

Status of ISOLDE facility improvement program : consolidation and EPIC

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In collaboration with:

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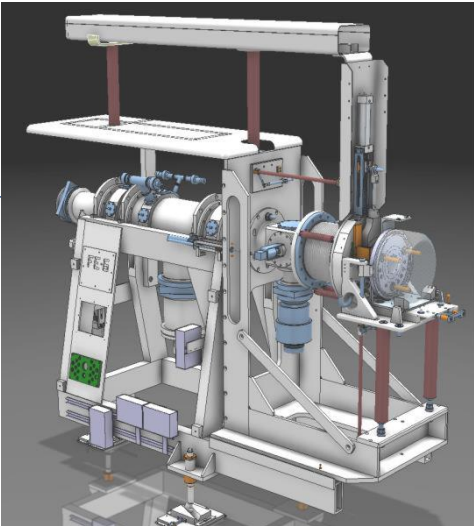
M. Calviani, S. Marzari, S. Rothe, A. P. Bernardes, J. Voltaire (SY/STI)



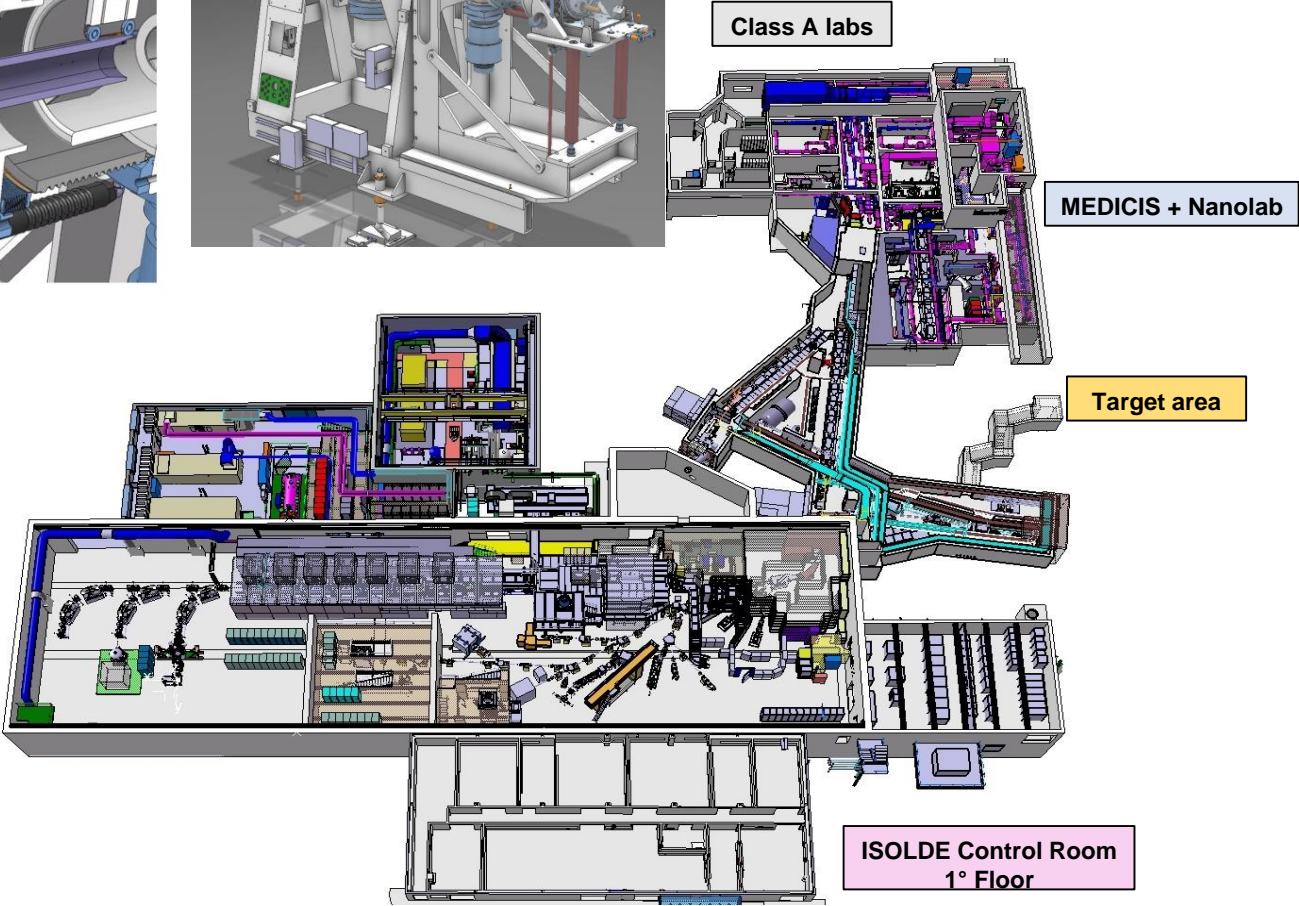
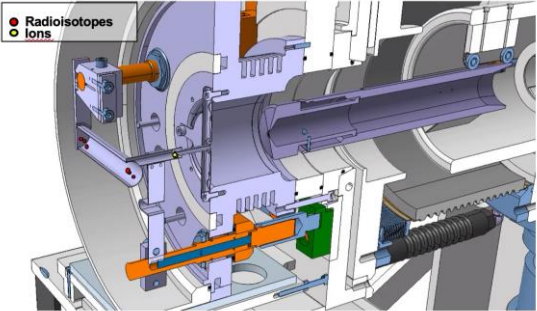
ISOLDE



