A banner with a collage of images from the HEARTS project. The text 'A HEARTLY WELCOME' is overlaid in large, bold letters. 'A HEARTLY' is in red, and 'WELCOME' is in blue. The background images show various experimental setups, including a large green cylindrical detector, a complex detector structure with labels, and a large hall with many people.

A HEARTLY WELCOME

Scintillator lining, trigger
DIRC and Cherenkov for PID
drift chambers determination of scattered antiproton

February 6th 2024

HEARTS Annual Meeting @CERN

Markus Brugger



An Amazing Endeavor

Very high energy (VHE) ion beams are extremely interesting to **test** space applications against **harsh radiation conditions in space**



Current availability and accessibility for VHE ion beam testing **is scarce** in Europe

Upgrade of VHE ion beam accelerator facilities in Europe located at CERN and GSI

Definition of user requirements from academia and industry for VHE ion beam testing

Knowledge transfer among partners on Monte Carlo **simulation methods** and **beam characterization tools**

Synergy between institutes (CERN, GSI), academic (UNIPD) and industrial partners (Thales Alenia Space Italy, Airbus) to validate VHE ion testing for **external users**

Single Event Effects testing to qualify electronic components for radiation hardness assurance

GOAL:
Accessible and available VHE ion beams to enable breakthrough space applications

Shielding and radiobiology studies to enable human spaceflight missions to the Moon, Mars



Quite A History of European Projects

HORIZON
2020

RADiation and reliability challenges for electronics used in Space, Avionics, on the Ground and at Accelerators

HORIZON
2020

RADiation facility Network for the EXploration of effects for indusTry and research

HORIZON
EUROPE

High-Energy Accelerators for Radiation Testing and Shielding

Start date
1 March 2017

End date
28 February 2022

Funded under
EXCELLENT SCIENCE - Marie Skłodowska-Curie Actions

Total cost
€ 3 882 975,78

EU contribution
€ 3 882 975,78



Coordinated by
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

Switzerland

Start date
1 June 2021

End date
31 May 2025

Funded under
EXCELLENT SCIENCE - Research Infrastructures

Total cost
€ 4 999 999,75

EU contribution
€ 4 999 999,75



Coordinated by
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

Switzerland

Start date
1 January 2023

End date
31 December 2026

Funded under
Digital, Industry and Space

Total cost
€ 2 999 965,00

EU contribution
€ 2 999 965,00



Coordinated by
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

Switzerland

RADMEP – a RADSAGA Spin-Off



With the support of the
Erasmus+ Programme
of the European Union

[RADMEP](#) ▾

[Consortium](#) ▾

[Studies](#) ▾

[Apply](#) ▾

[For students](#) ▾

[Blog](#)

[Contact](#)

Welcome to the RADMEP EMJMD Website!

The 2-year (120 ECTS) European Master in [Radiation and its Effects on MicroElectronics and Photonics Technologies](#) (RADMEP) will provide a multidisciplinary and innovative programme covering the interactions between Radiation and MicroElectronics and Photonics, two Key Enabling Technologies for the future of Europe. RADMEP objective is to educate students in those advanced technologies, providing methodologies and introducing practical applications for their implementation in a variety of natural or man-made radiation-rich environments. RADMEP has two goals: first to improve their career prospects and second to respond to the needs of the industry, agencies and society. Thanks to this EMJMD, students will develop useful professional and soft skills in the rich European cultural context.

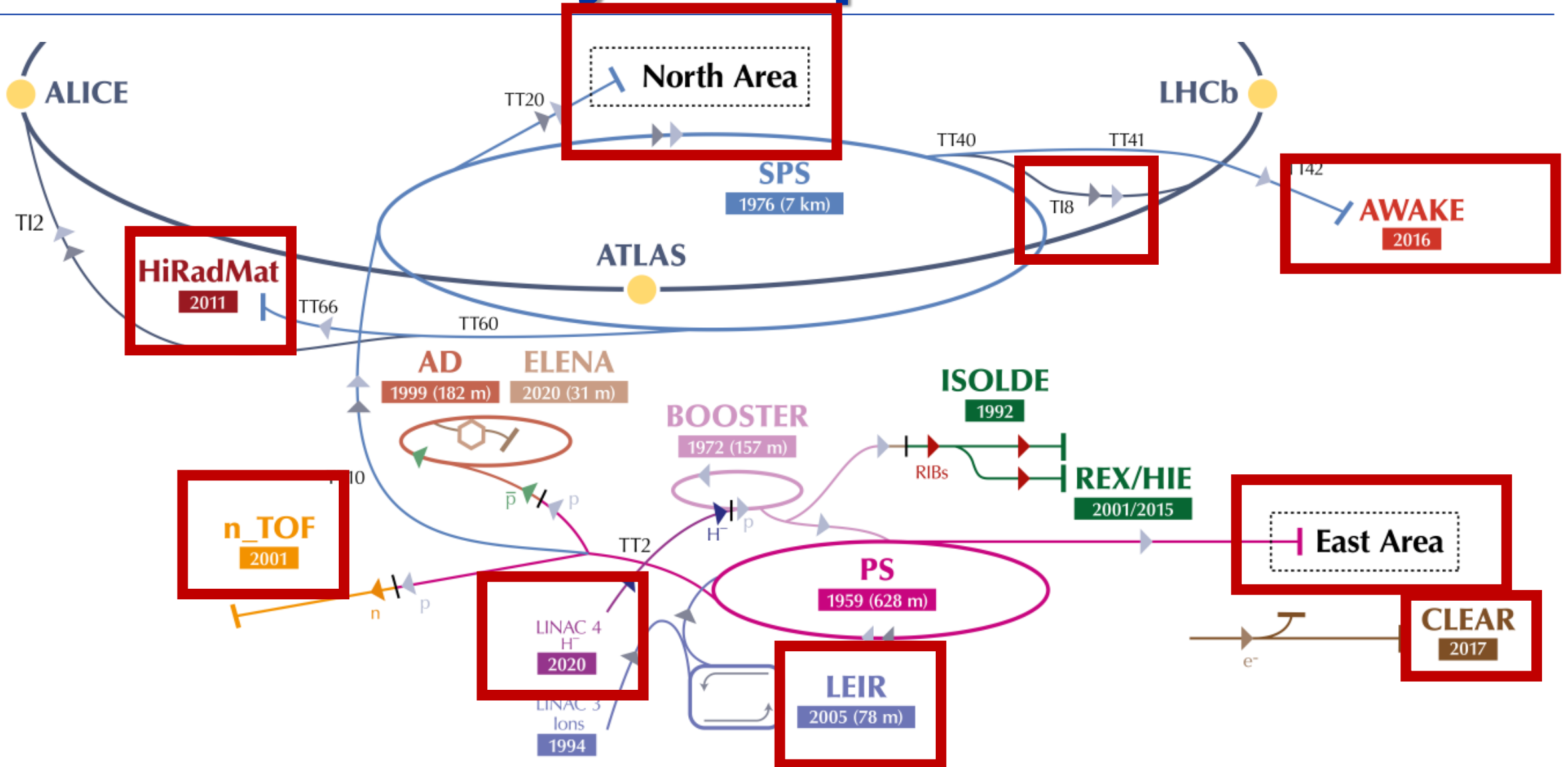
[GET IN TOUCH](#)

