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KIT Superconducting Undulator Development - Story of a Successful Industrial Collaboration & Future Prospects

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Undulators are X-ray sources widely used in synchrotron storage rings and free-electron laser (FEL) facilities. The development of undulators has a long tradition at KIT, dating back to the 1990s. With the commercial availability of low-temperature superconductors (LTS), a new type of undulator was born, the superconducting undulator (SCU). Compared to conventional cryogenic permanent magnet undulators (CMPUs), the SCU offers a higher maximum magnetic field on axis for the same magnetic geometry, i.e. gap and period length, and thus a higher tunability and/or brightness, which lead to a wider range of applications at modern synchrotron light sources.

In this context, the industrial cooperation between KIT and Bilfinger Nuclear & Energy Transition GmbH (formerly Babcock Noell GmbH) started more than 15 years ago. Since then, many projects have been successfully completed, leading to the production of the world's leading full-scale commercial superconducting undulators based on conduction cooling. Starting with the SCU15, the first of a kind installed superconducting undulator providing light to a beamline, followed by the SCU20 installed and still in operation at the Karlsruhe Research Accelerator (KARA). The successful realization of such new SCUs has required the simultaneous development of appropriate measurement facilities such as CASPER I & CASPER II. They allow local and integral measurement of the magnetic field profile, training of the undulator, optimisation of the (end) fields and analysis of the magnets, for which specific procedures and techniques have been developed within the collaboration. The fundamental research of this collaboration has resulted in a commercial product that is in demand and sold worldwide.

In addition, the measurement systems are constantly improved to remain at the cutting edge of technology. In parallel with direct improvements through new electronics or technologies, the focus is also on new concepts in fundamental research, taking into account the social challenges of sustainability and energy efficiency. This includes new cooling concepts for current leads, the use of new superconducting materials and the creation of new undulator designs.

In this contribution, we would like to give a general overview of what we have achieved in the field of superconducting undulator technology with regard to the products built within our partnership, as well as an outlook on our new prospects and investigations.

I plan to submit also conference proceedings

Yes

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