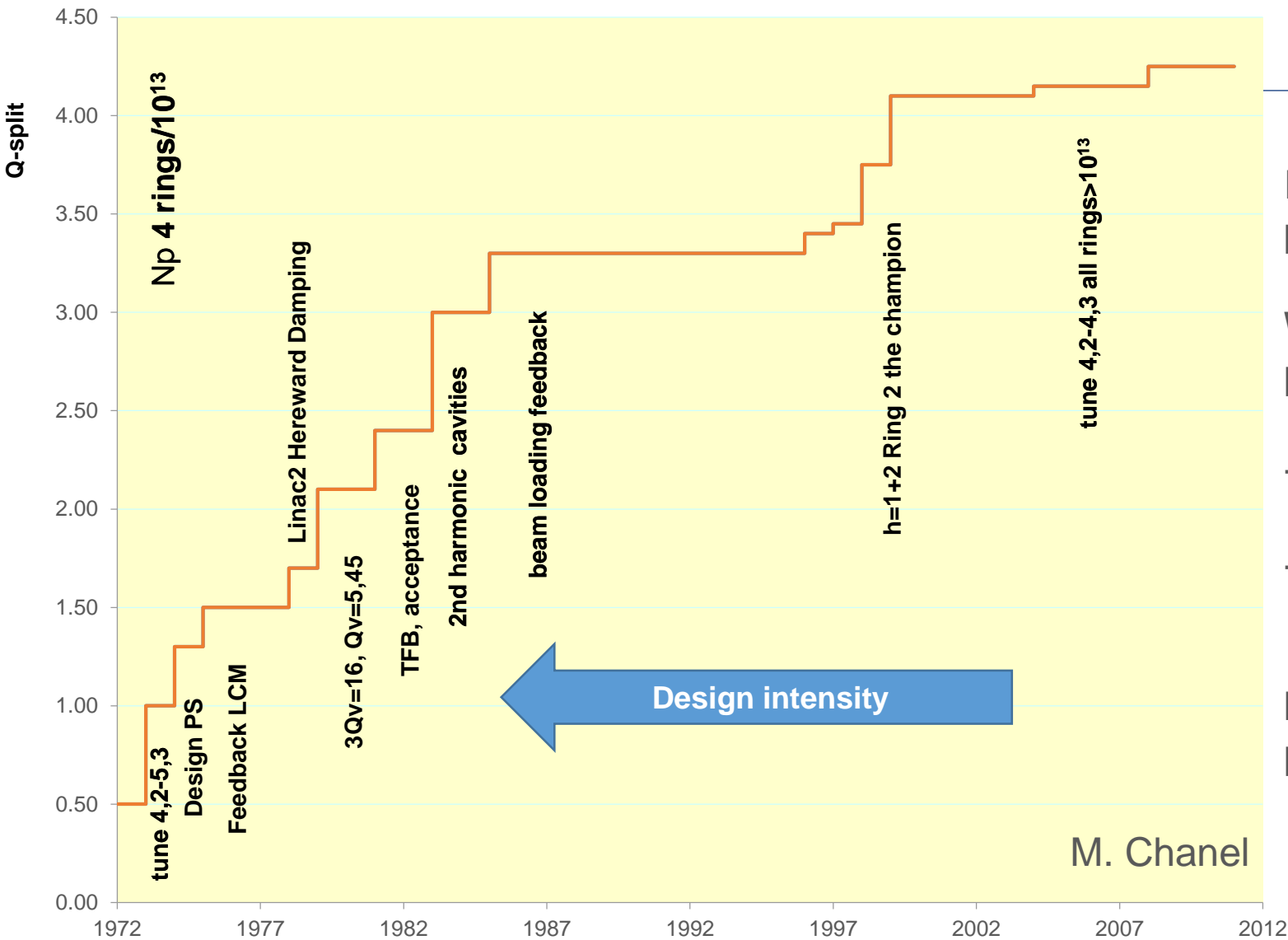
Front-ends



Targets



PSB evolution



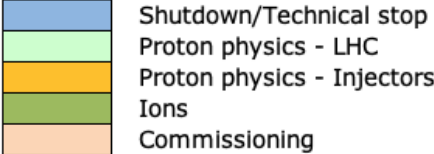
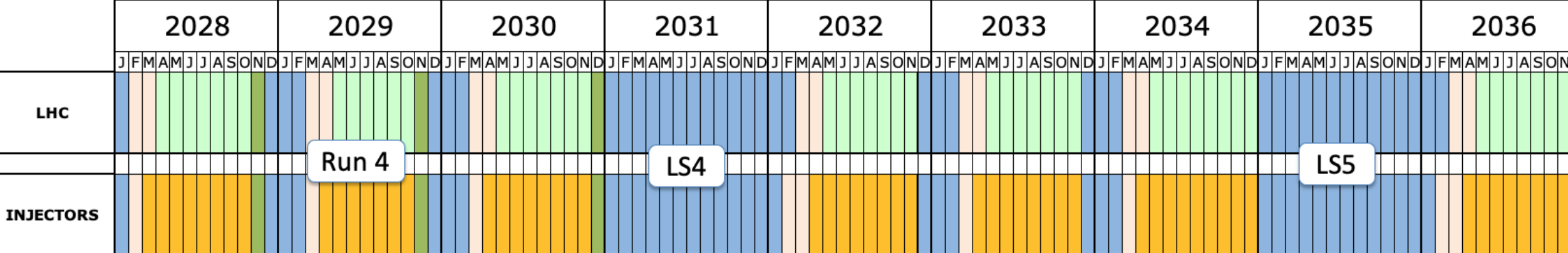
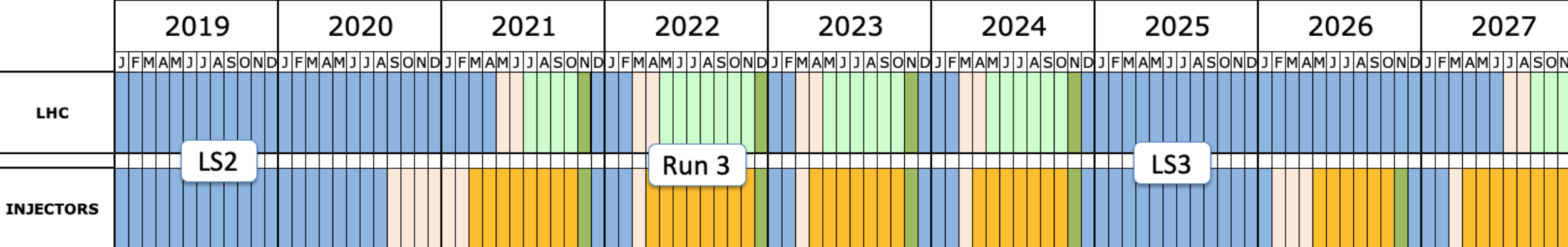
ISOLDE improvements could match potential PSB increased performance

With LIU (LHC INJECTOR UPGRADE) post LS2 for PSB:

- 2 GeV beams → all users except ISOLDE
- Potentially higher intensity (~6E13 POT)

ISOLDE consolidation/upgrade considering potential offered by Linac4+PSB@2GeV

Draft of future CERN accelerator plan



By M. Lamont, <https://lhc-commissioning.web.cern.ch/schedule/images/LHC-and-injectors-to-2036.png>