Call for applicants 2024-2026 : from October 15th 2023 to February 8th 2024

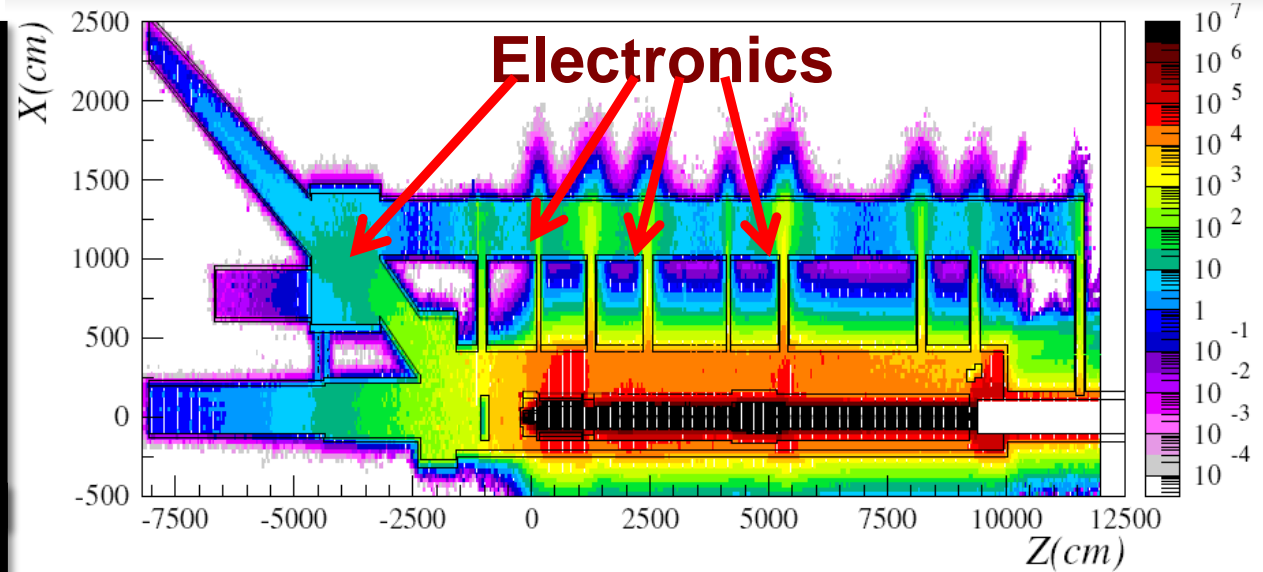
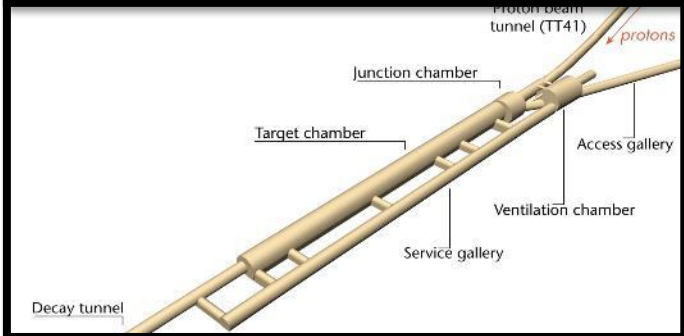
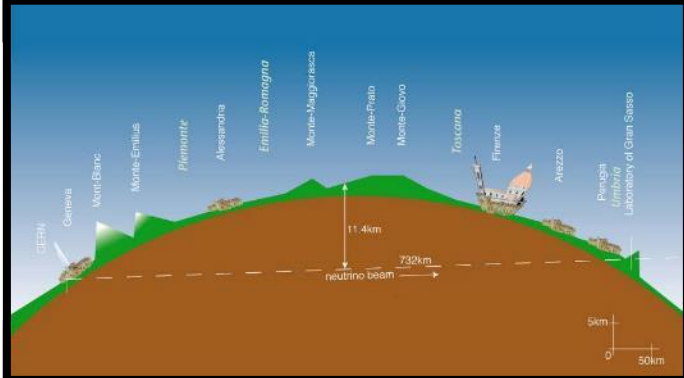
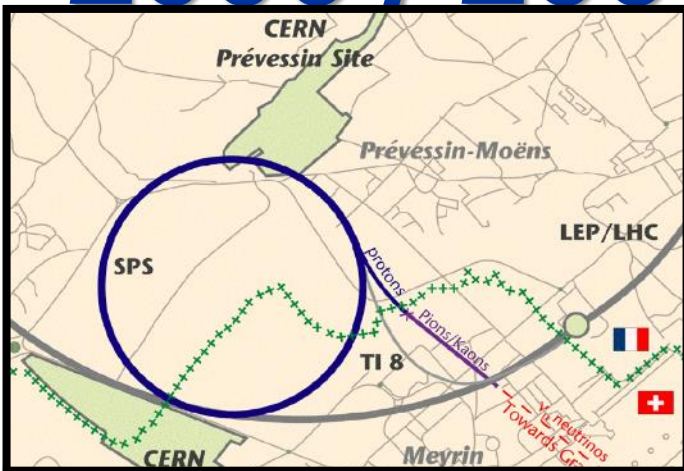


A Brief History of (CERN R2E Facility) Time

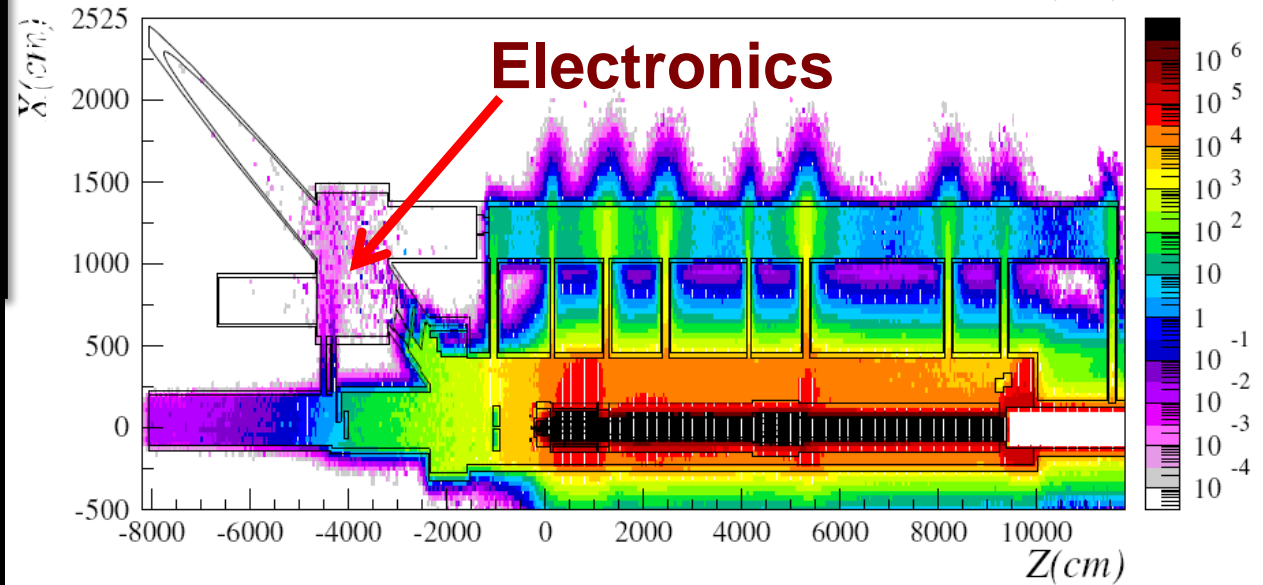
The R2E Facility Footprint over Time



2006 / 2007 - CNGS



■ 2006 – 2007
Electronics
Failures



■ Mitigation
by Shielding

TCC2 is Now Qualified to Provide a
Radiation Test Environment
Similar to That of the LHC Tunnel (Arcs)

