Big Science Business Forum 2024

TRIESTE
1 – 4 OCTOBER 2024

Host Organizers

REGIONE AUTONOMA FRIULI VENEZIA GIULIA · ILO Network Italia, Rete Industrial Liaison Officers · AREA SCIENCE PARK · IO SONO FRIULI VENEZIA GIULIA

Technology Transfer Track Posters

Towards a meter-long bulk high-temperature superconducting undulator

SLS2.0 · LEAPS INNOVATION · CHART Swiss Accelerator Research and Technology

In the context of the Swiss Light Source 2.0 (SLS 2.0) upgrade at the Paul Scherrer Institute (PSI), a meter-long high-temperature superconducting undulator (HTSU) is planned to increase the brilliance of X-ray photons generated.

This apparatus consists of placing high-temperature superconducting (HTS) Gd-Ba-Cu-O bulks in a staggered array, as shown in the first figure, and magnetizing them with a field-cooling (FC) magnetization procedure to achieve strong field trapping (~10 T).

Recently, we have developed a 10-cm long HTSU and have demonstrated that it can increase the on-axis field by more than a factor of two when compared to conventionally used permanent magnet undulators due to the strong field trapping capabilities of HTS bulks. So far, we have shown that an undulator field greater than 2 T is possible with the HTSU and ferromagnetic poles, while the field error remains below 3%. We are now working up towards a one-meter-long prototype aimed at being operated in the synchrotron facility at PSI.

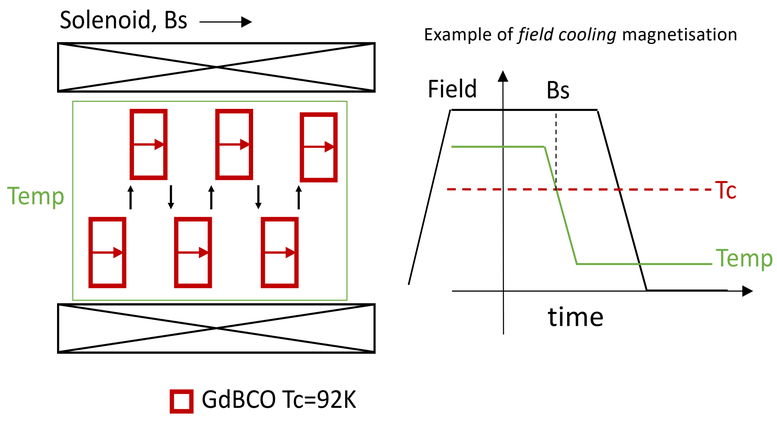
The HTSU requires several state-of-the-art technologies in order to function successfully. More specifically, the operating temperature must be kept below ~7 K to obtain the appropriate superconducting properties of the bulks, and a magnetic field greater than 10 T is required to magnetize them. In addition, since any fluctuation in the on-axis field can be detrimental to the operation of the undulator, tight tolerances are required.

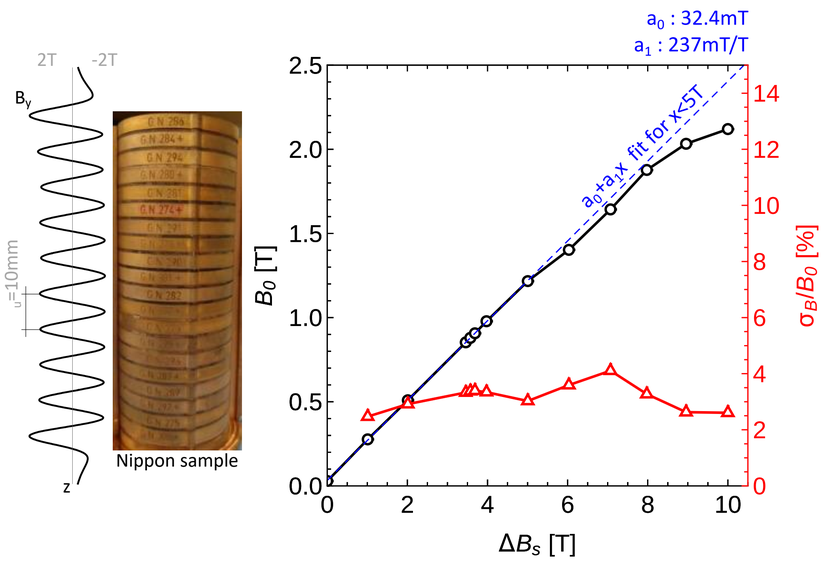
The main components of the HTSU are:

