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Paul Scherrer Institut

Projekt IMPACT an HIPA

Festsymposium 50 Jahre HIPA, 27.2.2024, Auditorium, PSI

IMPACT = HIMB + TATTOOS

Courtesy of Mahir Dzambegovic

Experimental hall
WEHA

Particle physics

590-MeV-
Ring
cyclotron

HIMB: Muon flux * 100

SINQ

TgE

TgM → HIMB

> 2.2 mA protons

100 μA

TATTOOS

Material science

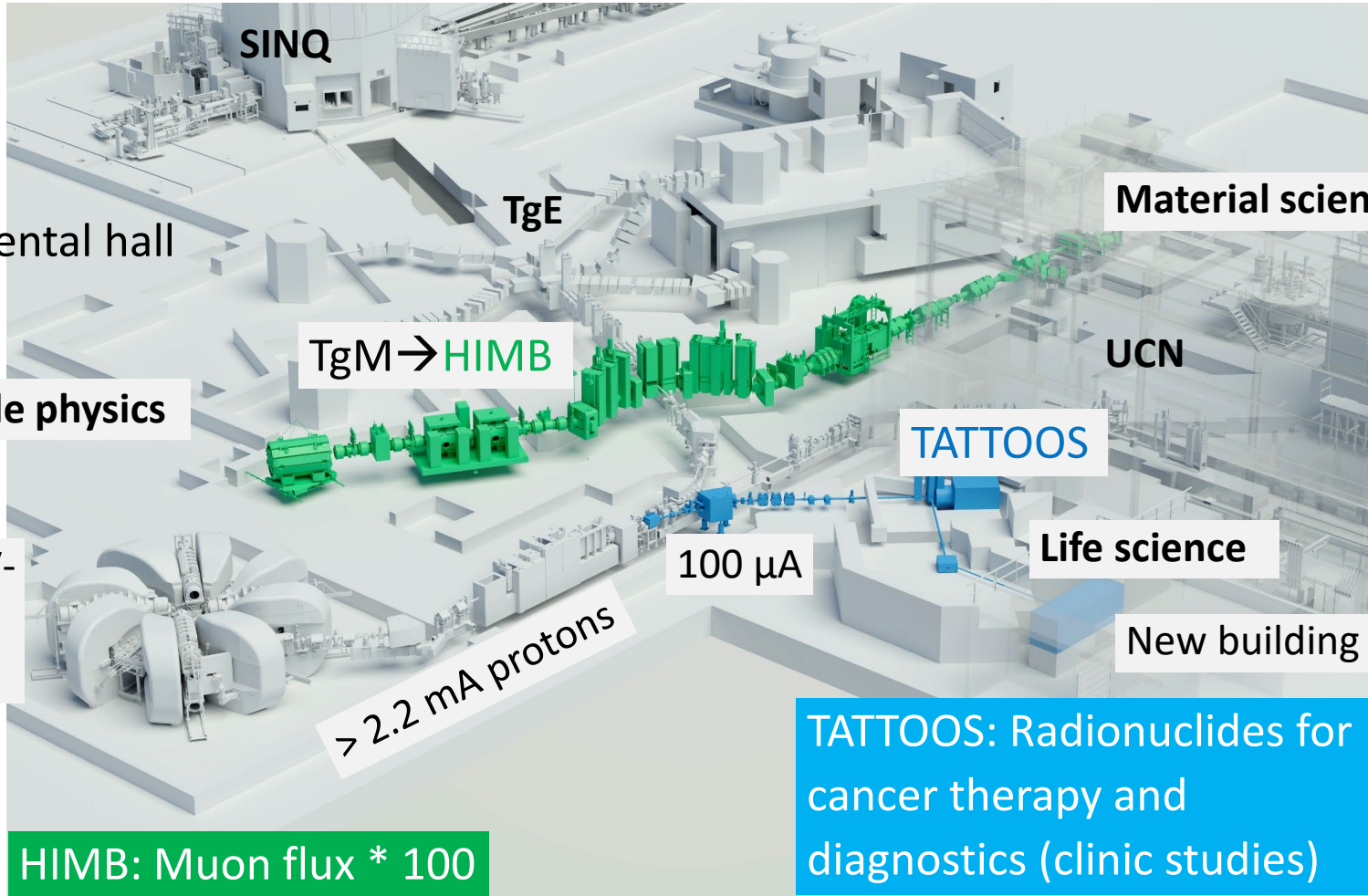
UCN

Life science

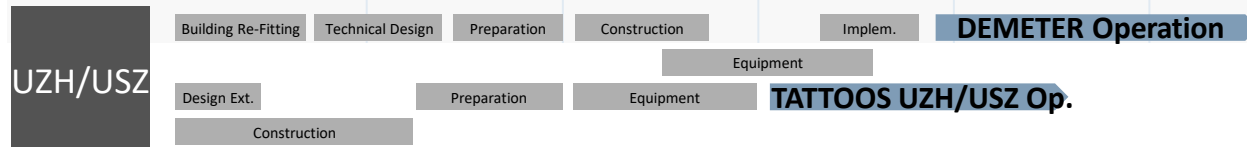
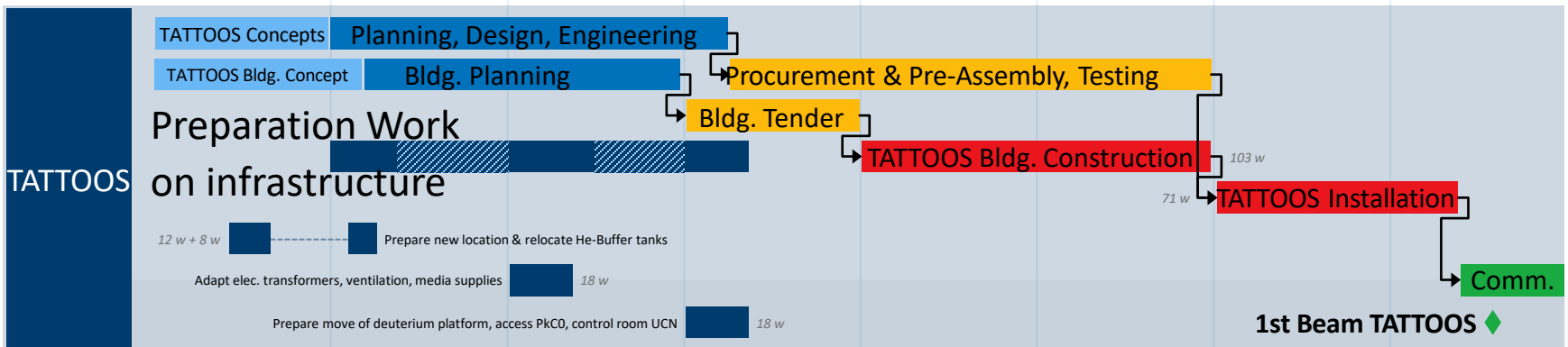
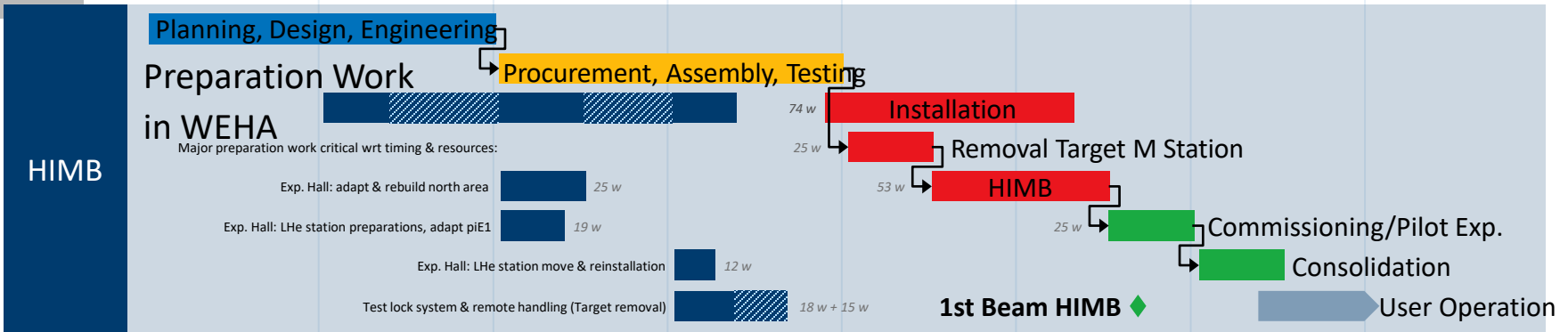
New building