TCC2 Test Area to be Used for the
Final Qualification of Electronic Equipment

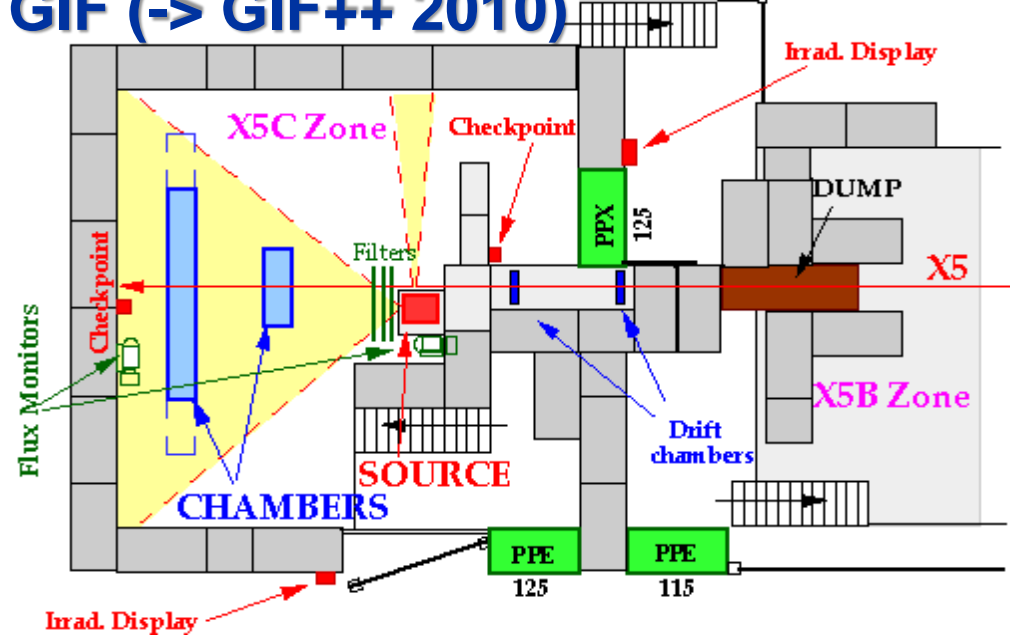
Test Reports Demonstrate that
All Electronic Components, Equipment & Systems
Intended for Installation in the LHC Tunnel
Must be Radiation Qualified.

2006 - 2008

- @ Protons
 - @ Louvain
 - @ PSI
- @ Neutrons
 - @ CEA Reactor
 - @ Thermal neutron facilities
- @ Heavy-Ion Facilities
 - @ CERN
 - @ GIF
 - @ IRRAD
 - @ xRay
 - @ ...



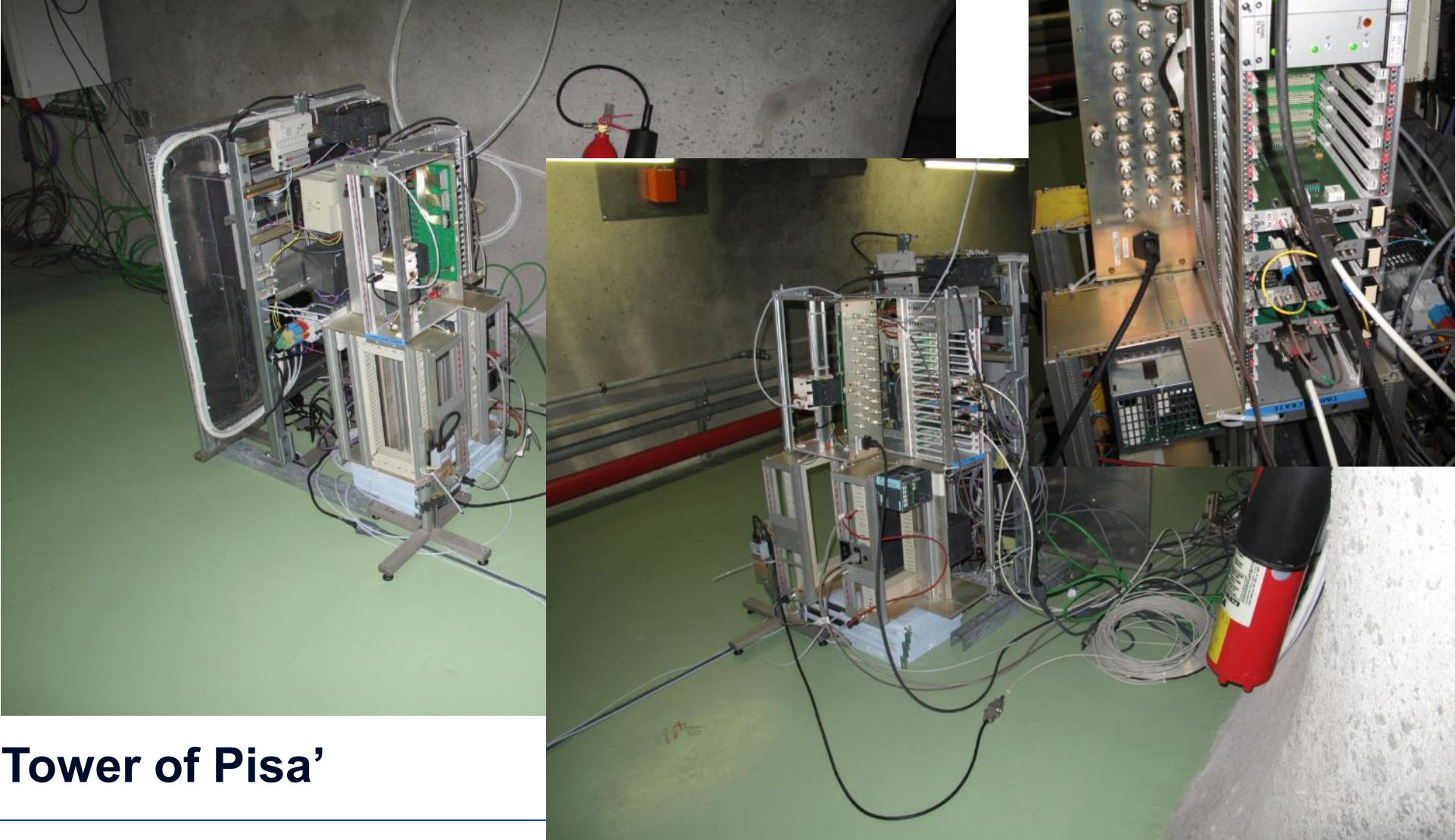
GIF (-> GIF++ 2010)



2007/2008 – T18 Tests (UJ88)



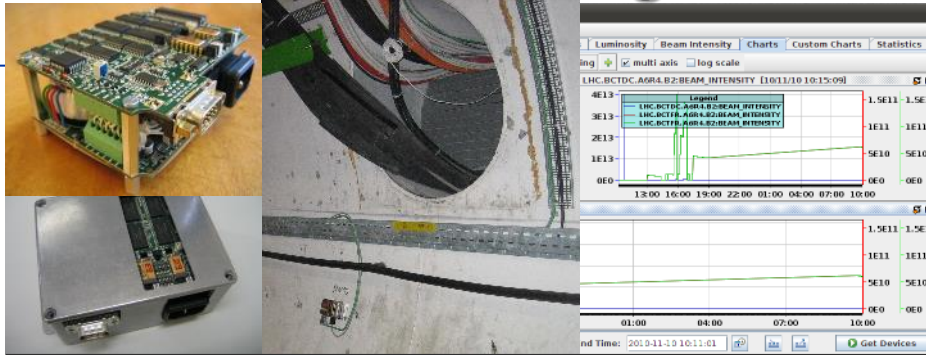
2008 – CNGS -> CNRAD



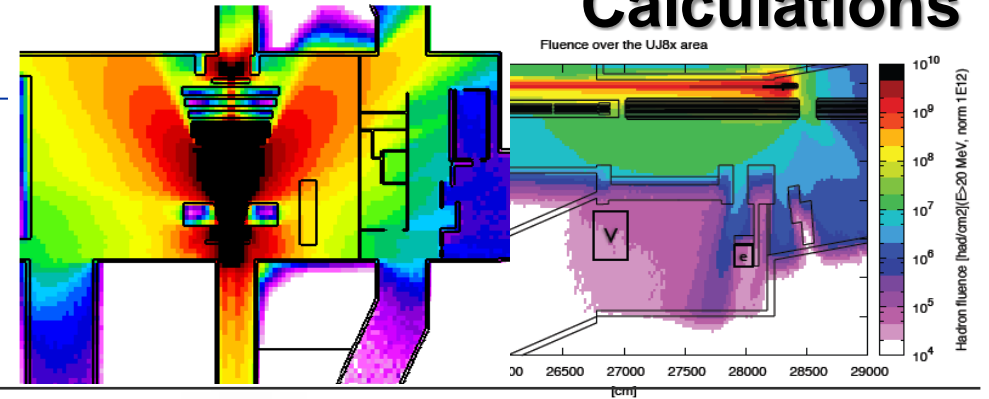
The 'Tower of Pisa'