Ideas for Isolde Upgrades and Expansion

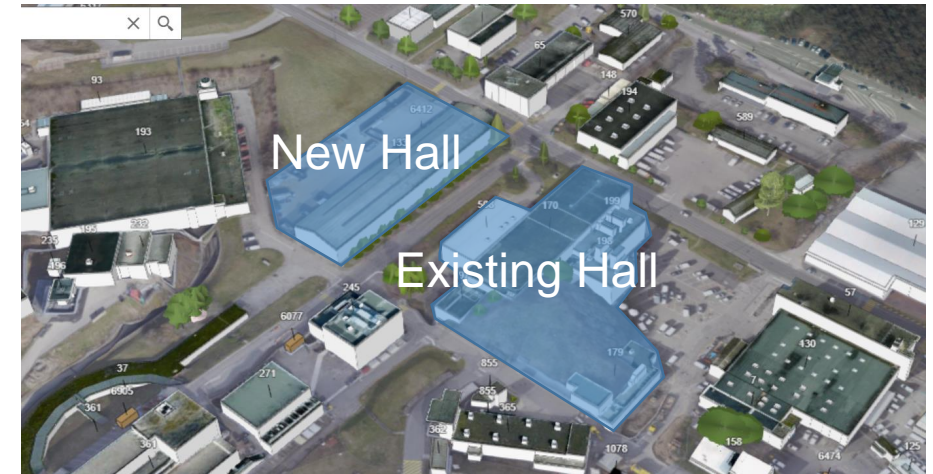


Mid-term goal (2025-2026)

- Parallel RIB operation
 - New beam dumps for 2 existing target stations, allowing to receive higher energy proton beam at double intensity
 - Upgrade of transfer line from Booster to ISOLDE to allow sending 2 GeV (and present 1.4 GeV) beams.
- ➔ Increase RIB beam intensity by factor 1 to 40 (isotope dependent)

Long-term goals (> 2026): EPIC proposal

- A new ISOLDE building + target stations
- Dedicated space and facilities for new (and existing) low-energy experiments
- Improved beam purity (mass resolution) and quality (time structure)
- Parallel operation with existing (HIE-ISOLDE) facility
- Space for new re-accelerated RIB experiments, including a new compact storage ring



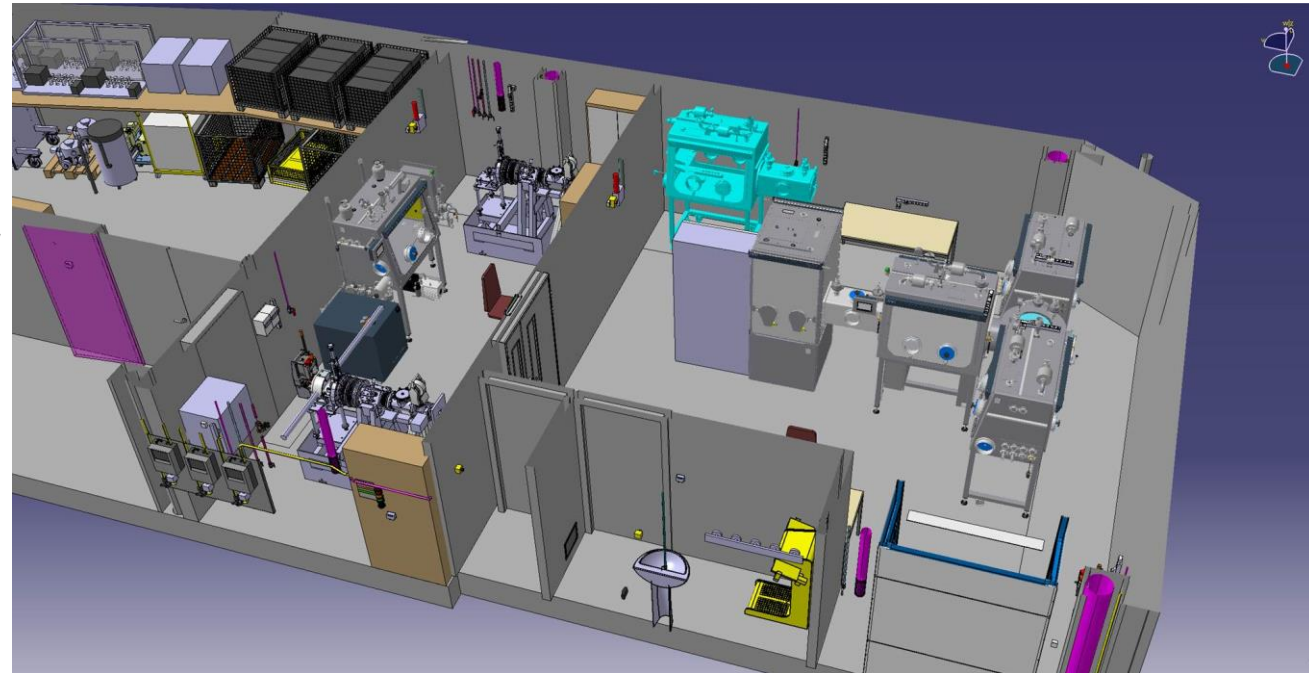
First: Nanolab

- Implementation of Nanolab driven by improvement of safety for production processes, potential reduction of number of targets (also less waste), and physics

Carburization area
(separated from power
supplies room)



New Nano production laboratory
(glove boxes to be installed after
the summer)