TATTOOS: Radionuclides for
cancer therapy and
diagnostics (clinic studies)

= "Thera(g)nostics"

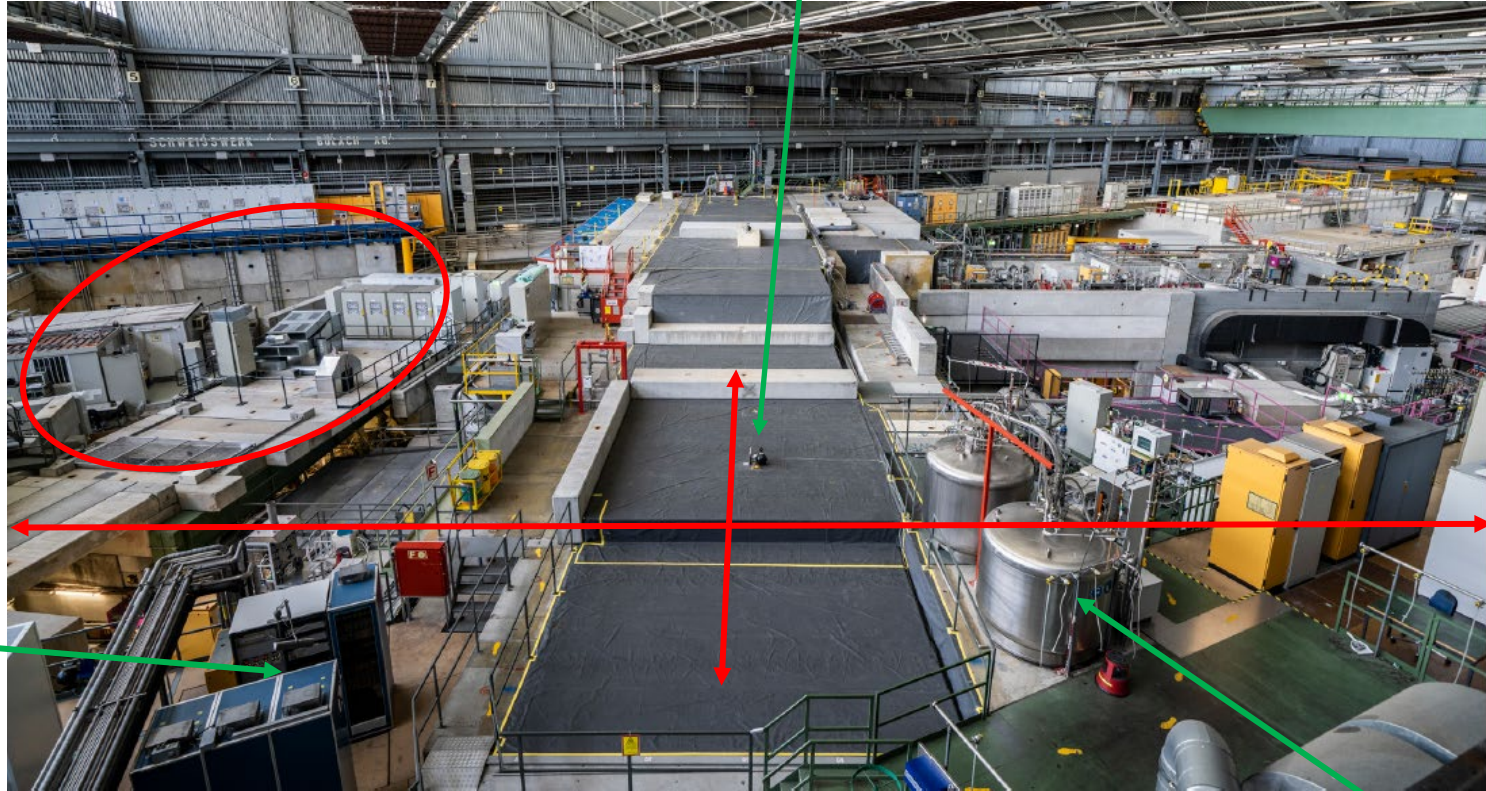


Time schedule



View in the experimental hall (WEHA)

Location of present TgM,
→ to be replaced by TgH(IMB)



Rebuilding
due to

MuH2

Power
supplies

MuH3

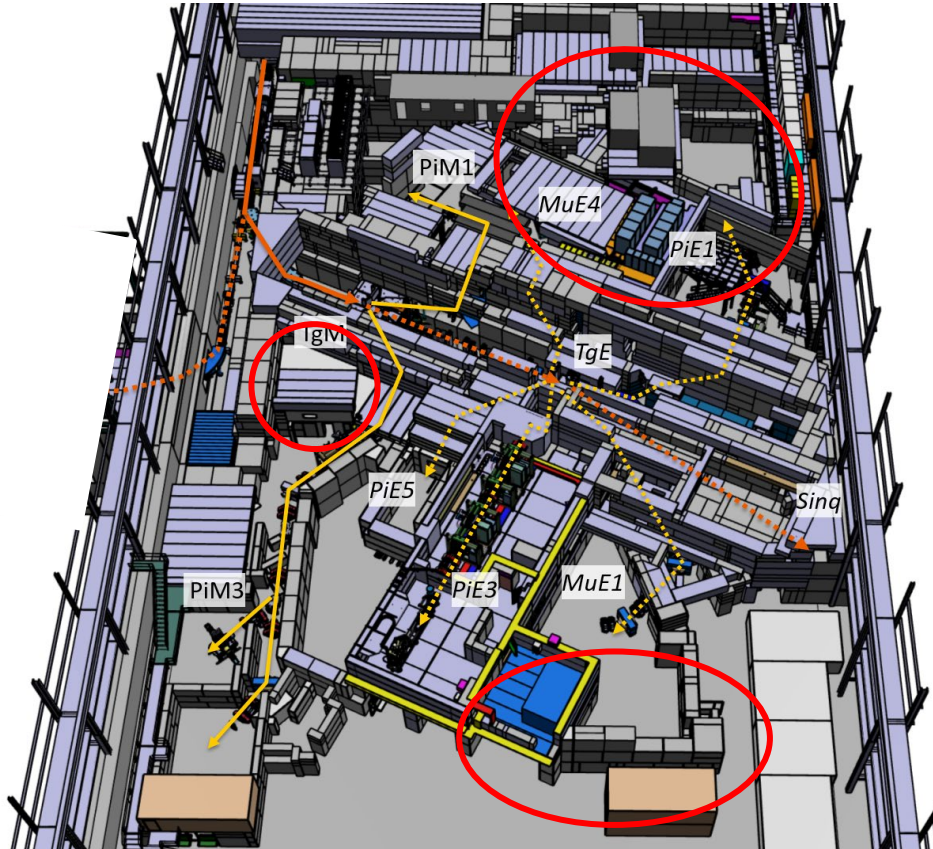
- Removing of tons of shielding and a lot of infrastructure
- Re-installation before beam permit