2010 R2E Strategy

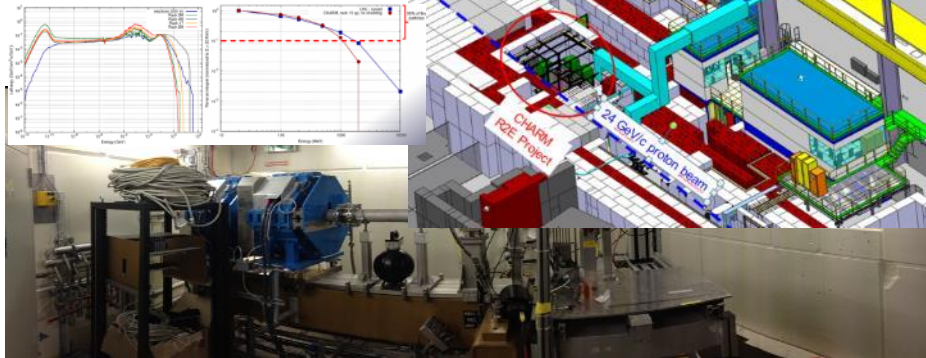
Radiation Monitoring



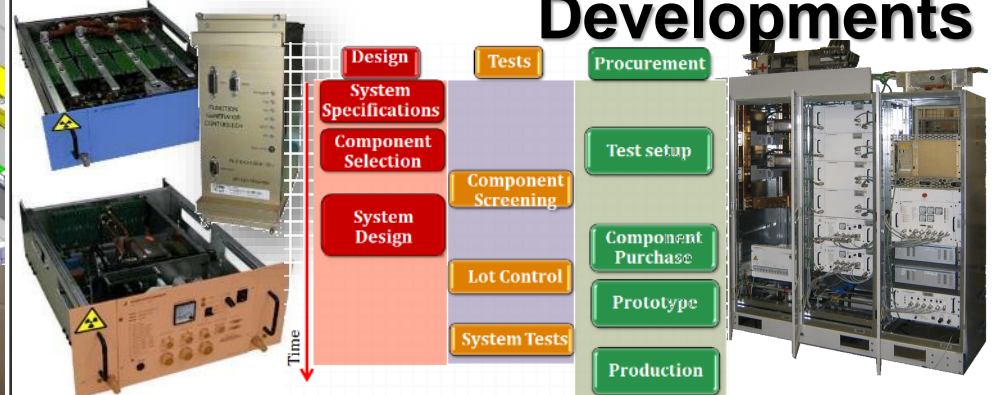
Calculations



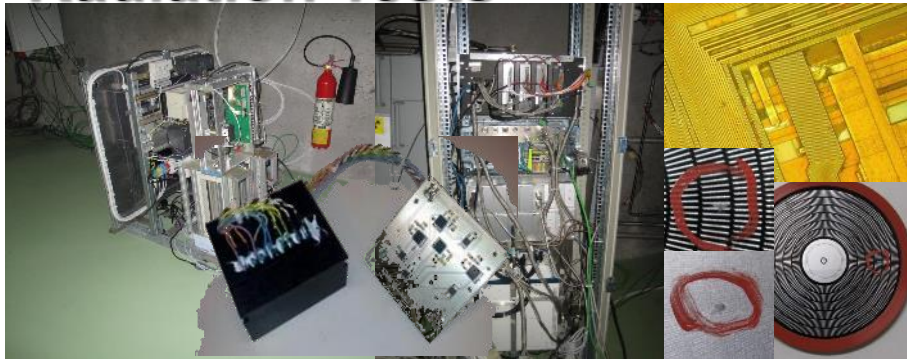
Test Facilities



Developments



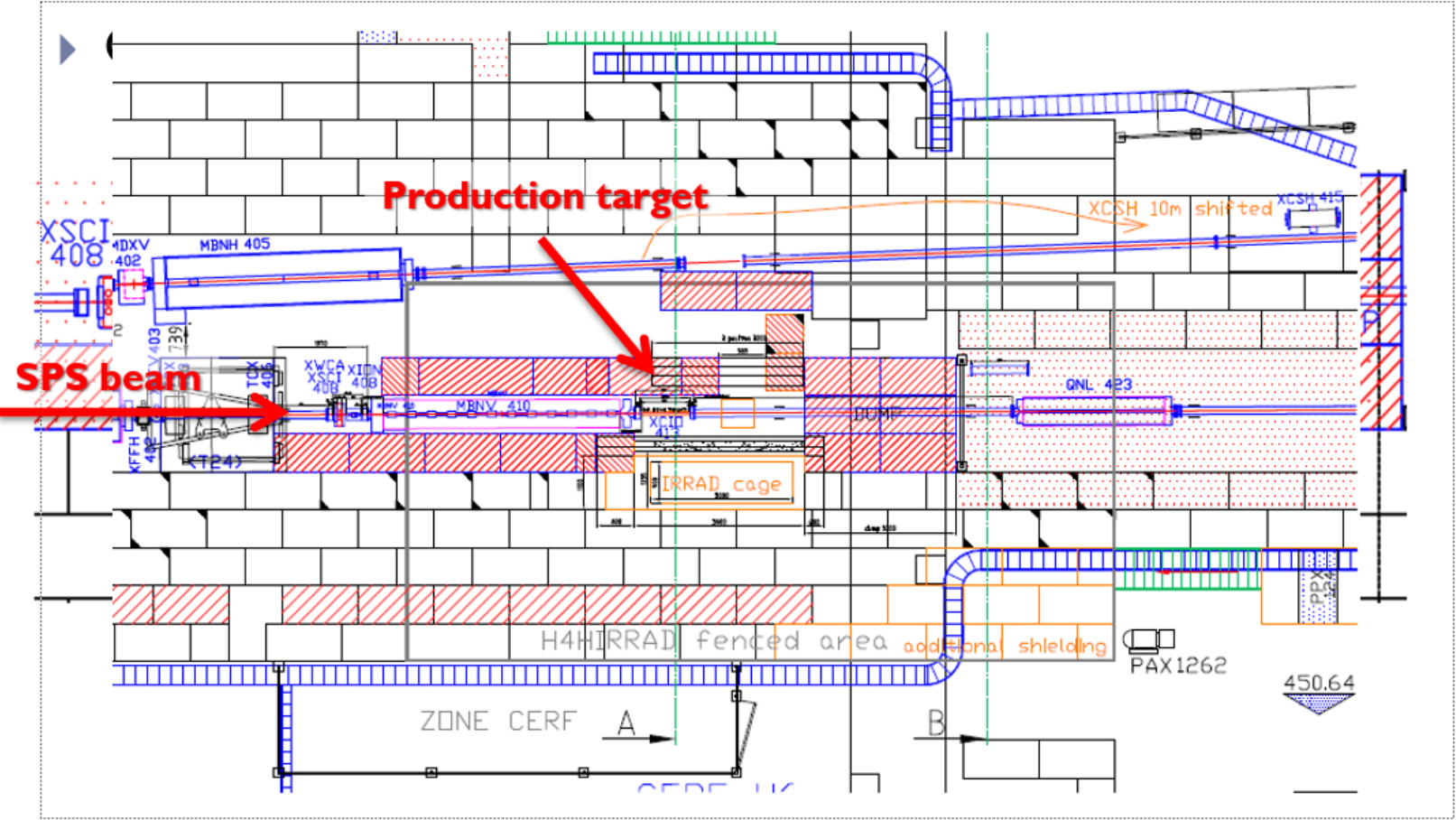
Radiation Tests



Production & Implementation



2010 H4IRRAD



2010 H4IRRAD

PSI Component Tests:



To FULL System Tests:



HERE

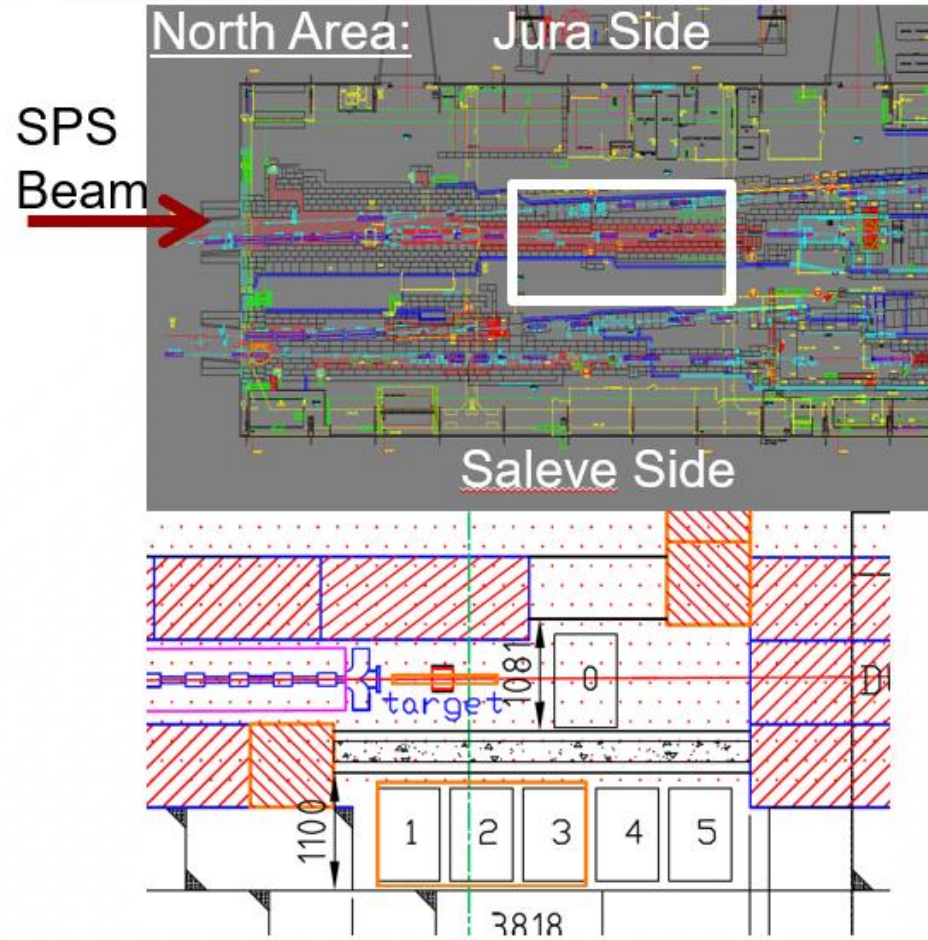


(W)HOW

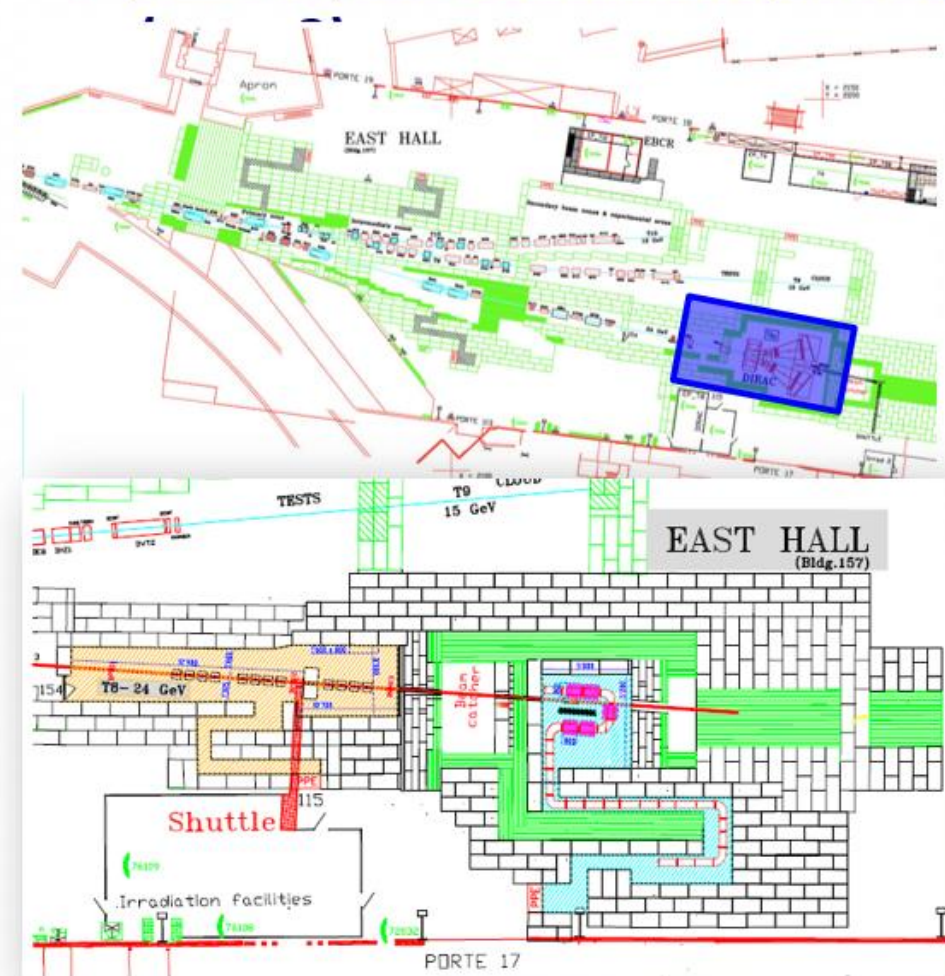


2012 A New Idea

1st Step: H4IRRAD (2011)



2nd Step: PS-EastArea (2013?)



