

# HIE-ISOLDE Project Status Report

TSR@ISOLDE International Workshop

CERN, 29-30 October 2012

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- Main Highlights & R&D Activities
- Project Schedule
- Outlook

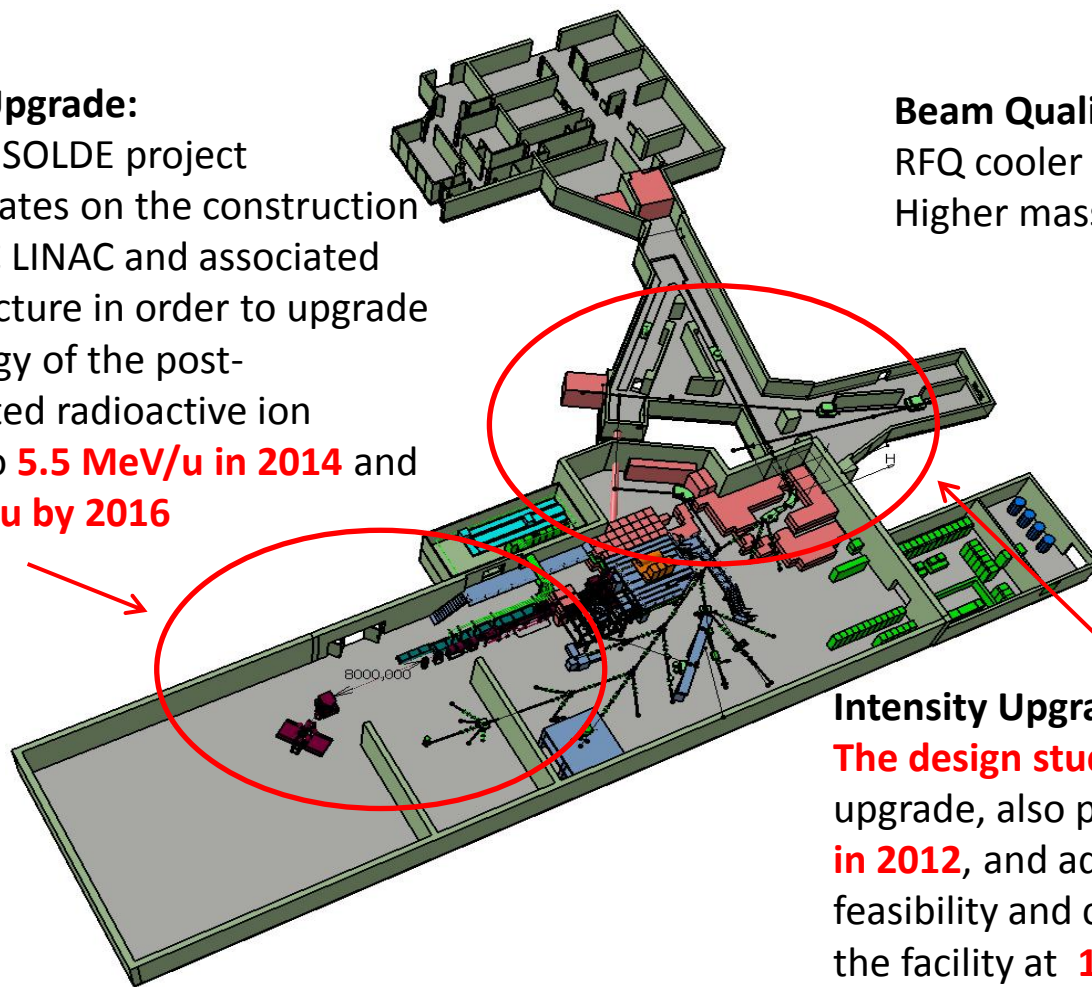
# HIE-ISOLDE aims at increasing the energy of the RIB up to 10 A MeV and their intensity by a factor 10

## Energy Upgrade:

The HIE-ISOLDE project concentrates on the construction of the SC LINAC and associated infrastructure in order to upgrade the energy of the post-accelerated radioactive ion beams to **5.5 MeV/u in 2014** and **10 MeV/u by 2016**

## Beam Quality Upgrade:

RFQ cooler and buncher  
Higher mass resolving power HRS



## Intensity Upgrade:

**The design study** for the intensity upgrade, also part of HIE-ISOLDE, **started in 2012**, and addresses the technical feasibility and cost estimate for operating the facility at **15 kW** once LINAC4 and PS Booster are online.

# HIGHLIGHTS (1/3)

- Civil Engineering contract adjudicated and signed (IT+FR for 1185 kCHF) => construction works finalized (1.5 month delay)
- HAVC System contract adjudicated and signed (IT for 1320 kCHF) => start of installation November 2012
- Cooling System contract adjudicated and signed (IT for 1255 kCHF) => start of installation November 2012
- Copper forgings for cavity fabrication (8 + 2 options) => 4 companies => first 2 blocks delivered
- Cavity Alignment system design and fabrication => CATE
- SC Solenoids contract adjudicated and signed (DK for 390 kCHF: 4 + 2 options) => expect first 2 solenoids in 12 months
- Invitation for Tenders
  - Cryogenic Plant => + reply from Air Liquide and Linde => under review
  - Clean room at SM18 => sent out
  - Cavity substrate manufacturing => in preparation
  - CM1 and CM2 vacuum + He vessels manufacturing via CATE => in preparation
- Market surveys
  - HEBT lines magnets (dipoles, quadrupoles and steerers) => launched

# HIGHLIGHTS (2/3)

- HEBT line Review (April 25 & July 6 2012)
- Cryomodule Technical Review (April 26-27 2012)
- Risk Assessment (Aug-Sep 2012)
- Design Study for the Intensity Upgrade well underway
  - Target + Front-end
  - Offline separator test bench
  - HVAC + Cooling => nuclearization
  - Charge Breeder => EBIS workshop Oct. 16-17 2012
- SRF activities
  - Cavity tests (more substrate, improved sputtering, procurement, etc...)
  - Cavity ancillaries (RF coupler and tuner)
  - LLRF (prototype, integration, etc...)
  - RF controls and interlocks

# HIGHLIGHTS (3/3)

- Design of prototype Diagnostic Box
  - AVS delivered Faraday Cup which was tested at REX-ISOLDE
  - Body of the DB is next
  - Additional Resources needed to develop the electronics for acquisition and motor control
  - MS in preparation
- Integration issues (building 170):
  - Advance on tunnel/shielding design and integration
  - Integration of power converter racks on mezzanine in building 170
  - Integration of beam transfer lines

# FINAL LIST OF RISKS ASSESSED « HIGH »

## Highest: 4

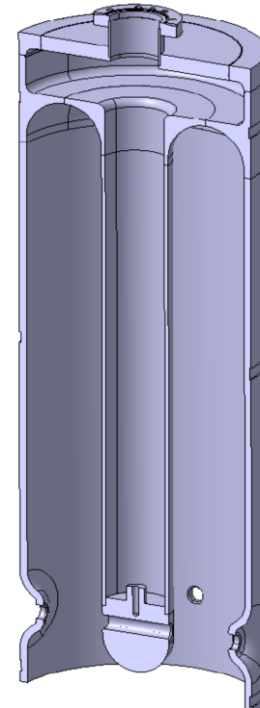
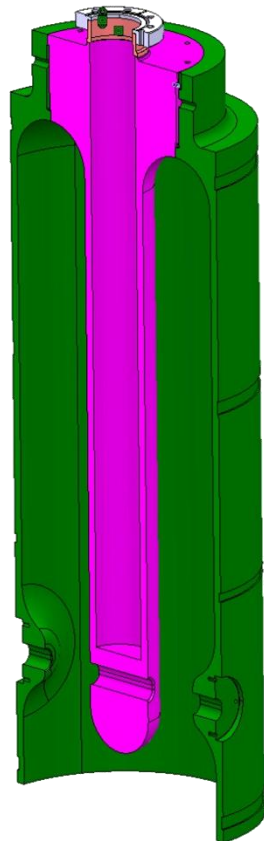
- ▶ 1A: Learning curve on 1st cryo-module out of schedule
- ▶ 1C: Learning curve on 1st RF cavities out of schedule
- ▶ 2B: cryogenics procurement and industrialization strategy lead to delays / cost overruns
- ▶ 3: inadequate availability of CERN and/or contractors' manpower

## Should be considered: 6

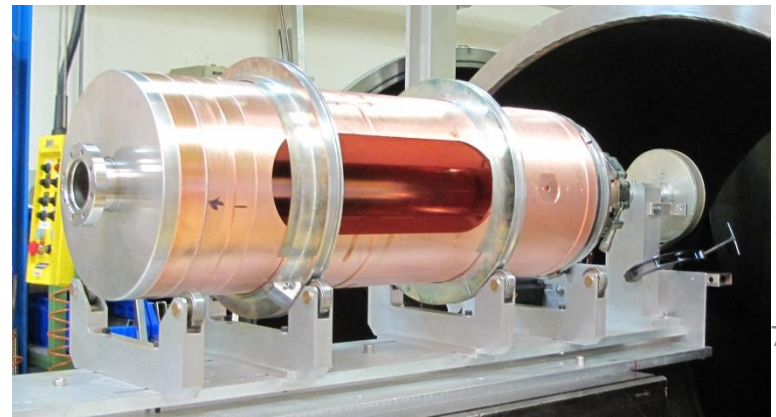
- ▶ 2D : RF cavities procurement strategy
- ▶ 4B: need to redesign cryo-module
- ▶ 5: technical management of interfaces
- ▶ 6: HIE-LINAC not delivering to spec
- ▶ 7: Performance of series RF cavities
- ▶ 8A: Cryogenics late delivery

# Cavity prototypes designed and built at CERN (W. Venturini)

- 4 units “old design”: Q1-Q2-Q3-Q5 (rolling, EB welding, deep-drawing)
- 1 new design: QP1 (3D machining in bulk copper, EB welding)



