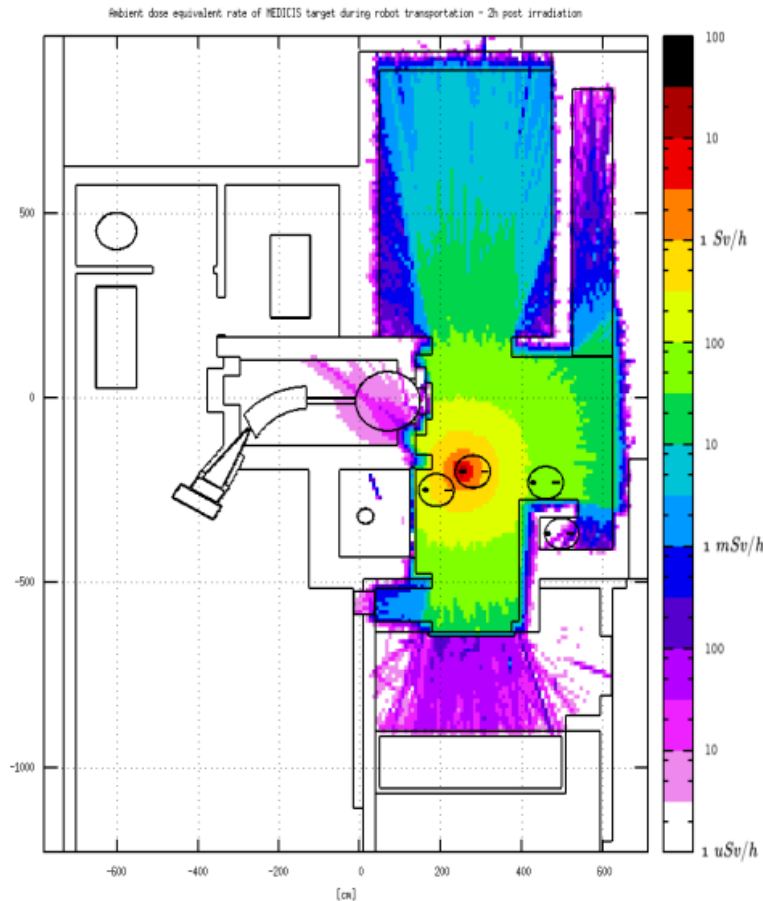
The isotopes extracted from the irradiated targets also require shielded handling and transfers; for which a new system has been designed.

The MEDICIS facility will be briefly introduced, followed by a description of the target remote handling and storage system and the isotope collection and handling system design.

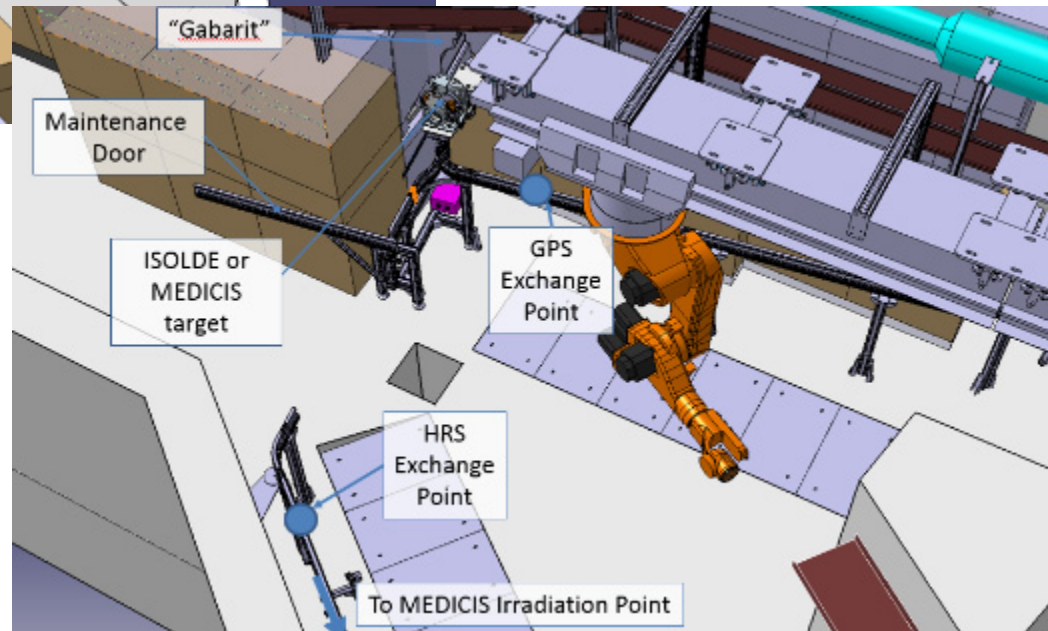
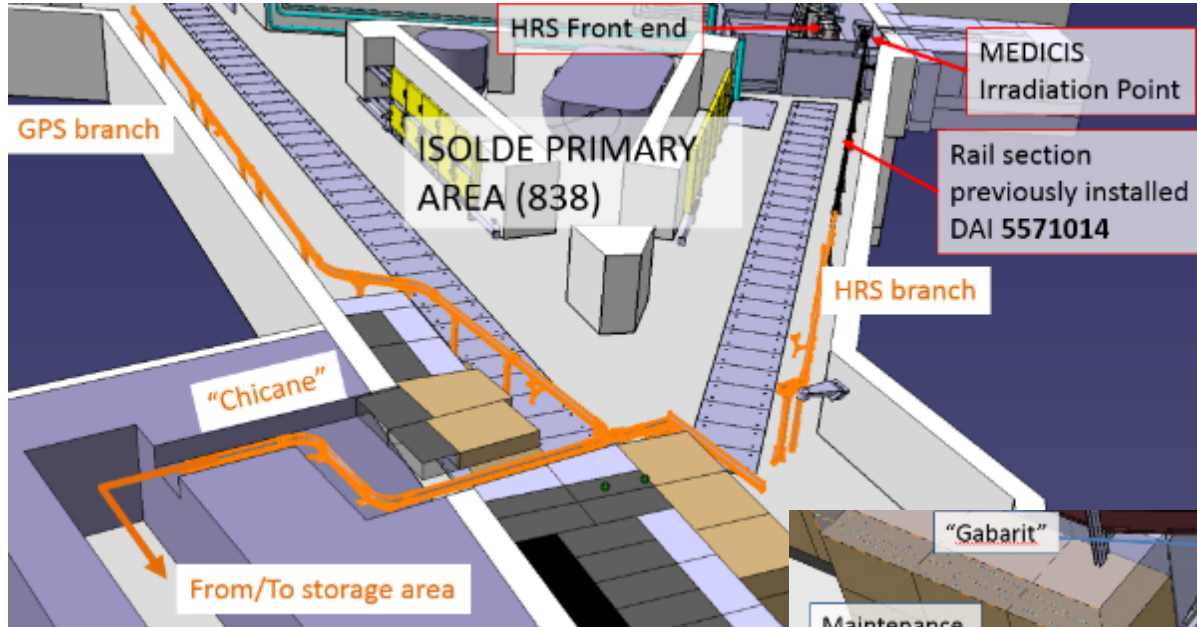
First ideas and prototypes for target transfers



