

## *Summary*

- *Project summary*
- *Project status*
- *Final steps scheduling*

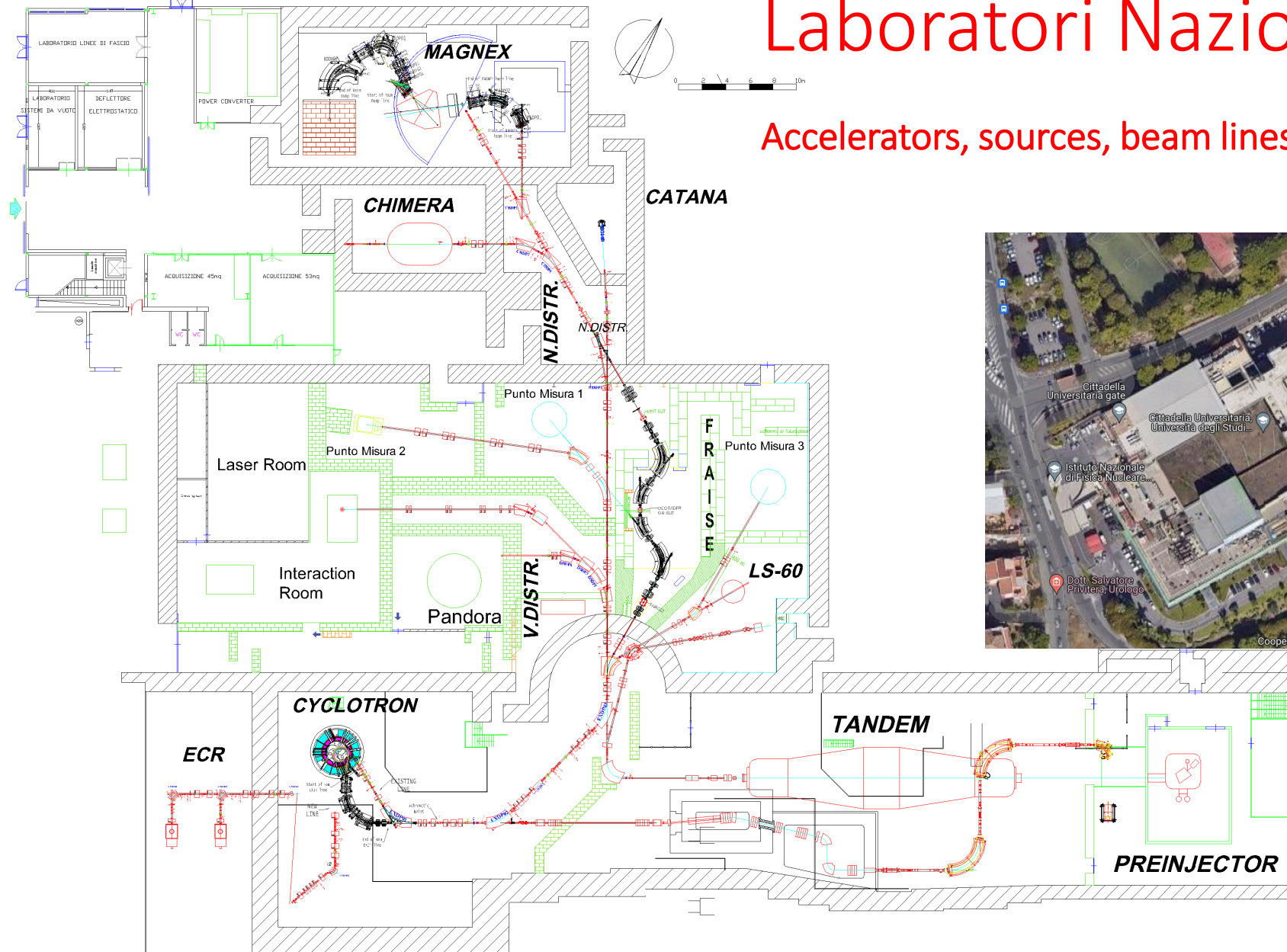


# *POTLNS*

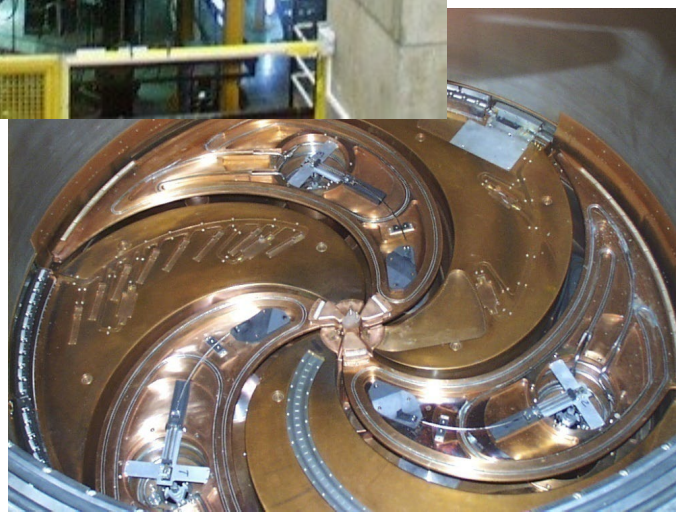
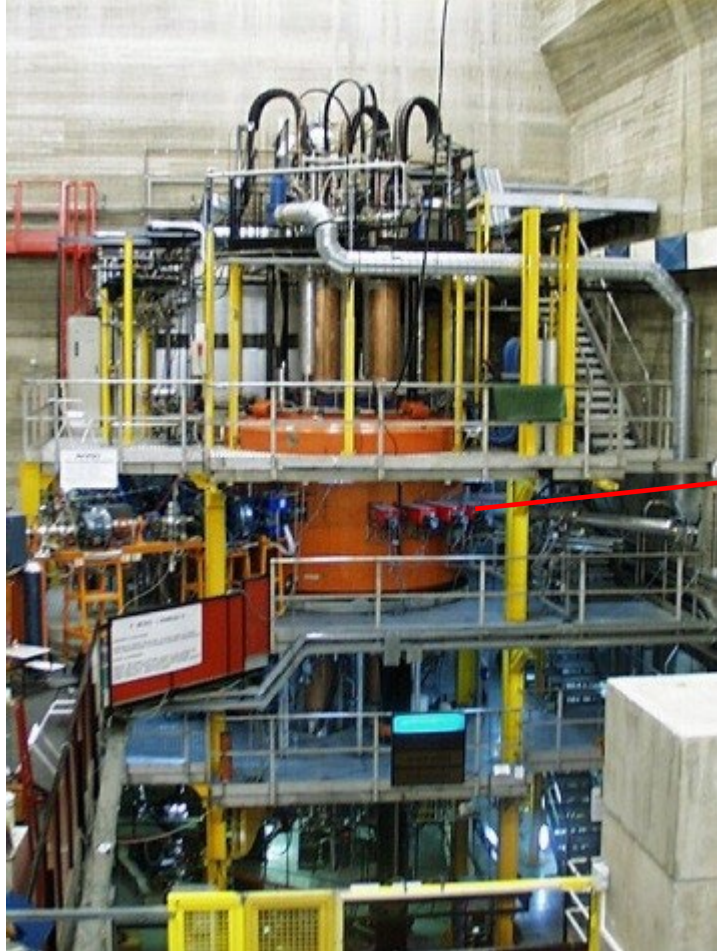
*LNS USERS MEETING 30/09/2024*

# Laboratori Nazionali del Sud

Accelerators, sources, beam lines, experimental rooms



# Where we are



# *POTLNS Project goal*

*POTLNS Project final goal is increasing the Laboratori Nazionali del Sud beams offer to Users, by increasing of two order of magnitude the beam current with respect to the previous one.*

*In particular such increase will apply for beam energies between 15 and 70 MeV/amu and for ions having atomic mass below 40*

## *Previous limits*

*Till the beginning of the refurbishment, the beam was extracted from the CS by an electrostatic deflector*

*The Superconducting Cyclotron, in its previous configuration, would have been capable of satisfying two out of three parameters required by the physics cases previously mentioned*

*It is, in fact, perfectly capable of accelerating the required ions to the specified energies*

*Due to the poor efficiency of the extraction method previously in use (electrostatic deflection) the beam current is limited*

*Increasing the extracted beam current by using the same extraction method would have the double effect of overheating the deflector and activating it beyond the limits of handling*

*Likewise, the radiation protection systems (shielding) previously available were also sized for the available beam currents*

# *How to overcome the previous limits*

*To overcome the limit imposed by the electrostatic deflection, it was decided to change the extraction strategy and use a stripping extraction system. This forced the following major changes to be made on the CS:*

- ✓ Replacement of the superconducting magnet, due to the modification of the penetrations to be made through the cryostat;*
- ✓ Replacement of the liners to increase the height of the acceleration chamber. Action required to reduce beam losses;*
- ✓ Installation of a stripping extraction system;*
- ✓ Installation of new magnetic channels to allow the focusing of the beam in the extraction channel;*
- ✓ Installation of a new beam line to allow extraction on a different angle from the one used for extraction with electrostatic deflection;*

*As a corollary to this, a series of interventions are necessary on the machine to guarantee its functioning:*

- ✓ Replacement of the central ring iron, due to changes to the penetrations;*
- ✓ Improved efficiency of the axial injection system;*
- ✓ Installation of a chopper along the axial line which guarantees the regulation of the beam intensity during the beam production operations;*
- ✓ ....*

# *What is besides required to get the full goal*

*Besides the changes on the CS, some other infrastructural changes are required:*

## *✓ Modify and improve the beam lines*

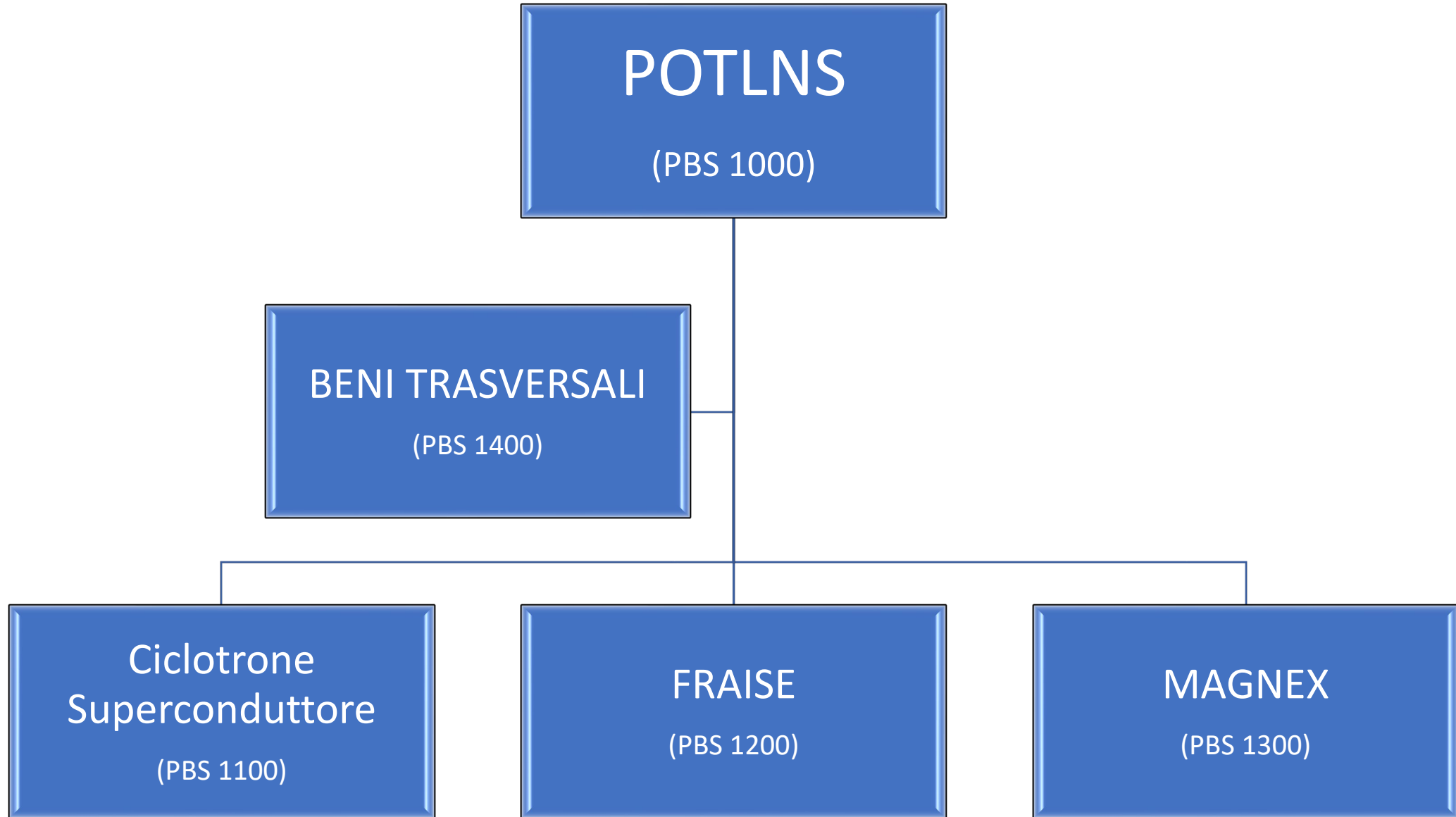
- ✓ New beam lines*
- ✓ New line magnets*
- ✓ New magnet vacuum chambers*
- ✓ Improved beam diagnostic devices*
- ✓ New vacuum systems*