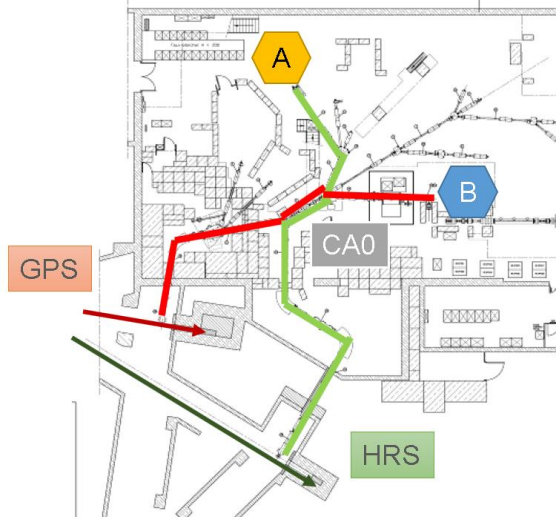


See S. Rothe for more details

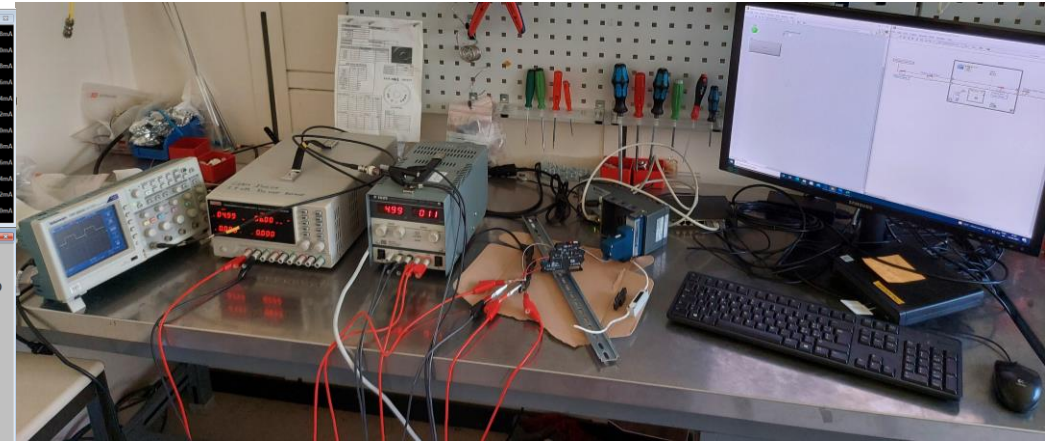
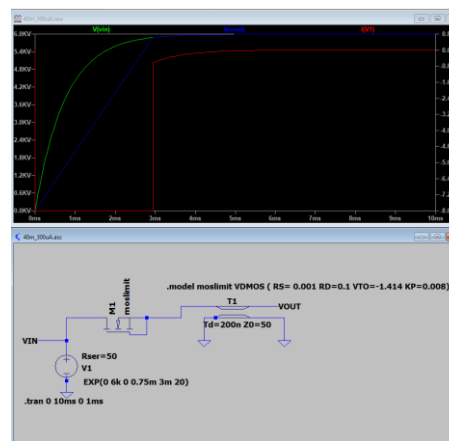
ISOLDE beamlines: Alternating operation

More details see presentation in [EPIC Workshop 2020](#)

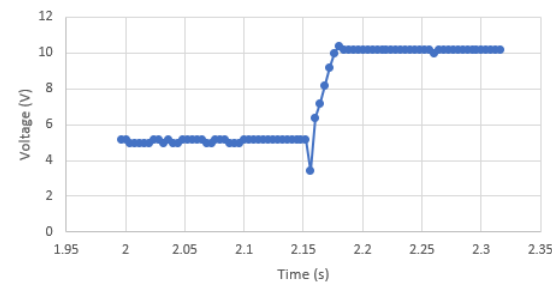
Alternating mode



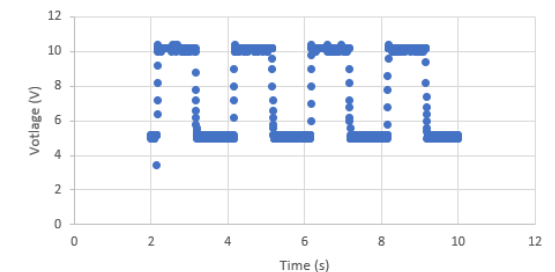
[TG06] [M. Lindroos and T. Nilsson, "HIE-ISOLDE: the technical options," CERN-2006-003, \(2006\).](#) (Chapter 7 by T. Giles)



Voltage Pulsing



Voltage Pulsing



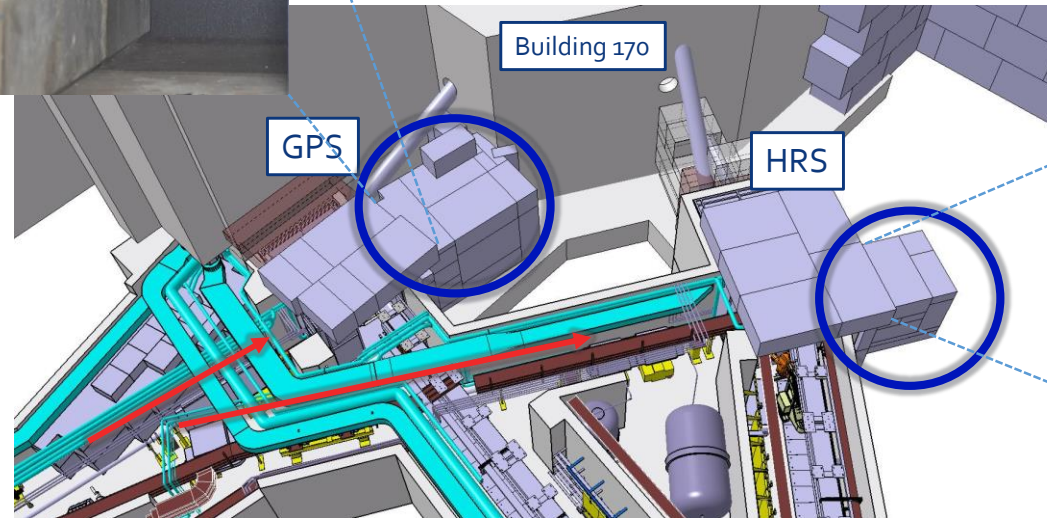
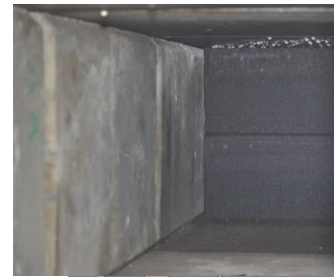
- Requires proof of concept + prototype
- Final design can be installed during a winter shutdown

- From S. Rothe:
 - Initial prototype setup (simulation, first measurement)
 - Functional specification drafted
 - Project board to be appointed

ISOLDE target areas consolidation : up to LS3

High priority consolidation items:

- Renovation of beam dumps at end of life-time:
 - Signs of rust and beam induced damage
 - Dump already operate at their limit in term of temperature and mechanical stresses
- Replacement of Front-end after few years of operation
 - FE lifetime given by integrated dose.
- ISOLDE RILIS Lasers regular replacement
- **FE and Laser replacement funded by CERN-CONS project for interventions in LS3**

