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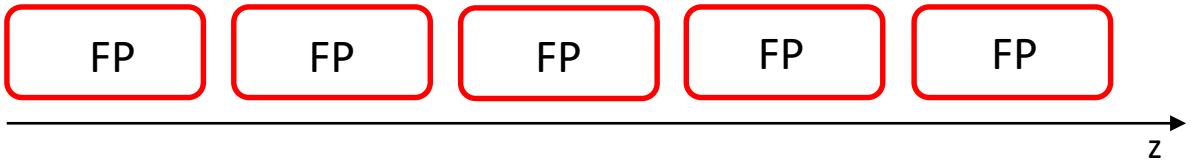
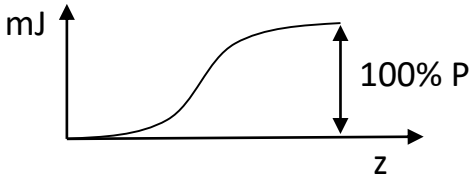
Marco Calvi :: ID group :: Paul Scherrer Institute

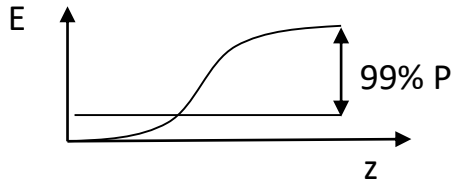
Porthos, updates on SC Undulators

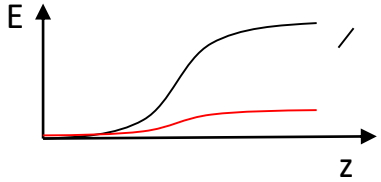
02.12.2022

From last time discussion









FP: Full Polarisation control

C: Circular Polarisation

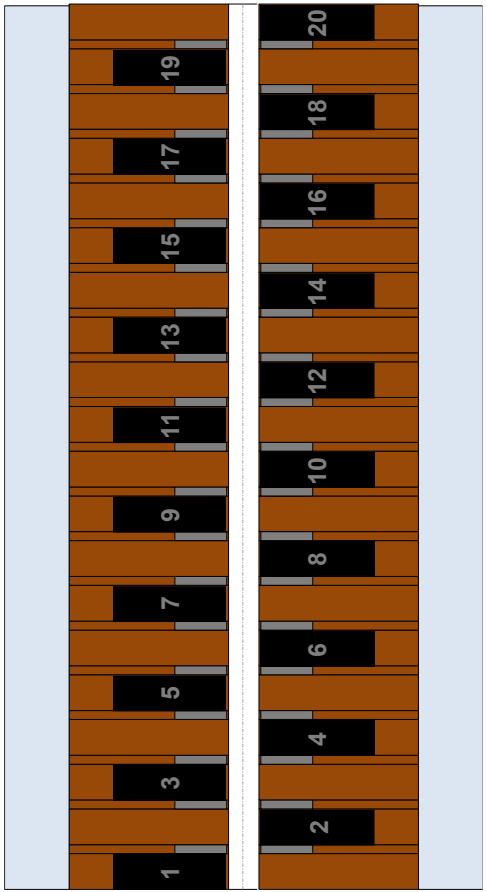
Overview

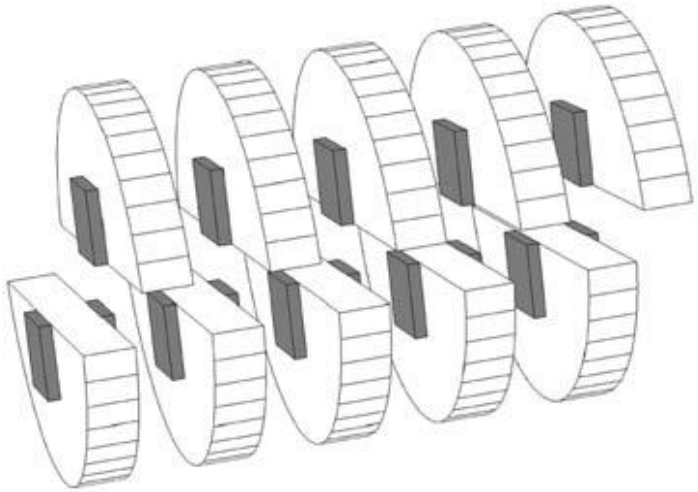
- Progress of the HTS bulks R&D activities:
  - Planar
  - Helical
- Full polarisation control
  - cryo APPLE
  - SCAPE: NbTi or Nb_3Sn
- More established Helical undulators