## *✓ Increase the shielding thickness*

## *✓ New beam stopper*

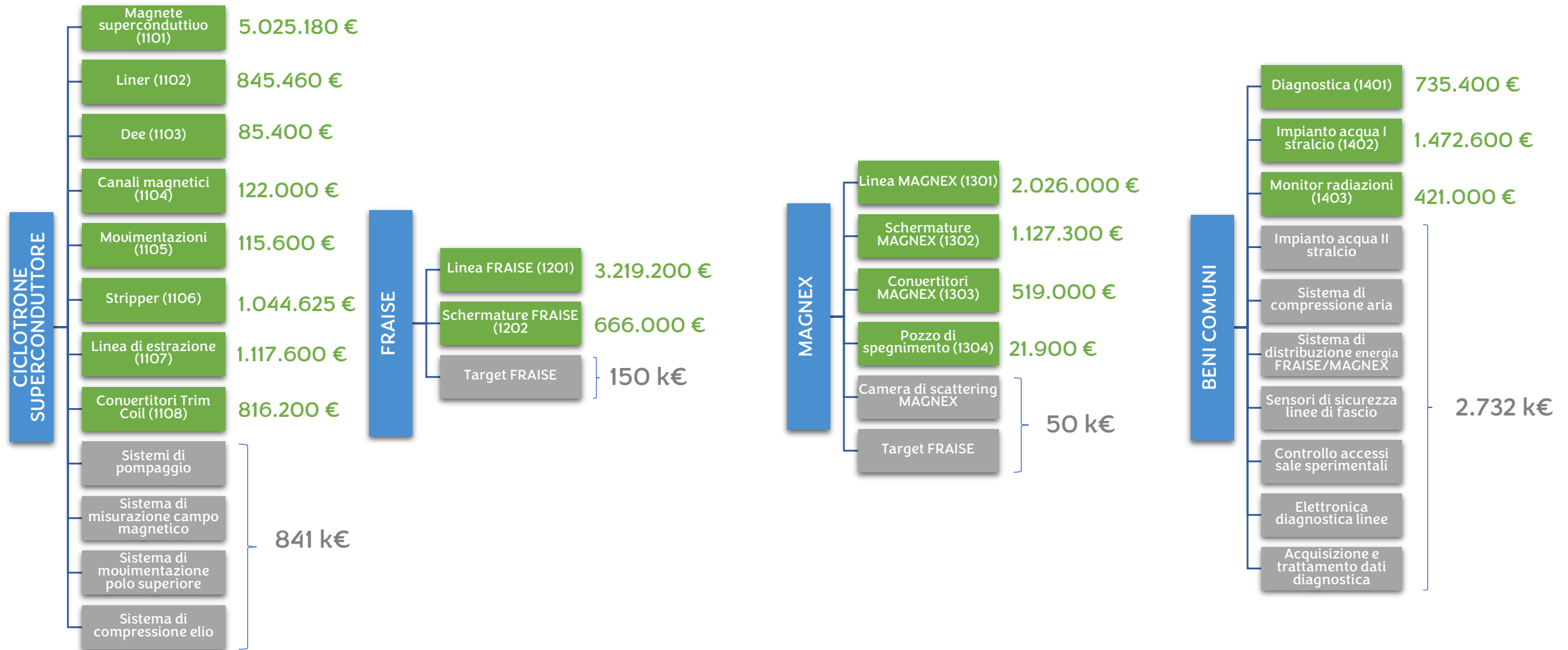
## *✓ Improved water chilling plant*

# POTLNS Project Breakdown Structure

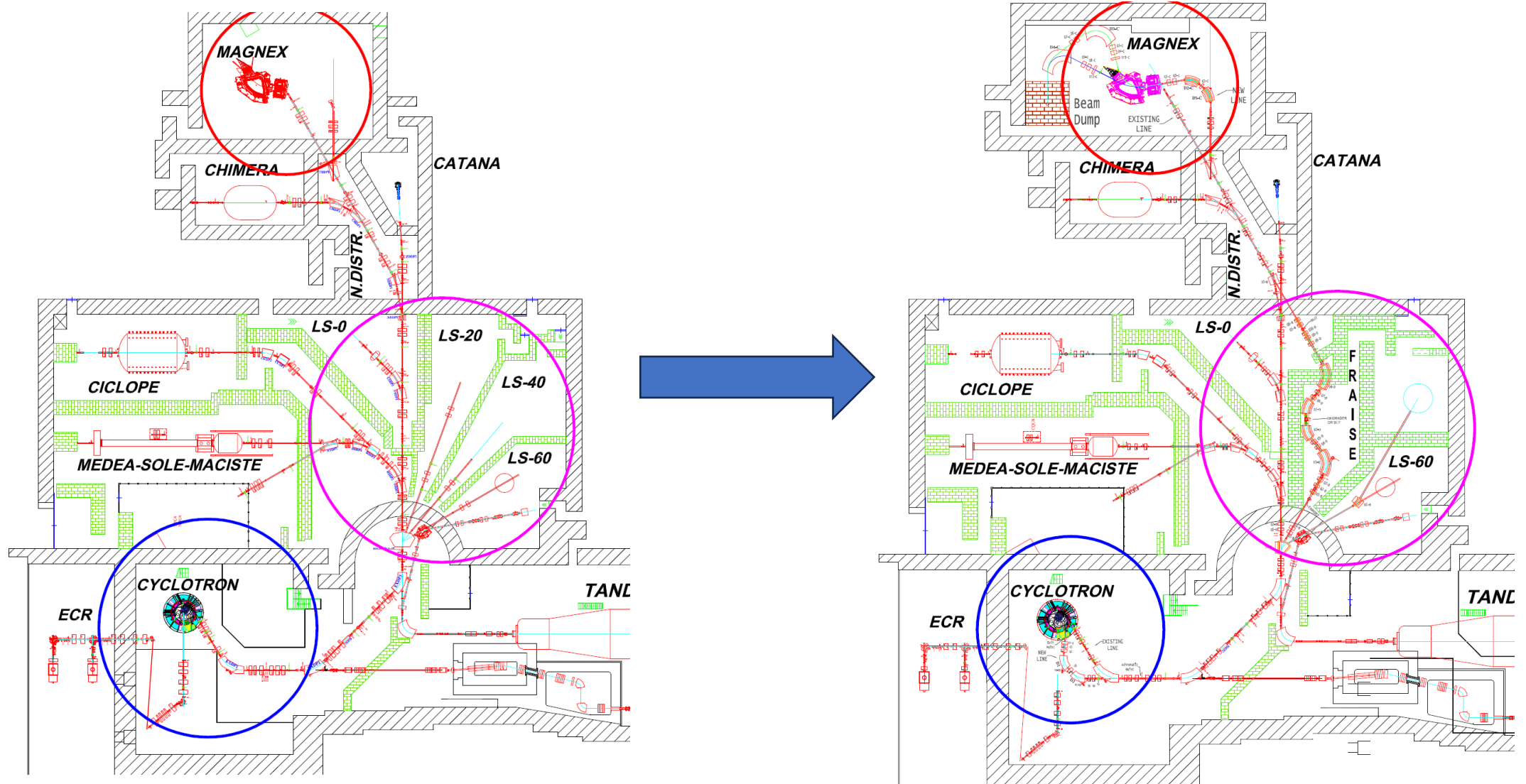




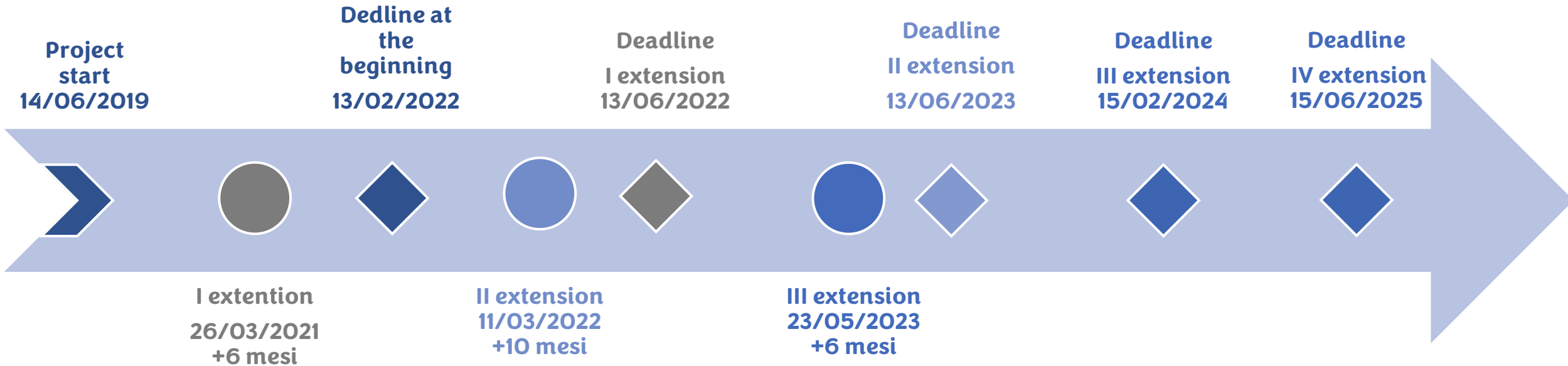
# Subprojects



# Laboratori Nazionali del Sud before and after POTLNS



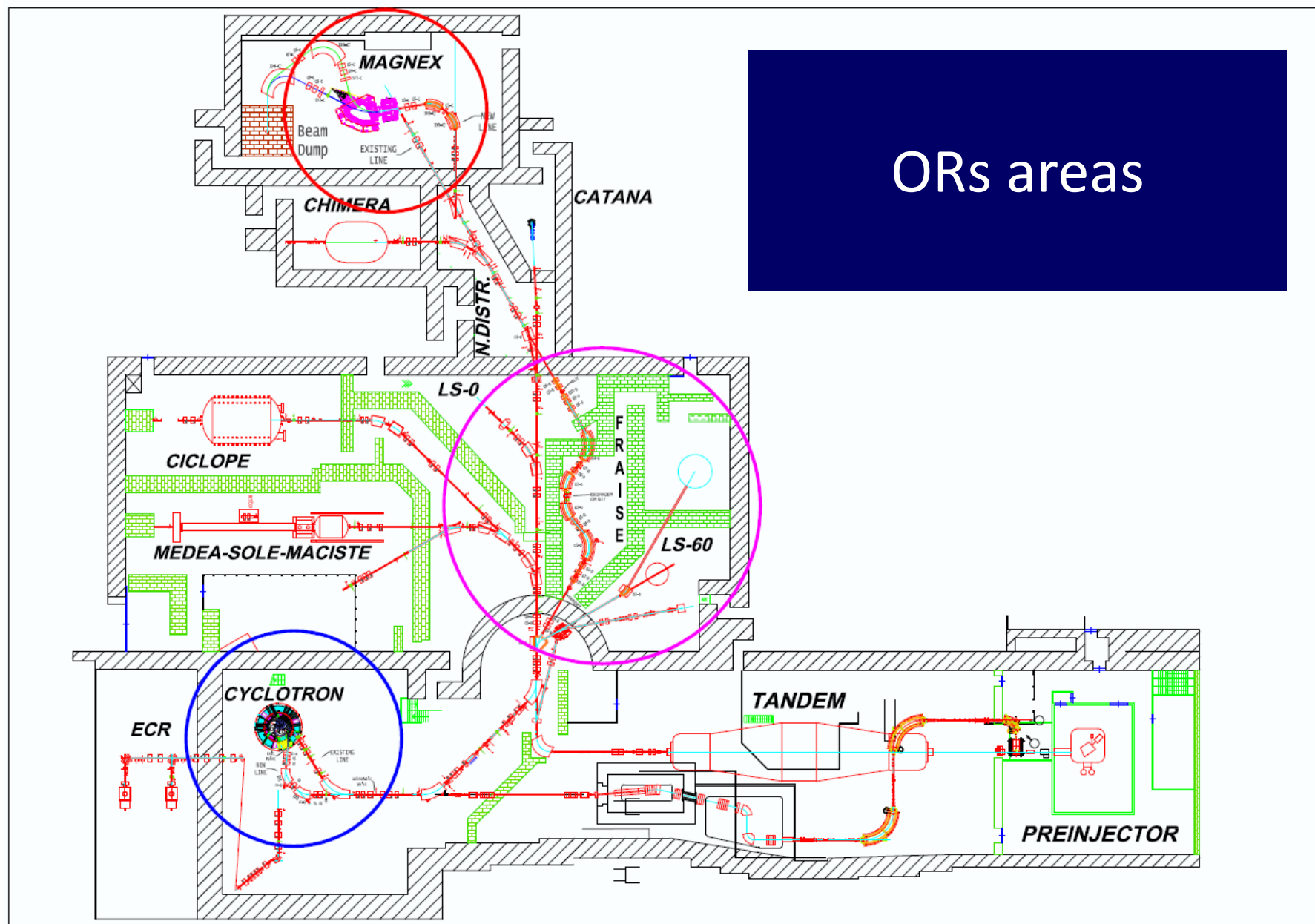
# Project timeline



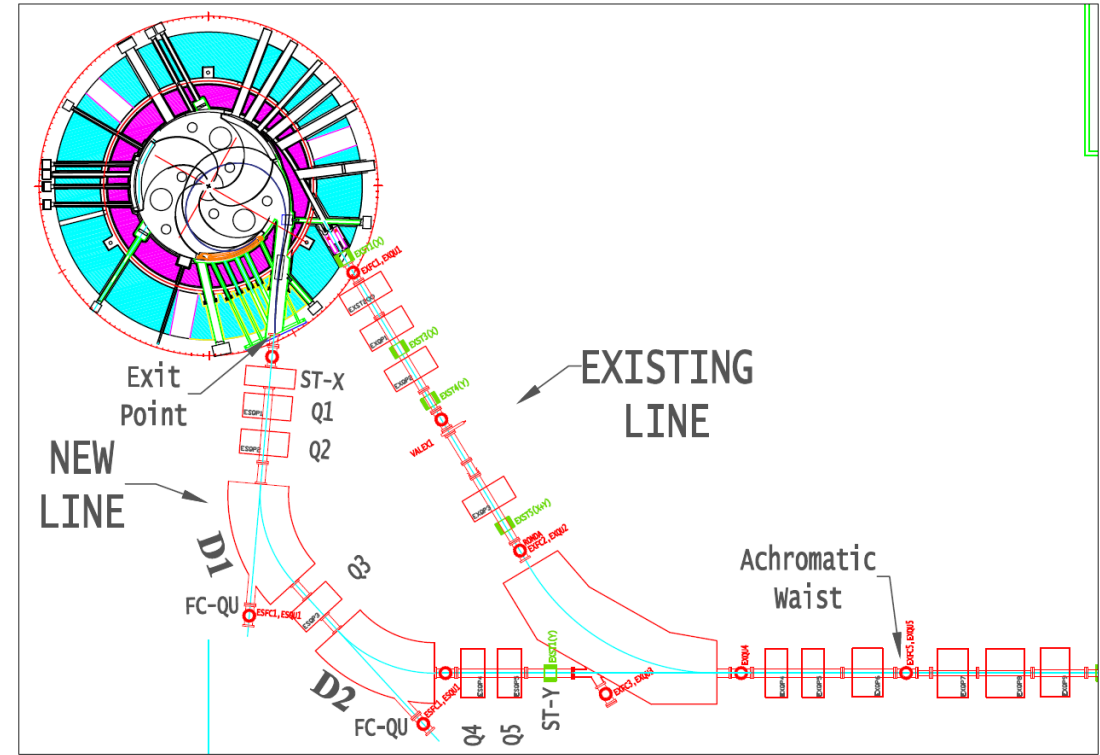
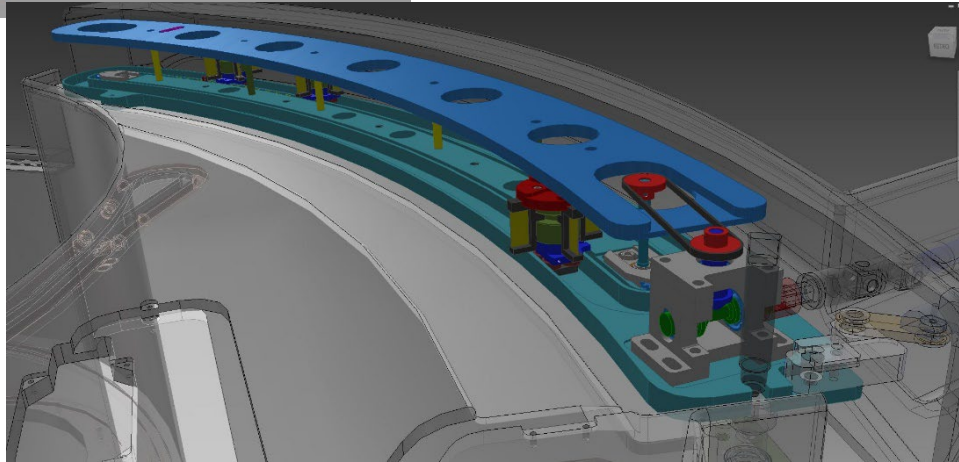
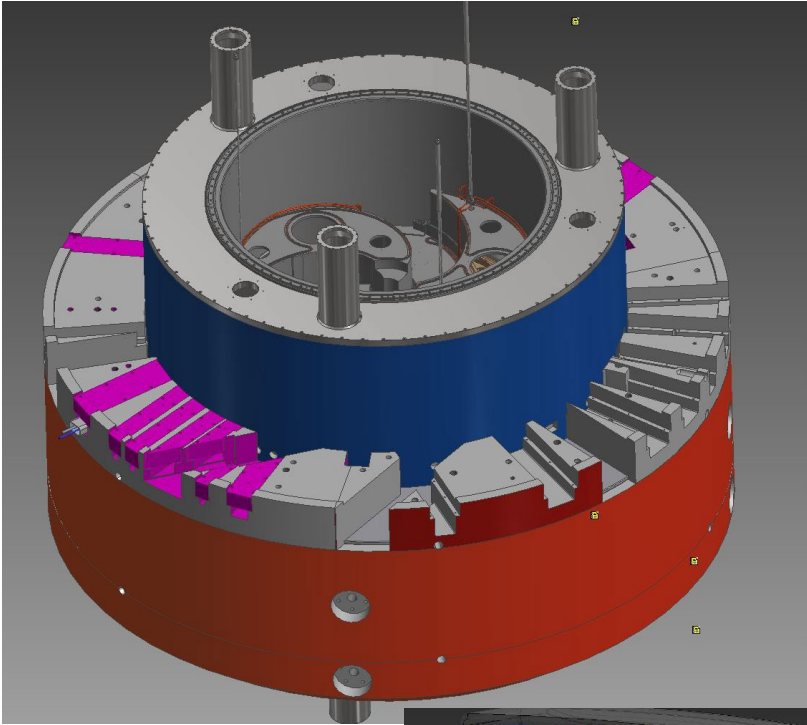
*Why have we gotten such project span extension from the Sponsor (Ministry)?*

- ✓ *Some worldwide issues (pandemic, raw materials shortening, wars)*
- ✓ *Giving maximum diligence demonstration by:*
  - *very early purchase orders placing*
  - *extremely tight progress checking and reporting to Sponsor*

# ORs areas



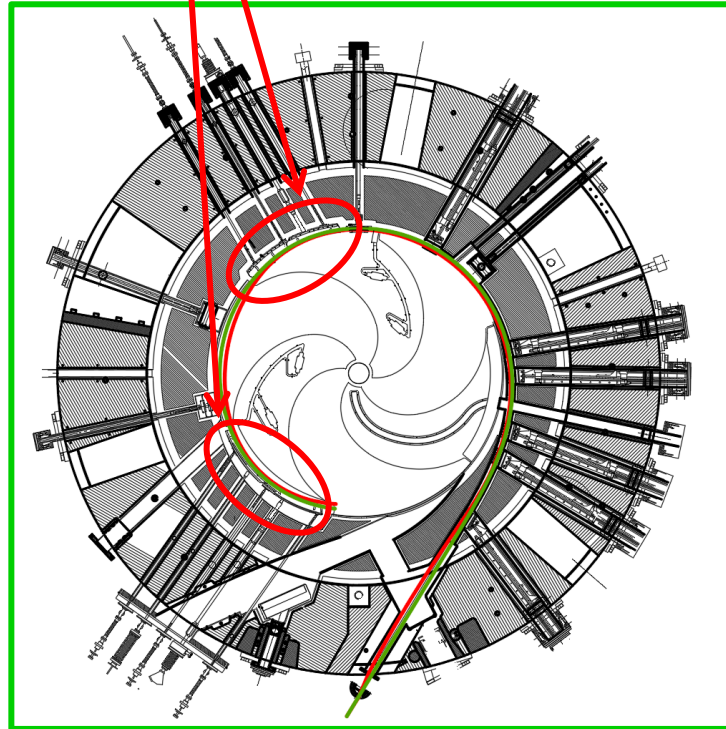
# OR 1100



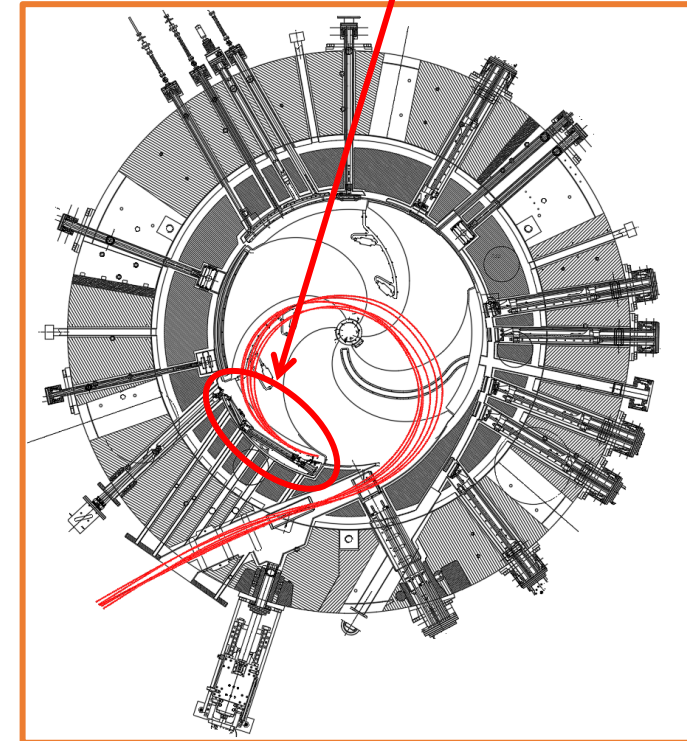
COD. PBS	DESCRIZIONE	COSTO K€
<b>1100</b>	<b>OR: CICLOTRONE SUPERCONDUTTORE</b>	<b>9.143.900,00 €</b>
1101	Magnete superconduttivo	5.026.400,00 €
1102	Liner	793.000,00 €
1103	DEE	85.400,00 €
1104	Canali magnetici	122.000,00 €
1105	Movimentazioni	115.800,00 €
1106	Stripper	1.067.500,00 €
