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Recent advances in superconducting undulators at the Advanced Photon Source

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The Advanced Photon Source (APS) continues developing novel SCUs, several of which have operated for a decade, delivering high-brightness, hard X-ray beams for scientific research. As part of the APS Upgrade, eight new NbTi SCUs were planned. While cryogenic and support systems were in place, challenges in scaling magnet lengths and reducing periods led to magnet failures and fabrication delays. The APS SCU team launched an R&D program to refine designs and materials, with two SCUs expected to be installed by late 2025 and six more to follow.

Before the APS Upgrade, a novel Nb_3Sn SCU deployed and operated successfully for three months, validating its predicted performance. Building on this, the APS SCU team is developing a 14 mm period Nb_3Sn SCU with cryogen-free, conduction-cooled magnets and a thin-wall vacuum chamber, enhancing the field and simplifying cryogenics. Looking further ahead, the team is exploring implementation of high temperature superconductors for lower period undulators (˜10 mm) to achieve unprecedented field strengths. This presentation will provide an overview of the APS SCU program, the challenges addressed, and ongoing efforts to advance SCU technology.

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