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Simulation approaches for magnet design in the ALBA II synchrotron upgrade

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ALBA II, developed by ALBA CELLS (Barcelona, Spain), is a fourth-generation upgrade of the ALBA synchrotron. To achieve its targeted increase in photon beam brilliance and coherence, the new storage ring requires precise validation and optimization of its magnetic structures. The design includes six magnet families—bending, antibending, quadrupoles, sextupoles, octupoles, and correctors—totaling around 720 units, including electromagnets and permanent magnets. This work compares three simulation workflows for ALBA II magnets: ANSYS Maxwell –Magnetostatic (FEA), ANSYS Workbench –Magnetostatic (FEA), and Opera/RADIA. Each is used to predict field distribution, magnetic forces, and mechanical loads, and to provide boundary conditions for coupled thermo-structural analysis. We discuss the capabilities and limitations of each approach, focusing on meshing, solution time, post-processing, and CAD integration. Results are consistent across platforms, with key advantages: meshing speed (in-house tool), multiphysics coupling (Workbench), and batch processing (Maxwell). Uncertainties, cross-validation, and schedule impacts are also addressed.

Footnotes

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