- 1 cavity (Q4) manufactured for sputtering tests on samples



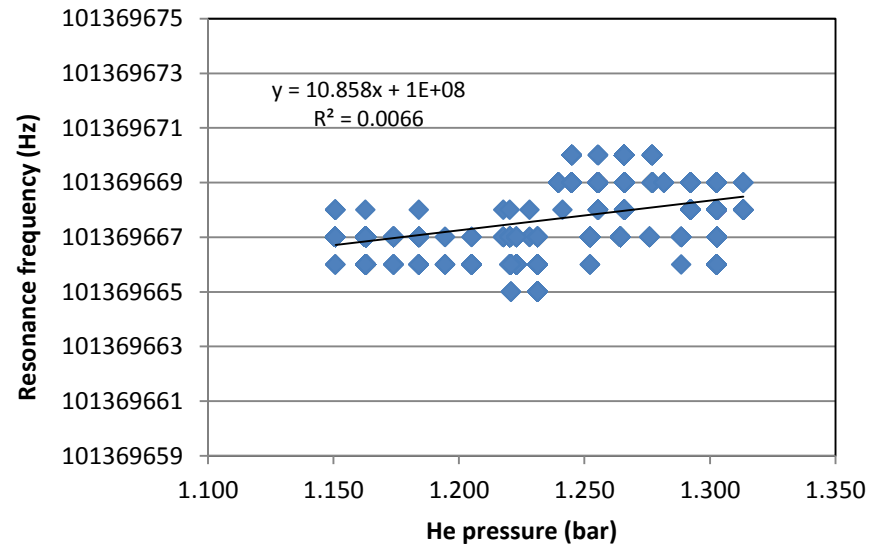
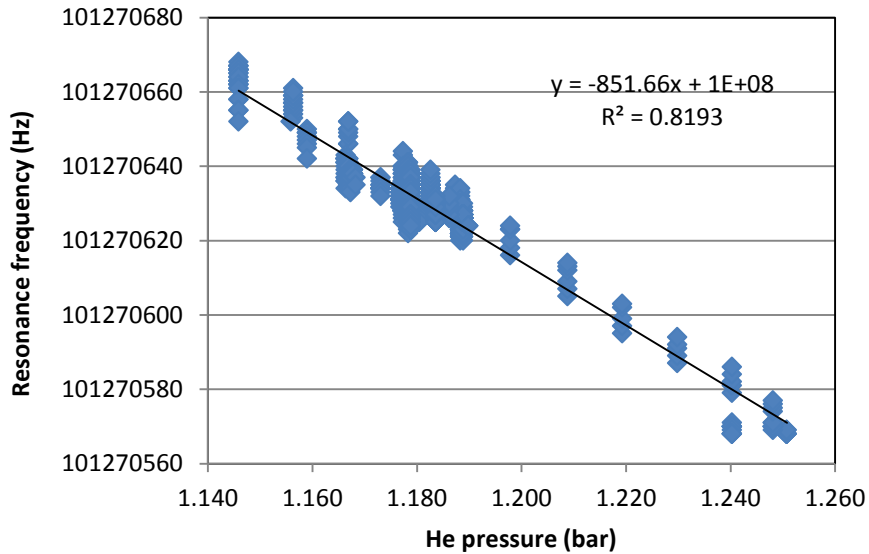
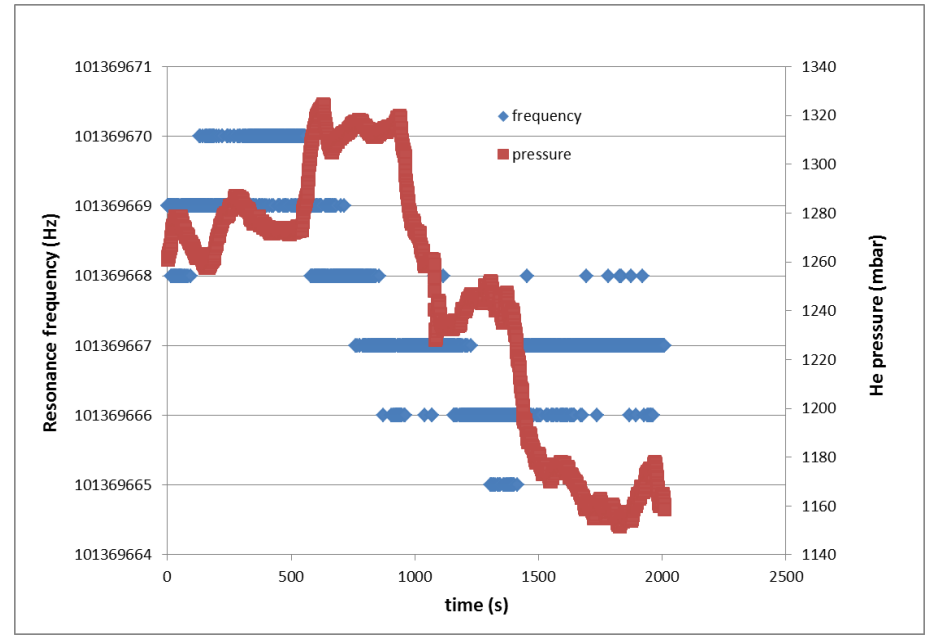
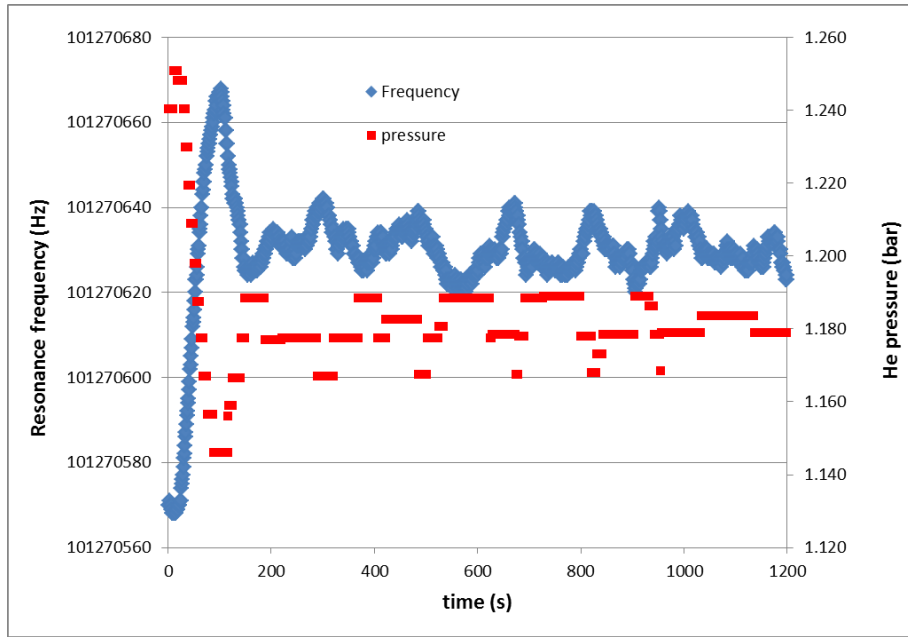
Note: Q3 and QP1 were left longer to reduce B on RF contact with tuning plate