1107	Linea di estrazione	1.117.600,00 €
1108	Convertitori TC	816.200,00 €

# *From the electrostatic deflection to stripping*

Deflectors

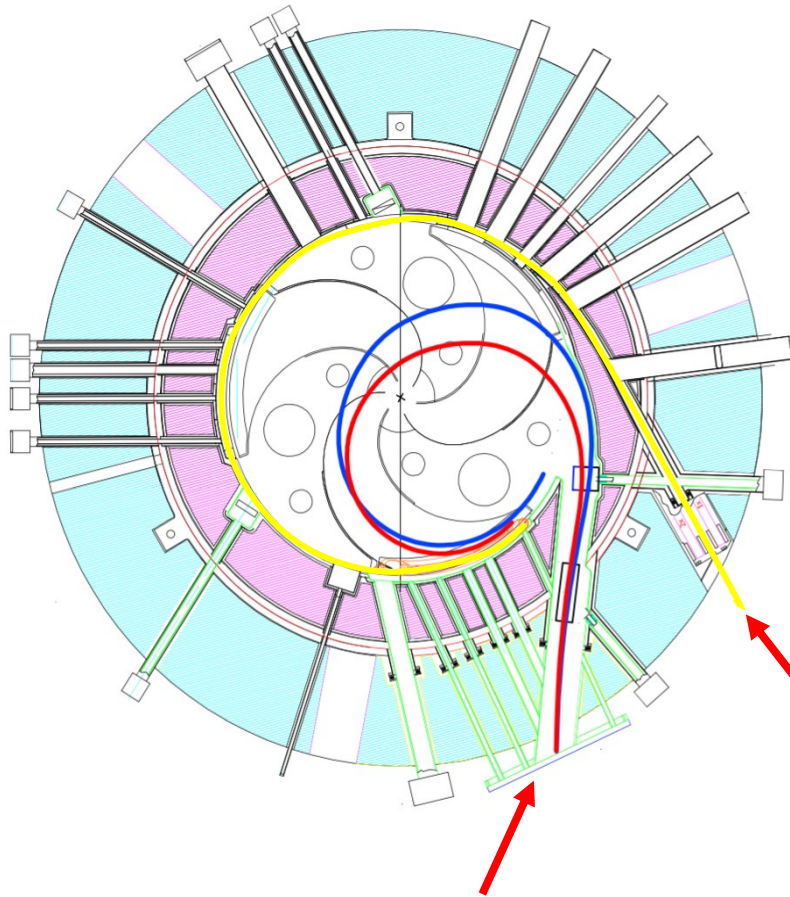


Stripper



# Extraction by stripping

High efficiency extraction => beam current increasing

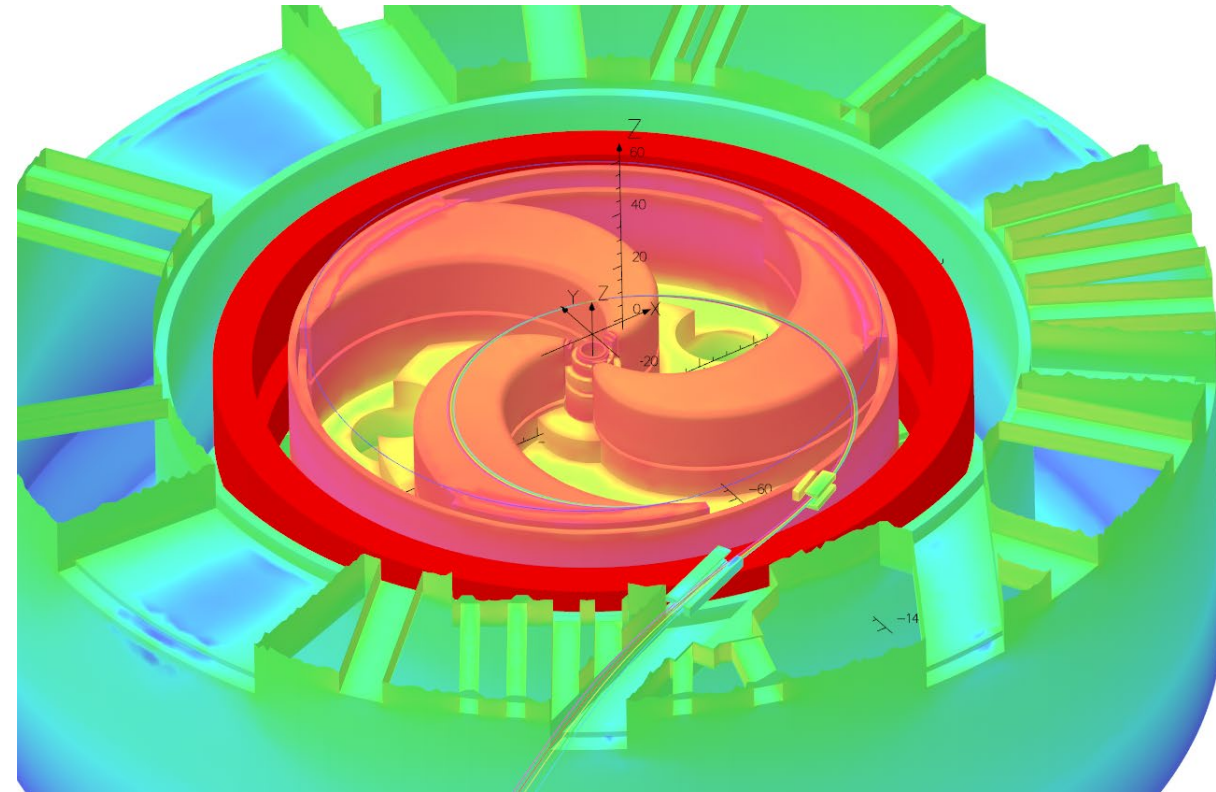


Extraction channel by stripping

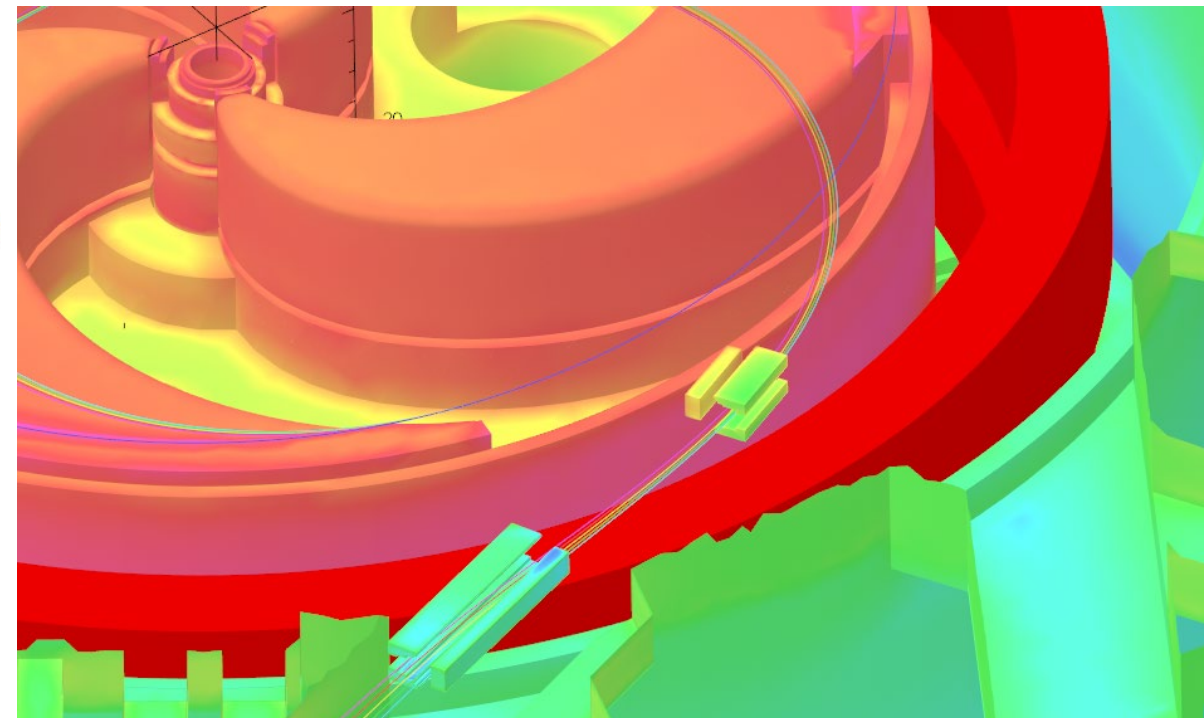
Extraction channel by electrostatic deflector

Extraction by stripping is based on the change in the magnetic rigidity of the accelerated ion, whereas the ions charge state increases by passing through a thin graphite sheet. Extraction by stripping has an efficiency higher than 99%

# Stripping extraction system, new extraction channel



Opera  
Simulation Software





# Superconductive magnet Special Tender (sorry for italian)



Atto GE n. 11760 del 12.07.2018 - CIG 7589078149  
"Fornitura e installazione di un magnete s.c. per il  
Ciclotrone Superconduttore del LNS"

Titolo Title	Documento no. Document no.	Rev. Rev.	Pag. Page	Di Of
RELAZIONE DI CALCOLO MAGNETICO PER MAGNETE <u>SENZA FERRO</u> : FF_bobina (Scr3.1)	S-21806/DOC-C.g)	0	21	21
	Altro identificativo no. Other identification no.	Rev. Rev.		