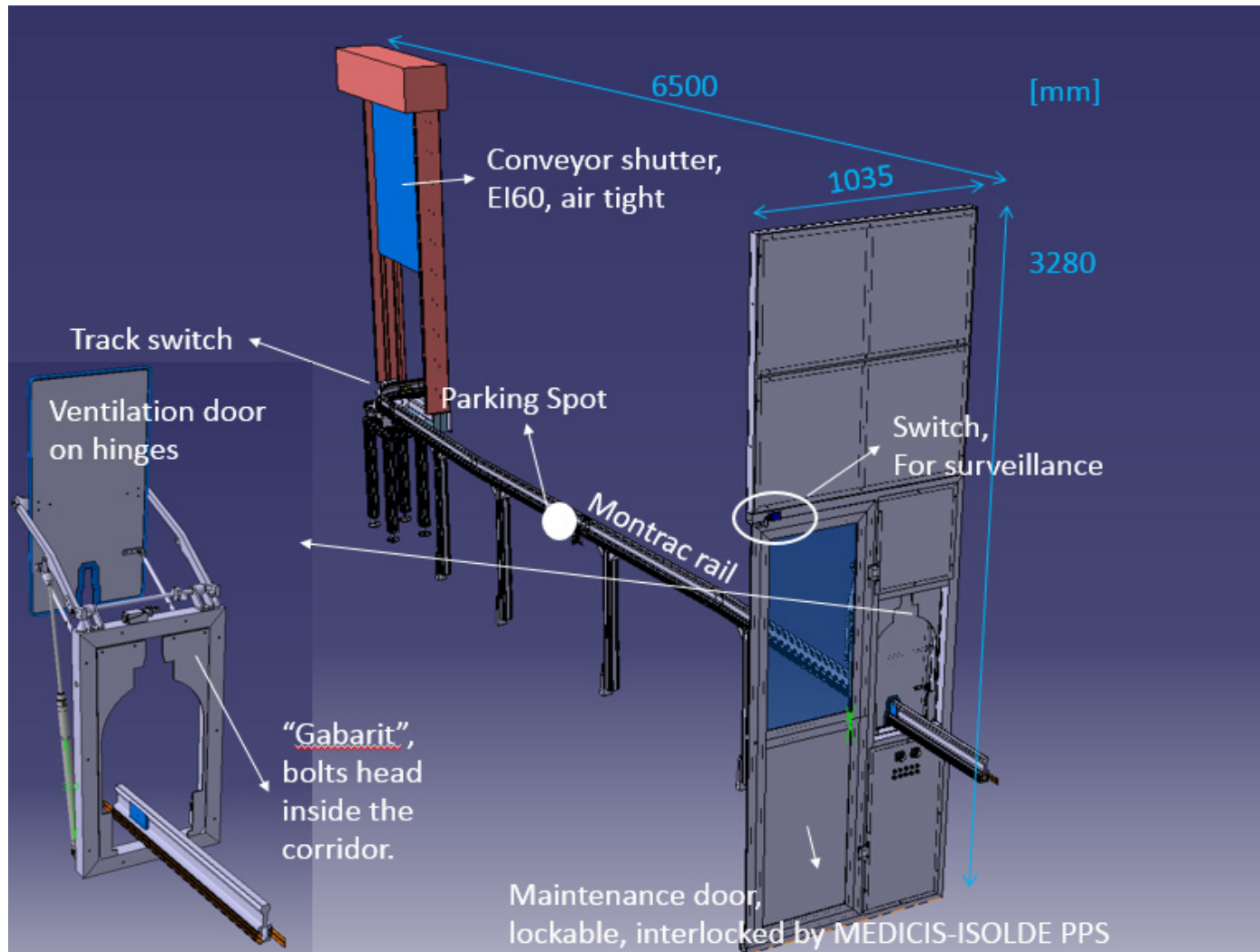
Fluka simulation for design of MEDICIS shielding



Shuttle monorail – ISOLDE portion



Air lock doors between ISOLDE and MEDICIS allowing target shuttle passage



Automated shielding hatch for robot arm passage