# QP1: sensitivity to He pressure (W. Venturini)

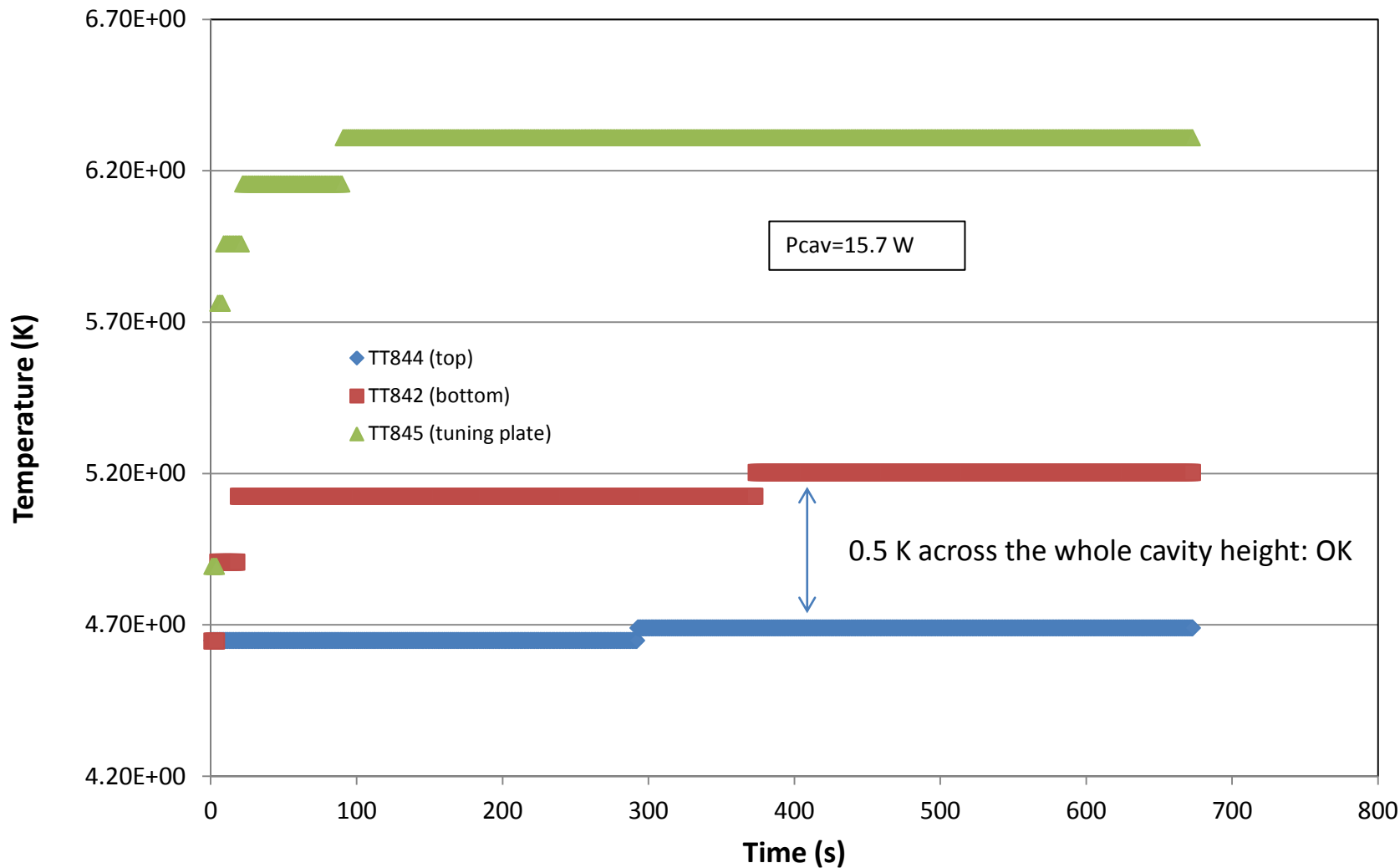
Q2 (old design)  $\sim 1$  Hz/mbar

QP1 (new design)  $\sim 0.01$  Hz/mbar

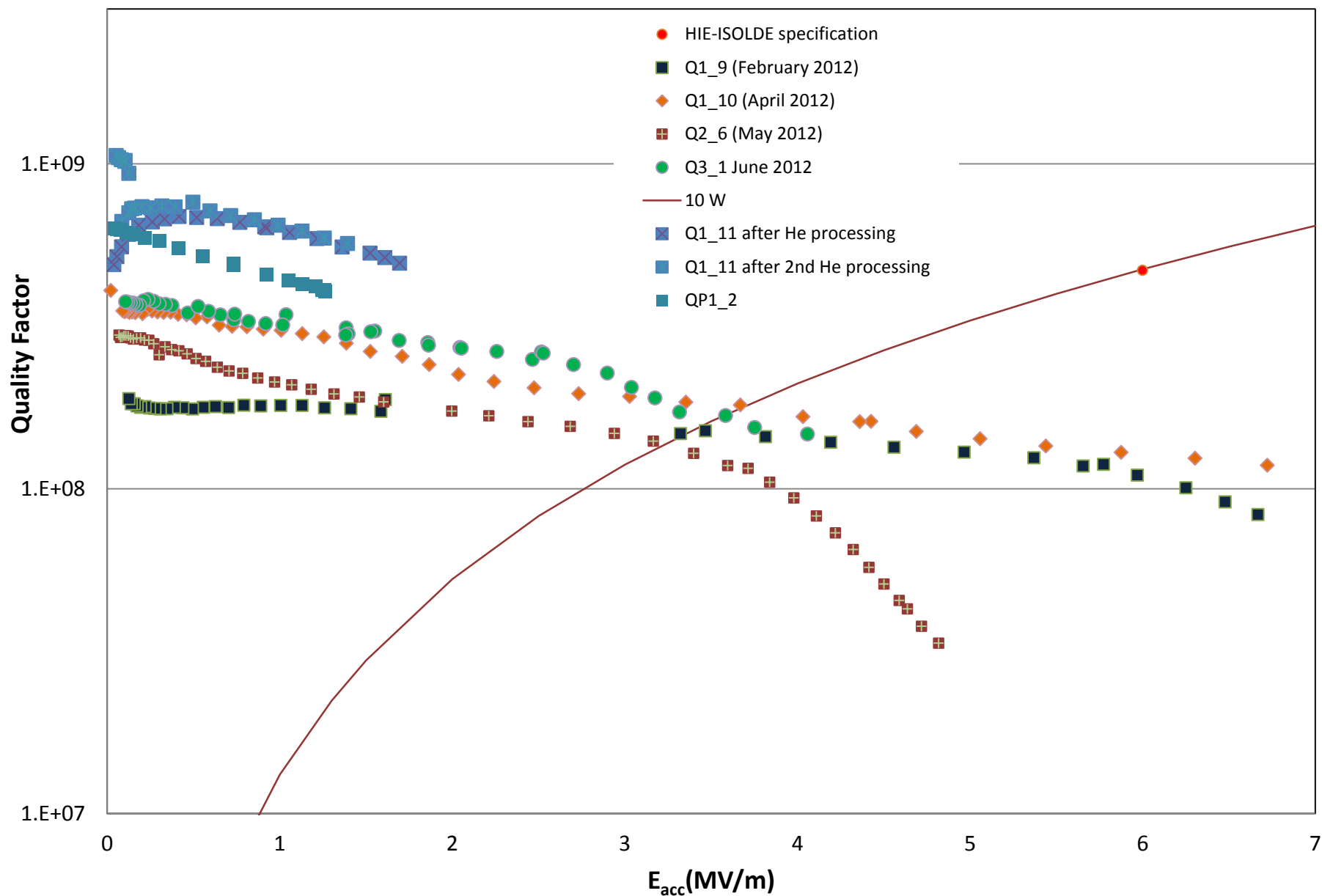




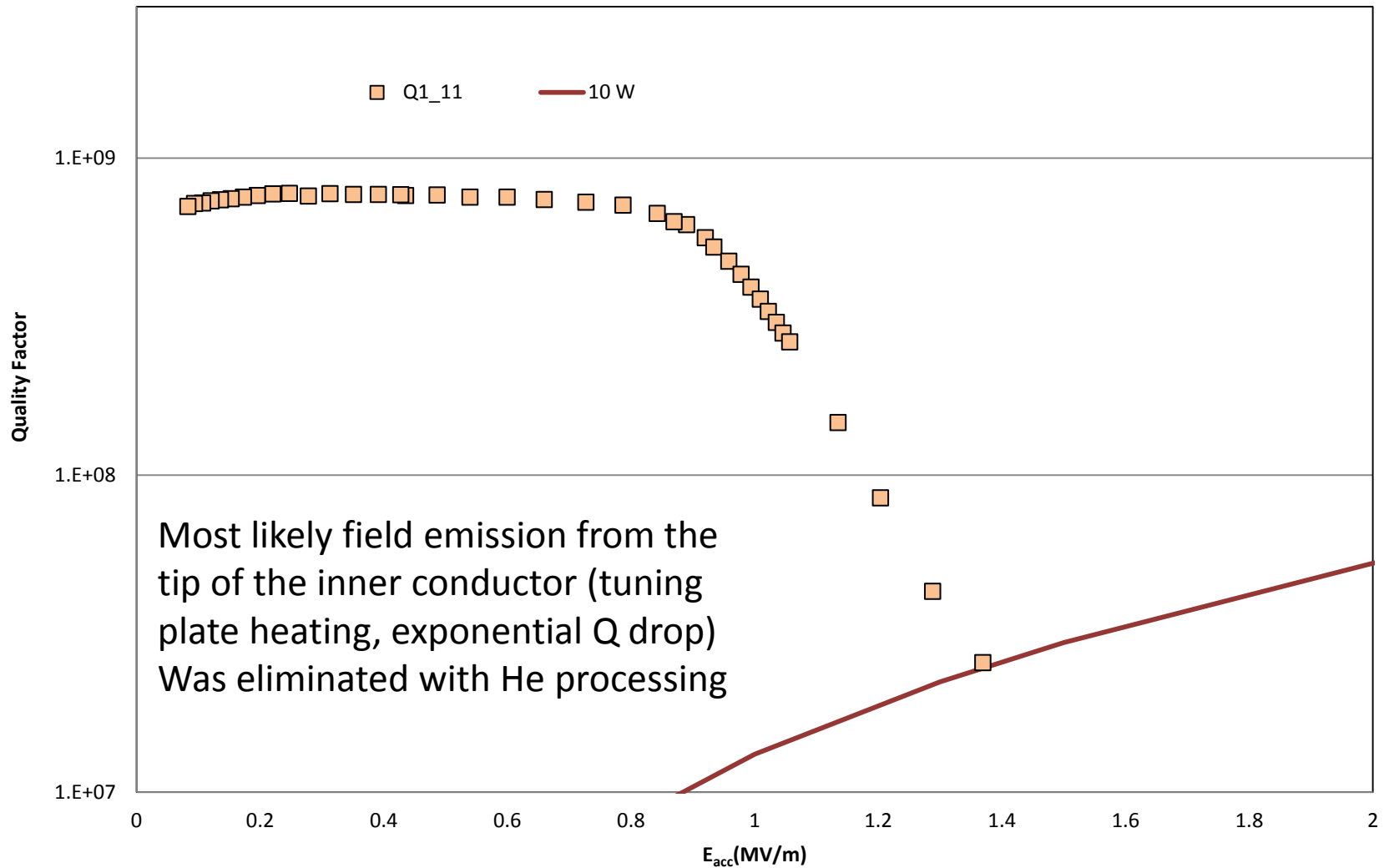
# QP1 thermal performance (with high dissipation in the cavity bottom after Q-switch) (W. Venturini)



# Test cavity performances in 2012 (W. Venturini)

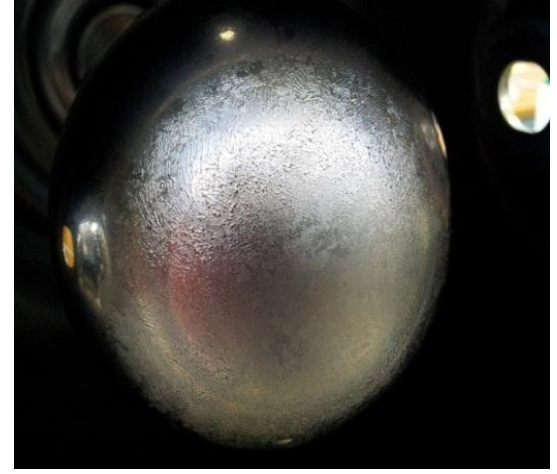


# Q1\_11 first test results at 4.5 K



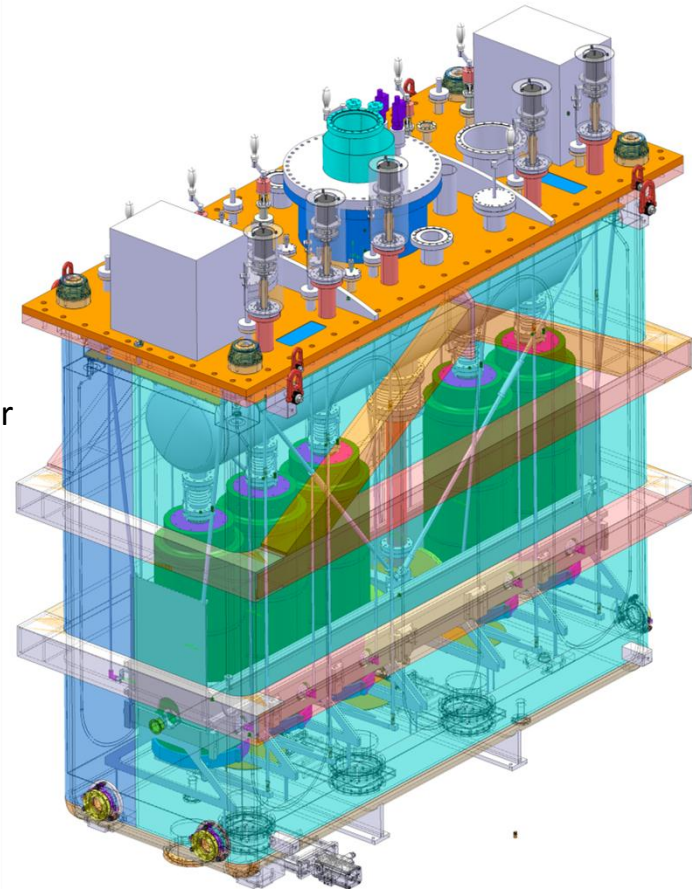
## Last two cavities (Q1\_11 and QP1\_2)

- Desired sputtering parameters almost reached (discharge power increased to 8 kW )
- Q1\_11: inner electrode at ground potential
  - Corrugated film surface on the tip of the inner conductor
  - Nb peel off at cavity lower edge
  - Tested with flat Nb/Cu tuning plate
- QP1\_2: inner electrode at cavity (bias) potential
  - Corrugated area on the tip was much reduced
  - Better adhesion on lower cavity edge
  - Tested with Cu/Be tuning plate