### 3.4 Conclusioni circa la correlazione stabilità campo/corrente

La risoluzione di campo di mezzo Gauss richiesta a Capitolato Tecnico risulta sufficientemente indipendente dal valore di corrente del punto di lavoro, con le ipotesi illustrate nel paragrafo 3.3.

La risoluzione richiesta è quindi ottenibile lavorando con delle correnti di Form Factor tali da soddisfare:

- o I Form Factor ALFA > 638.358 [A].
- o I Form Factor BETA > 336.06 [A].

### 4. Conclusioni

Il documento illustra:

- La geometria a freddo della bobina ALFA
- La geometria a freddo della bobina BETA
- La corrente minima delle bobine ALFA e BETA per rispettare i requisiti di stabilità di campo
- La corrente di Form Factor della bobina ALFA, pari a 725.400 [A]
- La corrente di Form Factor della bobina BETA, pari a 343.374 [A]
- La massima deviazione del Form Factor della bobina ALFA, pari al 0.045%
- Lo scarto medio di progetto della bobina ALFA, pari a 0.00031
- La massima deviazione del Form Factor della bobina BETA, pari al 0.0408%
- Lo scarto medio di progetto della bobina BETA, pari a 0.000247

I modelli .sat delle bobine sono presenti come allegati al presente documento nei seguenti files allegati:

FF\_bobina\_file.sat  
FF\_bobinaALFA\_file.sat  
FF\_bobinaBETA\_file.sat

In aggiunta ai files richiesti sono forniti anche i seguenti files .cond delle bobine ALFA e BETA:

FF\_magneteALFA\_file.cond  
FF\_magneteBETA\_file.cond

- La massima deviazione del Form Factor della bobina ALFA, pari al 0.045%
- Lo scarto medio di progetto della bobina ALFA, pari a 0.00031
- La massima deviazione del Form Factor della bobina BETA, pari al 0.0408%
- Lo scarto medio di progetto della bobina BETA, pari a 0.000247



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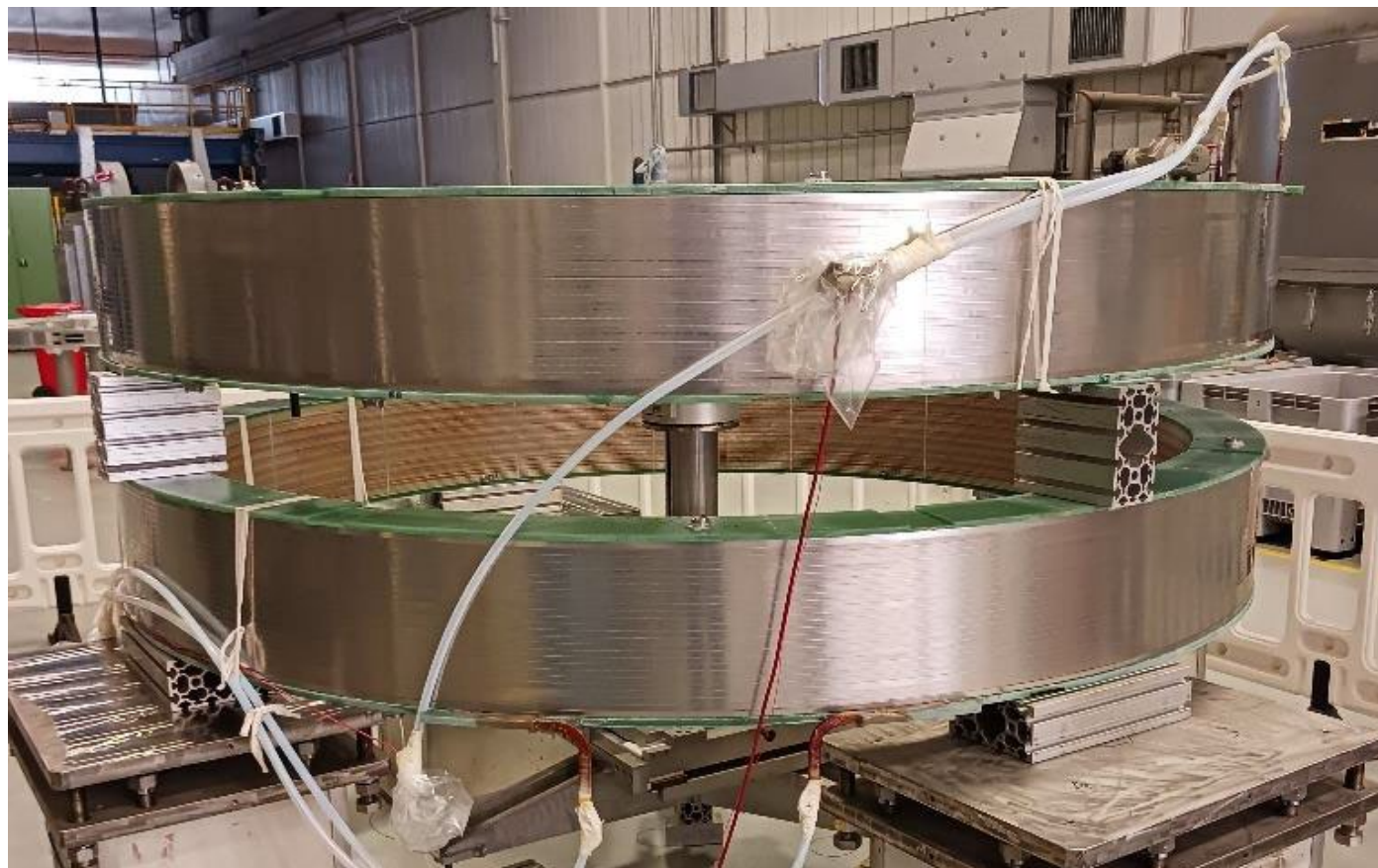


Mario Salvatore MUSUMECI - Coordinatore Scientifico POTLNS  
Mario Salvatore MUSUMECI, Project Scientific Coordinator

# *Superconductive magnet, additional measurements to get the performance*

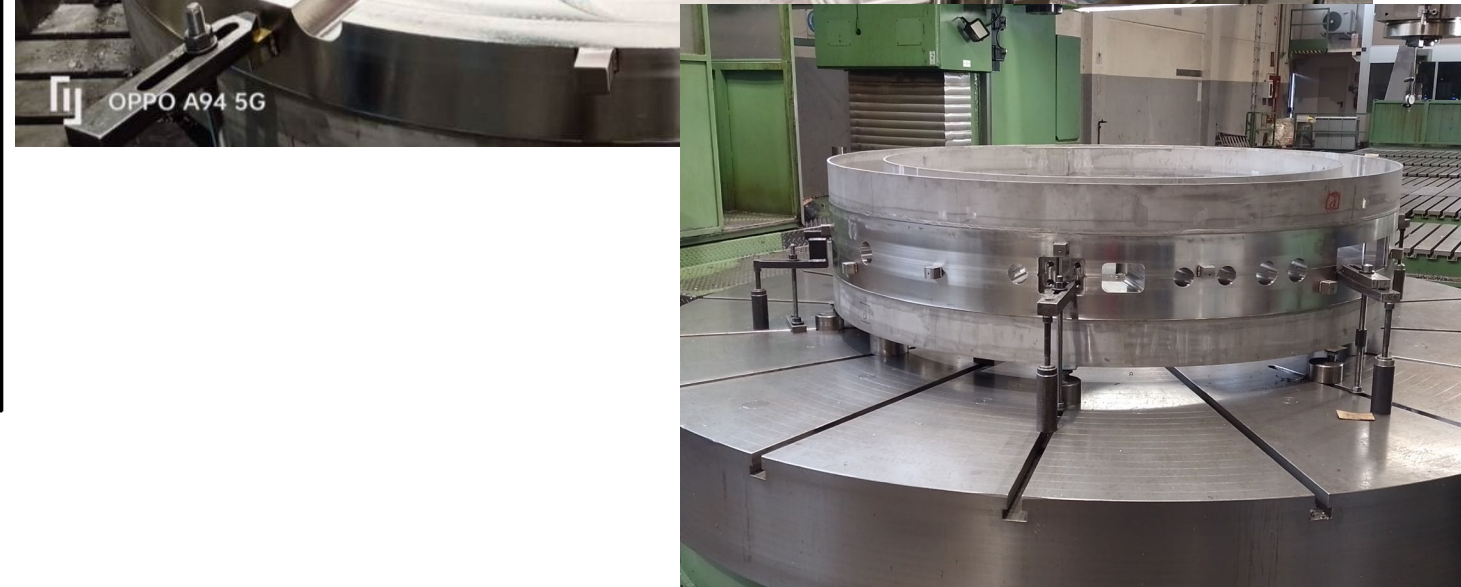
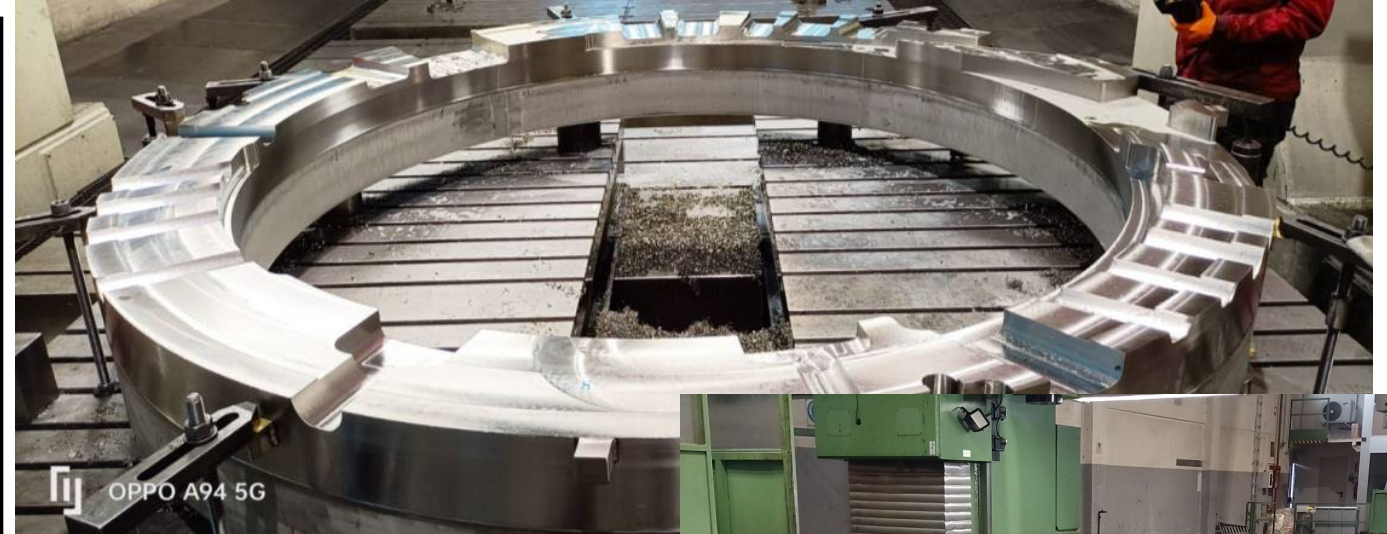
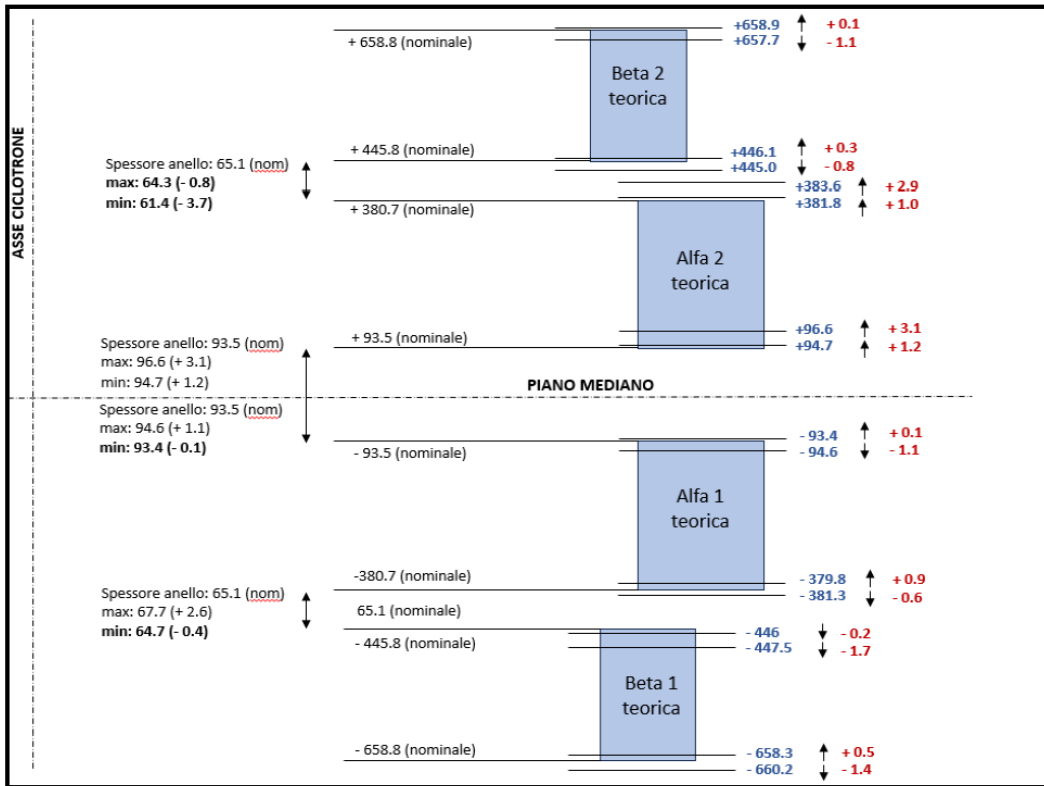
## Room temperature magnetic mapping

