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Design and Engineering Challenges in the SOLEIL II Storage Ring Upgrade

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SOLEIL II is the upgrade project of the French synchrotron radiation facility SOLEIL. It includes a complete renewal of the accelerator systems (linac, booster, and storage ring), the 29 beamlines and 3 laboratories, as well as an overhaul of the information technology infrastructure. The project is entering the construction phase and proposes a near-final lattice for the storage ring. The compactness of this lattice, along with the extremely tight mechanical tolerances, presents significant engineering challenges. Ensuring technical feasibility with limited design resources requires extensive use of advanced CAD techniques. The expected alignment precision for the magnets of the section matching achromat is ±10 μm (2σ), and the vacuum chambers must pass through the magnets—some of which are permanent—with clearances as low as 0.5 mm. The magnet design is further complicated by the large number of variants within each magnet family, which requires efficient collaboration and careful design standardization to maintain quality despite limited staffing. The complexity and interdependence of the various subsystems also require intensive coordination among multidisciplinary teams to ensure the machine's successful integration.

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