Staggered Array With CoFe Poles

4mm gap

10 mm period





With additional ferromagnetic poles :

CoFe $\Delta B_0 = +0.20$ T

CHART
Swiss Accelerator Research and Technology

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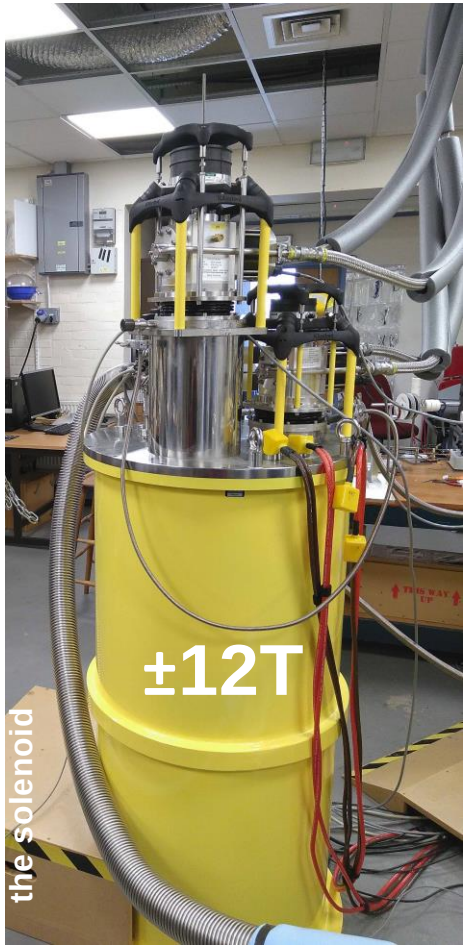
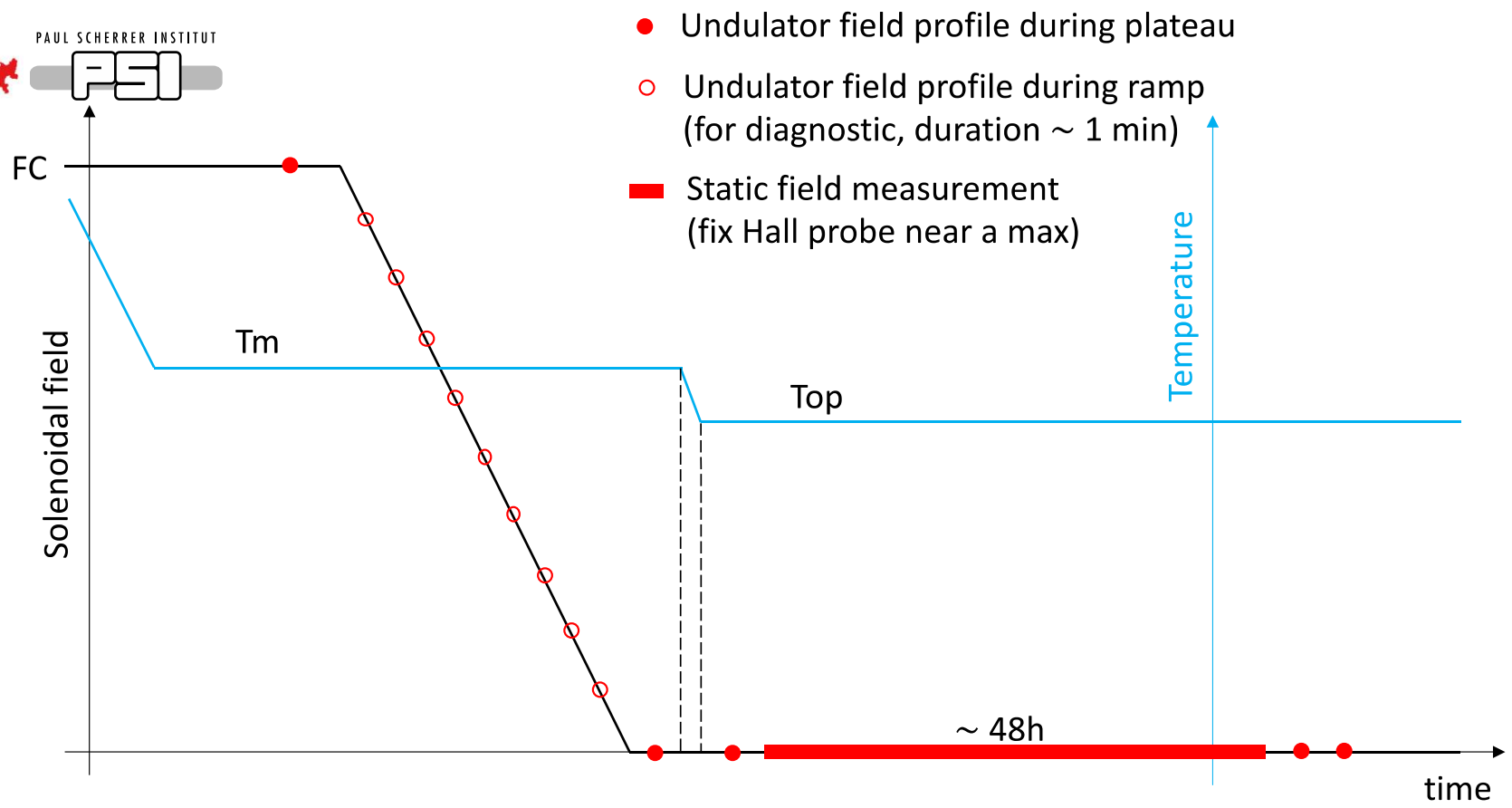
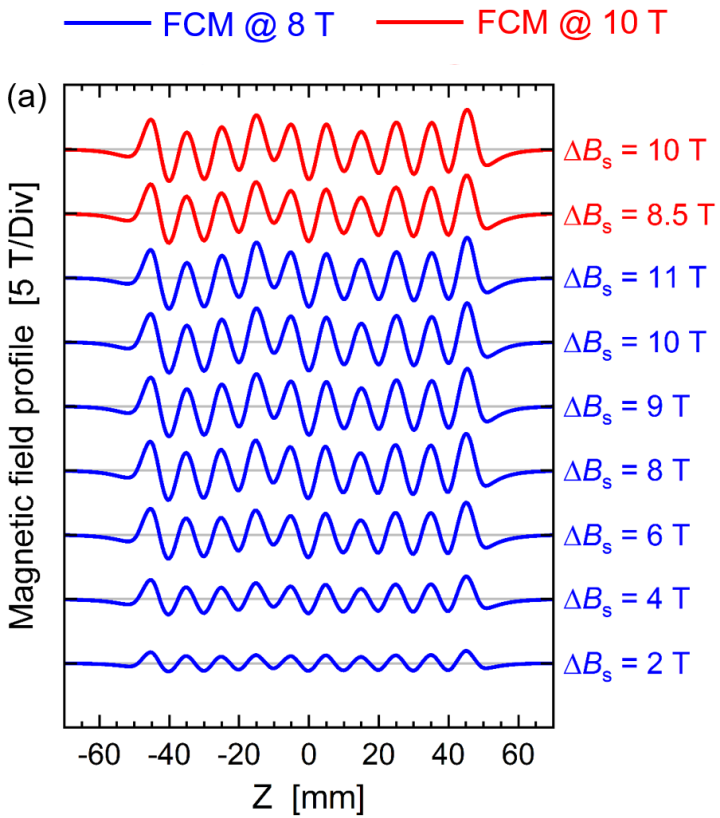