- Single coils to correlate geometrical reference points with the magnetic field actual shape
- Alfa pair measured since 15th june 2023 till 15th september 2023

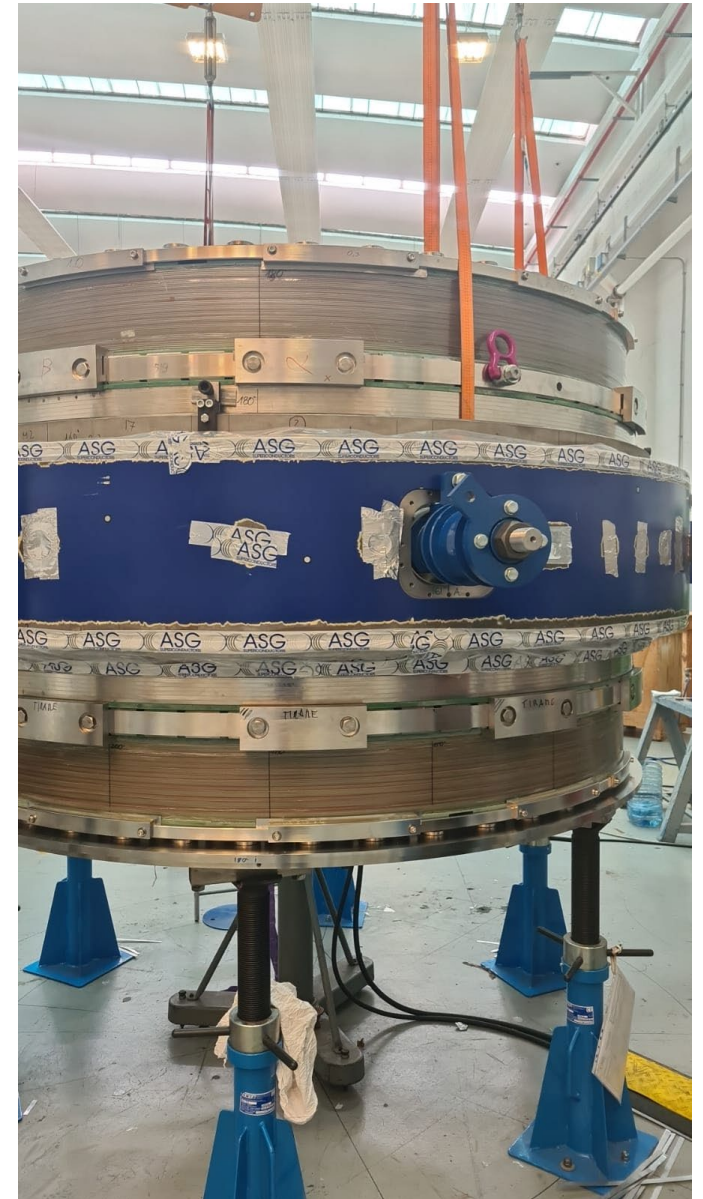


# Accurate machining to meet the required coils positioning accuracy

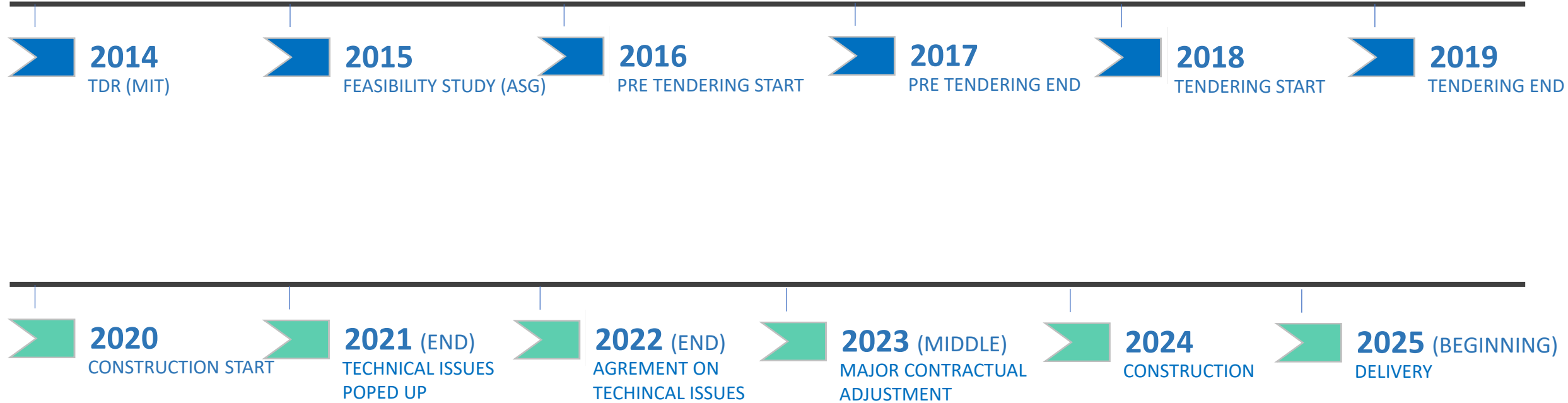
The measurement performed on the coils has been used to machine the middle steel part in order to get the final goal



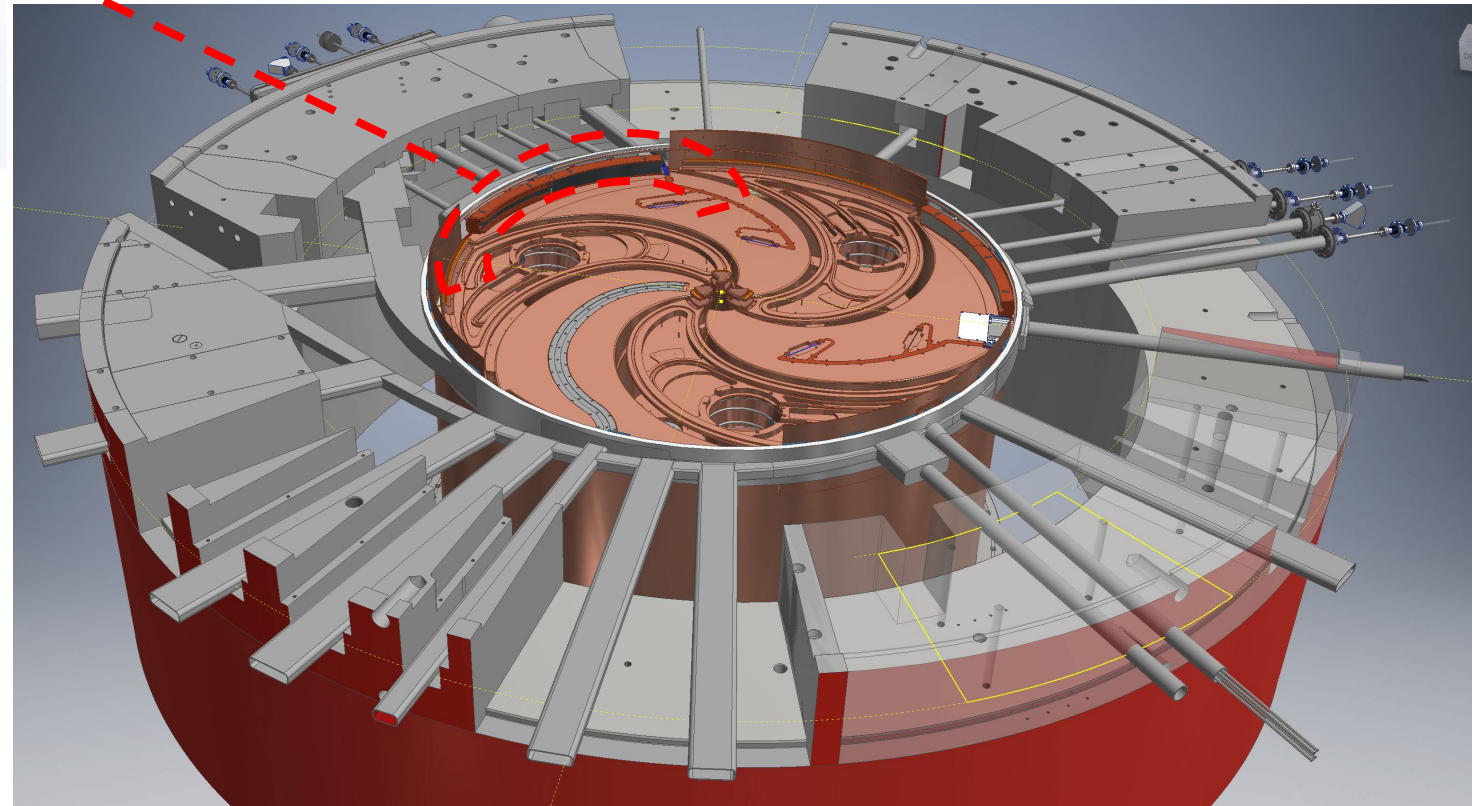
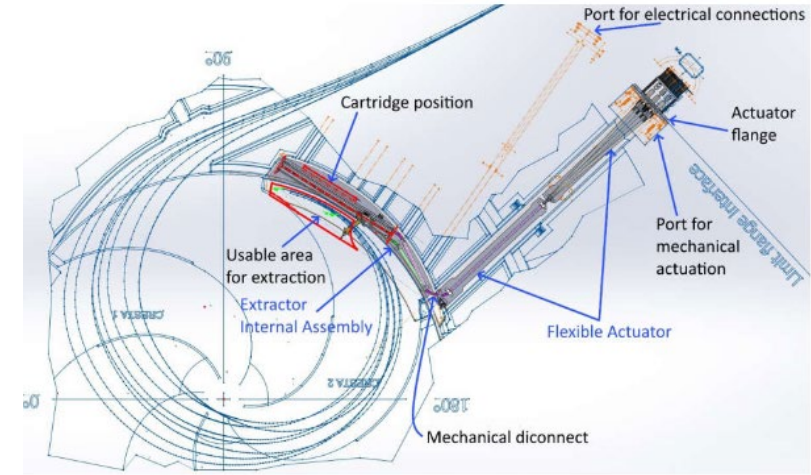
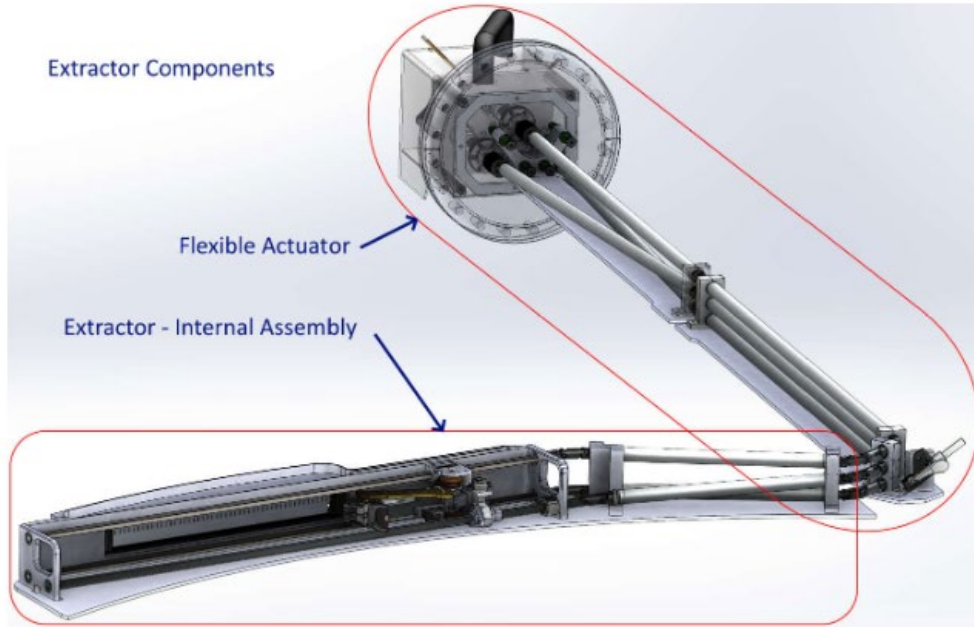
# Current magnet assembling status