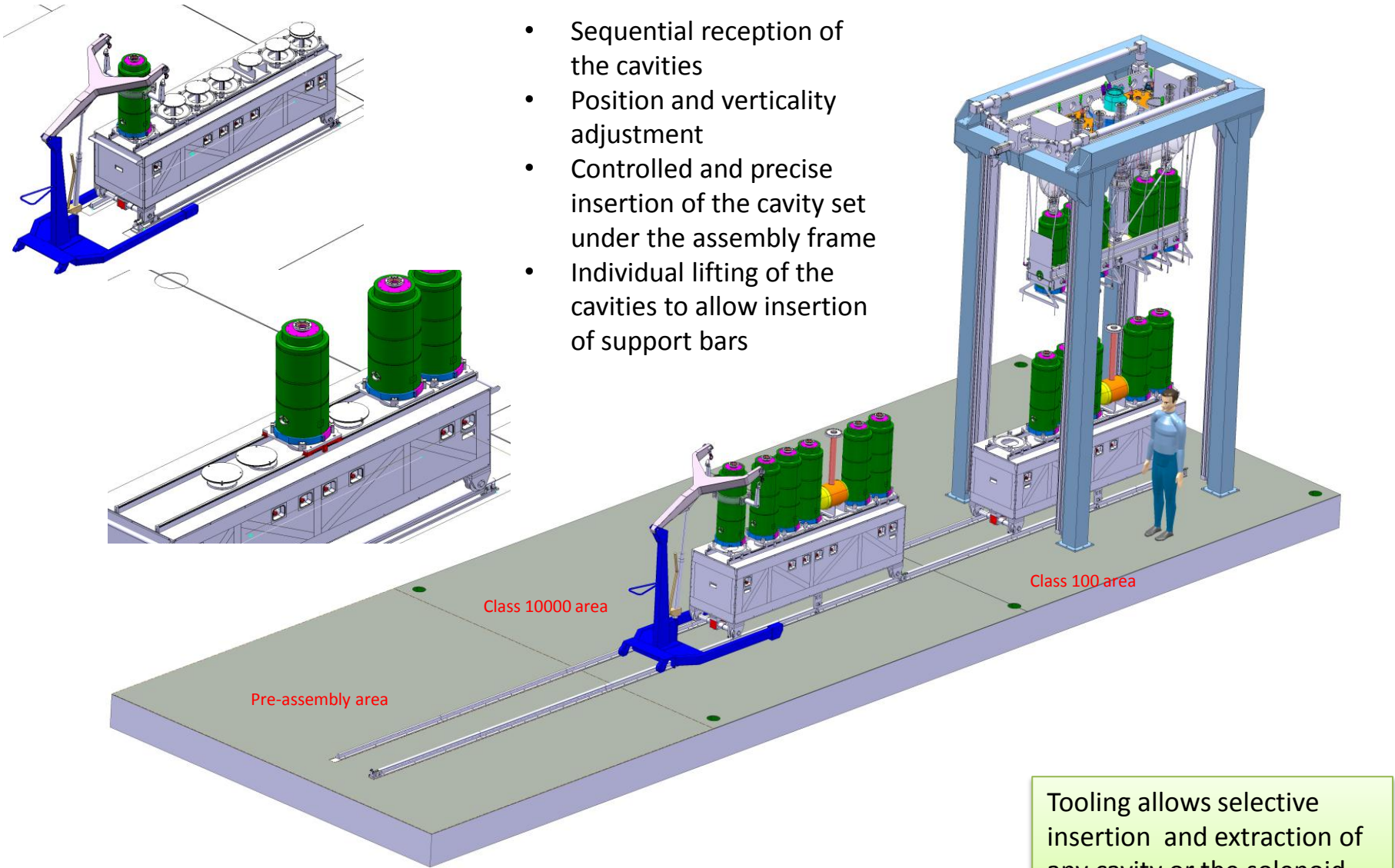
# What's going on now and next steps

- **Design**
  - Support frame detail design
  - Specific tooling conceptual and detail design
- **Specification Drawings**
  - Thermal Shield
  - Support frame
- **Procurement**
  - Frame position Adjusters - industrial production underway
  - Clean room – Out to industry next week
  - (Vacuum and helium vessels) – Out to industry by mid October
  - Thermal Shield – Out to industry by end November
  - Support Frame – Out to industry by mid December
  - External jacks - Out to industry by mid December
  - Specific Tooling Out to industry in January 2013
- **Documentation**
  - Assembly procedures
  - Technical specifications
  - Product Breakdown Structure (PBS)
  - Work-package description
- **New studies**
  - Integration of the Cryo-module into the shielding tunnel

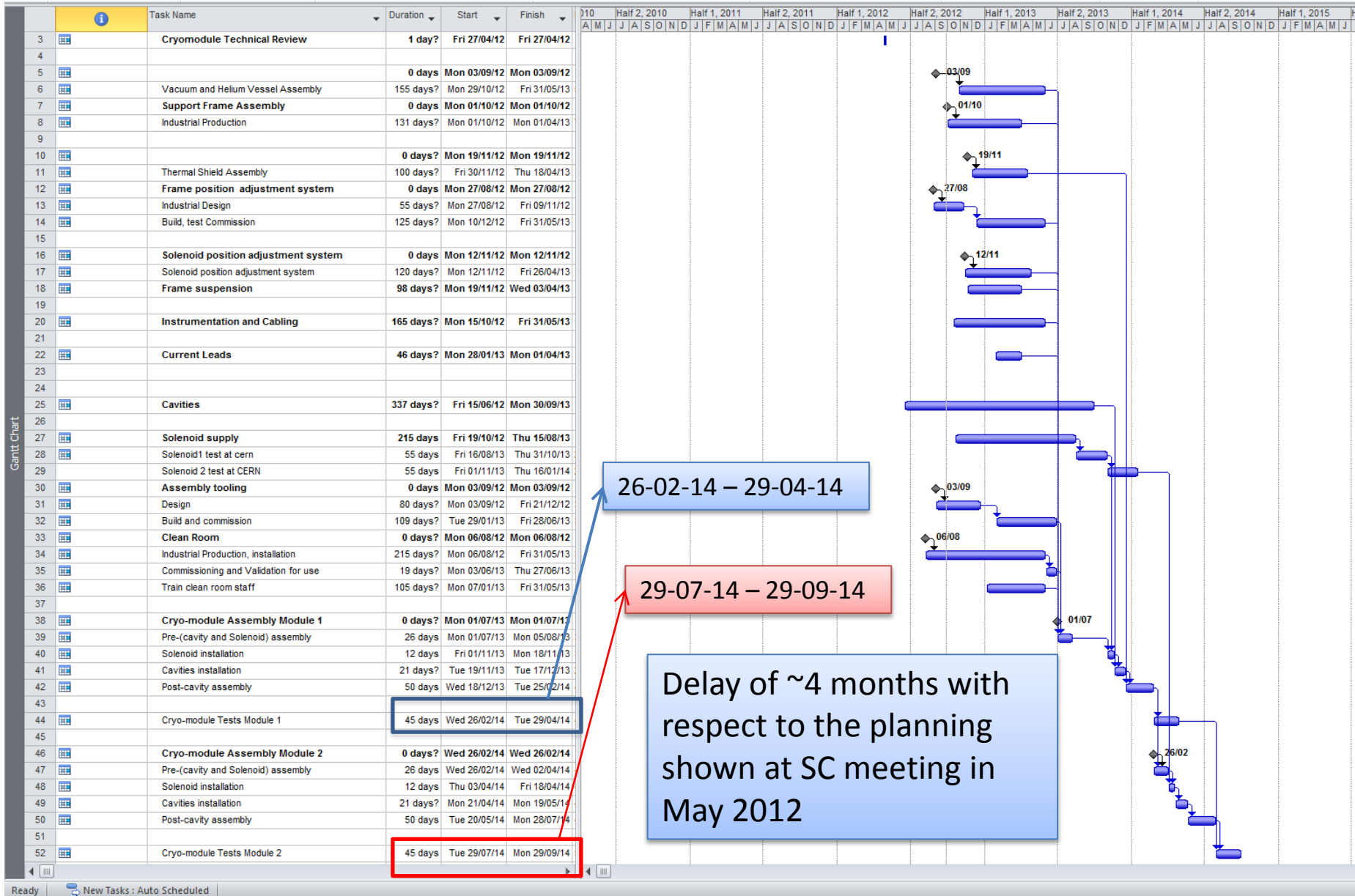


# Specific Assembly Tooling

- Sequential reception of the cavities
- Position and verticality adjustment
- Controlled and precise insertion of the cavity set under the assembly frame
- Individual lifting of the cavities to allow insertion of support bars