2012 -> 2013 CHARM

Cern High Energy Accelerator Mixed Field/Facility

⊙ We'd also Other Good Options,

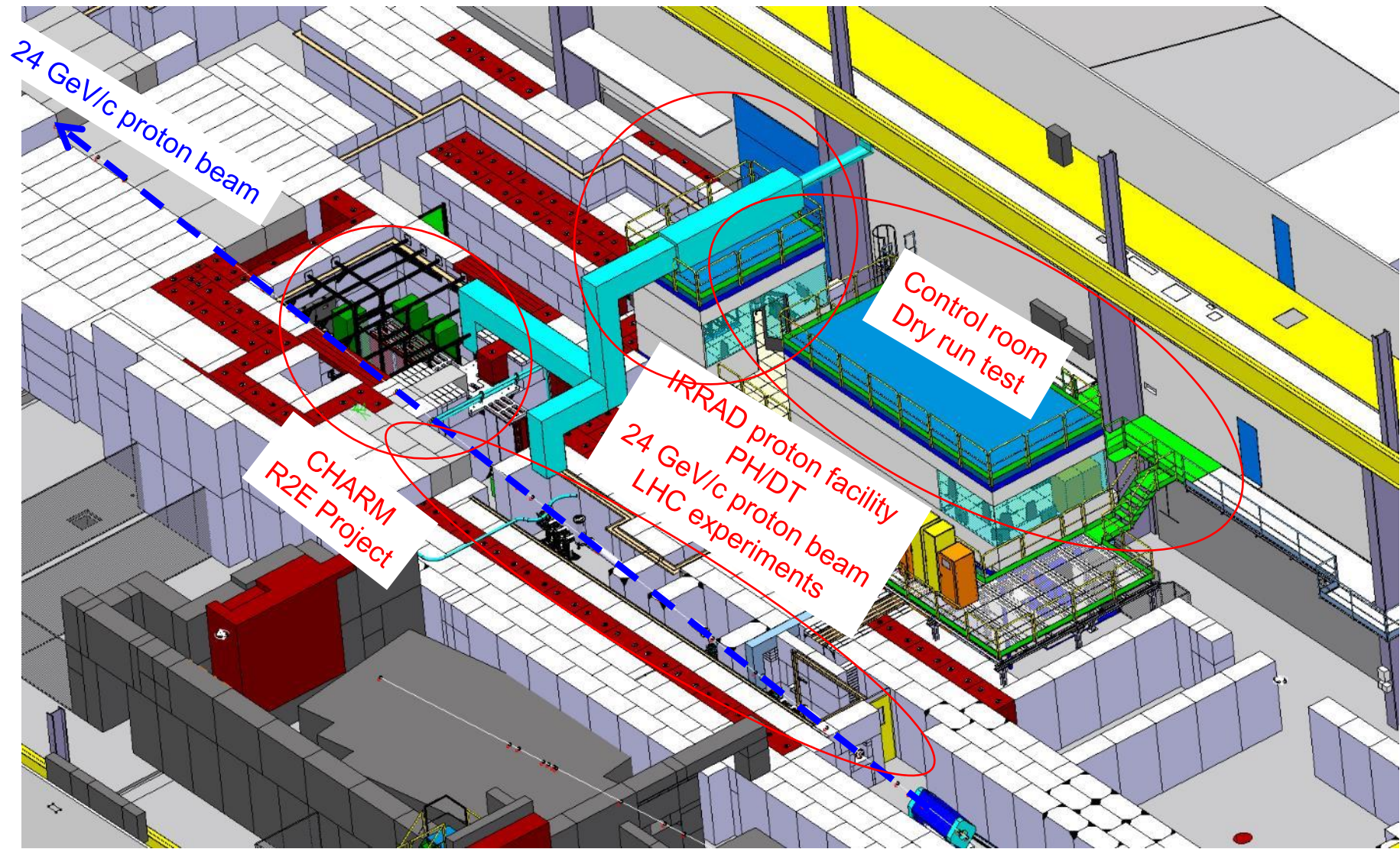
⊙ (Cern High Energy Radiation Facility)

... But

...CHER (French = expensive)



2012 -> 2013 CHARM



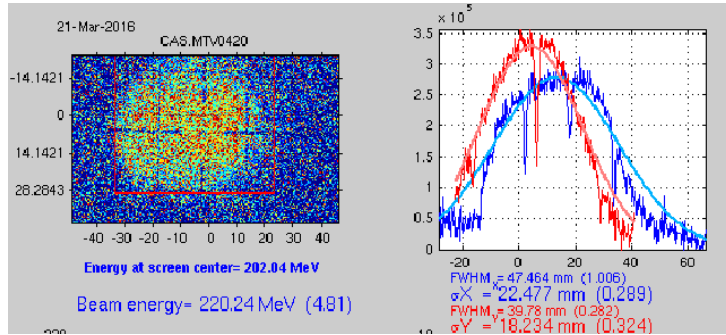
2012 -> 2013 CHARM



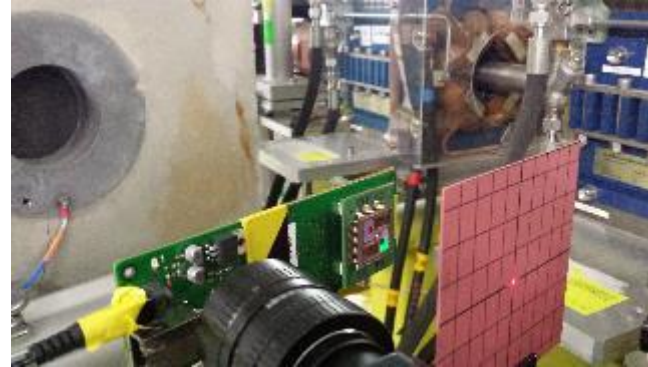
2014 CC60



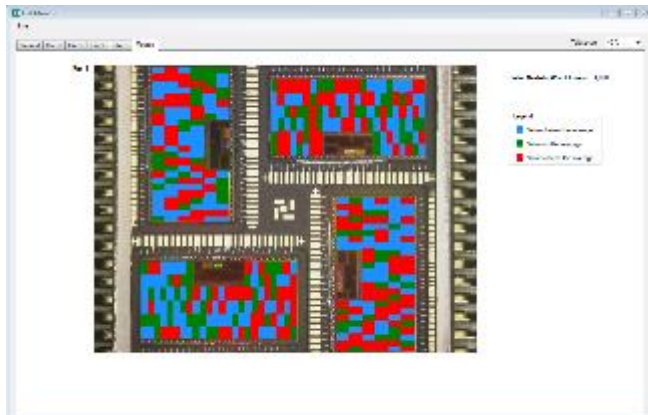
2015 CLEAR -> High-E Electrons



BTV screen for beam profile monitoring



Laser alignment system



ESA Monitor SEU distribution (20 x 20 mm²)

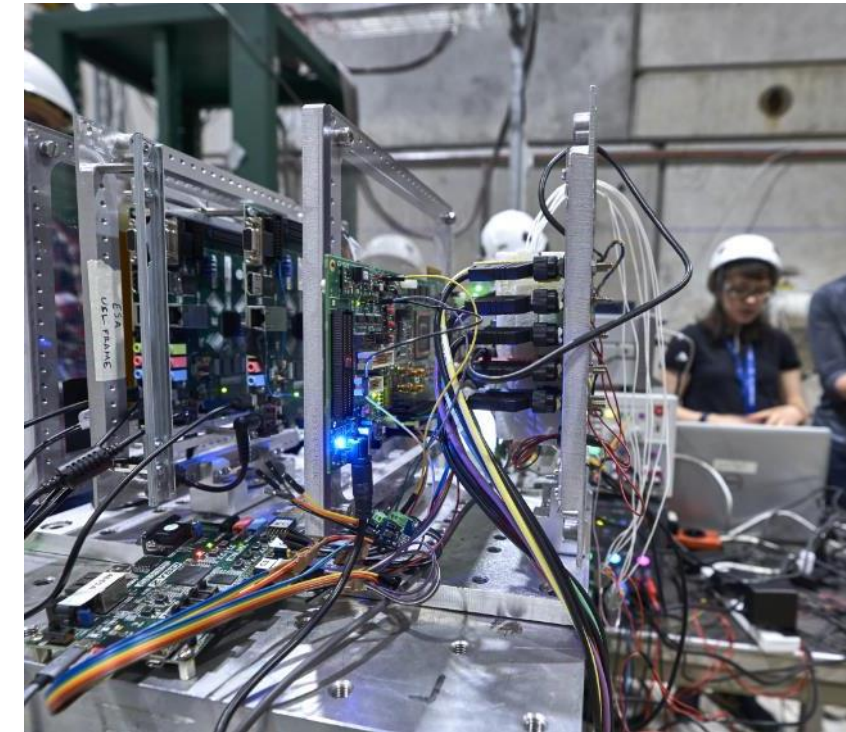
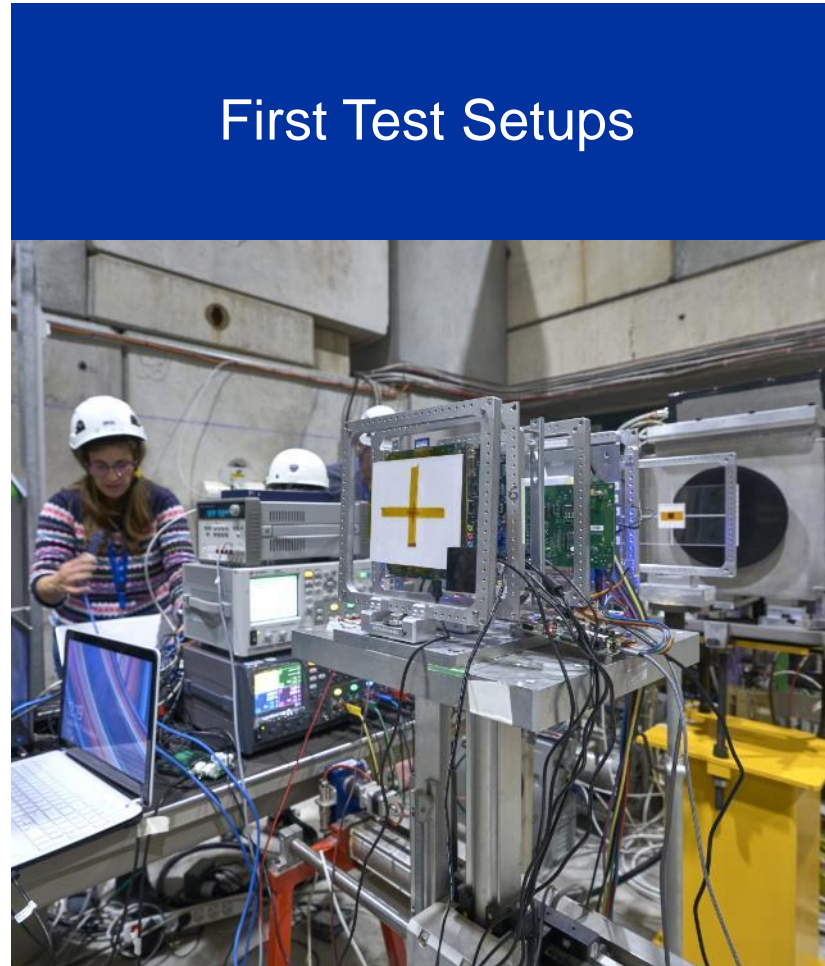