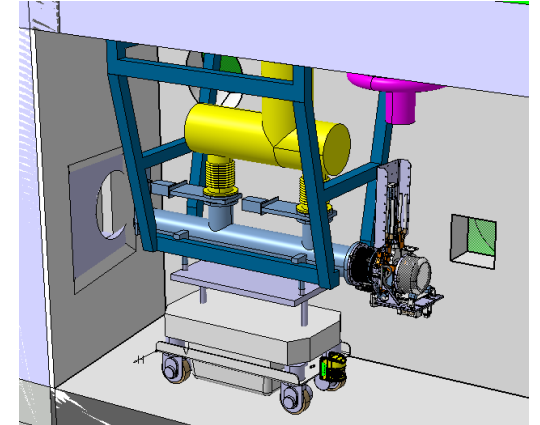



Frontend exchange : new investigations

- Front-end exchange is a major work requiring an LS both for cooldown as for installation
- Typical FE lifetime is 4 – 8 years depending on dose cumulated (seals, HV, etc...)
- Design of new generation started for implementation for LS3 (opportunity to explore improvements):
 - Alignment system
 - Handling (installation-removal)
 - Vacuum system
 - Less radioactive wastes
 - Less Human intervention (ALARA)
 - Repair – Reuse – Recycle
 - Connectivity
 - Maintenance philosophy
 - Running costs



Possibly



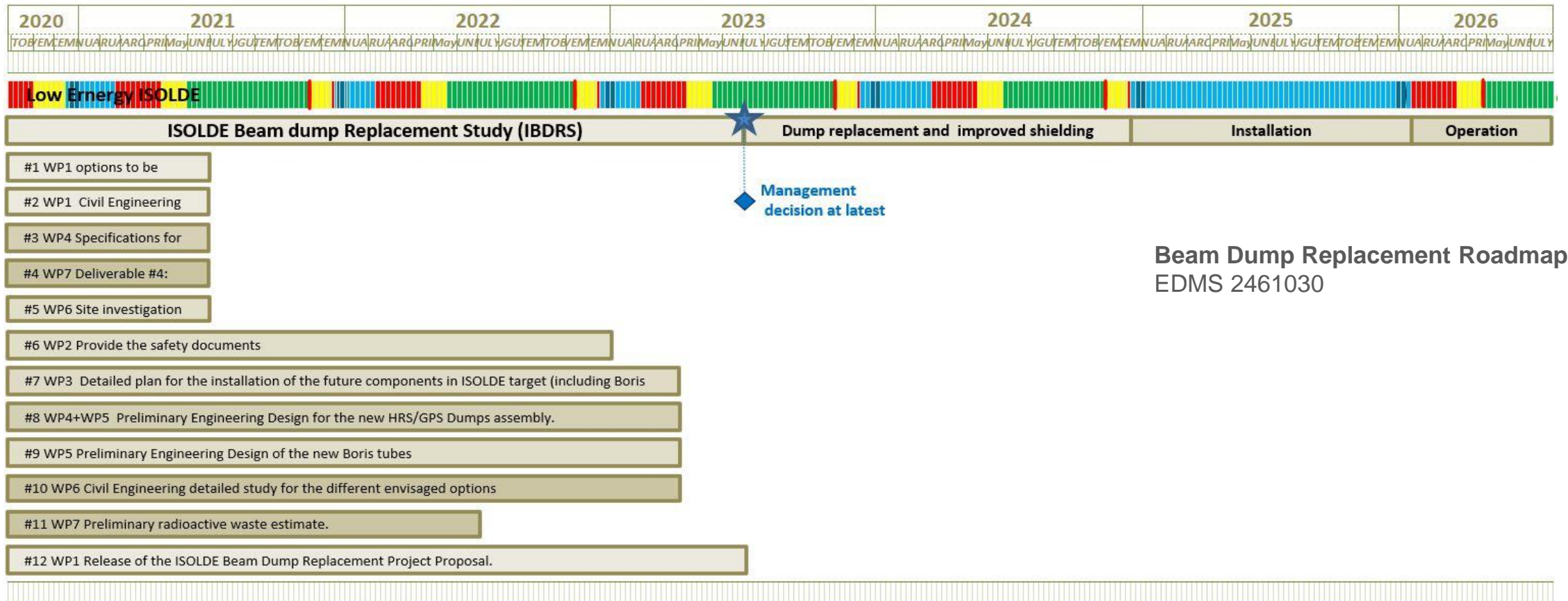
EPIC will profit from all of these

Courtesy of S. Marzari (SY/STI)

Beam dump consolidation

- ISOLDE Beam Dump Replacement Study (IBDRS) Project
 - Study funded by CERN consolidation (CONS) project
 - IBDRS managed by A. P. Bernardes (SY/STI)
 - WBS defined with workpackages: **project is active**
- Design to be compatible with higher beam intensity + energy (power) on target
 - Studies to be check compatibility of targets and FE
- Final deliverable : technical input for dump replacement targeting/seeking CERN approval at the latest in 2023
 - Target budget and workforce being defined
 - Schedule options being analysed

