EUROPEAN
PLASMA RESEARCH
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EuPRAXIA

Chapter 19: Magnets and Power Supplies

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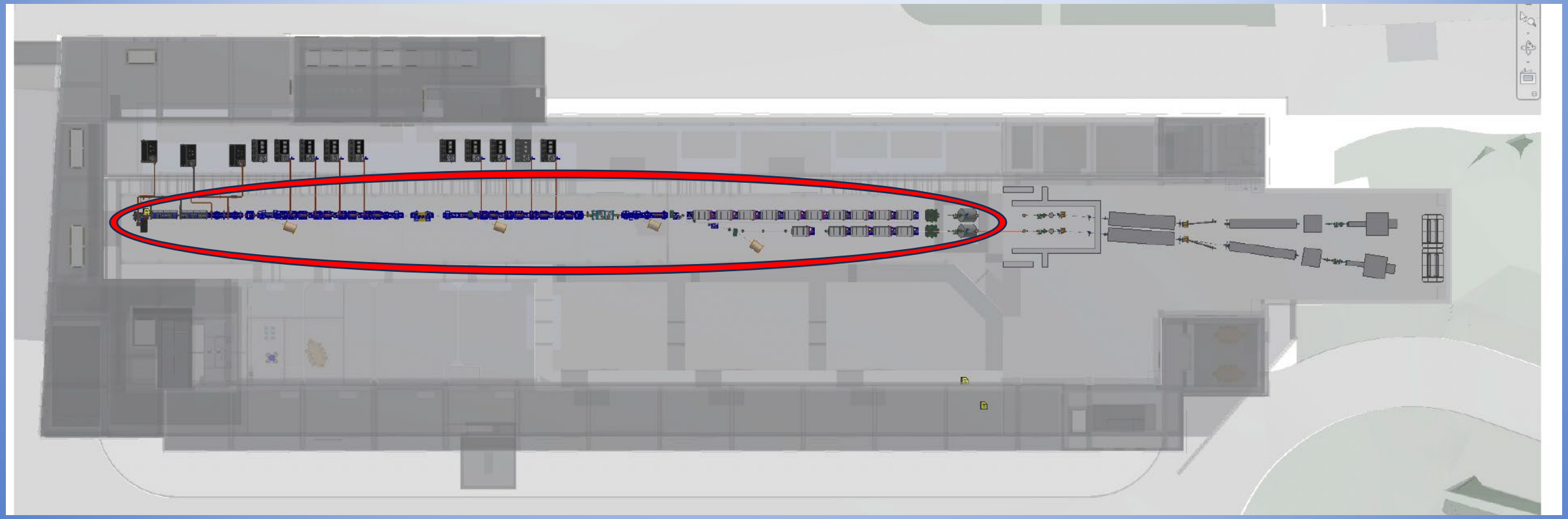
My Area



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- The magnets are described following the accelerator path, from the gun to the dump.
- For each magnet, there is a brief description followed by a parameter table, especially those needed for defining the technical specifications.

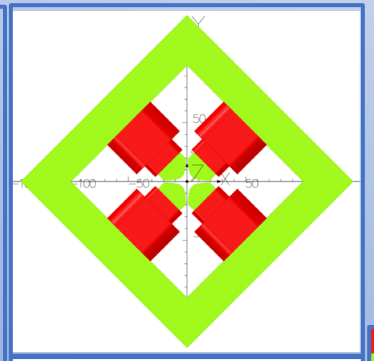
Global Goals:
3D electromagnetic design of all magnets

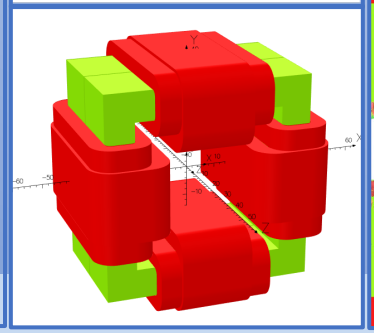
The goal is to develop a preliminary 3D design of all the machine's magnets, to ensure the feasibility of certain design choices, particularly with respect to longitudinal dimensions, and to prepare tables of technical specifications:

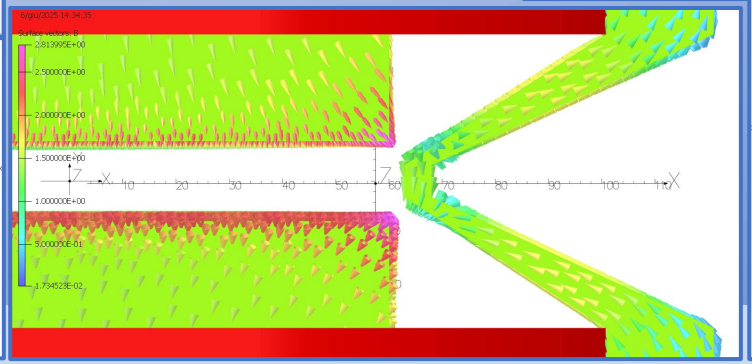
- For “standard” magnets, a preliminary design is sufficient to define the main parameters, leaving some construction choices to the supplier.
- For more critical magnets, a more detailed design review has been carried out, and the plan is to proceed to tender with stricter specifications.