He liquefier station
below:
Water cooling cycle

The WEHA in CAD

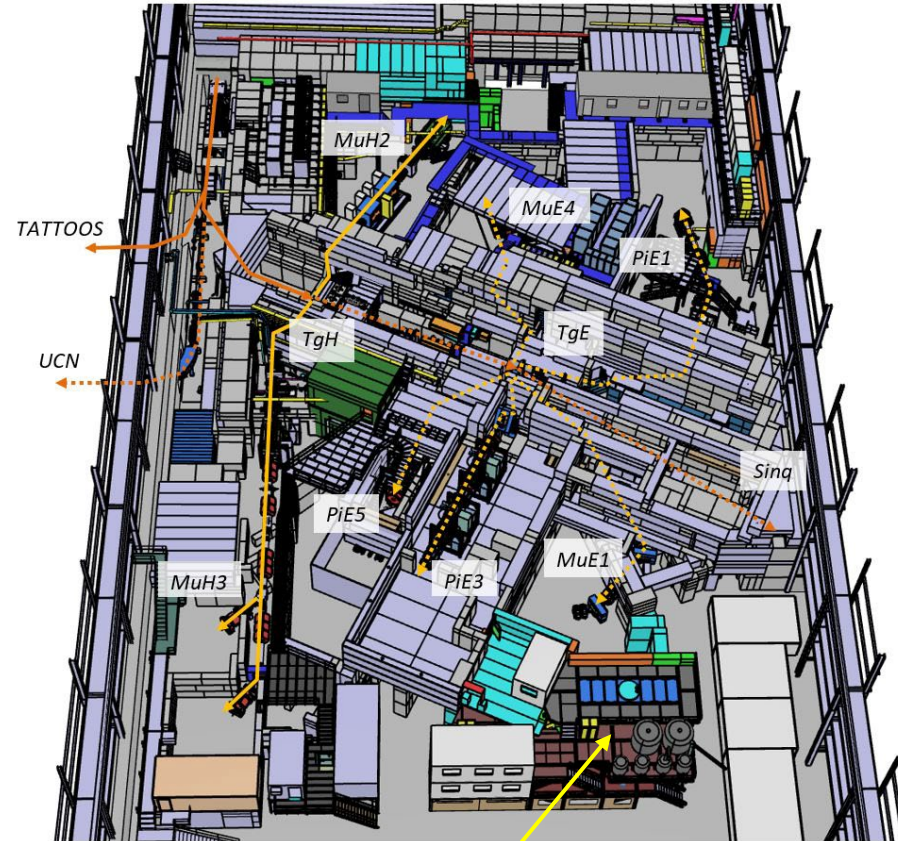
IMPACT triggered CAD model (complete for the 1. time) based on recent surveys

Present situation:



3 areas of major rebuilding
(preparatory work)

Including IMPACT:

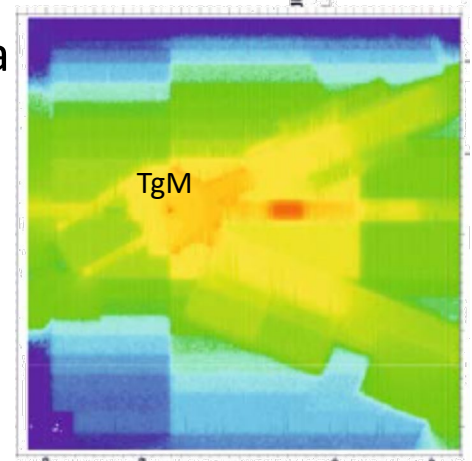


Installation He liquefier

Intelligent design → nice side effect:
Shorter emergency routes on ground level

Removal of Target M

“Hot” area



Sufficient shielding & underpressure



Crane (32 t)

Remote work area

Lock doors No 3, 2, 1

Area for removing container

Lock for container

Power manipulator: 200 kg + 2 t hook

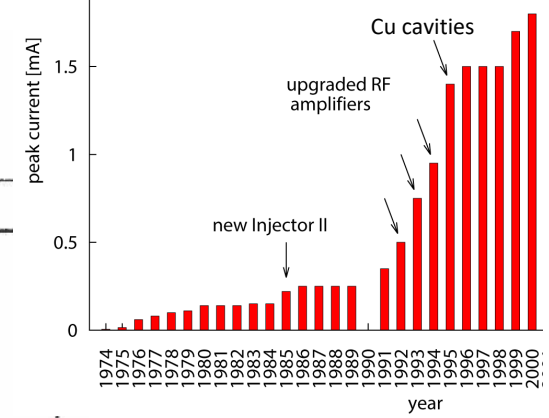
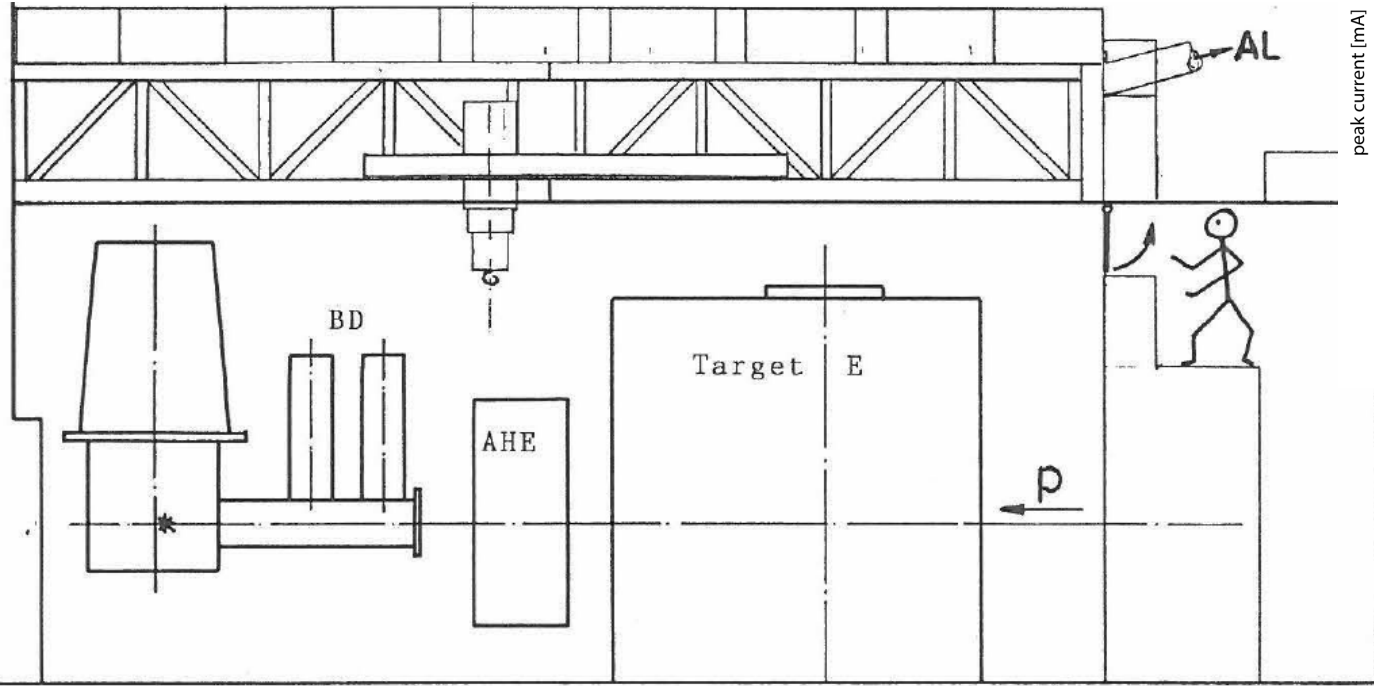
Safe area in case of infrastructure failure