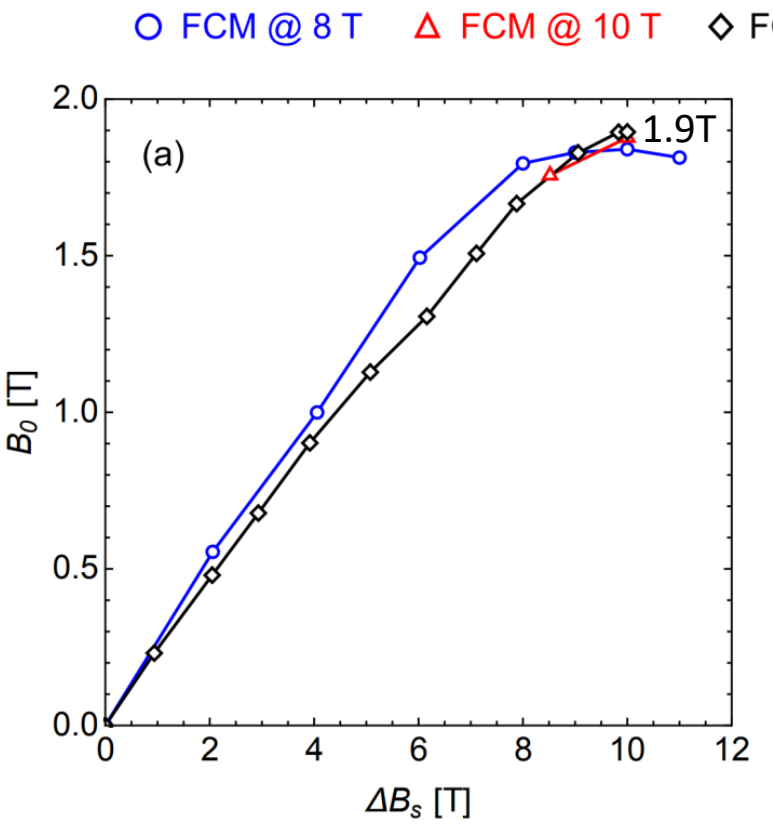


FC, Field Cooling magnetisation level, 10T
Tm, magnetisation temperature ~ 10K
Top, operational temperature ~ 7K

Experimental results



Experimental results

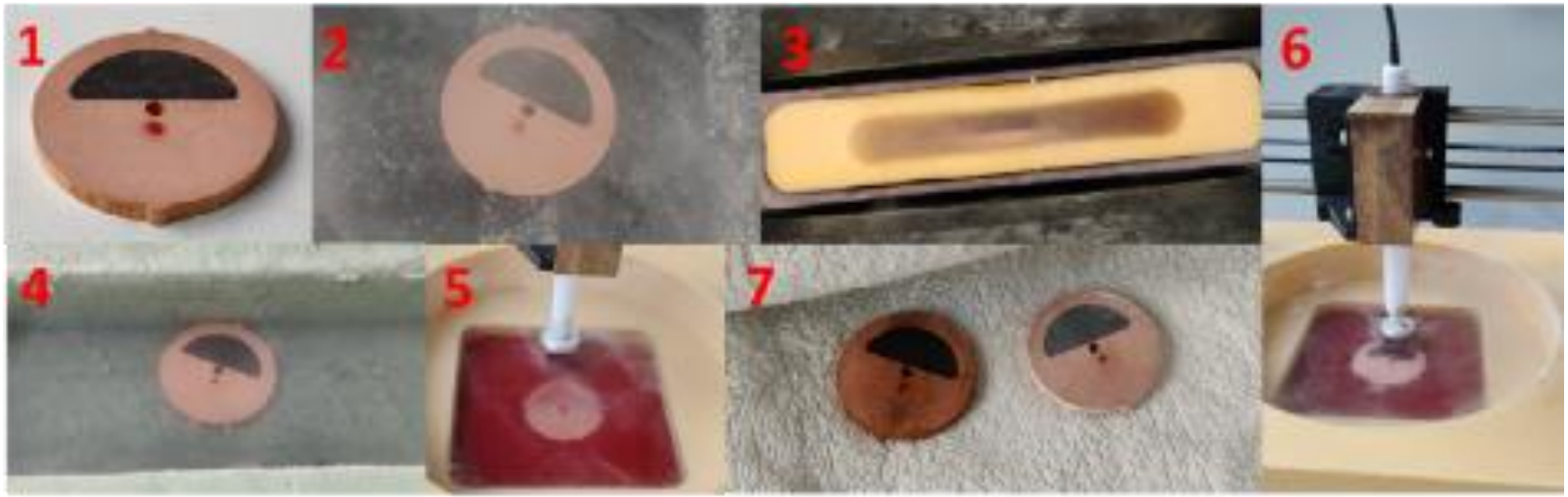


1/3

2D field map of single disks

We have manufactured additional 200 disks from CAN-GdBCO / EuBCO & NS-GdBCO

All of them will be individually cooled in 1T down to LN2 and 2D field mapped, on both sides, with the aim to spot the broken ones / and to pre-sort them with respect to their strength



[1]the disk [2]pre-cooling [3]field Cooling [4]flux creep [5]disk support [6]2D field map [7]drying