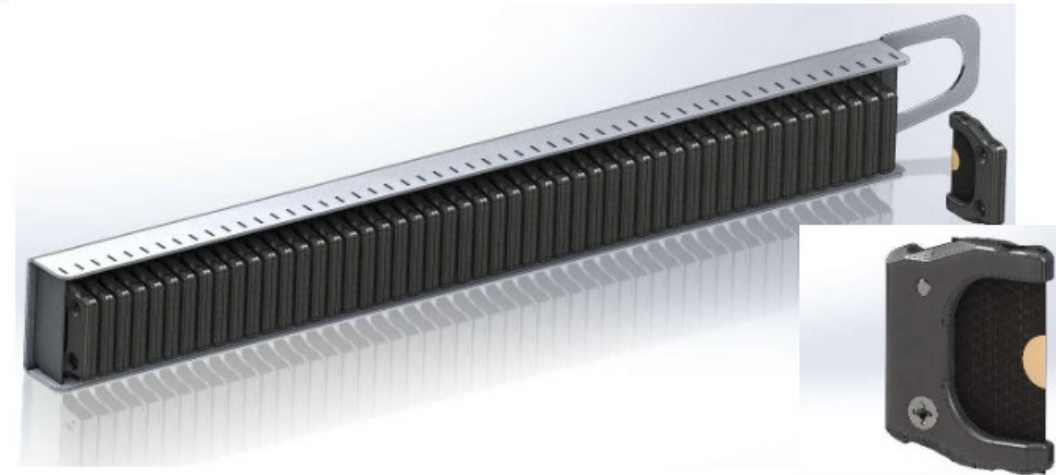
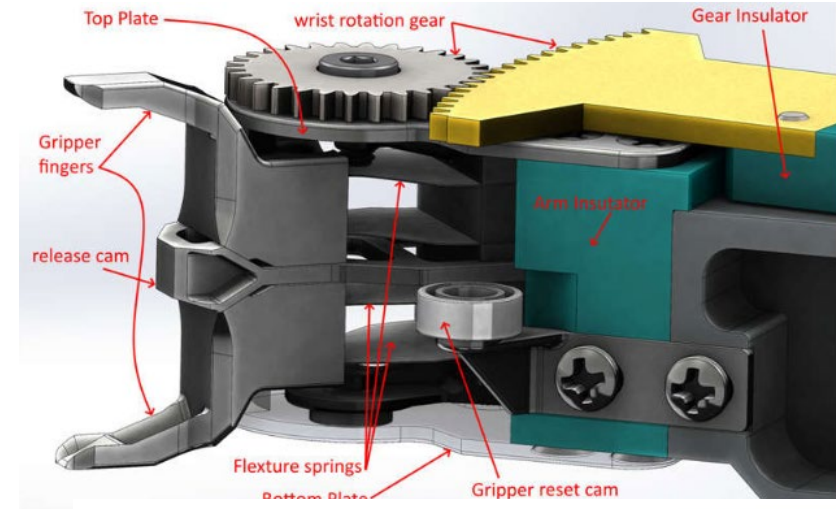
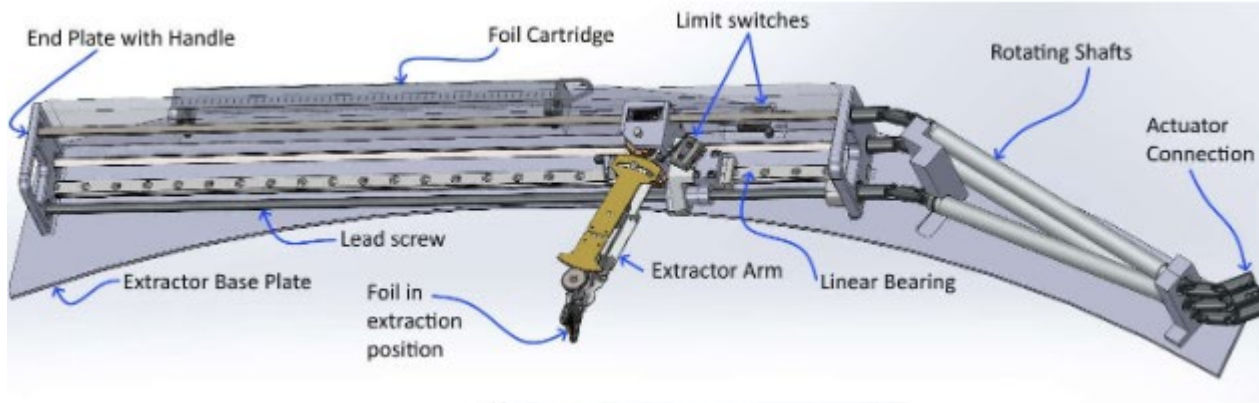
# Superconductive magnet timeline



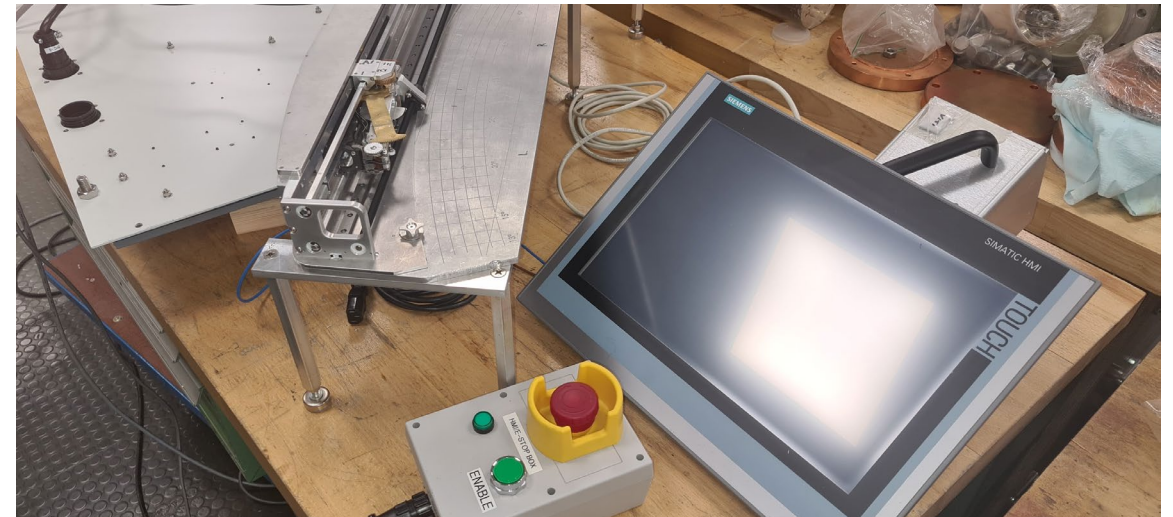
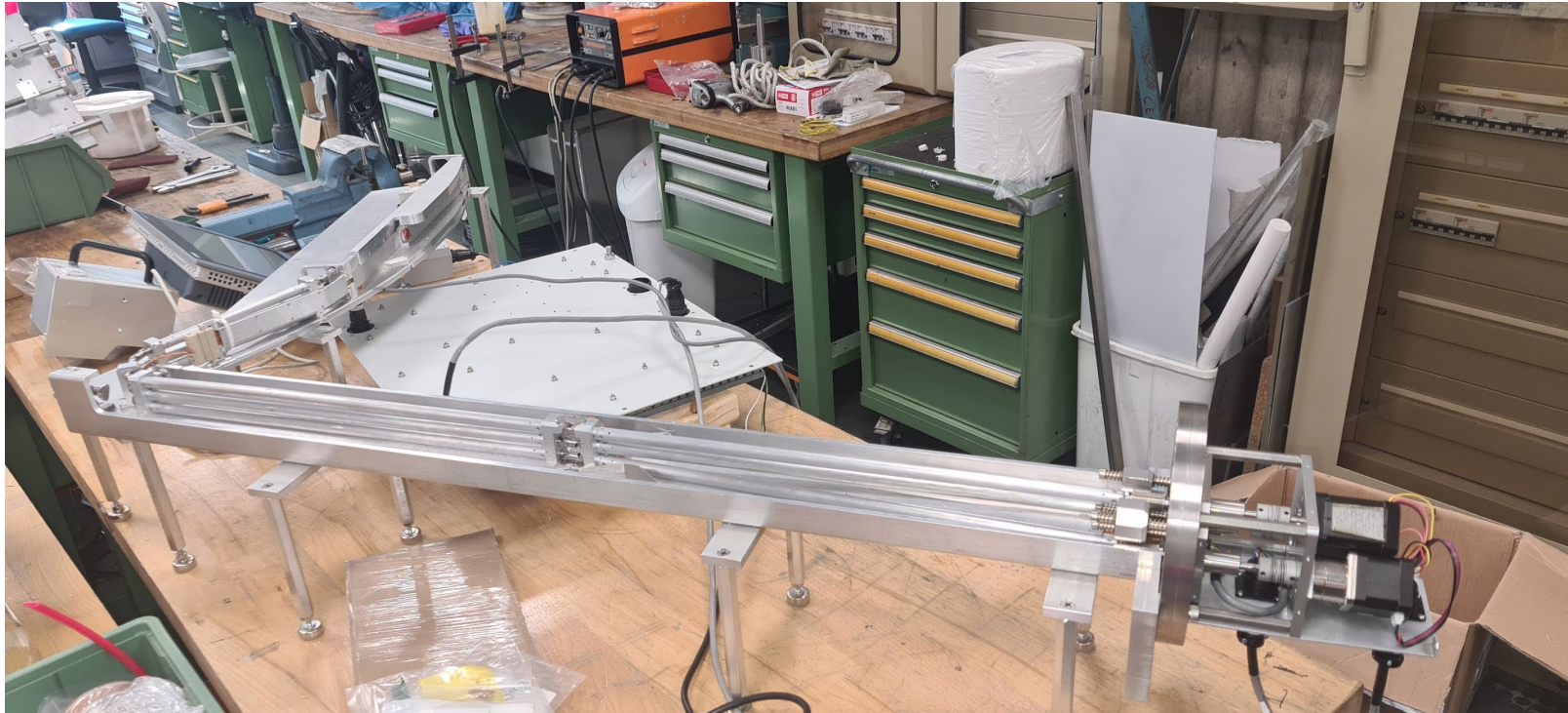
# Stripper positioning system



# Stripper positioning system



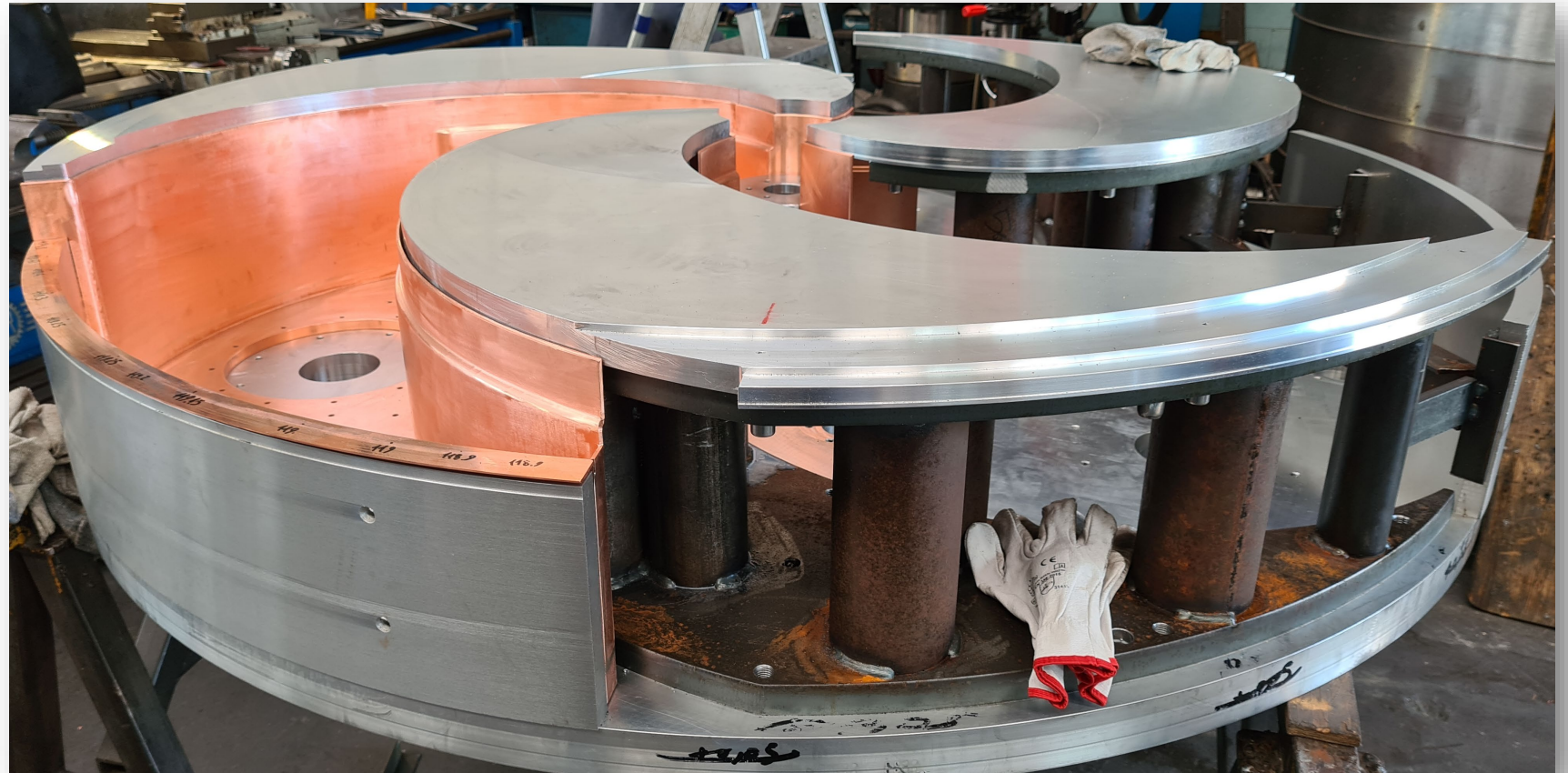
# Stripper positioning system





## Upper Liner

Accurate mock-up of the pole has been machined, in order to maximize the accuracy of a such tricky items



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Ministero dell'Università  
e della Ricerca

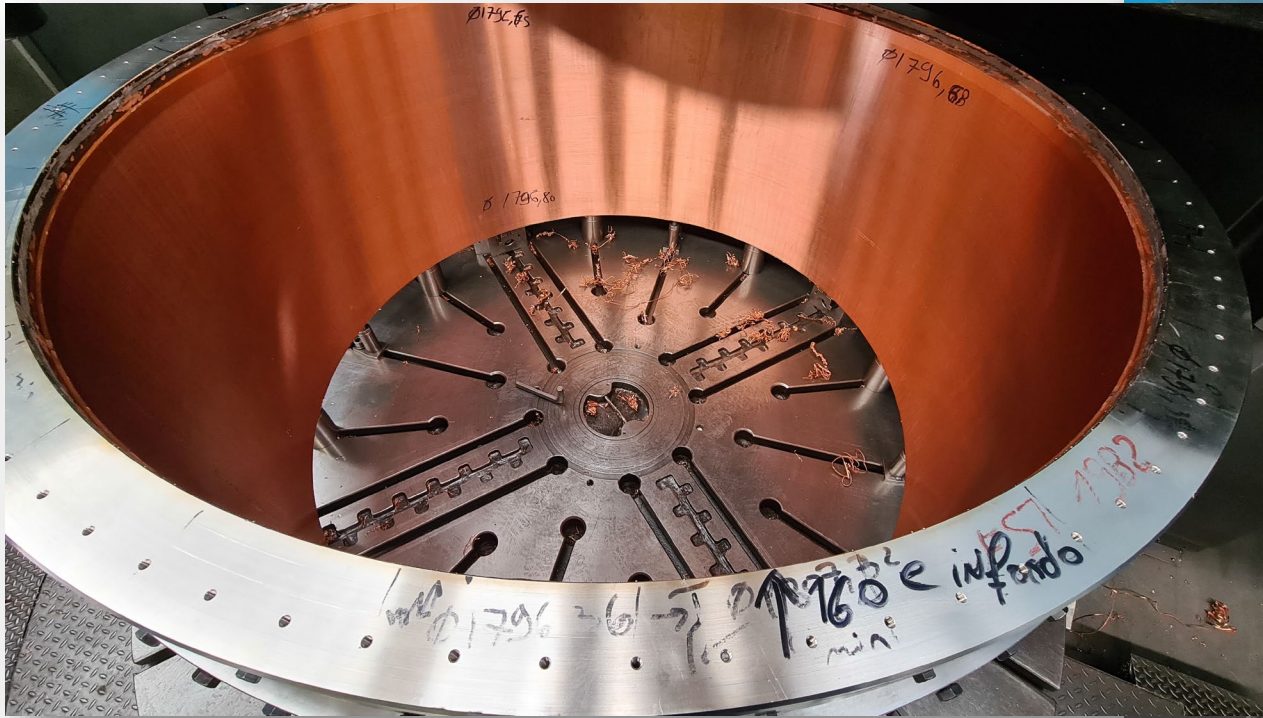


PON  
RICERCA  
E INNOVAZIONE  
2014 - 2020



Mario Salvatore MUSUMECI, Project Scientific Coordinator

# Upper Liner



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Mario Salvatore MUSUMECI, Project Scientific Coordinator

