



Contribution ID: 251

Type: **Contributed Oral**

Wed-Af-Or3-05: Modeling and experiment result of double staggered-array helical undulator made of stacked RE-Ba-Cu-O tapes

Wednesday 2 July 2025 17:30 (15 minutes)

High-temperature superconducting (HTS) materials have attracted significant interest for use in insertion devices due to their higher critical temperature, T_c and larger critical current density, J_c compared to low-temperature superconducting wires [1-3]. These properties enable the development of undulators with shorter period and larger on-axis magnetic field. Helical undulators, which suppress higher harmonic photon generation, are particularly well-suited for free electron laser (FEL) facilities that utilize photons at their fundamental wavelength. To facilitate the future upgrade of the Shanghai Soft X-ray Free Electron Laser (SXFEL) facility, we propose the development of a 12 mm-period HTS helical undulator incorporating a double staggered-array configuration based on stacked RE-Ba-Cu-O tapes. Numerical optimization for various configurations of stacked tapes indicates that an on-axis field B_{x0} and B_{y0} reaching 1.0 T (with an effective magnetic field, B_{eff} , of 1.4 T) can be achieved using 12 mm-width stacked tapes in a trapezoid configuration, with a period length of 12 mm and a magnetic gap of 6 mm. Based on the optimized configuration, we fabricated an HTS helical undulator model with ten periods at Zhangjiang Laboratory. The short model underwent an initial testing following field-cooled magnetization from 0.3 T to 0 T at 77 K, with subsequent testing conducted using a superconducting solenoid magnet with $B_s > 10$ T. This study provides a detailed summary of the sample preparation process and the corresponding test results.

Key words: helical undulator, high-temperature superconductor, RE-Ba-Cu-O

References

- [1] Z. Chen et al., 2024, Supercondivity, 12, 100134
- [2] K. Zhang et al., 2023, Supercond. Sci. Technol., 36, 05LT01
- [3] K. Zhang and M. Calvi, 2022, Supercond. Sci. Technol., 35, 093001

Author: CHEN, Zhuangwei (Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai)

Co-authors: WEI, Dabin (Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai); LIU, Chan (Zhangjiang Laboratory, Shanghai); TONG, Yimin (Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai); CALVI, Marco (Paul Scherrer Institute PSI); Dr ZHANG, Kai (Zhangjiang Laboratory, Shanghai); ZHAO, Zhentang (Shanghai Advanced Research Institute, Chinese Academy of Sciences, Shanghai)

Presenter: CHEN, Zhuangwei (Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai)

Session Classification: Wed-Af-Or3 - Wiggler Magnets