Draft scheduled with details of WPs IBDRS

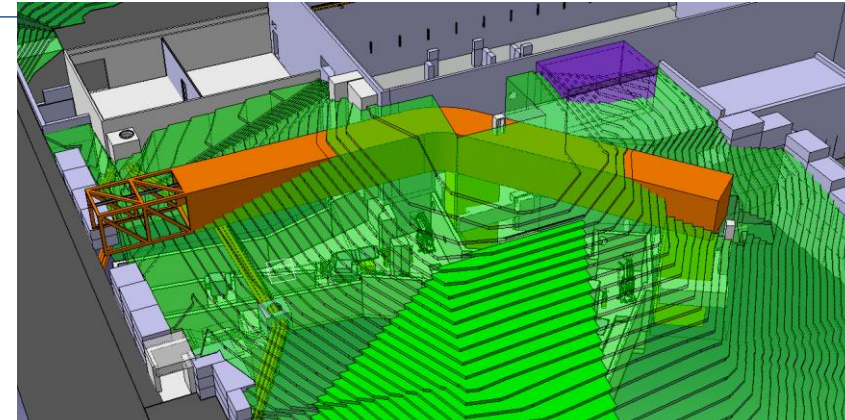
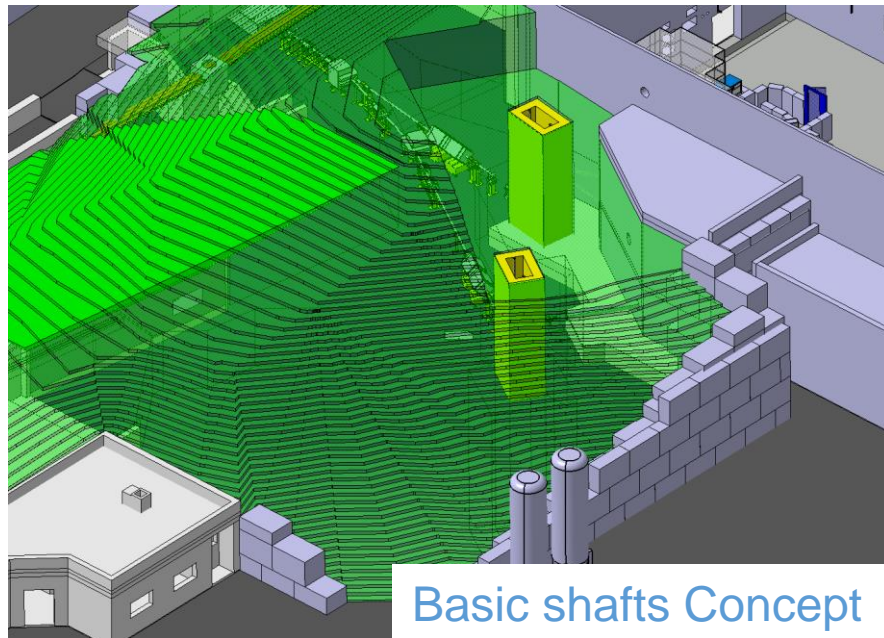


Beam Dump Replacement Roadmap
EDMS 2461030

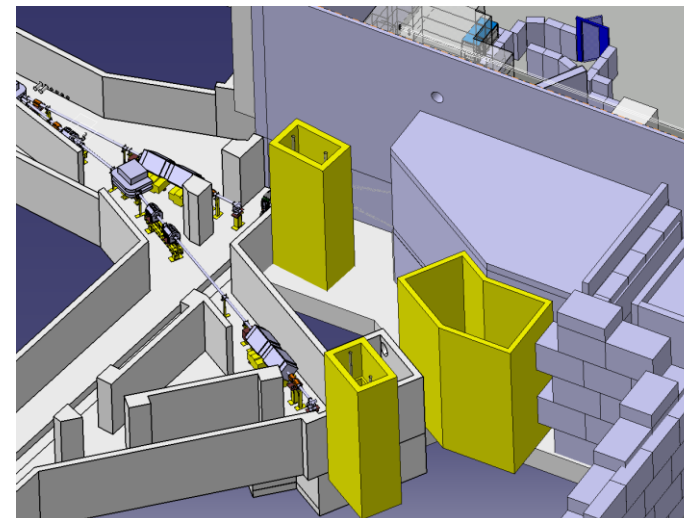
S. Mataguez (BE/OP/ISO)

Example of concepts and options

One **Basic Shafts** concept with 2 options



Option Bridge: Permanent Handling access to dump



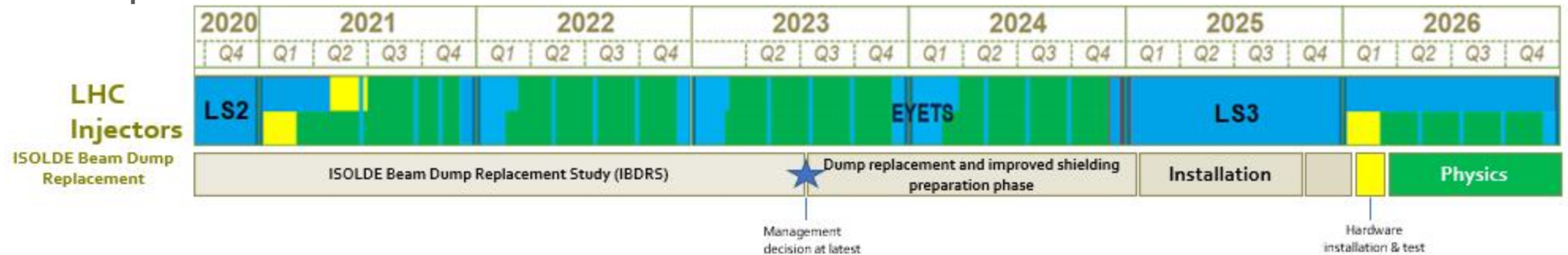
Option HRS: Access to HRS magnet and line

Other options less compatible with budget and timeline under investigation for optimization