# Planning

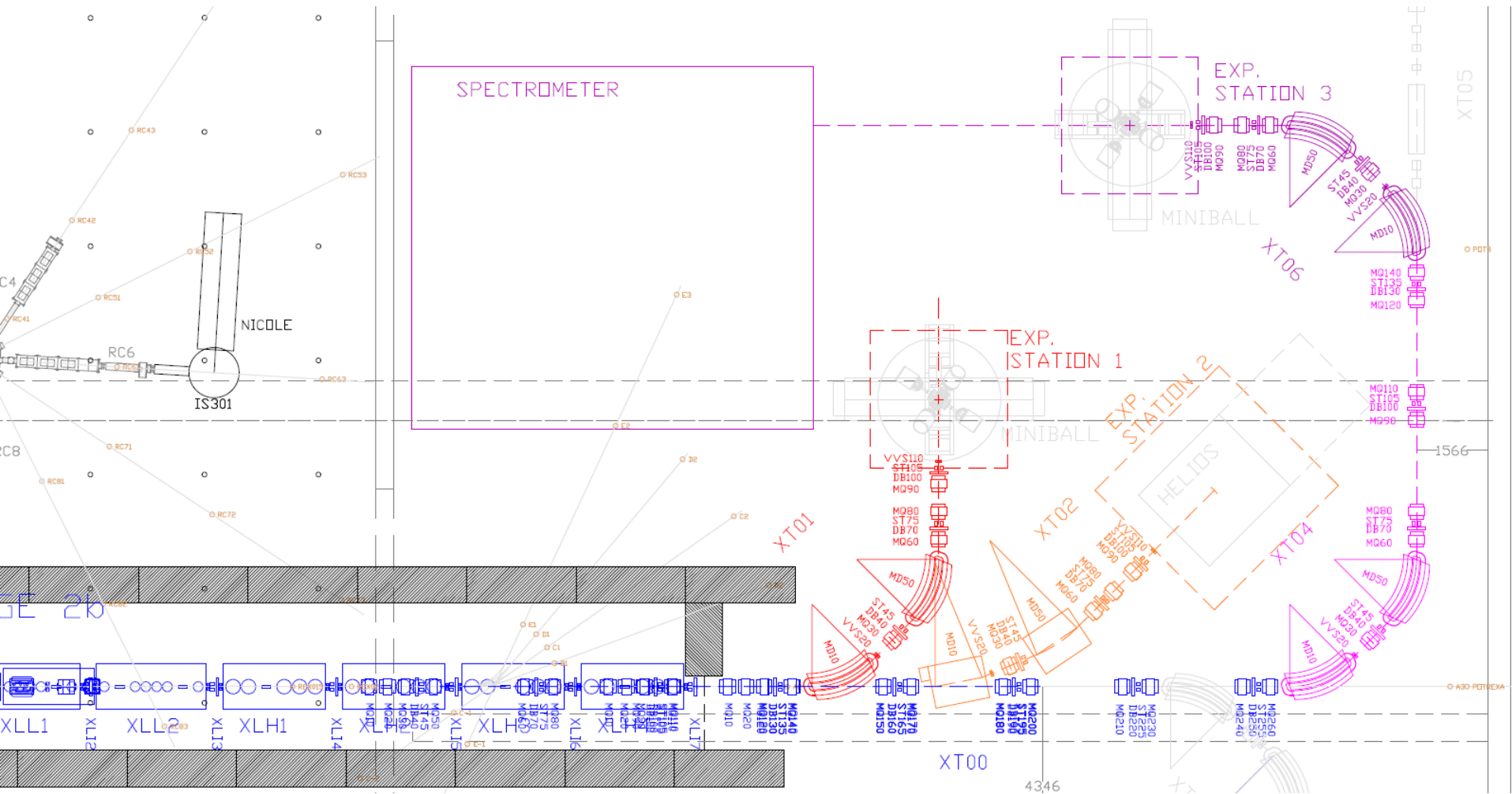






# Latest HEBT design – stage 2b

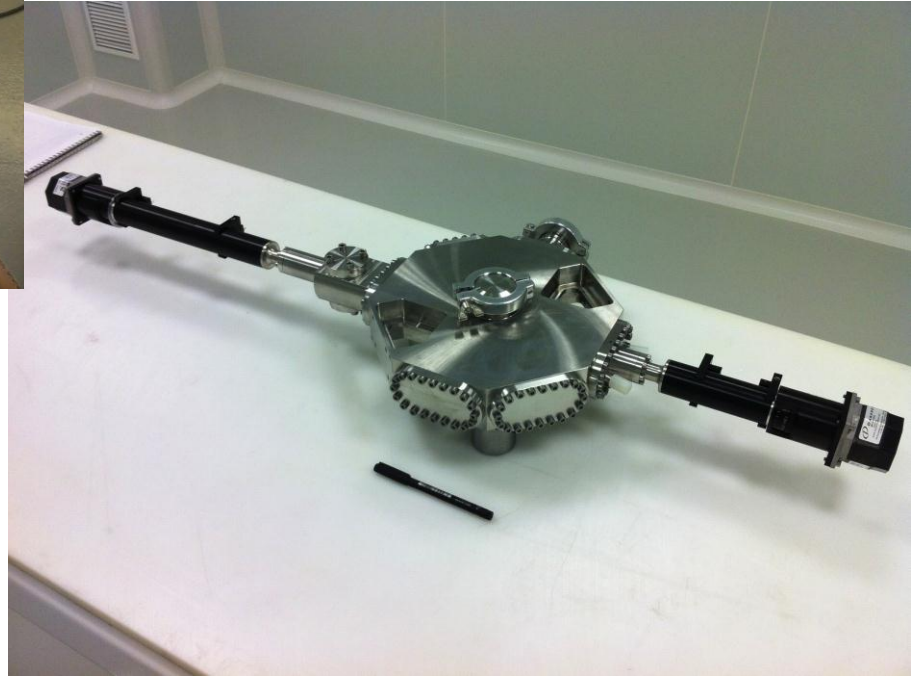
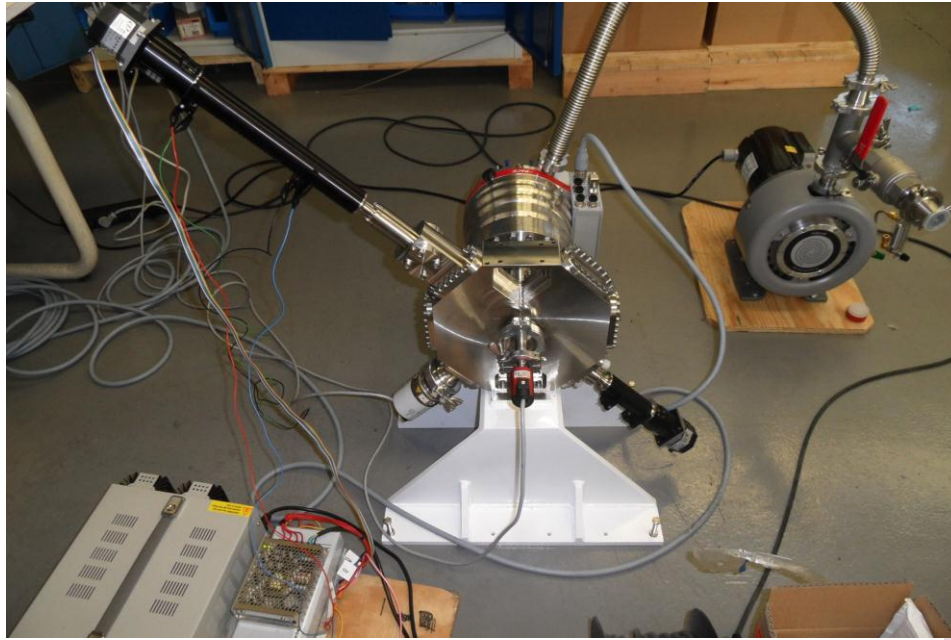
- All details on EDMS (HIE-ISOLDE/HEBT LINES OPTICS AND LAYOUT)
  - Drawings, layout tables and (new) madx reference optics files



# Subsystems - diagnostics

- DB functional and mechanical specification finished
- Market Survey document in preparation
- Prototype Faraday cup being tested at CERN
  - Problems observed – see next talk
- Prototype DB being assembled at AVS – acceptance test at AVS 5<sup>th</sup> October, now at CERN for further testing
- Cabling needs defined and requests made
- Concern about electronics (acquisition and positioning) progress – agreed new strategy with BE/BI to obtain extra resources

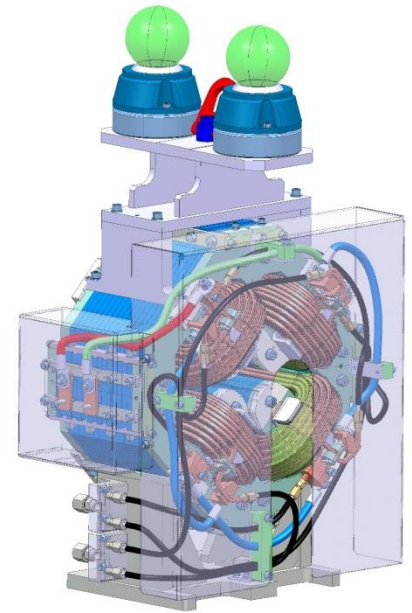
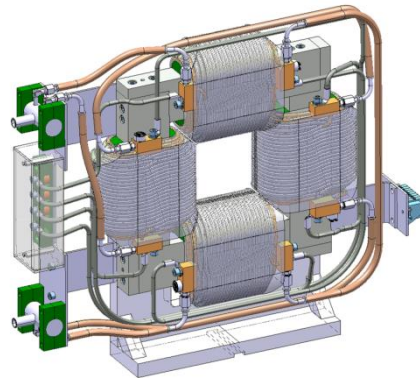
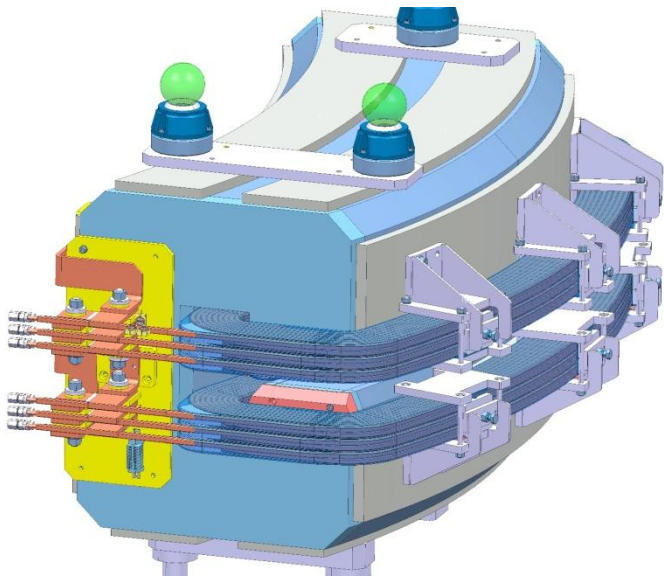
# Diagnostic box



# Subsystems - magnets

- Requirements, specifications purchasing strategy fully defined
- **22.5 deg dipoles:** Refurbishment ongoing, electrical and magnetic measurements to do. **Missing specification details for spare coils.**
- **45 deg dipoles:** Electrical, cooling and vacuum interfaces defined, magnetic design done, mechanical design and technical specifications ongoing. **Tendering end Oct. 12**
- **Quadrupoles:** Electrical and cooling interfaces done, vacuum and survey ongoing, magnetic design, mechanical design and technical specification ongoing. **Tendering Nov. 12**
- **Steerers:** Design updated after CdR (water cooling), electrical, cooling and vacuum interfaces defined, magnetic design done, mechanical design being adapted to watercooled version, technical specifications started. **Tendering end Oct. 12**

# Magnets – present designs





# Subsystems – power convertors

- All requirements finalised and technical solutions being defined
- FGC3s to be used for all control
- Quadrupole:
  - Industry. Potential solutions tested and a draft specification is almost ready. Current looping control needs some more work.
- Steerer:
  - CERN design and assembly. MS deadline is set for October and tendering in December 2012. The first batch is then expected at CERN in December 2013. Second batch in 2015.
- Dipole:
  - CERN S250 design. Power convertors production in 2014.

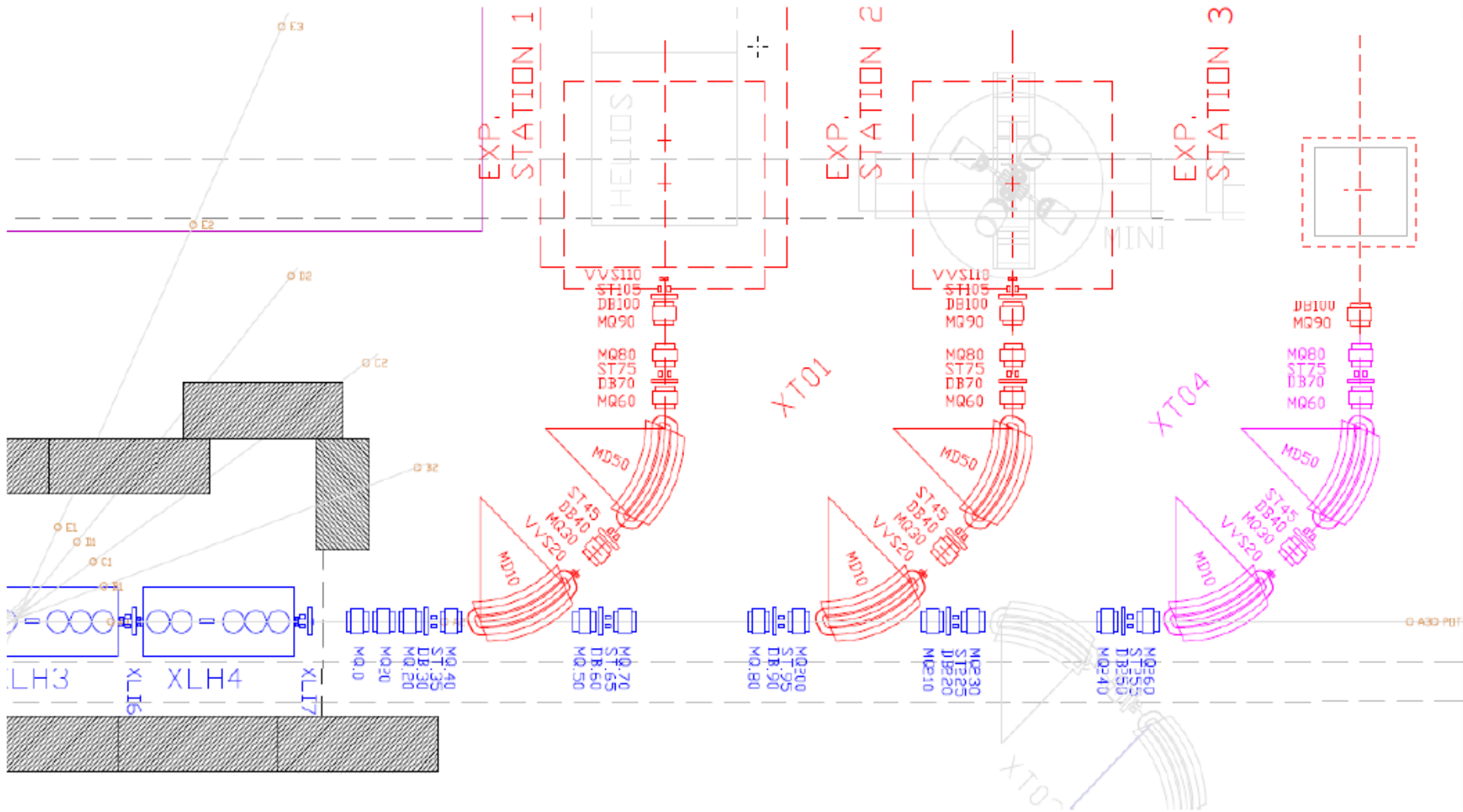


# Remaining issues/concerns

- Performance of the Faraday cup in the DB
- Electronics for diagnostic boxes (acquisition and positioning). Resources requirement defined – need to obtain the people.
- Fast-valve effectiveness for protection of SC cavities
- Shielding of HELIOS magnetic field