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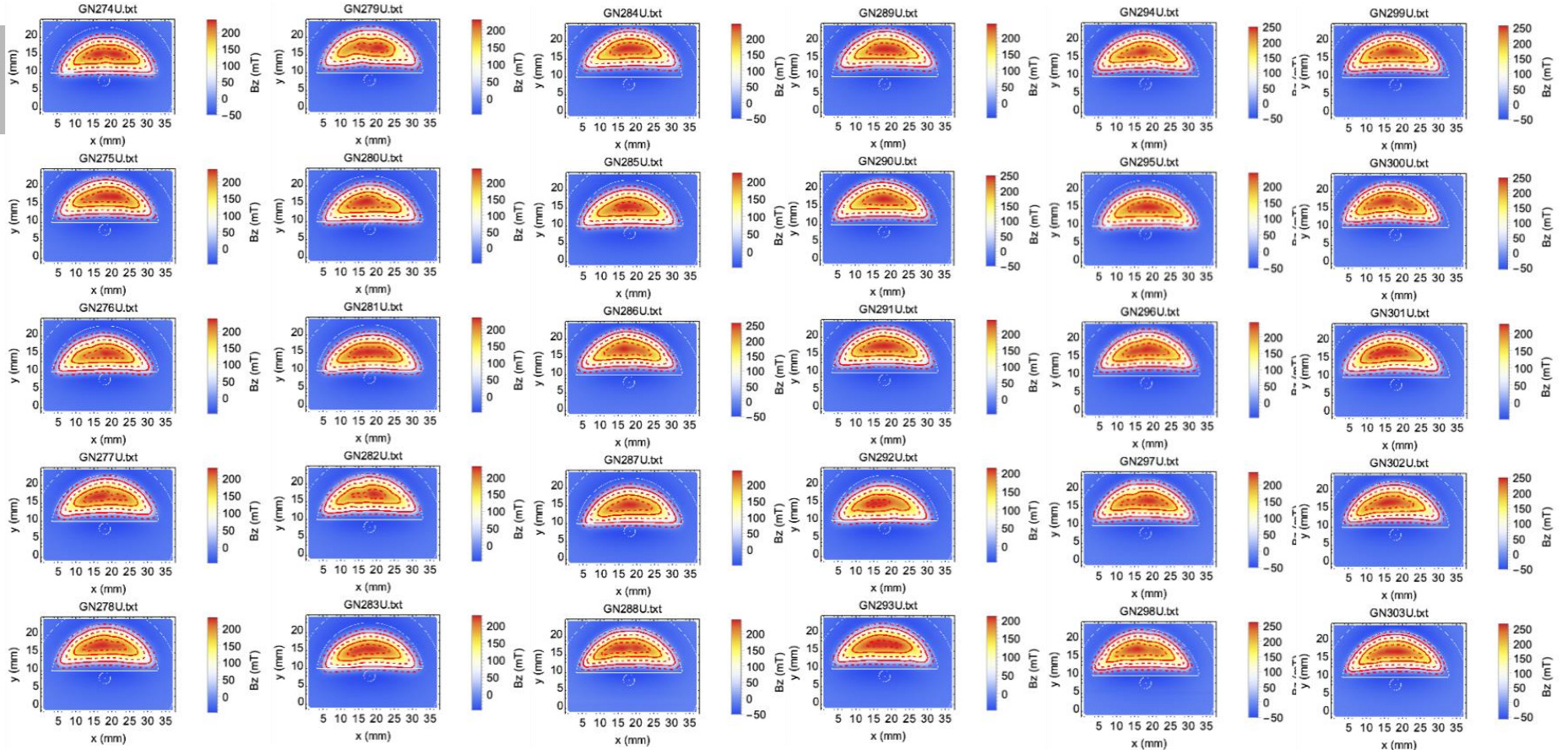
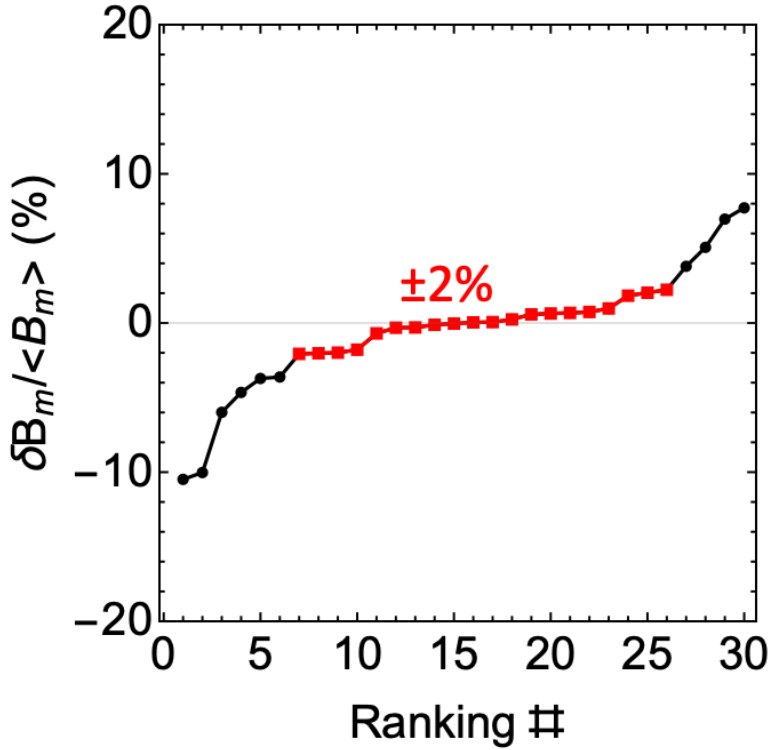
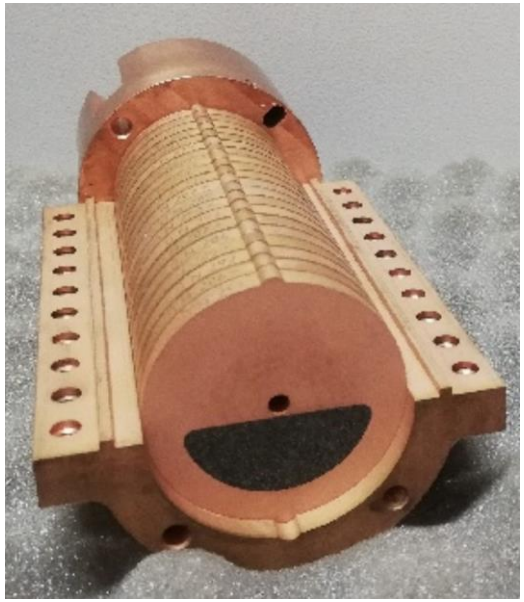
Nippon Steel results

