



ID de Contribution: 1

Type: **Poster**

Progress of PrFeB Based Hybrid Cryogenic Undulators at SOLEIL

Cryogenic Permanent Magnet Undulator (CPMU) takes advantage of the enhanced field performance of permanent magnets when cooled down to low temperature, enabling shorter period with sufficient magnetic field to achieve high brightness radiation in the X-ray domain. Several CPMUs have been manufactured at SOLEIL. The first CPMU of period 18 mm (U18), optimized with a phase error of 3.2° at 77 K, has been installed and operated for the past 5 years at SOLEIL NANOSCOPIUM beamline. We report on photon beam based alignment enabling for a better adjustment of the offset with a precision of $50\text{ }\mu\text{m}$, and on the correction of the taper with a precision of $5\text{ }\mu\text{rad}$ to enhance the radiation. A second U18 cryo-ready undulator, with a new mechanical and magnetic sorting of module shimming, has attained a phase error of 2.3° without any further adjustments after the assembly. Currently, two more cryogenic undulators are being built; a 2 m long U18 for SOLEIL ANATOMIX beamline, and a 3 m long U15 reaching a magnetic gap of 3 mm. The new challenges encountered with magnetic measurements and mechanical designs for U15 are presented.

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