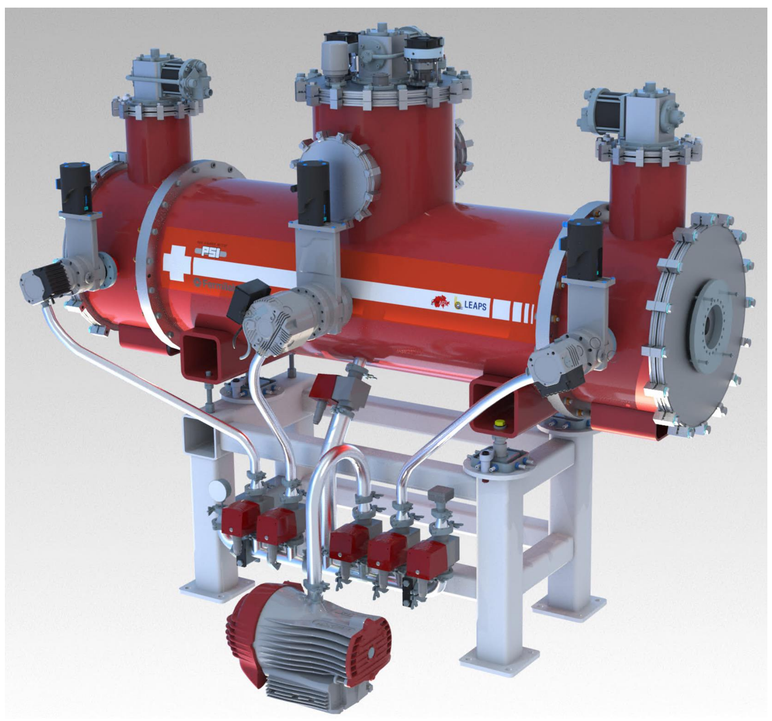
1. Half-moon disks of Gd-Ba-Cu-O.
2. Ferromagnetic poles placed between the Gd-Ba-Cu-O bulks.
3. Copper sleaves to increase thermal stability and hold the components of the undulator fixed.
4. A Nb_3Sn solenoid capable of reaching a field of 12 T.
5. A large cryostat encompassing the undulator and solenoid, with cryocoolers to cool everything down <7 K.

Cylidrical HTS bulks are grown by Can superconductors using the new Single Direction Melt Growth (SDMG) process capable of generating uniform properties and more efficient batch production. The bulks are then cut into half-moon shapes using electric discharge machining in order to get precise tolerances while having minimal effects on the bulk's magnetic properties. Finally, the half-moon disks are shrink-fitted into copper sleeves to secure their position inside the undulator are add prestress to counteract the tensile forces generated during the magnetization process.

The meter-long undulator requires 200 half-moon disks, which are currently being machined and inserted into copper sleeves. The cryostat and solenoid are also in production and should be delivered to PSI at the beginning of 2025. Commisionning and testing are then planned for the ongoing year to test the capabilities of the HTSU before being inserted in the synchrotron ring.







LEAPS-INNOV Hall 27/A37

Reference person

Alexandre Arsenault

Contacts

alexandre.arsenault@psi.ch

www.psi.ch/en

Download BSBF2024 app for live chat

If you like this poster, download the BSBF2024 app to vote for it and live chat