2017+ High-E HI @CHARM and @NA



Modified NA User Area

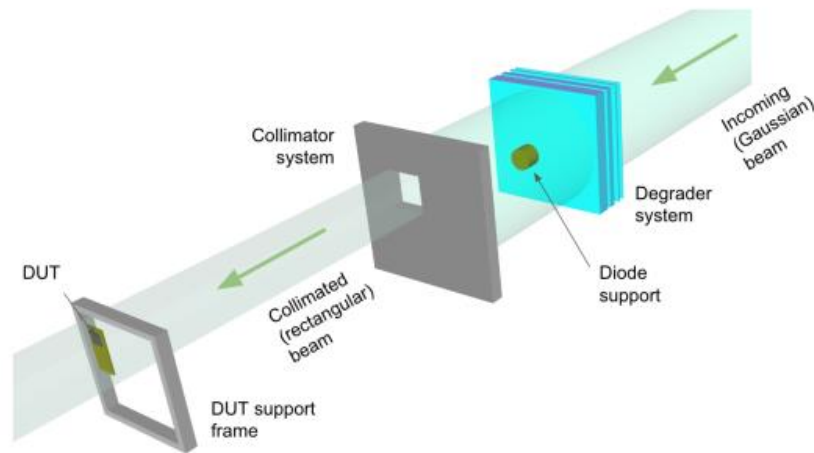
First Test Setups



Benchmarking & 1st Tests

2017+ High-E HI @CHARM and @NA

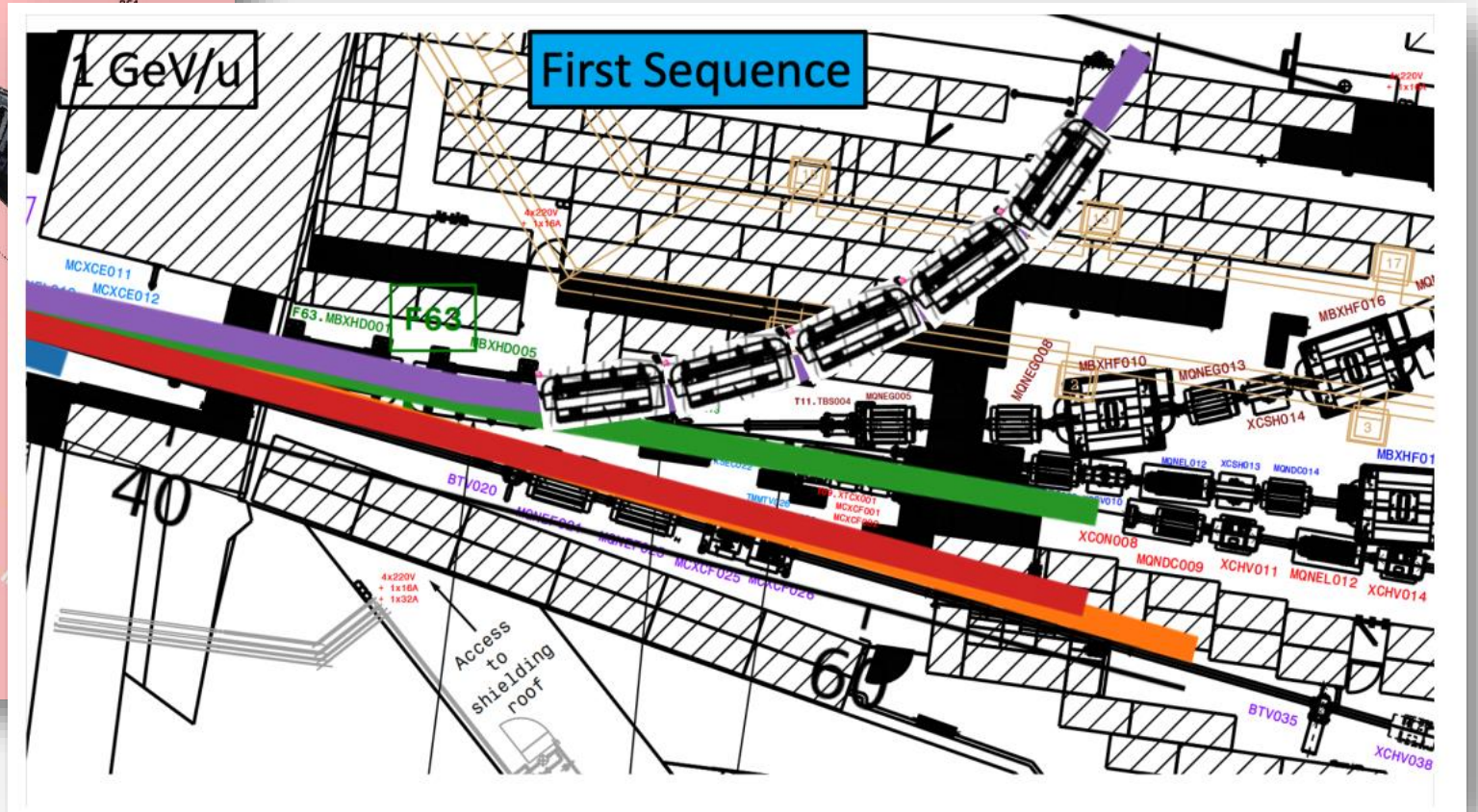
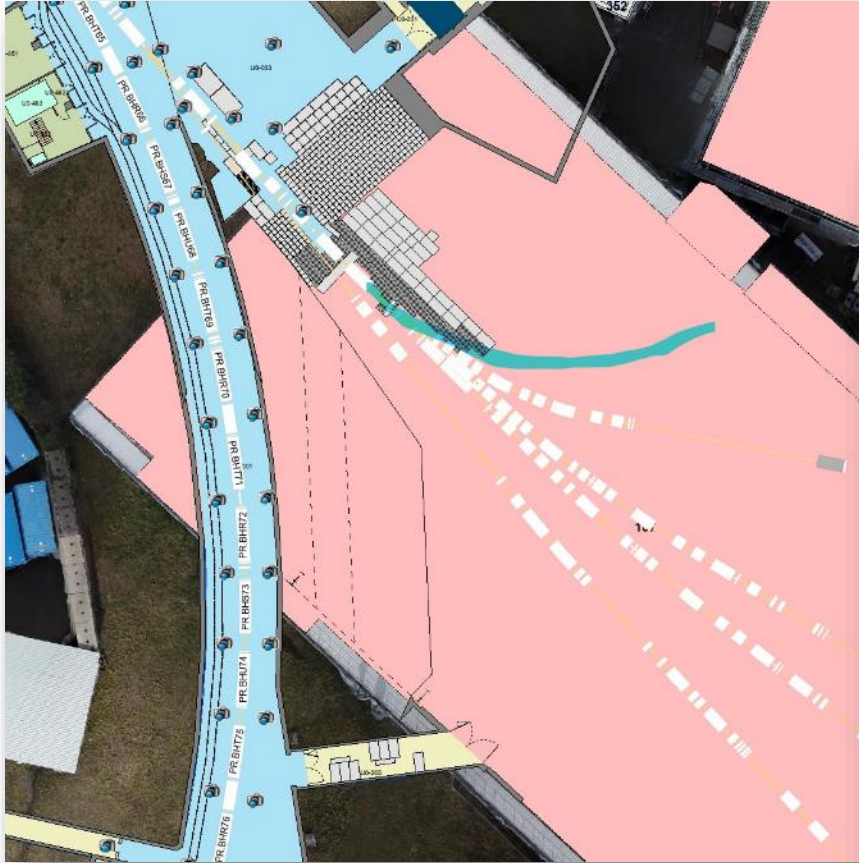
Degrader Design



