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APPLICATIONS

Chapter 25 : System Engineering

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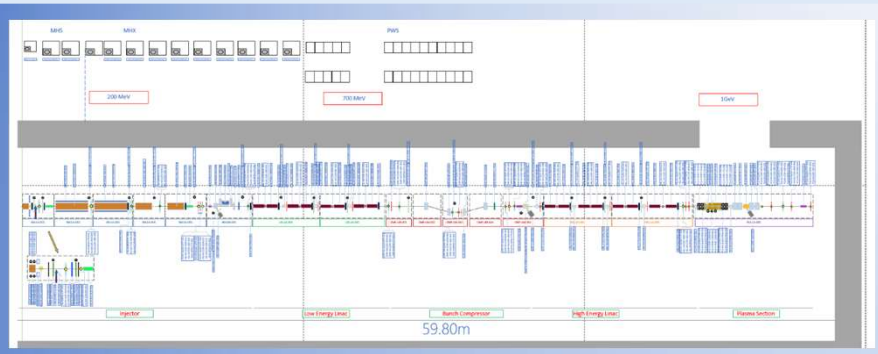
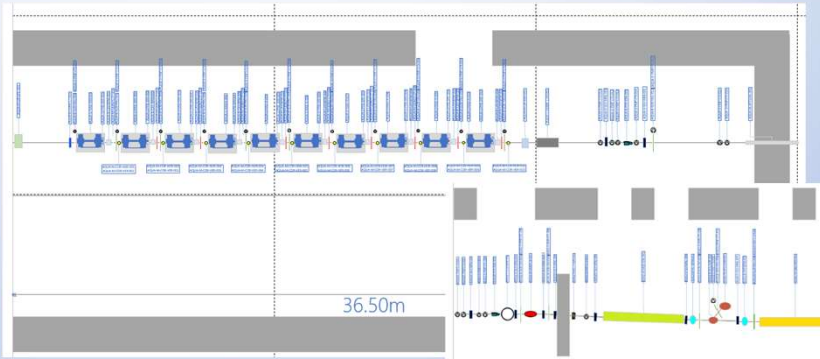
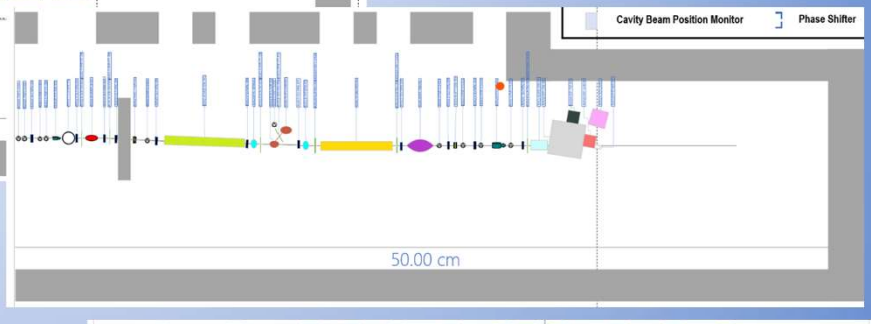
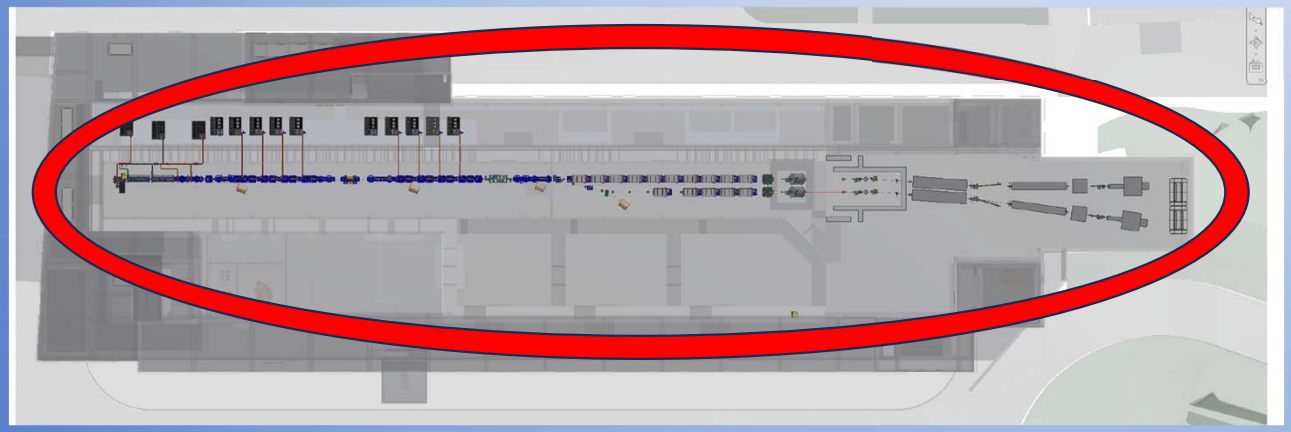
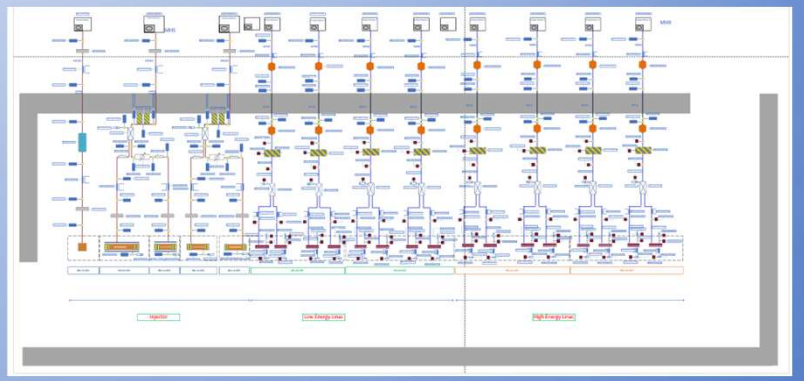
My Area