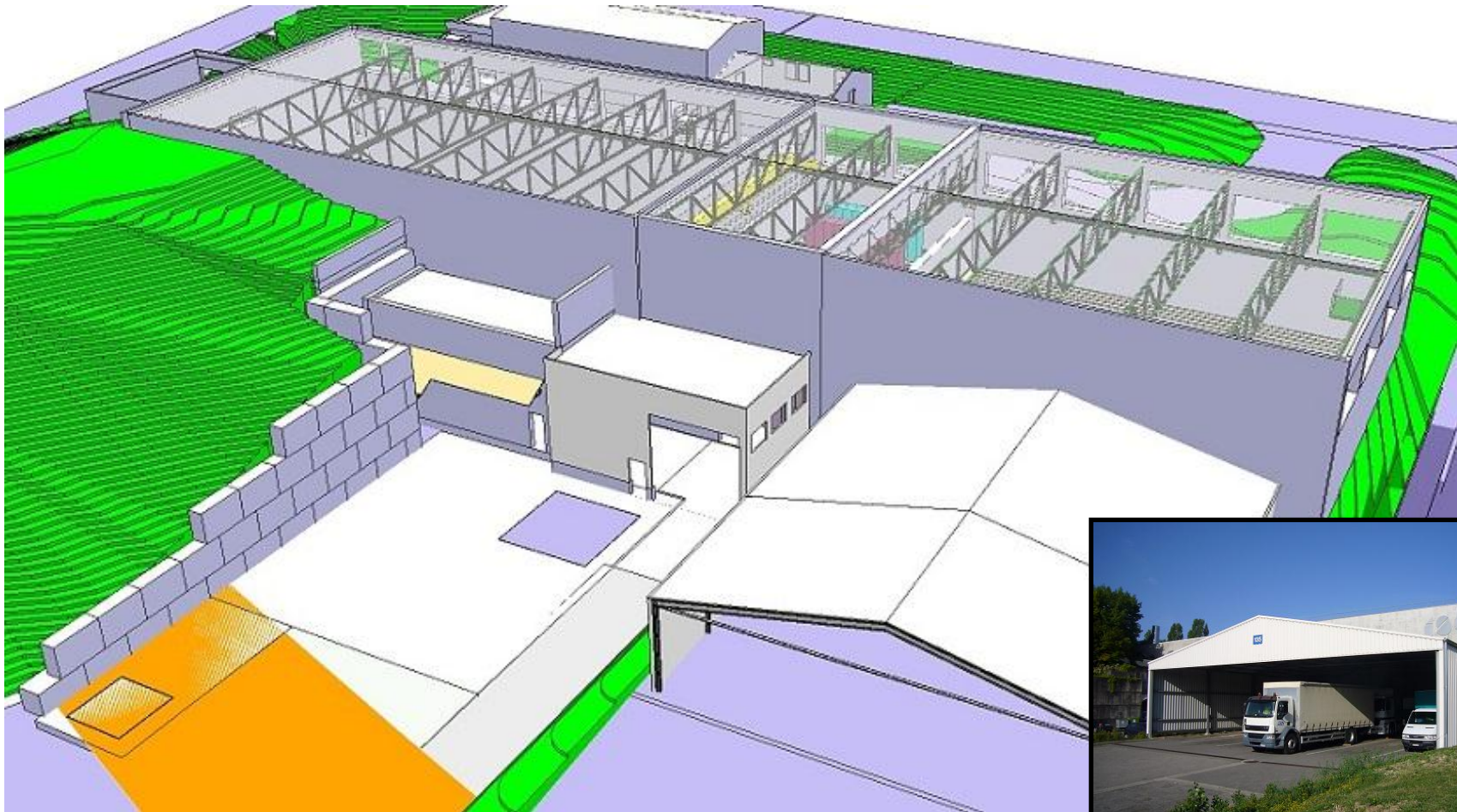


# Proposed stage 1 HEBT layout





# Civil Engineering



Construction starting date: Aug 2011

# Civil Engineering



9th Steering Committee May 2012



# Civil Engineering

Top-view construction site: 10 July



Construction site

July 2012

B199 (Cold Box) and B198 (Compressors)



# Civil Engineering



B198 (Compressors), roof closed: 19 Sept



Compressor building  
198

Installation of the crane  
and roof September  
2012



# Civil Engineering

B199 (Cold Box) finishing the walls: 16 Aug & 29 Aug



B199 (Cold Box) installation of the roof: 5 Sept & 19 Sept



Cold Box building installation of the roof Sept 2012

# Civil Engineering

Top-view construction side: 20 September



Construction site  
September 2012



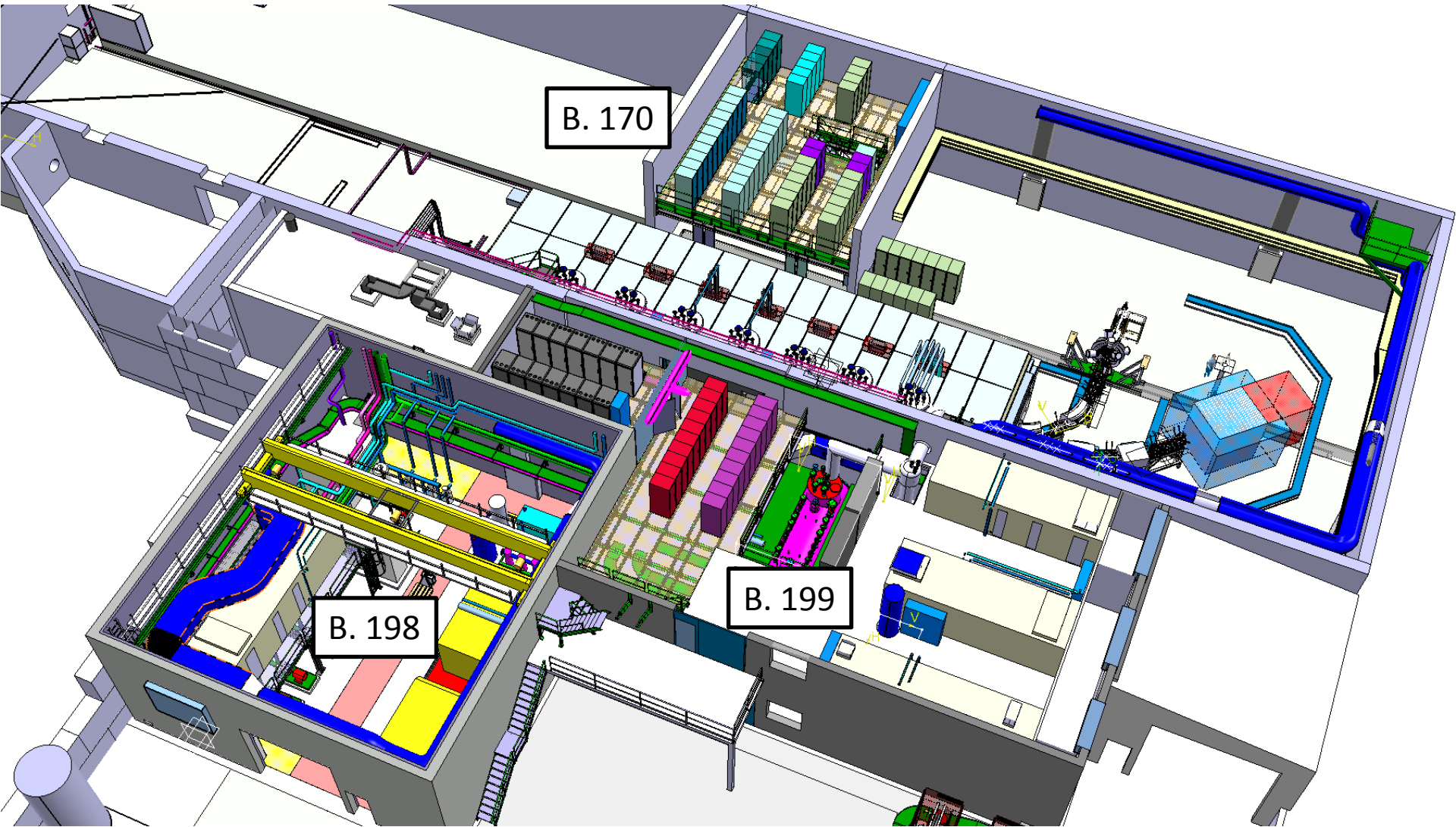


# Civil Engineering



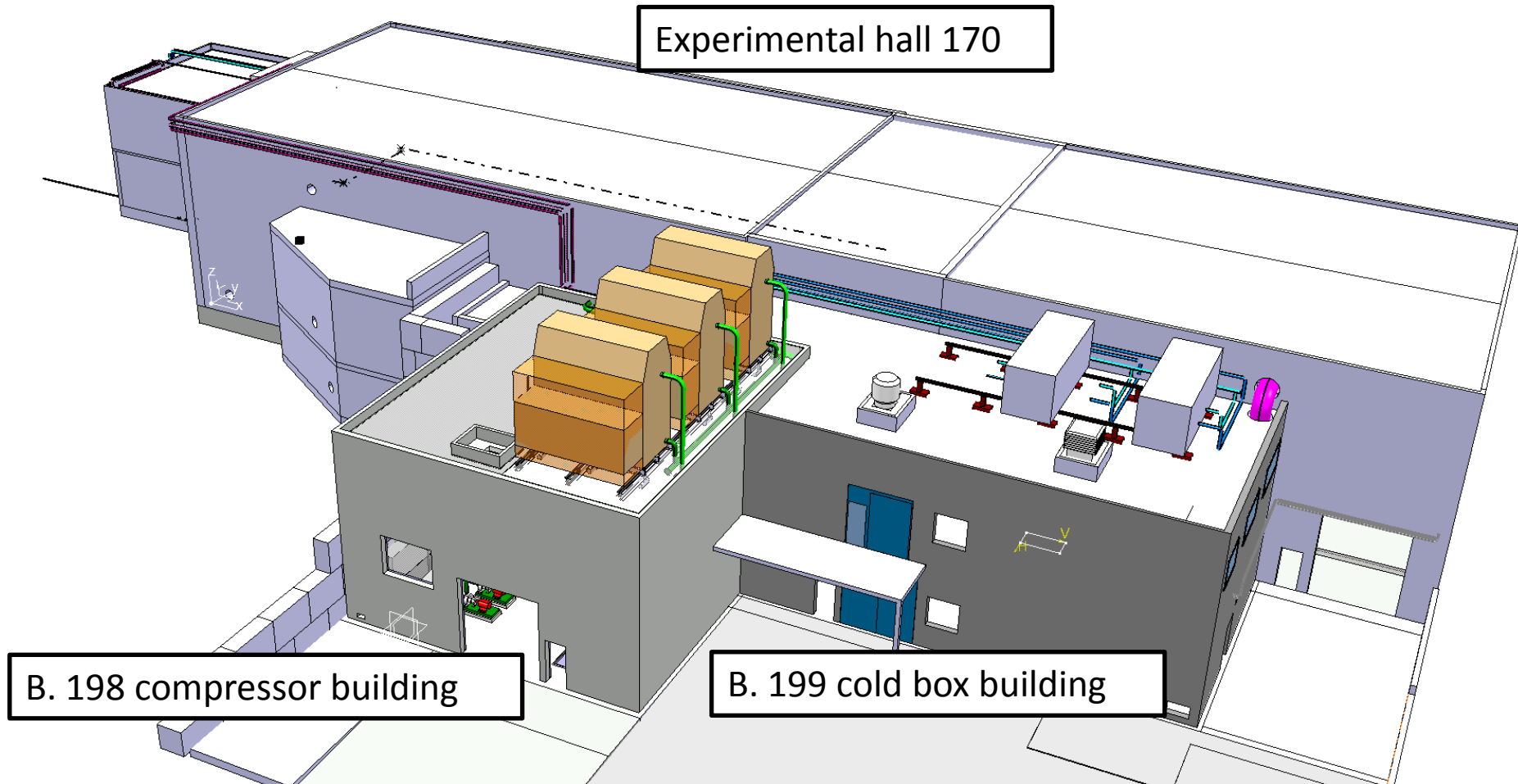
Civil Engineering finished summer 2012!