Parameter	Units	Value
Energy	MeV	300
Deflection angle	mrad	4
Integrated field	T mm	4.0
Peak field	G	220
Magnetic length	mm	180
Yoke length	mm	70
Free aperture	mm x mm	70 x 70
Good field region	mm	$\pm$ 10
Field quality	-	$6x10^{-4}$
Conductor dimensions	mm x mm	1.0 x 2.2
Number of turns per coil	-	528
Current	A	3.2

Table 1.4: Main parameters of the steerers between accelerating sections.

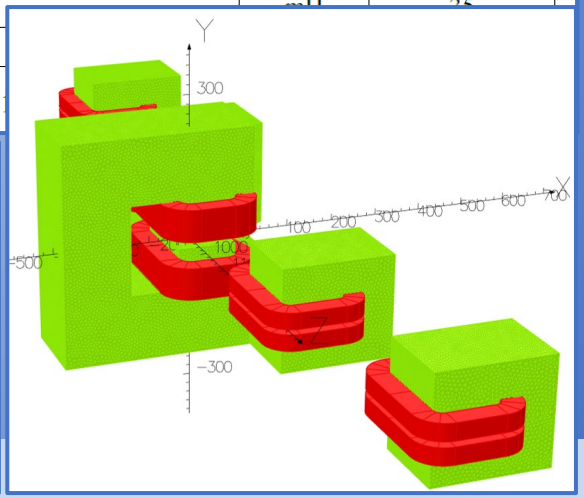






Parameter	Units	Value
B_{max} in ++ config	G	3943
B_{max} in +- config	G	3629
Yoke material	-	St.37
Integrated field on axis, B_z	T mm	62.6
Integrated field quality	-	$4 \times 10^{-}5$
Good field region radius	mm	30
Minimum free aperture diameter	mm	308
Focusing strength on axis in +- config	T^2 m	0.015
B_{max} on cathode	G	8.5
Number of turns per coil	-	136
Cooling	-	water cooled
Conductor size	mm×mm	5×5 (⌀ 3 mm)
Water pressure drop	bar	3
Water flow rate	l/mm	4.2
Water Δ T	° C	25
Nominal current in ++/+- config	A	182/192
Nominal voltage	V	35
Inductance		
Resistance		

Table 1.



Achievements:
Technological Readiness Level (Sub-Components)

Sub - systems	TRL	Comments
Magnets for the gun	9	Solenoid, quadrupole and steerers: already designed and successfully operating on the SPARC gun.
Accelerating sections solenoids	9	Experience gained with SABINA focusing solenoids. Only minor adjustment are required to decouple the mechanical support of the accelerating sections.
Steerers	9	Different types of steerers are foreseen in the machine (air-dominated or with iron yoke). The technology is well established.
Quadrupoles	8	Different types of quadrupoles are also included in the layout, including combined function quadrupoles with integrated steerers. The technology is well established.
Dipoles for chicanes	8	Standard dipoles with non-critical magnetic fields and parameters. May include magnetic shielding to reduce crosstalk. The technology is well established.
Magnets for the plasma section	6	PMQ designed based on similar implementations at other accelerators. A prototype, based on our specifications, to be built and tested.
Separator chicane	7	Four chicane dipoles and one septum magnet. The septum design is delicate, although the technology is well known.
Dump dipole	9	Optimization efforts are focused on minimizing the overall size.

Pending Items:

Funded by the European Union

Magnet Descriptions

Descriptions for a few magnets are still pending, specifically:

- Spectrometer
- Quadrupoles

Table data

- Magnetic and electrical parameters have already been defined for all magnets.
- Few parameters are still missing in the tables and need to be completed.

Magnet Parameters Table

- A comprehensive table with the main parameters of all magnets is to be inserted.

Power Supply Parameters Table

- A table summarizing the main parameters of all power supplies is to be inserted.

Planned Actions:

FOR THE TDR

Weeks 25–26 (Late June)

- Finalize the description of the remaining magnets.

Weeks 27 (Early July)

- Complete the missing data for all magnets.

Weeks 28 (Mid July)

- Compile summary tables for magnets and power supplies.

NEXT STEPS

- Engineering design of selected (critical) magnets
- Tunable PMQ prototypes development

Conclusions

- In recent months, **significant effort** has been made to achieve the TDR objective.
- A few **minor parts** still need to be completed on the TDR, but overall, the objective is considered to be achieved.
- The work was carried out in constant collaboration with **beam physics**, taking into account the overall **layout**.