



MAGNETIC FIELD CALCULATION

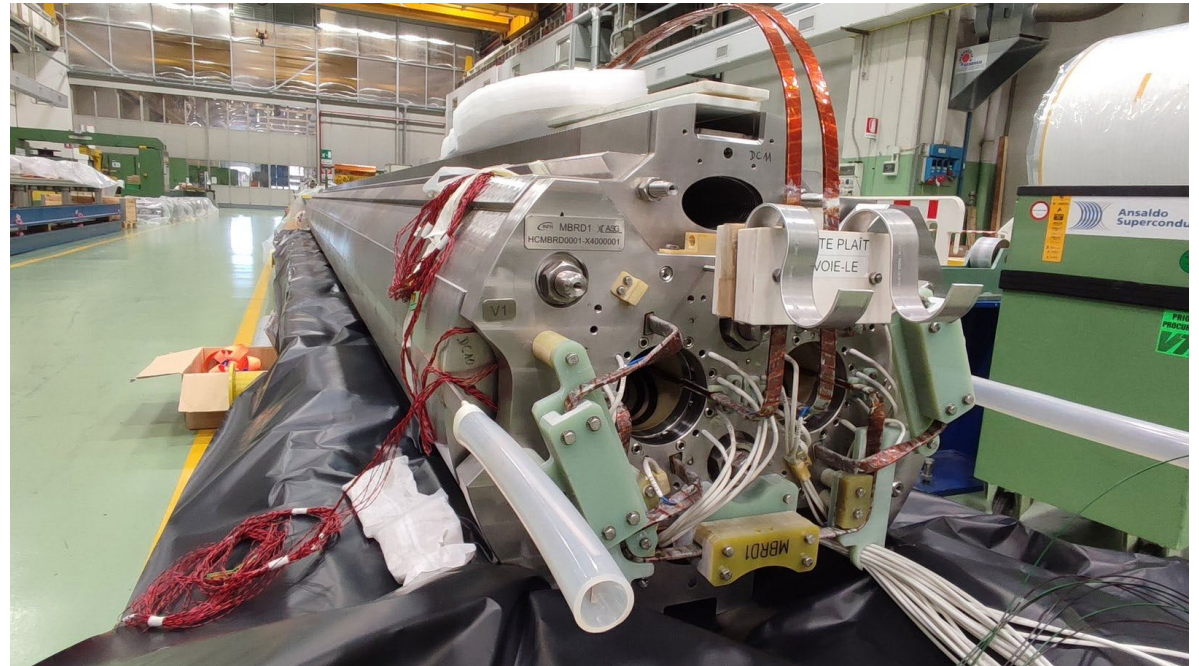
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- Magnetic fields play a critical role in the operation and performance of a wide range of detectors. Their significance can be understood through the following points:
 - **Particle Trajectory Measurement:** Magnetic fields are essential for bending the trajectories of charged particles, enabling precise momentum and charge measurements in particle physics experiments.
 - **Focusing and Guiding Beams:** In accelerators and beamlines, magnets generate fields to focus, guide, and control particle beams with high precision.
 - **Integration with Detectors:** Many detectors rely on integrated magnets to shape or control fields directly within their working environment, requiring detailed field characterization.
 - **System Performance Optimization:** Uniform and predictable magnetic fields are crucial for achieving optimal detector performance. Any deviation can impact resolution, efficiency, and overall data quality.
 - **Impact on Engineering and Design:** The design of magnets—be it superconducting, permanent, or resistive—affects the mechanical, thermal, and electrical constraints of the overall detector system.
 - **Interplay with Surrounding Systems:** Magnetic fields interact with nearby components, such as electronic equipment, shielding, and support structures. Precise calculations ensure safe and efficient integration.
- In summary, accurate magnetic field analysis is indispensable not only for the success of the detector but also for the reliability and safety of the system as a whole.

- Decades of experience in analyzing superconducting magnets in diverse configurations.
- Examples:
 - CMS solenoid



HL-LHC D2 dipole magnets



● Frontal Lectures:

OBJ: Provide a strong theoretical foundation and introduce the tools and techniques used in magnetic field calculations.

- Basics of magnetic field calculation.
- Fundamentals of Finite Element Analysis.

● Hands-On Activity:

OBJ: Apply the concepts learned during the lectures to solve practical magnetic field problems.

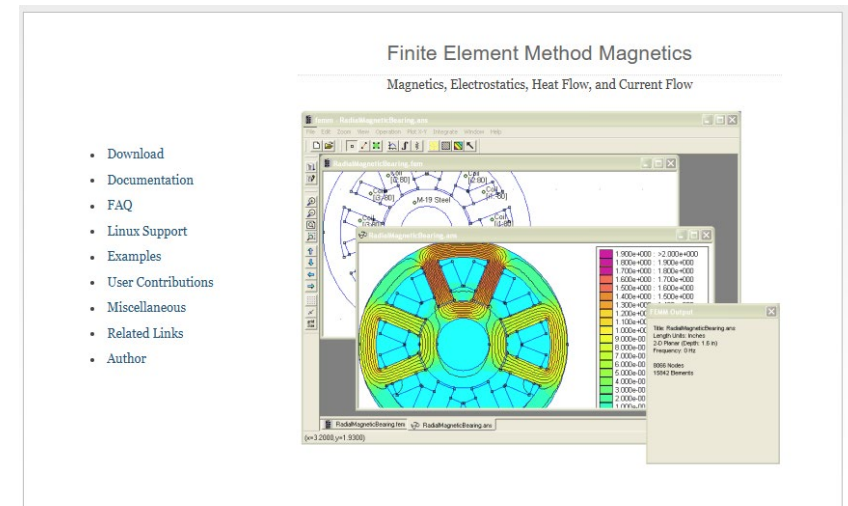
- Practical examples using the open-source program FEMM.
 - ★ 1. ****A Solenoid****: Calculate and analyze the magnetic field.
 - ★ 2. ****An Accelerator Magnet****: Focus on field uniformity and its importance.

● Required resources:

- participants should have access to a Windows notebook
- laptops or PCs can be provided if needed (with the associated items included in the budget).

● People involved:

- Stefania Farinon



<https://www.femm.info/wiki/HomePage>

- Advantages of Morning Integration
 - The combined lecture and hands-on approach ensures that theoretical knowledge is immediately reinforced through practical application.
- Lab for the Entire Group
 - The proposed hands-on activity is designed for the entire group to participate simultaneously. Participants will work on shared problems, fostering collaboration and peer learning. This collaborative environment enables efficient use of time and encourages group discussions to tackle challenges collectively.
- Optimization of Resources
 - No need for additional slots or significant schedule disruptions. Tools like FEMM are accessible and easy to implement without requiring extensive hardware or software installations.
- Expected Outcomes
 - Gain comprehensive theoretical and practical knowledge.
 - Enhance the proficiency in magnetic field analysis, which is critical for detector design.

- The benefit of Advancing Magnetic Field Expertise are:
 - Develop skills in advanced magnetic field analysis.
 - Gain hands-on experience with real-world examples.
 - Enhance the group's capability to tackle complex detector designs.

Thanks for the attention
