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C1Or2C-04: [Invited] Superconducting undulator development for synchrotrons and FELs

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Superconducting undulators with a period >15 mm can offer a much higher on-axis undulator field than state-of-the-art cryogenic permanent magnet undulators with the same period and vacuum gap. The commissioned NbTi planar SCUs for user operation in the KIT synchrotron and the APS storage ring are operated stably without quenches, producing outperformed photon flux in the high energy part of the hard x-ray spectrum. Another potential advantage of deploying SCU is its radiation hardness, a crucial characteristic for being used in free electron lasers (FELs) driven by high repetition rate superconducting linear accelerators (LINACs) and diffraction limited storage rings (DLSRs) with small vacuum gap and large averaged beam current. The development of shorter period but high field SCU is an important mission for compact FEL as this technology would reduce both the length of undulators and the length of LINACs. This presentation will first overview the research and development of SCUs worldwide from the late 1970s to 2022 and the technical challenges including the SCU cryostat, the magnetic field measurement and the integral/local field correction. Then we compare the theory limits of different types of planar and helical SCUs and summarize the technological needs for future undulators, e.g. made of coated-conductor or bulk HTS materials.

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