★ : Locations of the four radiation-resistant cameras

Sophisticated door system prevents contamination outside of the work area

Looking back: "Hochstromausbau" 1990/91

Dismantling & rebuilding of the beamline from Target E (old) to beam dump



Prerequisite for higher currents and SINQ operation



New Target E chamber

Beam line from Target E to beam dump (side view)

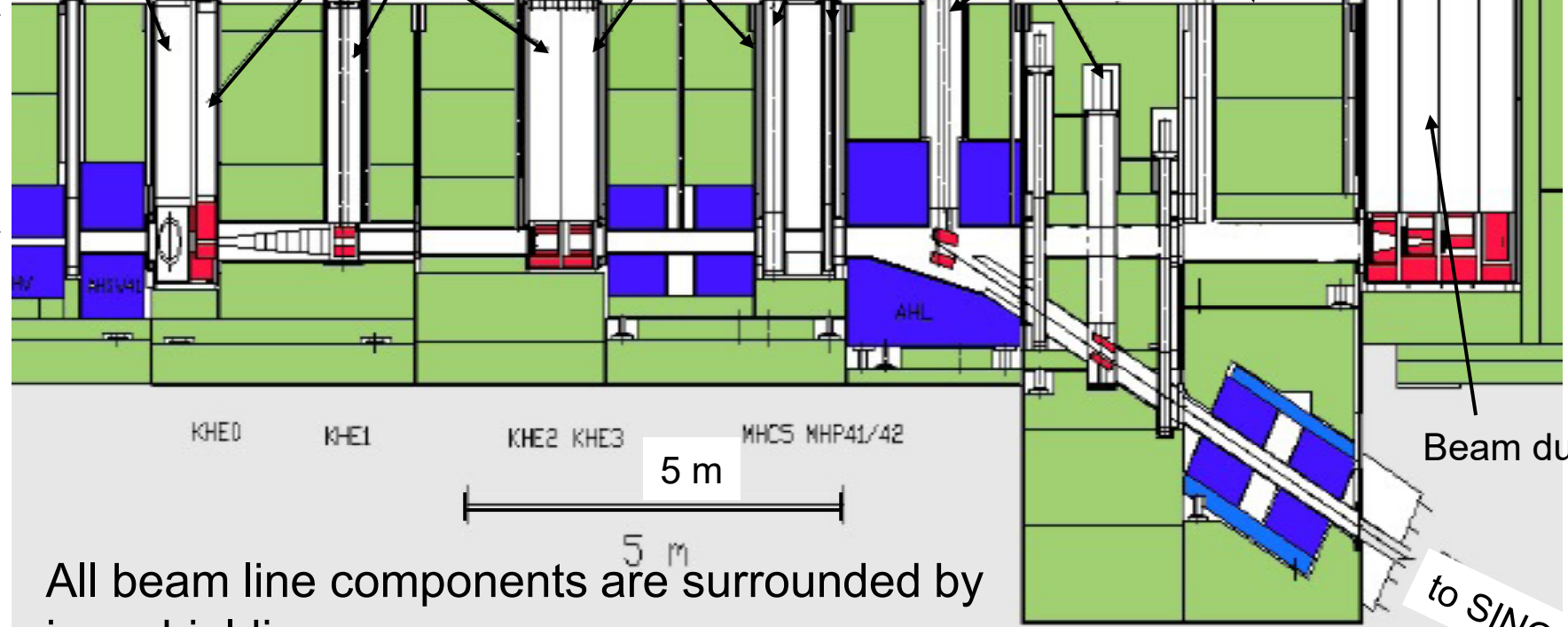


Concrete shielding

Working platform

Collimators inflatable seals Diagnostics movable slits

2.5 m

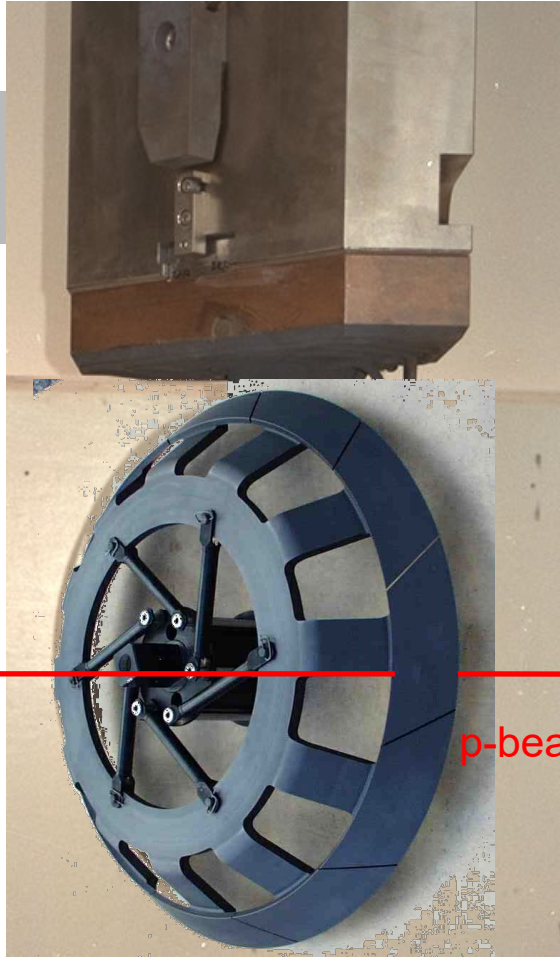


Beam dump

to SINQ

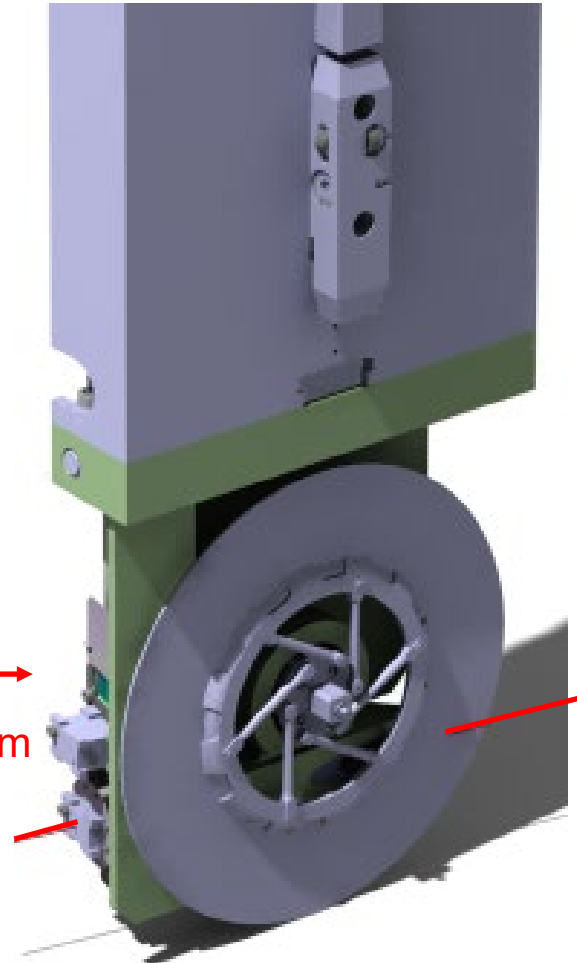
All beam line components are surrounded by iron shielding.