Draft schedule for final replacement

Master Long-term Schedule
for the CERN Accelerator Complex
ACC-PM-MS-0004

S. Mataguez (BE/OP/ISO)



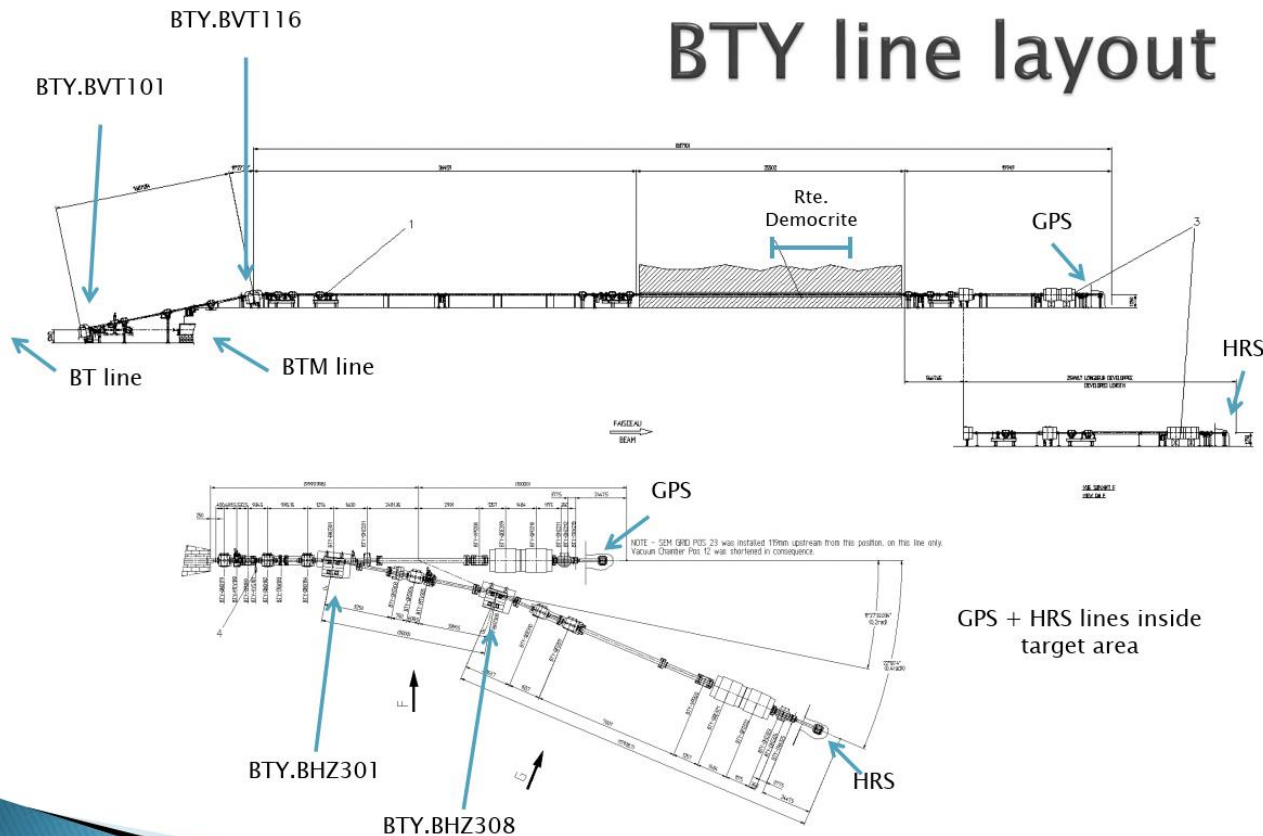
- We will be back to the collaboration with a more detailed planning and will keep updated wrt to options and eventual impact on post-LS3 physics start-up
- Options adding more flexibility to the facility/physics could need longer than the currently planned duration of LS3

2 GeV transfer line upgrade

- **2 GeV transfer line upgrade driven by physics**
 - Funding should be identified as different budget line than beam dumps
 - In the recent past investigated with Kieran possible in-kind or contributions from UK for example
- Current Plan: revise the cost estimate of 2019 and wrap-up device list to be upgraded
 - Infrastructure upgrade not included (magnet integration, cooling, new cabling, etc...)
- No technical show-stoppers identified so far
 - Could be still in time for LS3 provided budget and workforce identified
- **This is not part of IBDRS Project**

PSB-ISOLDE transfer line: BTY

BTY line layout



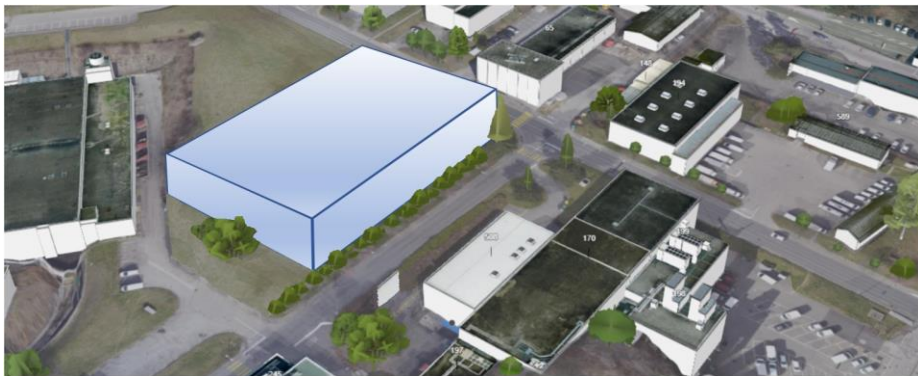
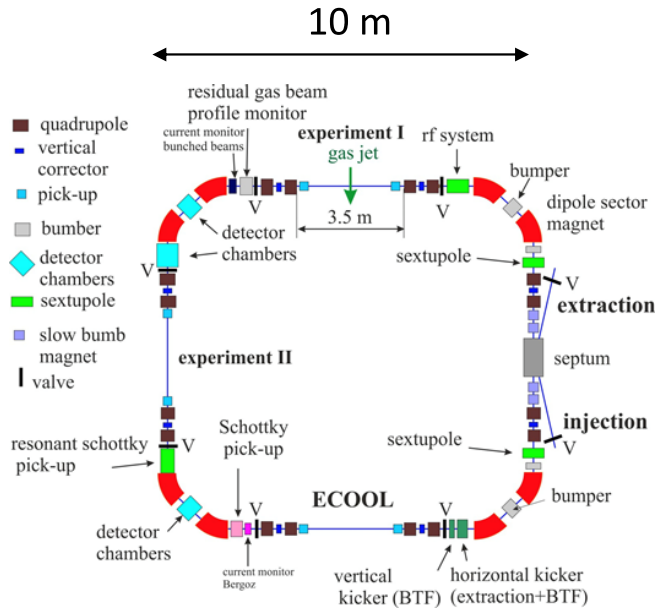
Quadrupoles

Quadrupole	type	GPS		HRS		Magnet peak current I(A)	Power Converter specification I(A)
		1.4GeV I(A)	2.0GeV I(A)	1.4GeV I(A)	2.0GeV I(A)		
BTY.QDE104	Q130	182.20	243.97	182.20	243.97	220.0	220
BTY.QFO108	Q130	134.95	178.22	134.95	178.22	220.0	220
BTY.QDE113	Q130	182.26	244.06	182.26	244.06	220.0	220
BTY.QFO119	Q130	136.51	180.32	136.51	180.32	220.0	220
BTY.QDE120	Q130	198.53	268.07	198.53	268.07	220.0	220
BTY.QFO122	Q130	77.33	102.58	77.33	102.58	220.0	220
BTY.QFO148	Q130	47.31	63.49	47.31	63.49	220.0	220
BTY.QDE151	Q130	113.90	150.26	113.90	150.26	220.0	220
BTY.QFO153	Q130	77.06	102.23	77.06	102.23	220.0	220
BTY.QFO179	Q130	0.00	0.00	107.86	142.32	220.0	150
BTY.QDE182	Q130	43.07	57.92	164.67	218.97	220.0	220
BTY.QFO184	Q130	67.12	89.32	105.15	138.78	220.0	220
BTY.QDE209	Q100	132.42	177.54			700.0	300
BTY.QFO210	Q100	140.07	187.99			700.0	350
BTY.QFO304	Q130			196.62	265.21	220.0	220
BTY.QDE310	Q130			182.53	244.45	220.0	220
BTY.QFO311	Q130			153.53	203.49	220.0	220
BTY.QDE321	Q100			186.10	248.97	700.0	300
BTY.QFO322	Q100			182.55	244.37	700.0	350