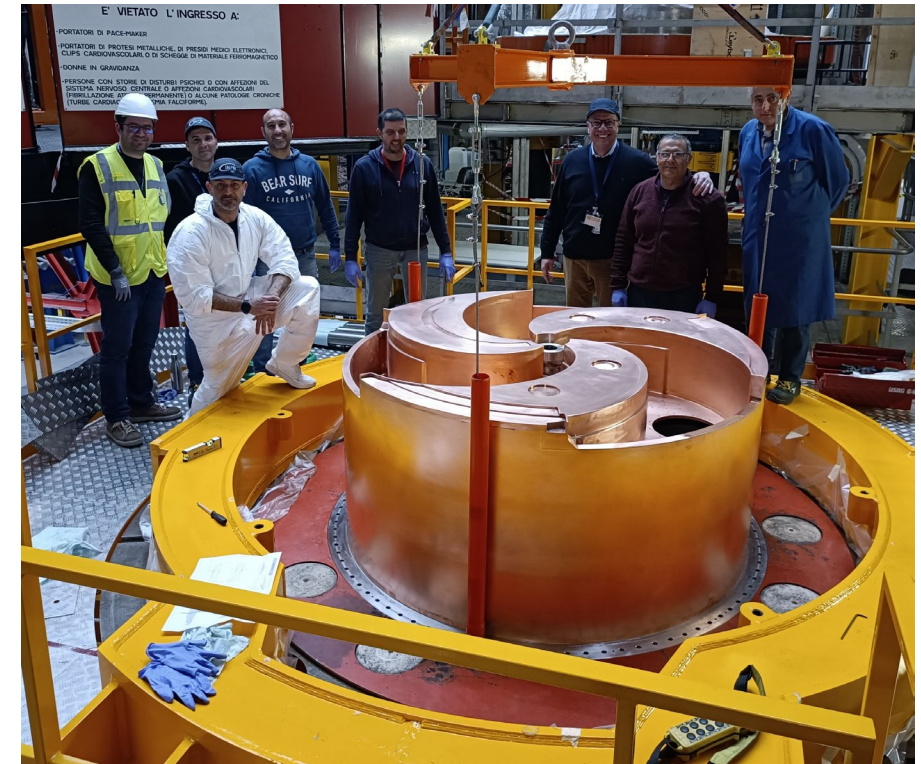
# Upper Liner

Post machining/welding measurements have been performed to



# Upper Liner

Good fitting with the pole, small adjustments (0,2mm) on the central area to fit with the plug



## Lower Liner

Despite all the cautions have been taken, some clashes of the lower liner the pole have been detected during the deployment on the pole

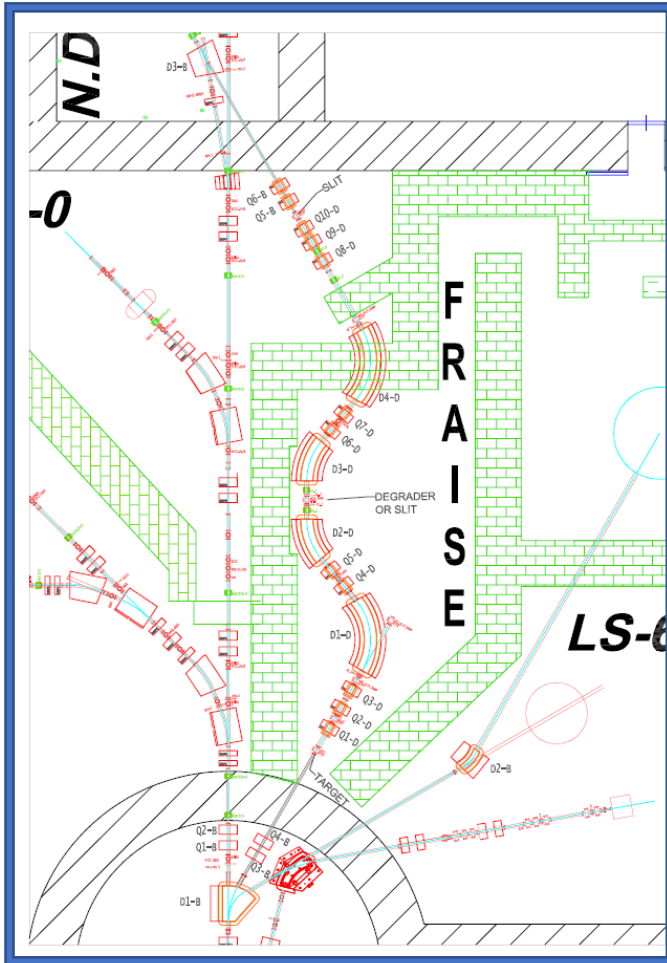


The issue has been addressed

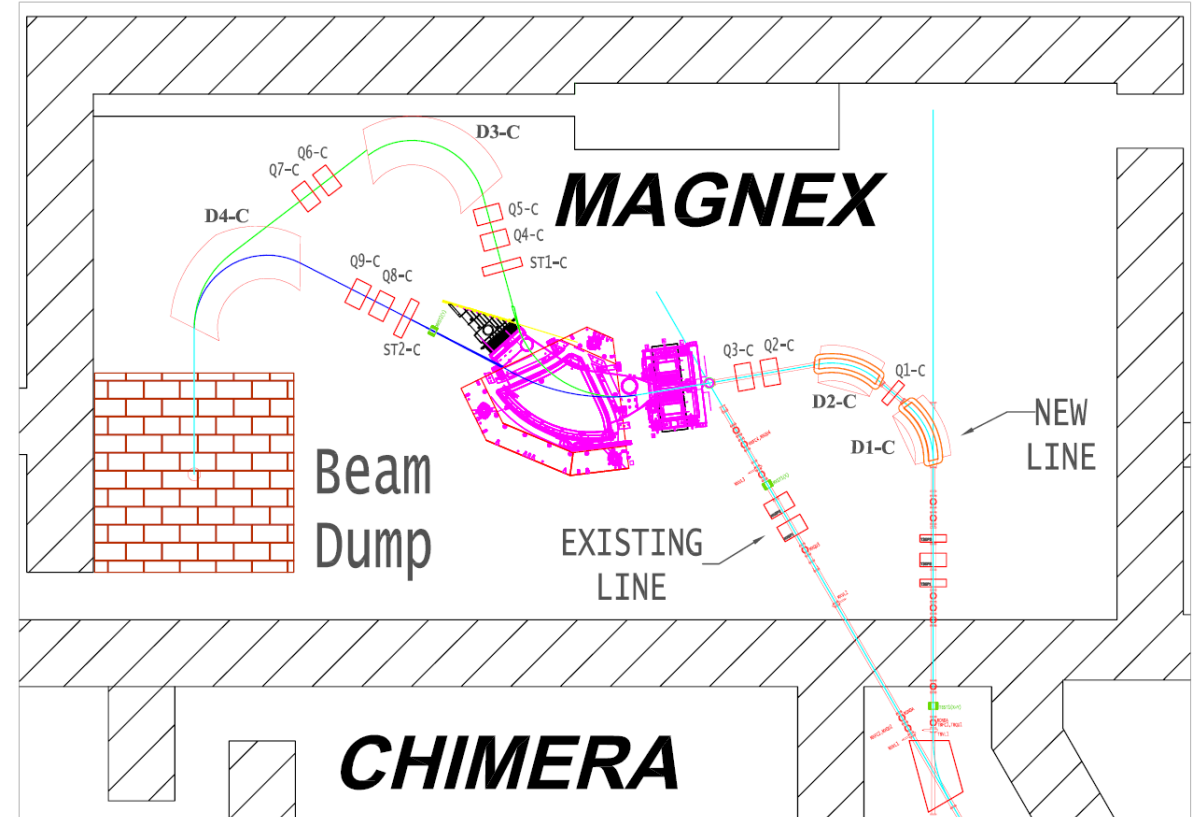
Several accurate further measurements and mapping have been performed on the liner and a way to safely and quickly fix it has been identified

The liner, once adjusted, shall be delivered to LNS within the end of november

# OR 1200-1300

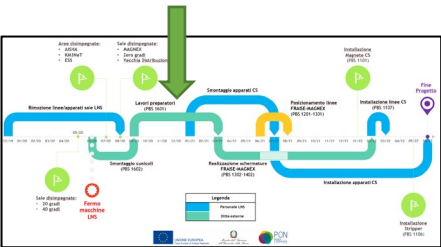
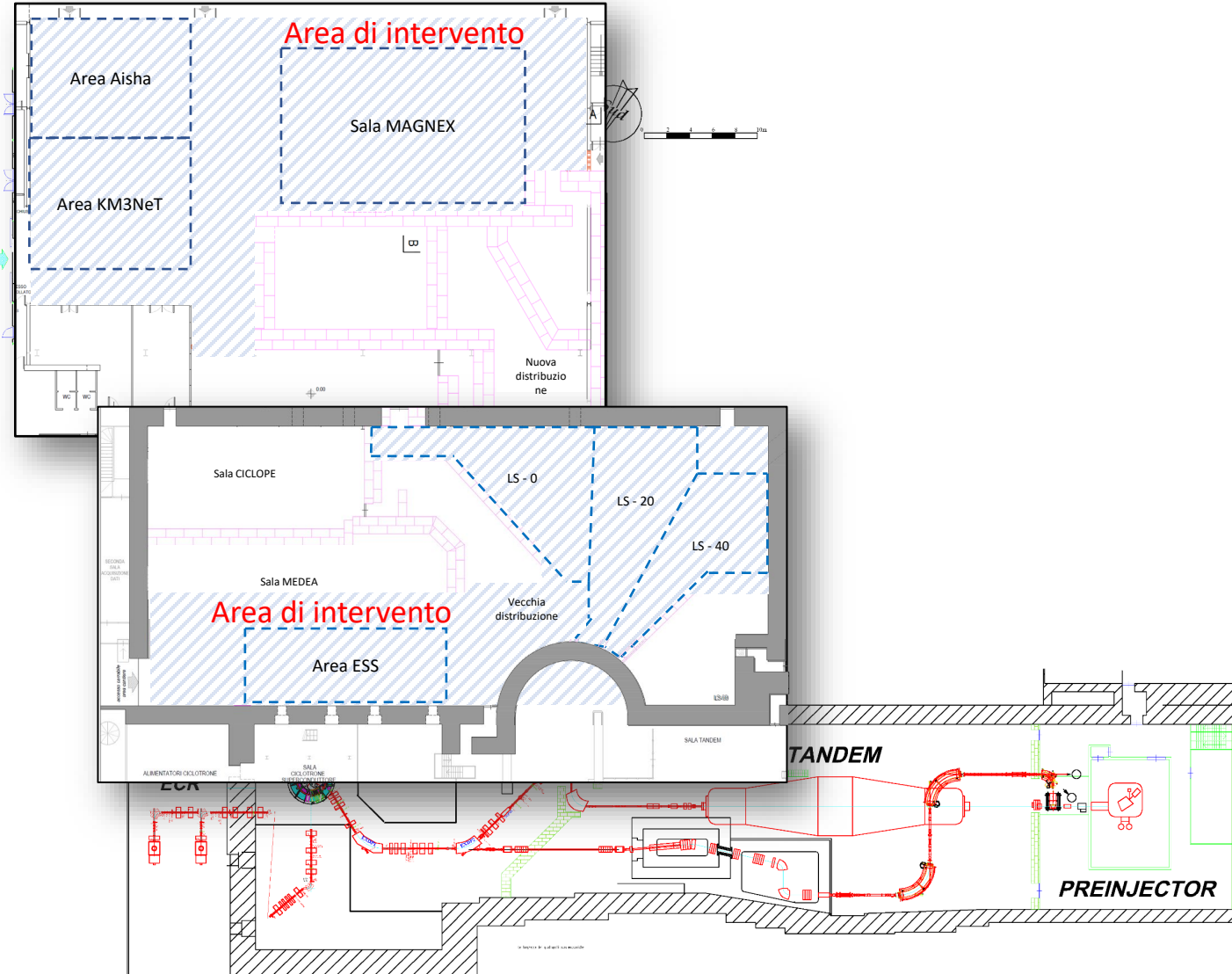


COD. PBS	DESCRIZIONE	COSTO K€
<b>1200</b>	<b>OR: FRAISE</b>	<b>3.885.200,00 €</b>
1201	Linea FRAISE	3.219.200,00 €
1202	Schermature FRAISE	666.000,00 €



COD. PBS	DESCRIZIONE	COSTO K€
<b>1300</b>	<b>OR: MAGNEX</b>	<b>3.694.200,00 €</b>
1301	Linee MAGNEX	2.026.000,00 €
1302	Convertitori MAGNEX	519.000,00 €
1303	Pozzo di spegnimento	21.900,00 €
1304	Schermature MAGNEX	1.127.300,00 €