The scope of System Engineering is comprehensive, as it oversees various management aspects related to the development of the accelerator machine.

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Systems Engineering is an interdisciplinary field of engineering that focuses on the development, design, integration, and management of complex artificial systems as EuPRAXIA@SPARC_Lab. It provides a structured process that helps organizations design and implement systems tailored to their specific requirements. As a specialized branch within Project Management (PM), Systems Engineering offers tools and methodologies essential for the realization of functional and sophisticated systems. It demands close collaboration among engineers, physicists, technicians, and other experts to successfully create and operate advanced technological infrastructures

Global Goals

- Centralized configuration management
- Requirements traceability through a dedicated database
- Integration of digital tools for monitoring and management
- Structured asset management
- Definition of KPIs for performance monitoring
- Effective coordination between subsystems

Achievements:
Systems Engineering CMMI

Level	Name	Description
1	Initial	Asset management is reactive and ad hoc. No formal processes or documentation.
2	Managed	Basic asset tracking exists. Some planning and maintenance are documented.
3	Defined	Standardized processes are in place. Roles and responsibilities are clear.
4	Quantitatively Managed	Performance is measured using KPIs. Data-driven decisions are made.
5	Optimizing	Continuous improvement and innovation. Predictive maintenance is implemented.

The maturity of the configuration management process was assessed using the **CMMI (Capability Maturity Model Integration)** framework. EuPRAXIA@SPARC_LAB is currently in a transition phase between **level 3 (Defined)** and **level 5 (Optimizing)**. This transition state reflects the different degrees of development maturity in the various aspects of project management. In particular, while individual subsystems have reached a level of maturity consistent with Level 5 - characterised by continuous improvement and process optimisation - the integration of these subsystems is still evolving. Efforts are underway **to achieve full optimisation** at the system level. These initiatives include: Continuous integration of subsystems, the improvement of validation and verification processes, and the evolution of digital tools for greater automation in performance monitoring and strategic decision-making

Planned Actions (beyond the TDR)

- Ongoing integration of subsystems
- Advancement of digital tools to enhance automation
- Effective coordination among subsystems to support integration and to finalized the Utility Matrix
- Certain KPIs may require revision or updates based on project developments
- Improvement of validation and verification processes
- Experimental database setup: transition to production phase once the machine becomes operational and integration with OpenCAD BIM tool.

Conclusions

The **EuPRAXIA@SPARC_LAB** project represents an advanced model of integration between **systems engineering**, **digitalization**, and **predictive asset management** for complex scientific infrastructures. The configuration management process has been assessed according to the **CMMI framework**, currently positioned in a **transition phase between Level 3 (Defined) and Level 5 (Optimizing)**, with several subsystems already compliant with the highest standards.
The adoption of the **Hexagon EAM platform** enables full **component traceability**, **predictive maintenance planning**, and **performance monitoring** through technical, economic, and safety-related KPIs. The **Project Breakdown Structure (PBS)** and **Utility Matrix** support the functional decomposition of the accelerator, ensuring both **design and operational consistency**.
The project stands as a **benchmark for the management of scientific infrastructures**, thanks to its approach focused on **innovation**, **standardization**, and **continuous improvement**.

"The chapter is aligned with the overall project requirements and provides a solid foundation for future technical integration."