# Racks sub systems



Electrical systems: Oct 2012 – June 2013

# Cooling & Ventilation

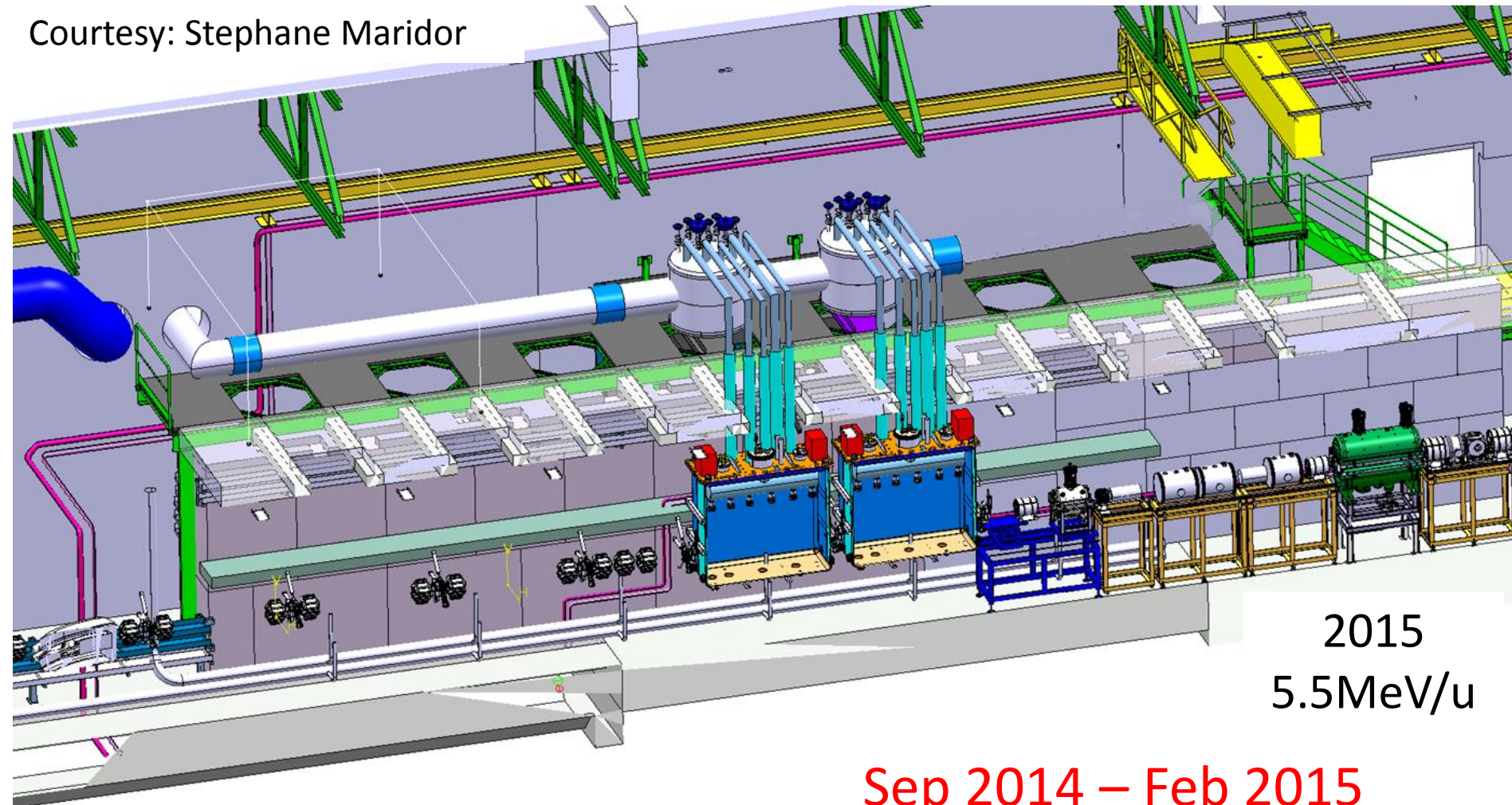


Cooling & Ventilation: Oct 2012 – June 2013



# Modular Linac & Cryo Line

Courtesy: Stephane Maridor



2015  
5.5MeV/u

Sep 2014 – Feb 2015

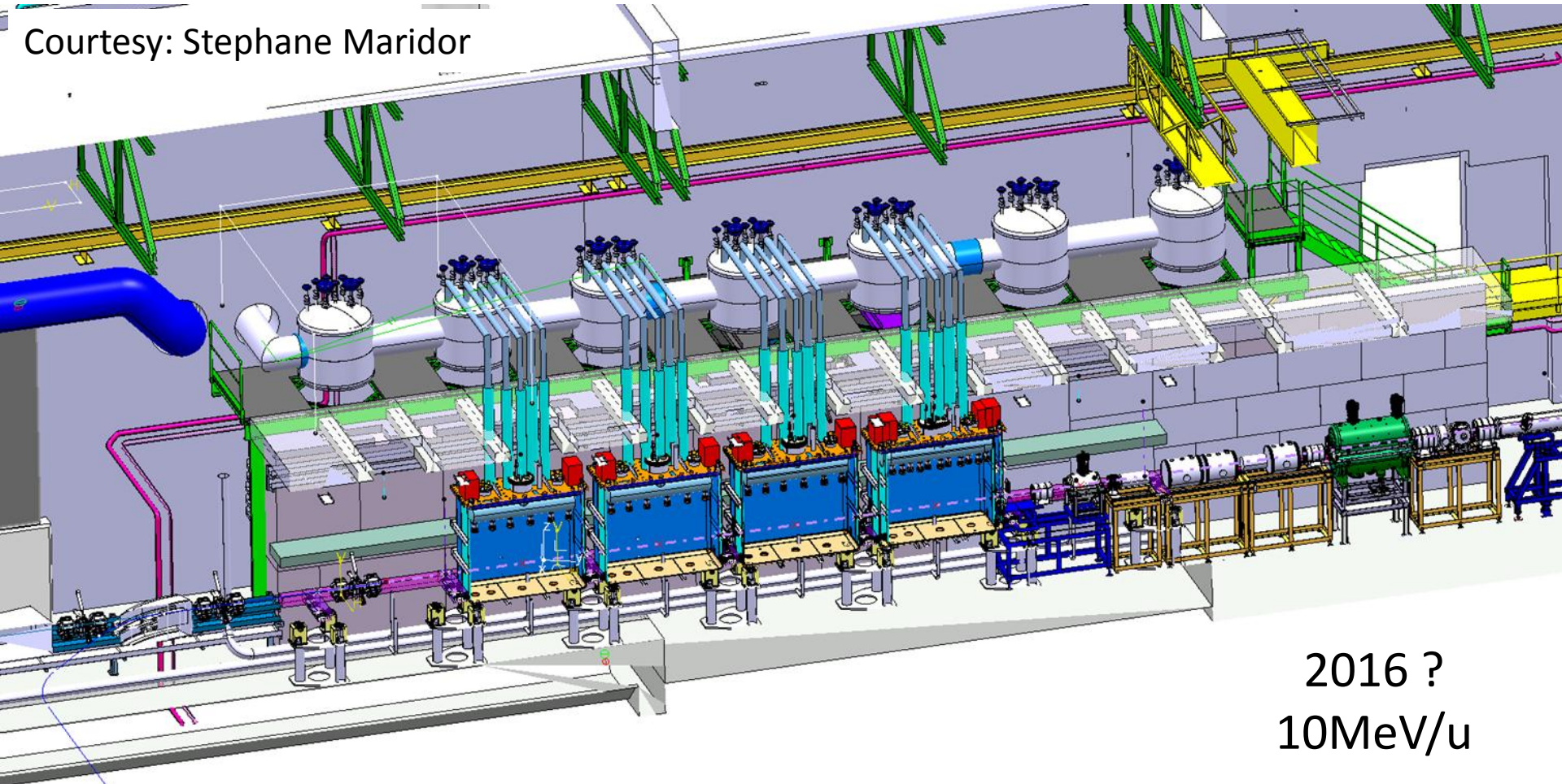
Cryo Cold Line- stage 1: ~~January 2014 – June 2014~~