# Civil works for new shieldings



# Civil works for new shielding (2021)





# *New Shieldings under construction (2022/23)*



# New Shielding (2023)

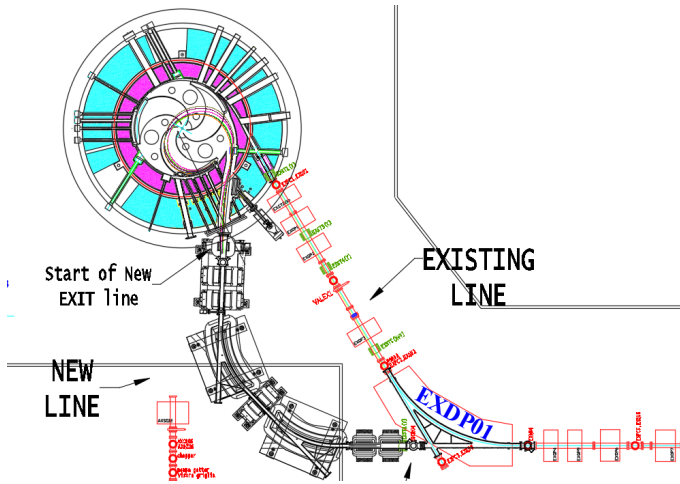
FRAISE experimental room



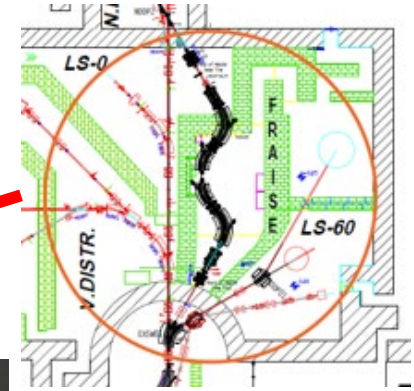
MAGNEX experimental room

# Beam lines

## New extraction line CS-Stripping

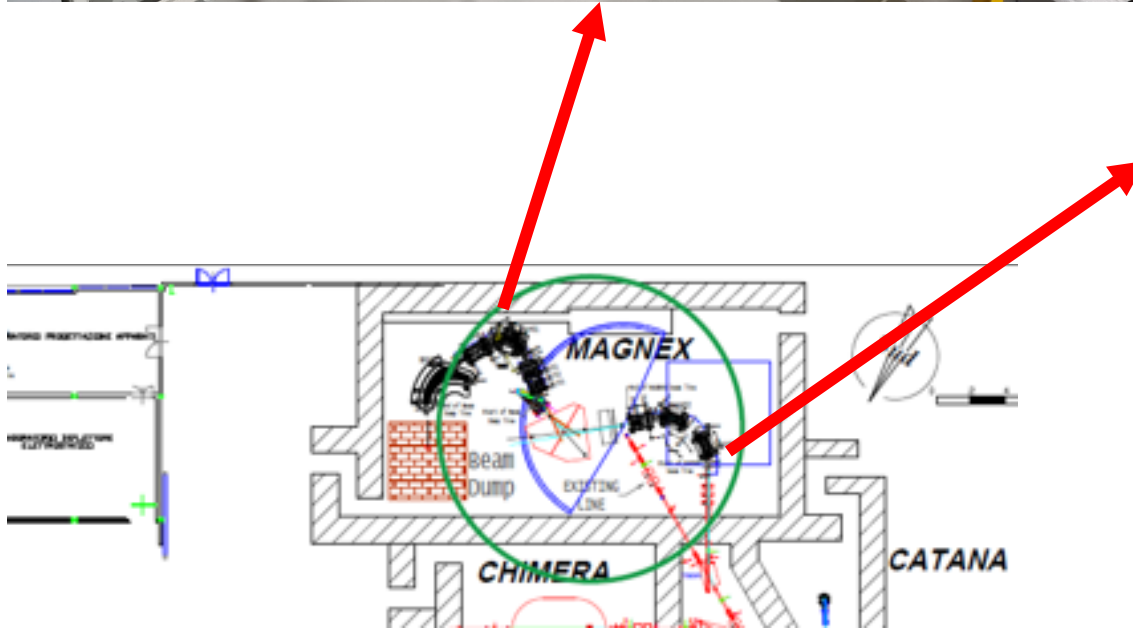


## FRAISE beamline



# Beam lines

## MAGNEX beam line



# OR 1400 (2021)

## Chiller: Old setup



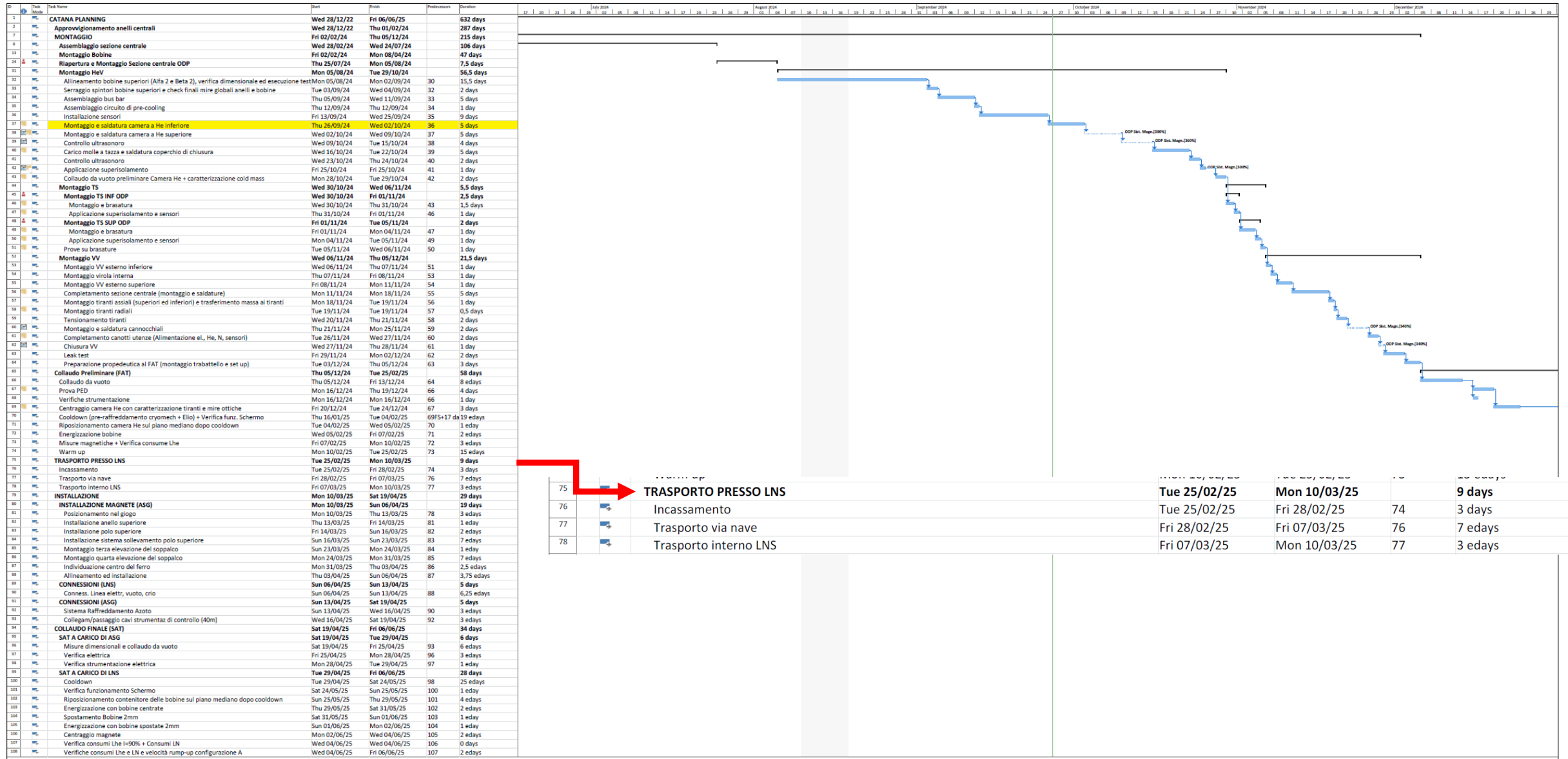
# Chiller: New setup (2022)



# Chiller: New setup (2022)

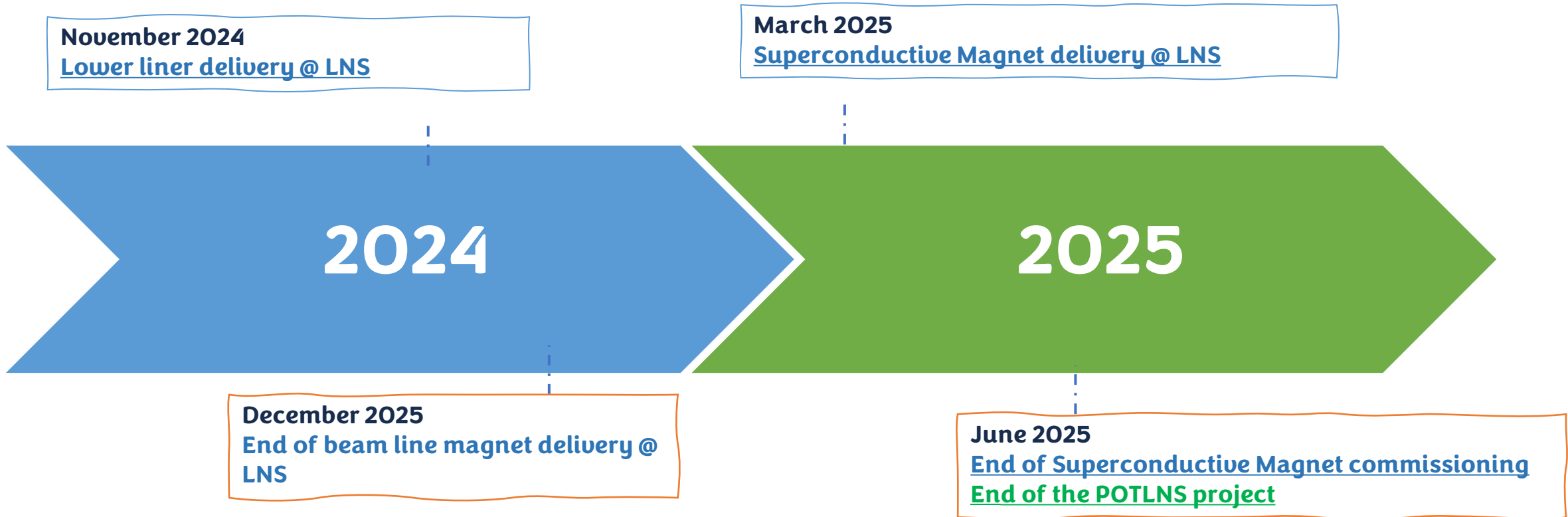


# Latest (got on Friday afternoon) Magnet schedule received by ASG

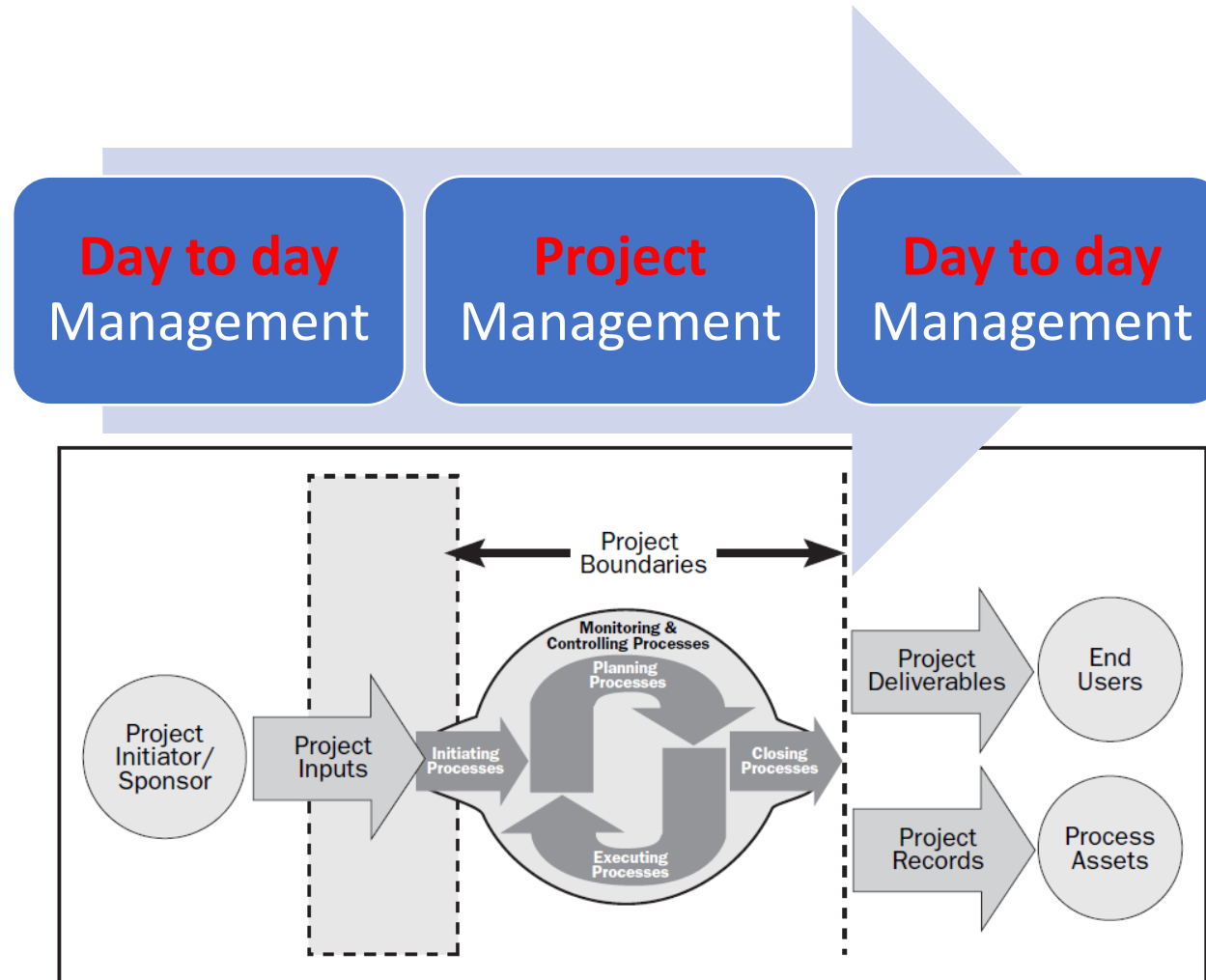




# POTLNS final steps



# PROJECT MANAGEMENT vs PROJECT MANAGEMENT



*A Guide to the Project Management Body of Knowledge (PMBOK® Guide) — Fourth Edition*  
©2008 Project Management Institute, 14 Campus Blvd., Newtown Square, PA 19073-3299 USA

## *Conclusions*

- *Most of the sub project have been completed*
- *Tre subproject are still under finalization*
  - ✓ *Lower Liner, shall be delivered within the end of November*
  - ✓ *FRAISE and Beam Dump beam line currently being deployed, end espected by January 2025*
  - ✓ *Superconductive Magnet delivery scheduled by march 2025*

*Thanks for your time 😊*