+ 4 large **Dipoles** to be replaced

Courtesy of W. Bartmann (SY/ABT)

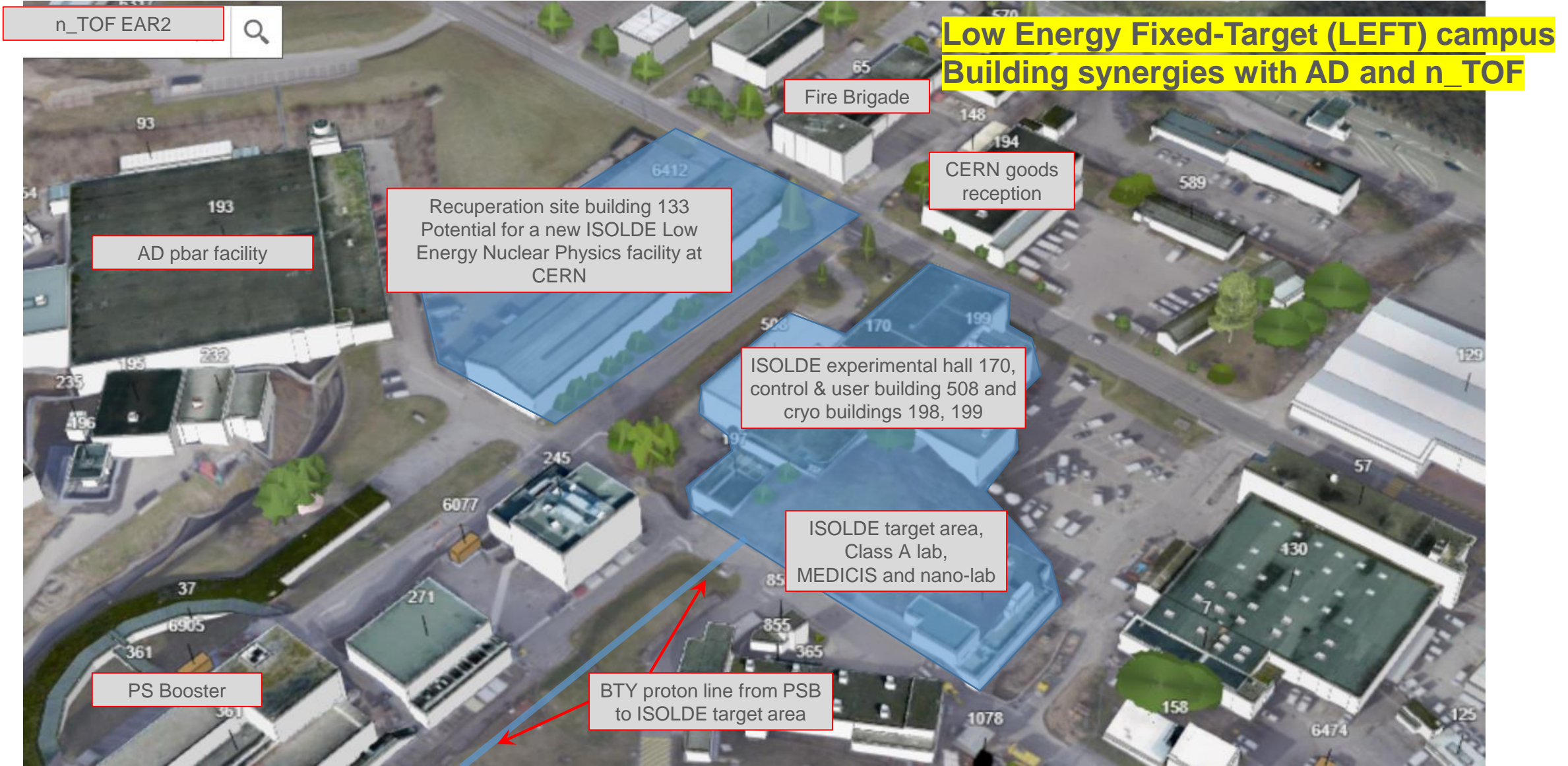
ISOLDE upgrade : EPIC – long-term (>LS3)



Goal:

- increase integrated intensity to final users
→ 1-2 new Front-Ends with RILIS systems
- increase possible experiments
→ New experimental hall
- New physics opportunities
→ Isotope storage ring
- **Details in presentation of J.A. Rodriguez in Feb. 2021 with ongoing studies of the facility new building**

Possible future of the ISOLDE area (> LS3)



Few considerations for EPIC

- Current financial situation is not optimal
 - Current studies and planning should take this into consideration to propose a **realistic implementation scenario**
 - **First cost estimate of new building being evaluated**
 - Timeline post LS3
 - LS4 first potential implementation time-window but studies should be done well before
- EPIC is a large-scale project
 - Both for funding/workforce as schedule
 - .. But could be built partially in parallel with machine operation
- Impact of increased facility operational cost (M+P) never analysed yet
 - Potentially more targets per years to be built/stored/disposed (1 target: ~ 50 kCHF)
 - More FEs to maintain/consolidate → profit from LS3 FE re-design
 - Lasers for RILIS → operation and maintenance costs
 - **Should be taken into account in the cost estimates**

Conclusions

- **Rich possible improvement program** following the long-term tradition of the ISOLDE community/facility
- **Clear need for physics community to keep/improve ISOLDE capabilities** in producing a large variety of isotopes, but also need in increase integrated time to users
 - Nanolab, parallel operation will arrive soon.
- **Staged proposed approach** with clear improvements in facility operability and physics potentials
 - Secure long-term facility operation without forgetting potential given by post LIU PSB (FEs, dumps, new faraday cages, targets, etc..)
 - **Explore possible funding schemes for each upgrade step outside CERN**
- **Explore synergies with other CERN physics programs** as synergies with PBC to be studied
 - n_TOF, AD for example → Low-energy fixed-target campus
 - Profit from group infrastructure in different facilities : hot-cell, irradiation stations, material science and development
- **To be done:**
 - **Continue working on technical proposals with horizon LS3 and LS4**
 - **Evaluate impact on facility future operational costs wrt to proposed upgrades**



Thank you for your
attention!