Present and future targets



Target E:

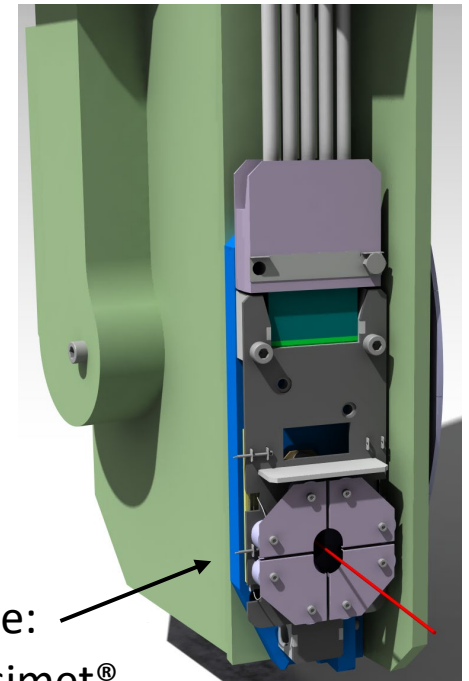
- 30 y of experience
- proven concept



Target H:

- Similar concept

In front of target



Inside:

Densimet[®]

Protection

Collimator

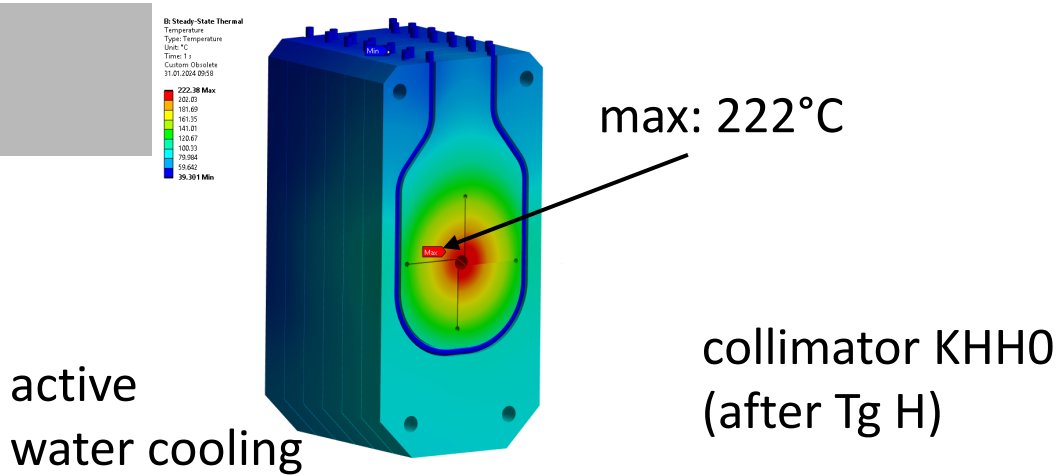
Halo

Monitor

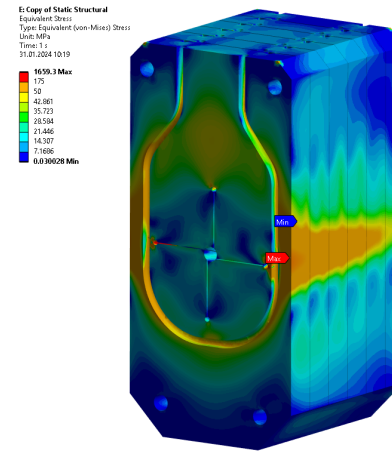
+ additional improvement:

- large target rim
- small beam angle
- integrated diagnostics

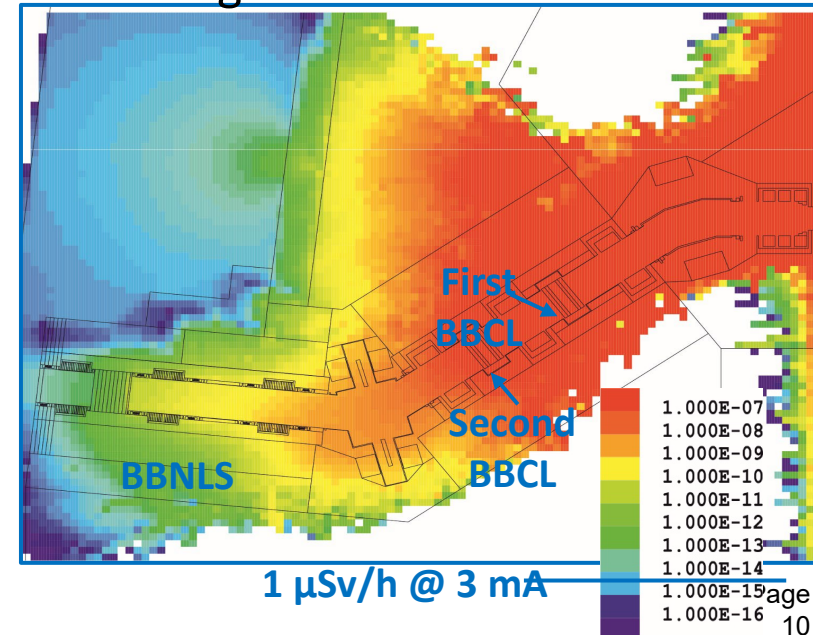
Temperature distribution:



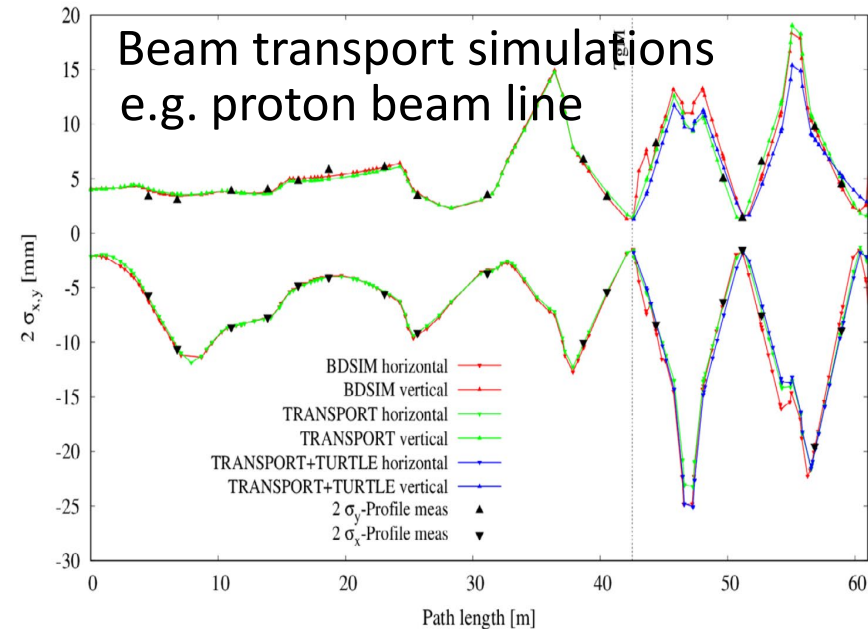
Structural analysis/stress distribution



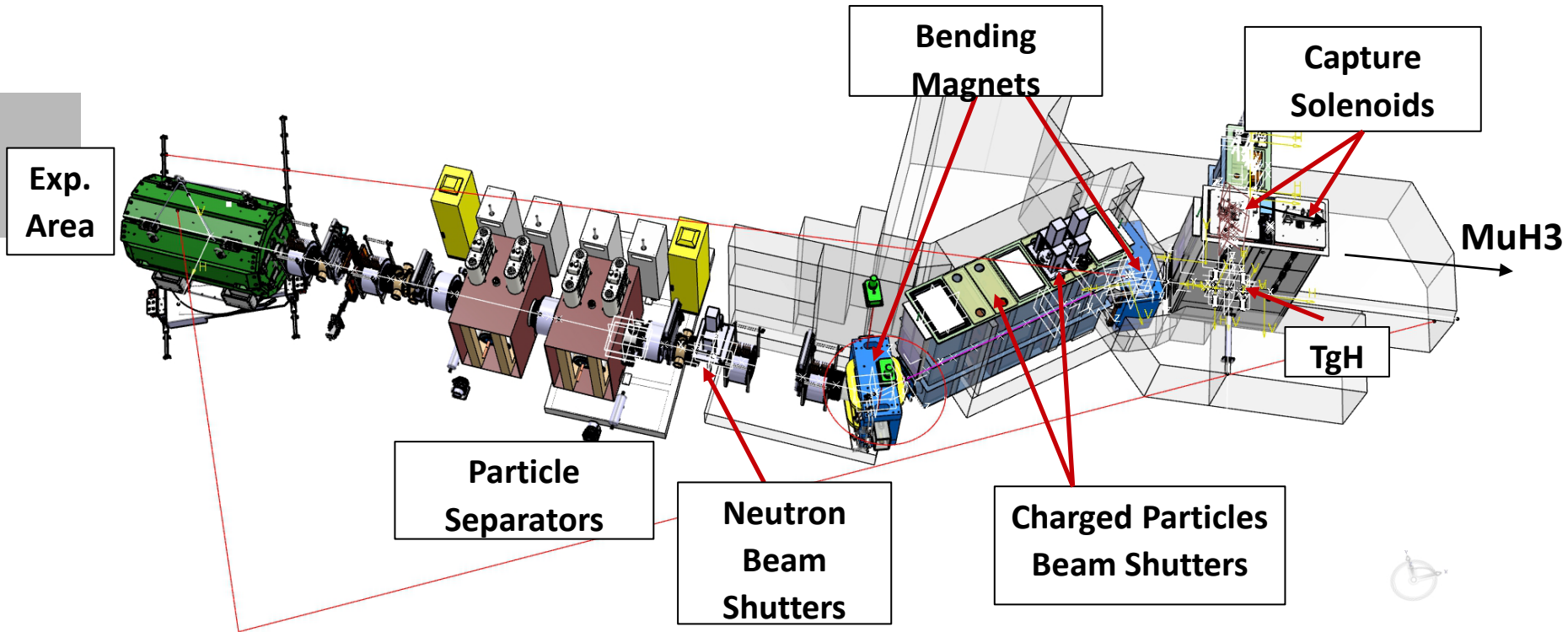
Shielding simulation



Beam transport simulations e.g. proton beam line



Layout of MuH2 Beamline at HIMB Target station



Current Design Status

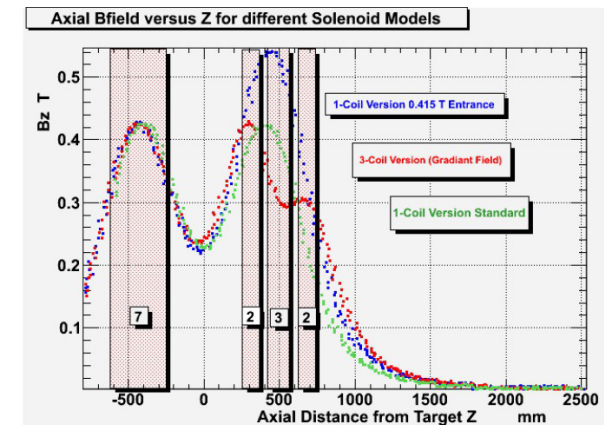
- 2 Bends
- 2 Particle Separators
- 3 Beam Shutters

Capture solenoids:

- +/- 250 mm from target!
- graded field
- optimized to max. μ flux

Many iteration & simulation to optimize muon transport.

→ Design goal $1.2 \cdot 10^{10}$ muons/s achieved!



TATTOOS: Current view on location

Facilities at PSI:

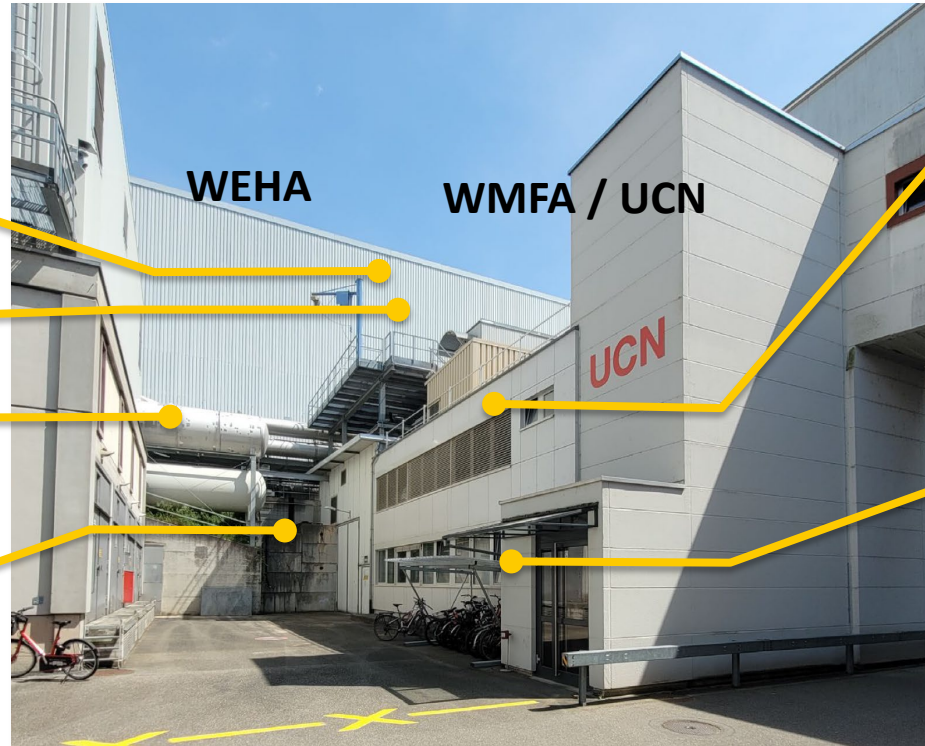


Top

- Proscan ventilation
- Transformers WEHA
- Deuterium tanks and control room
- He-buffer tanks
→ DONE

Back

- Access to UCN beamline
- Removal of UCN Coldbox and compressors
→ planned for summer24