Ions @CHARM

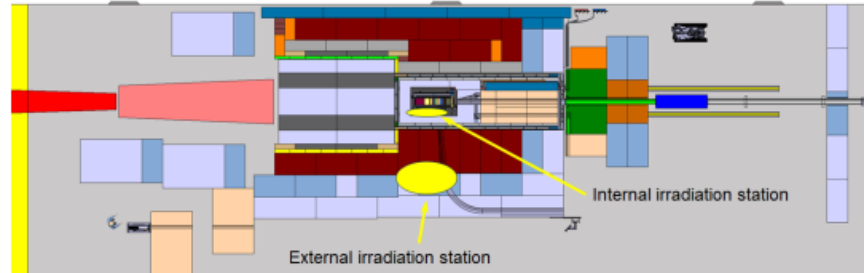
Installation @ Conveyor

NEW (Challenging) HEARTS IDEAS



And others to consider...

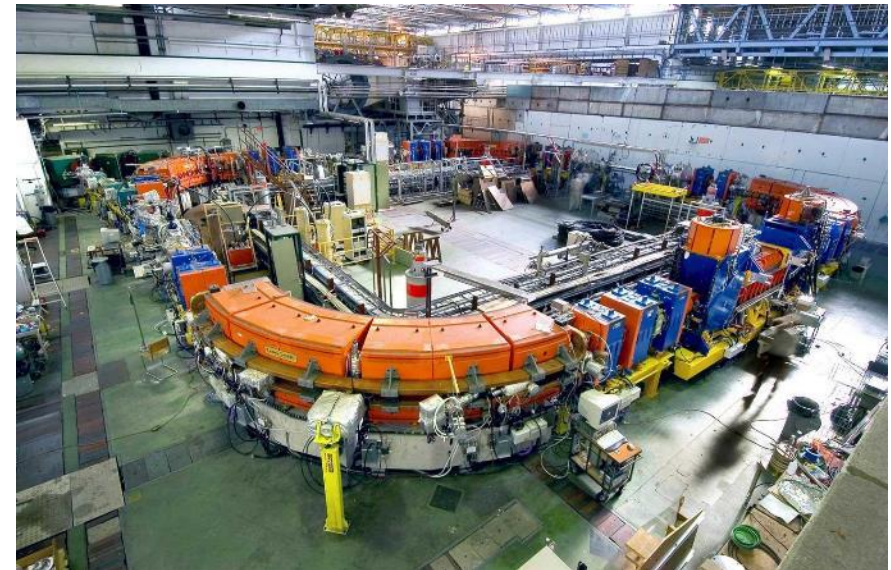
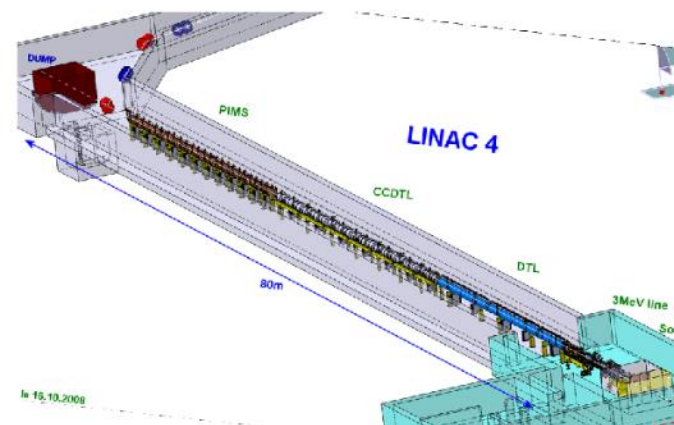
@ Irradiation Stations @SHIP



@ LEIR
-> BioLEIR
-> R2E LEIR ?

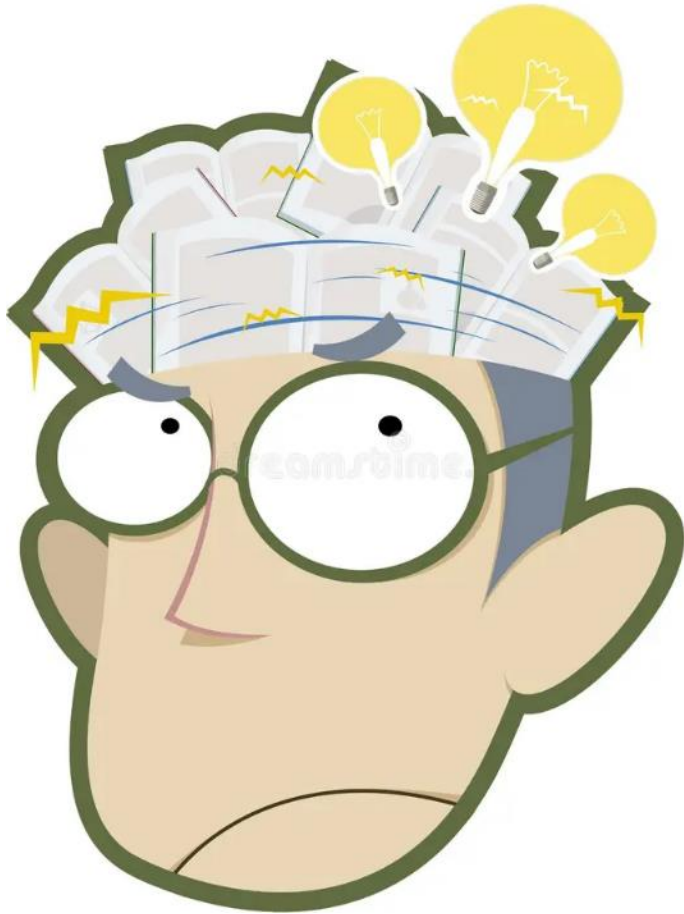


Figure 2: Linac4 layout.



@ LINAC-4 Dump Line

... Wishing You a GREAT Meeting





!!! WELCOME & ENJOY !!!