Linac CM 1&2 - stage 1: August 2014 – October 2014



# Modular Cryo Line

Courtesy: Stephane Maridor



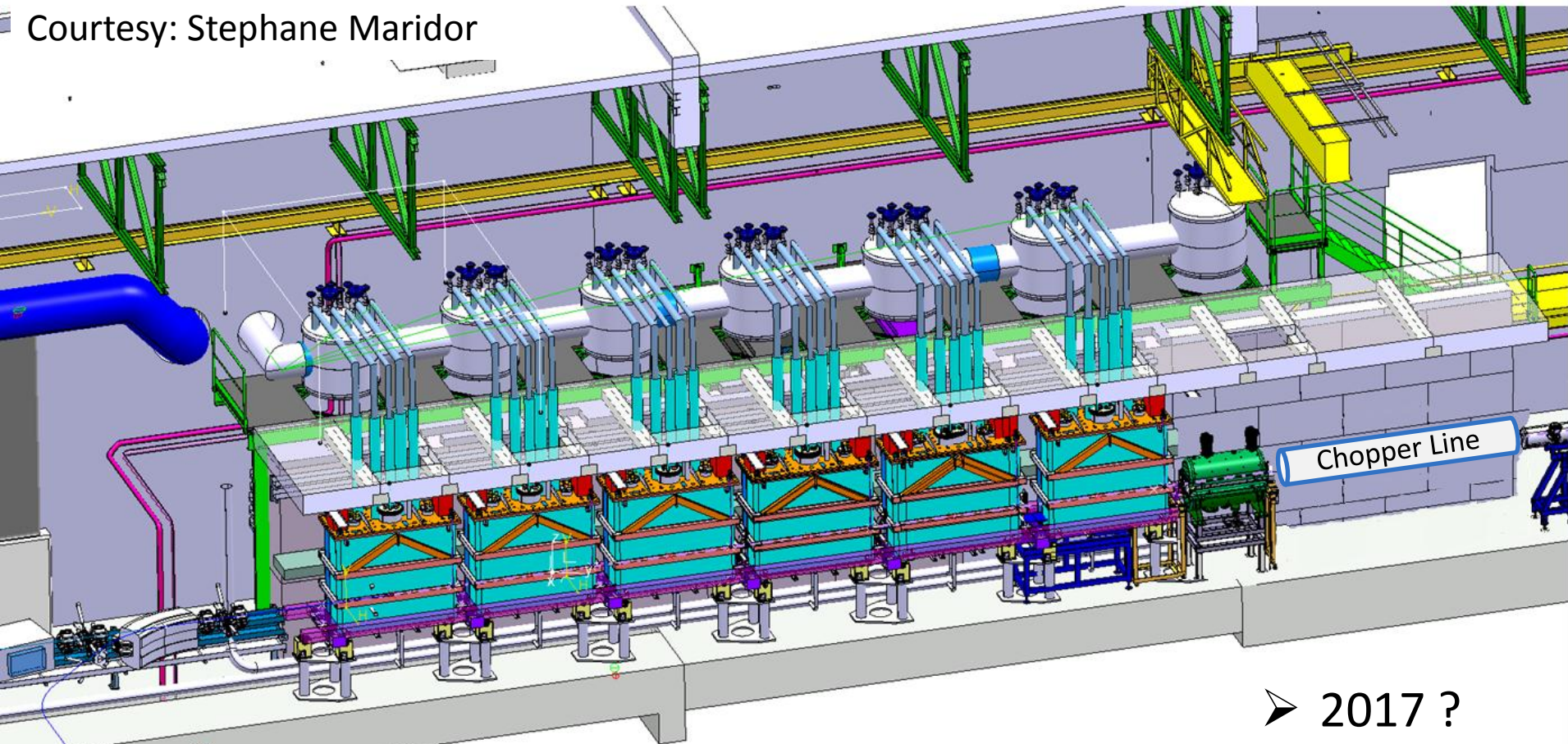
2016 ?  
10MeV/u

Cryo Cold Line- stage 2  
Linac CM High- $\beta$  1,2,3&4 - stage 2a



# Modular Cryo Line

Courtesy: Stephane Maridor

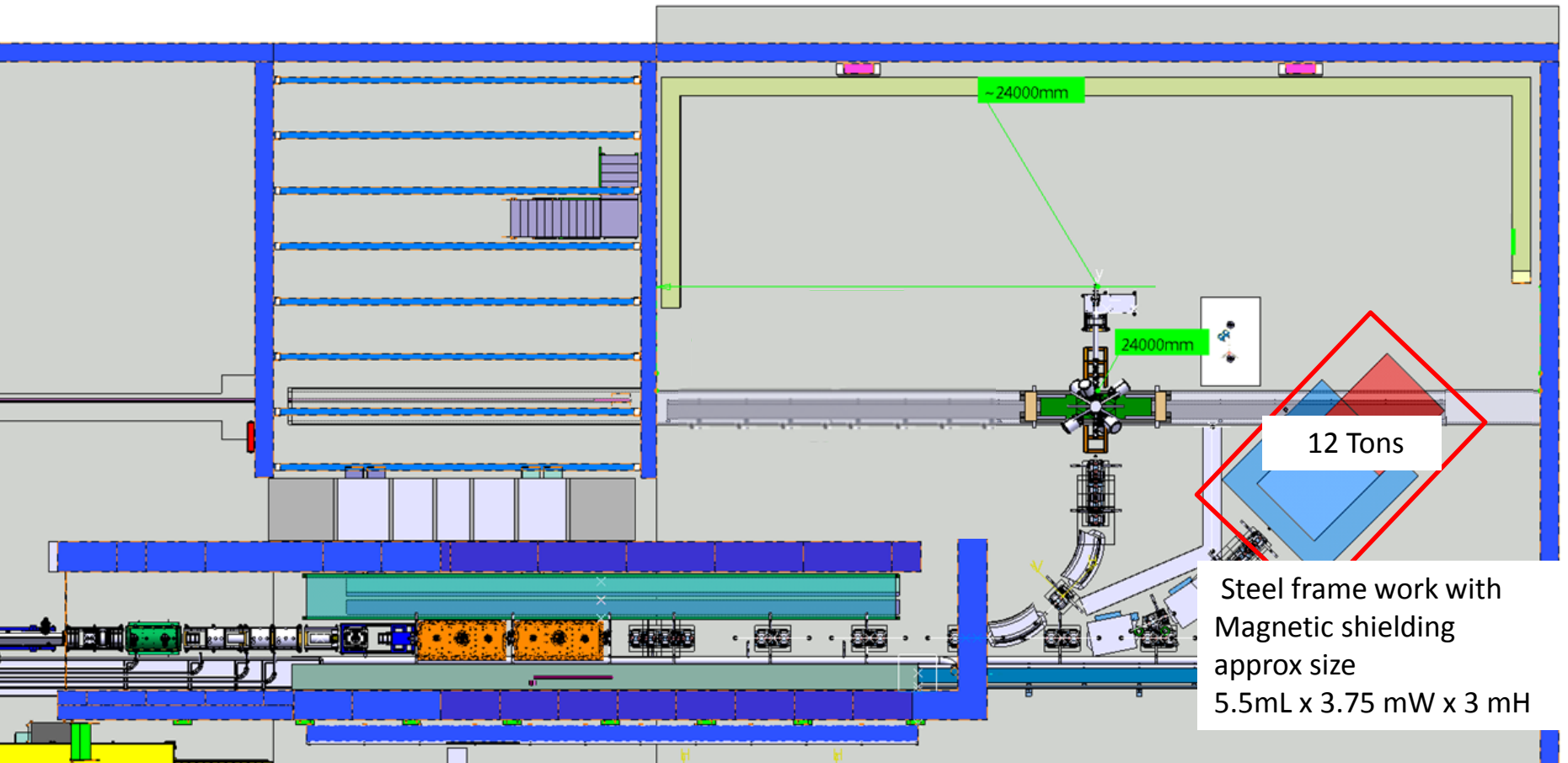


➤ 2017 ?

Cryo Cold Line- stage 2

Linac CM High- $\beta$  1,2,3 & 4, Low- $\beta$  1&2 - stage 2b  
and Chopper Line

# HEBT Stage 1

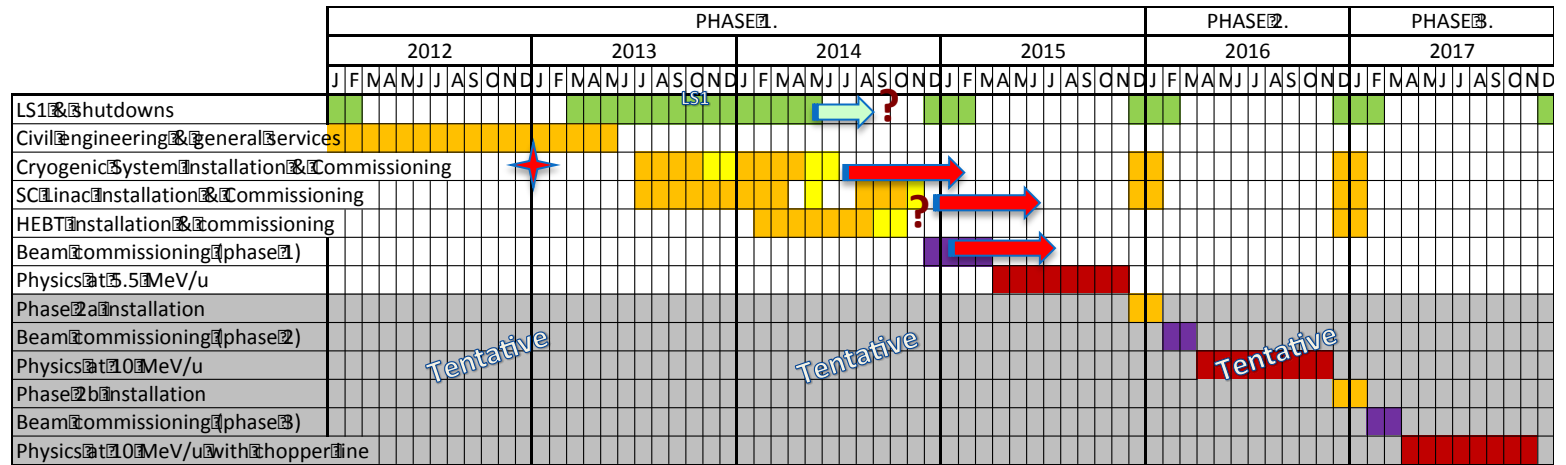


Straight line with 2 experiment stations – Oct 2013 - Sept 2014

Miniball move: Oct 2013 – April 2014

# Main Issue

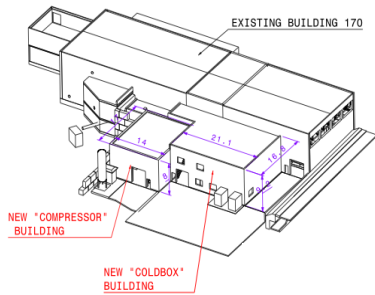
- Procurement of Cryogenic System
  - Analysing response of the 2 bidders (Air Liquide and Linde)
  - Compressor system delivery November 2013
  - Compressor commissioning March 2014
  - Cold box + transfer line delivery July 2014
  - Cold box + transfer line commissioning Jan/Feb 2015 =>



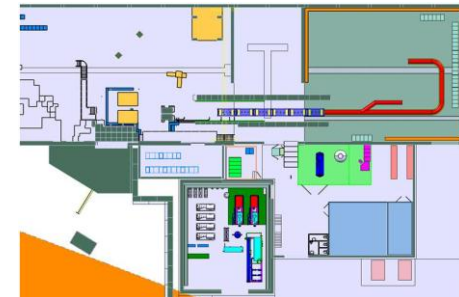
■ Installation  
 ■ Hardware Commissioning  
 ■ Beam Commissioning  
 ■ Physics Run  
 ■ Shutdowns

# OUTLOOK

- **Civil Engineering Works completed**
- **Installation of Main Services (EL, CV, others)**
- **Decision on the procurement of Cryogenic Plant (FC Dec. 2012)**
- **Ready to launch procurement of first batch of high-beta cavities => via CATE + others**
- **Ready to launch procurement of CM1 and CM2 => via CATE**
- **Ready to launch procurement of HEBT phase-1**
- **Cost and Schedule Review (22-23 Nov. 2012)**



Thank you



HIE-ISOLDE web site -> <http://hie-isolde.web.cern.ch/hie-isolde/>

CATHI-ITN web site -> <https://espace.cern.ch/Marie-Curie-CATHI/default.aspx>