1. floor

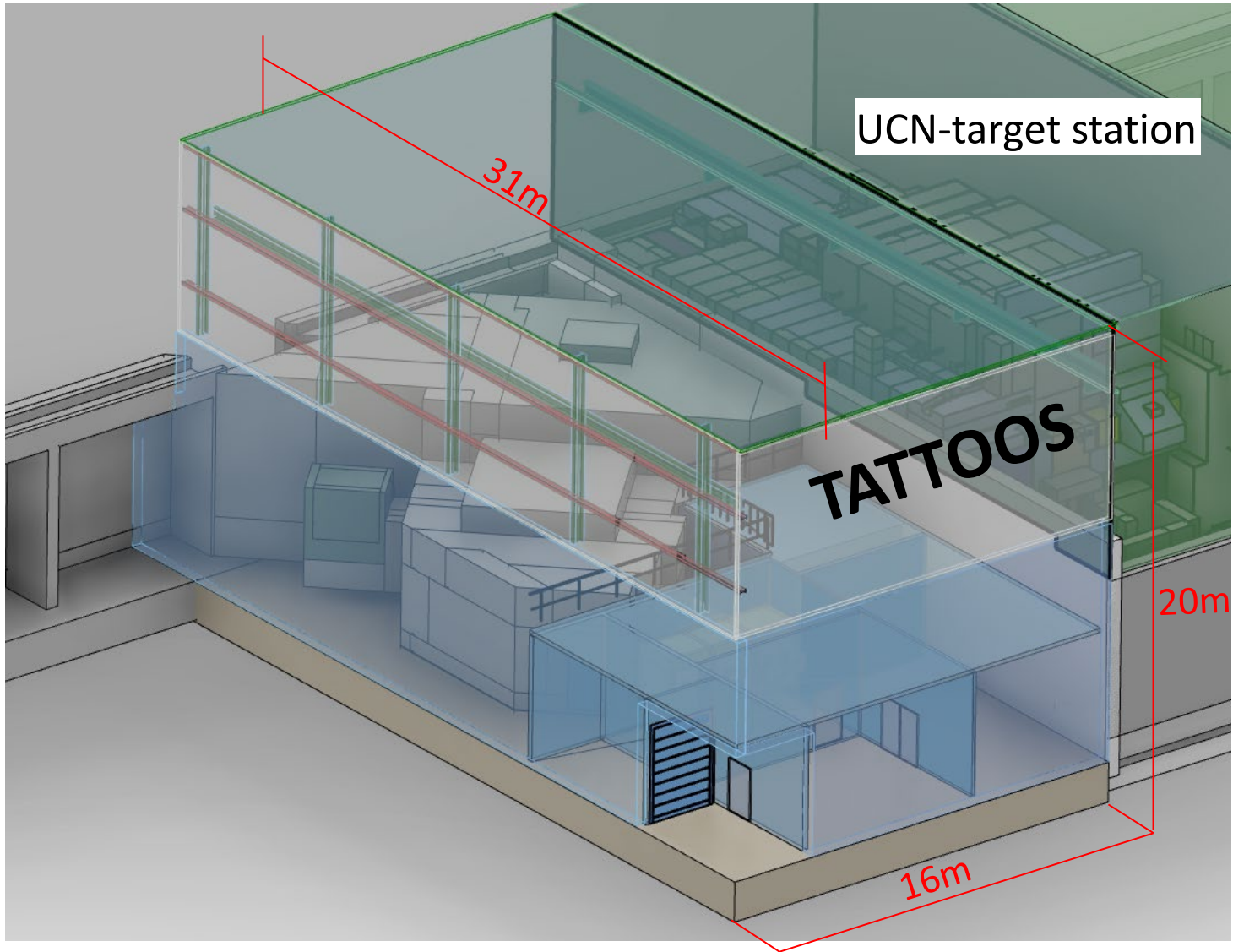
- UCN control room
- Offices and Labs

Basement

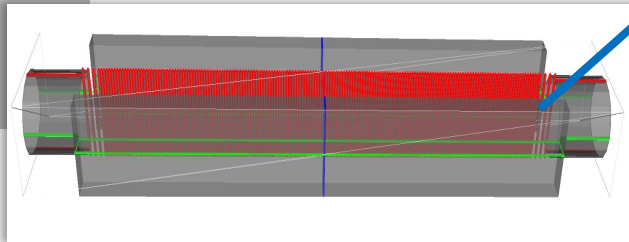
- Supply lines for UCN beamline, experiments, control room
- Waste water WMFA
- Supply lines for Sultan
- Breathing air supply

A lot of infrastructure has to be removed for the new building (start 2027)

New Building: 500 m²

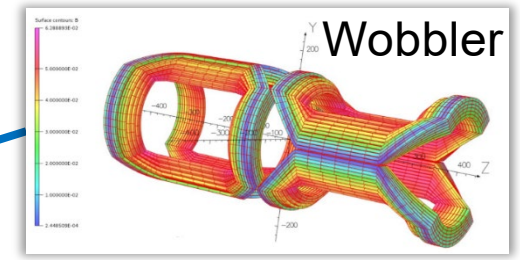
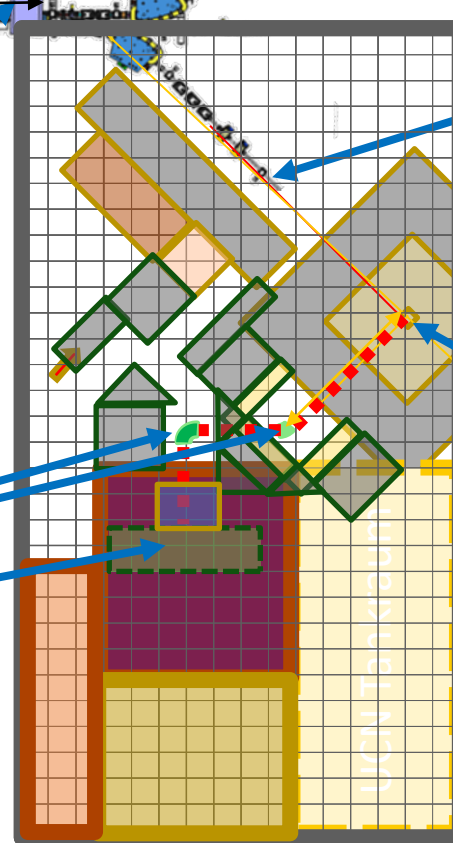


Beam splitter for
100 μ A 590 MeV protons



proton beam

UCN



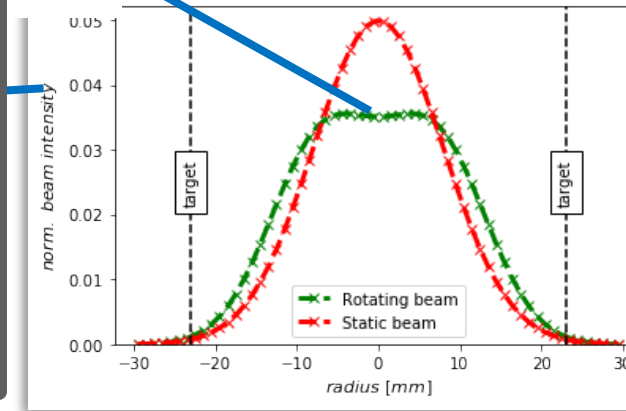
Wobbler

3 shielded cells



2 separator
magnets

Beam shape on target



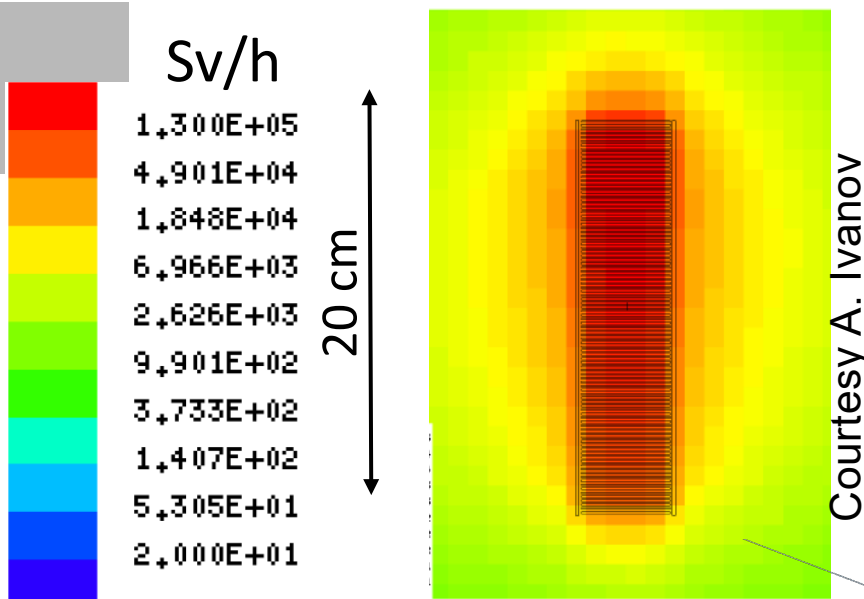
Separation of ions by

- Mass separation \rightarrow 2 Magnets: ISOL (Isotope Separation Online)
- Laser: RILIS (Resonance Ionization Laser Ion Source)
- Chemistry in shielded cells

Clinical preparation (radiolabeling) in a separate clean room (GMP),
collaboration with University hospital Zurich (USZ)

Current concept for target exchange

Remanent gamma dose of Ta target (28 d, 100 μ A, 12 h cooling)



1000 Sv/h in 10 cm

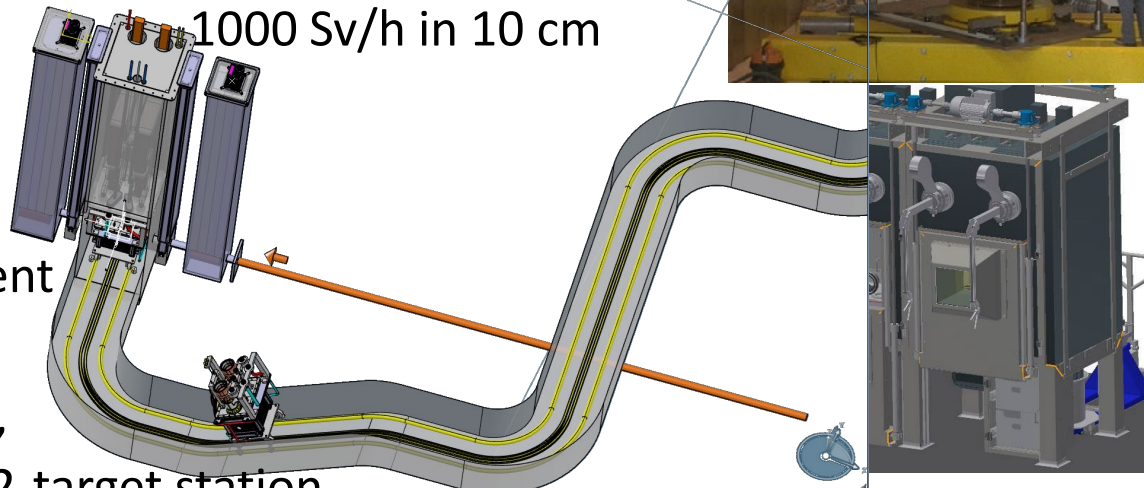
New exchange flask needed



shown:
existing flask,
45 t due to
shielding

Target,
beamdump etc
incl. shielding
can be pulled
by exchange flask

Trolley
system
for frequent
target
exchange,
similar IP2-target station



Service cell
for target exchange

- ISAAC TRIUMF: Collaboration Meeting in April 2023 in Vancouver



MoU in preparation

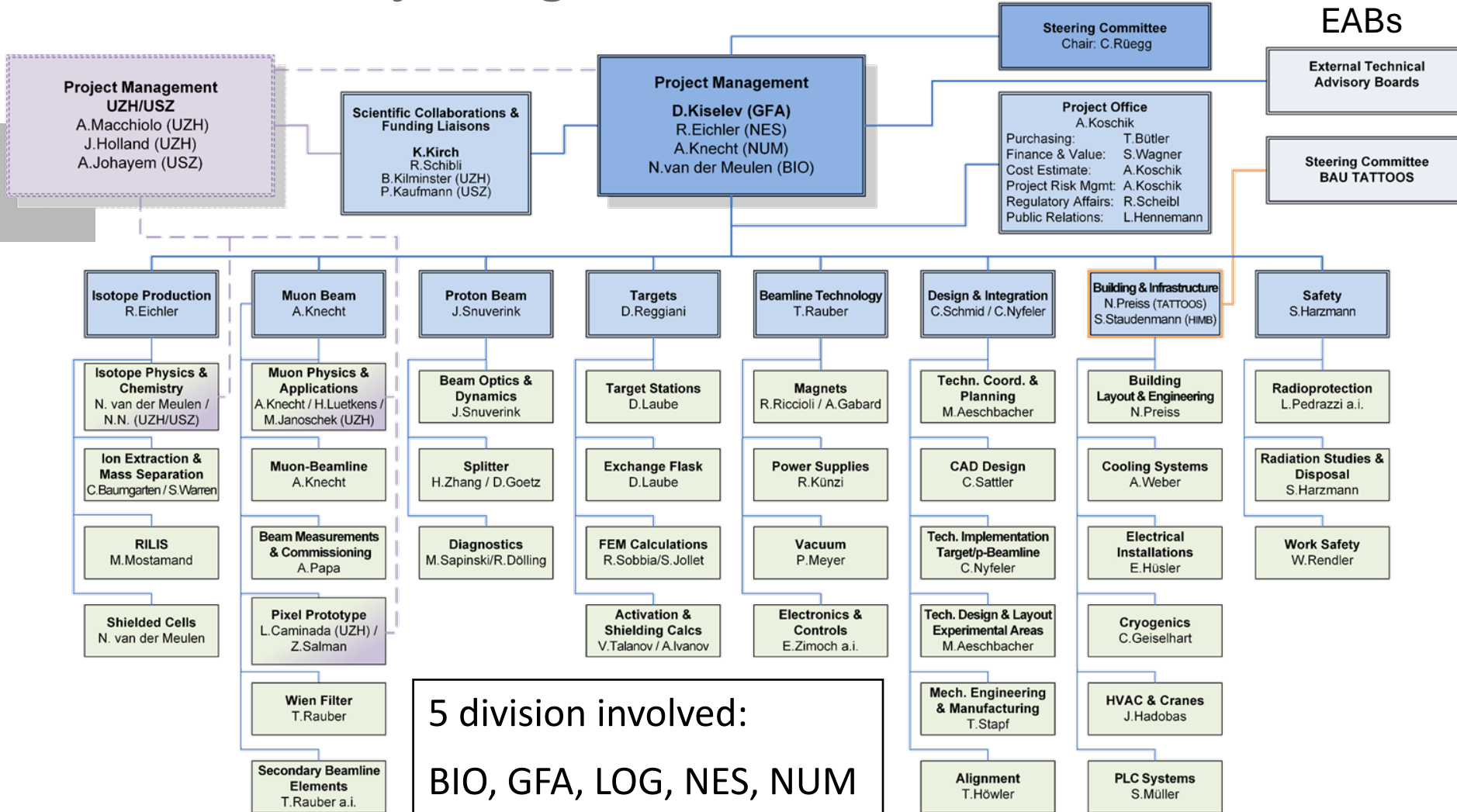
- ISOLDE user community: MOU signed in 2023 :



- PSI/Switzerland part of ISOLDE Collaboration
- CERN-PSI MoU in preparation

- CERN-MEDICIS...PSI Partner since 2017





- External Advisory Committees (EABs) for HIMB und TATTOOS: each 2 times a year
- Contribution UZH, USZ: Detector lab Demeter
Infrastruktur for med. preparation of radionuclides

- IMPACT = HIMB + TATTOOS: to be realized in 2027 to 2030
- HIMB: upgrade of the existing meson production station M
- TATTOOS: new target station to produce radioisotopes with 590 MeV protons
 - covers a broad field of applications: particle, solid state physics, life science

We appreciate the support of



Many thanks to the IMPACT team

With contributions of:

- | | |
|---------------------|-------------------------|
| • M. Aeschbacher | • N. Preiss |
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Thank you for your attention!

Thanks to the project team IMPACT