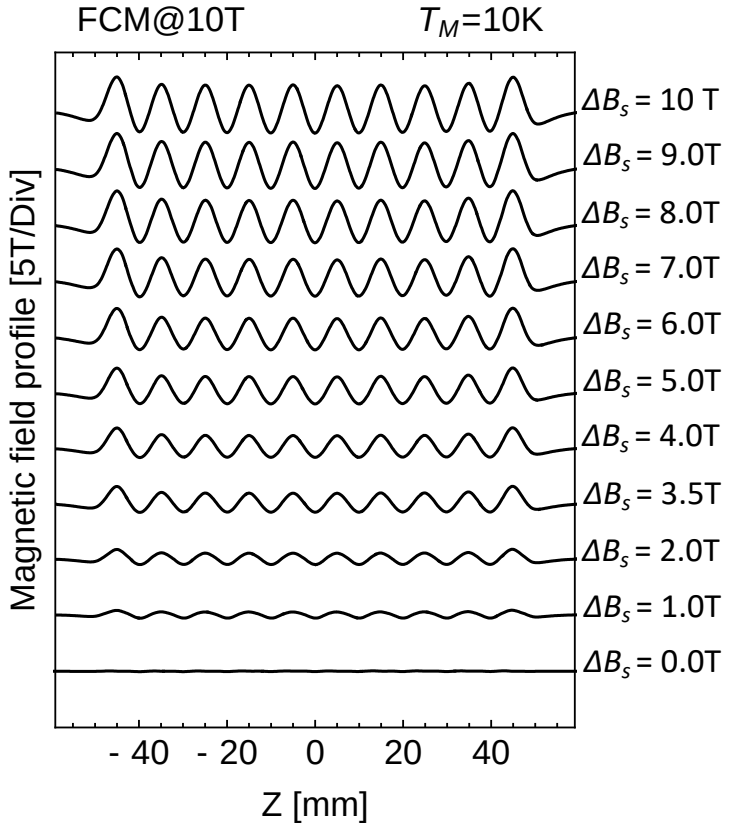


Nippon Steel disks pre-selection



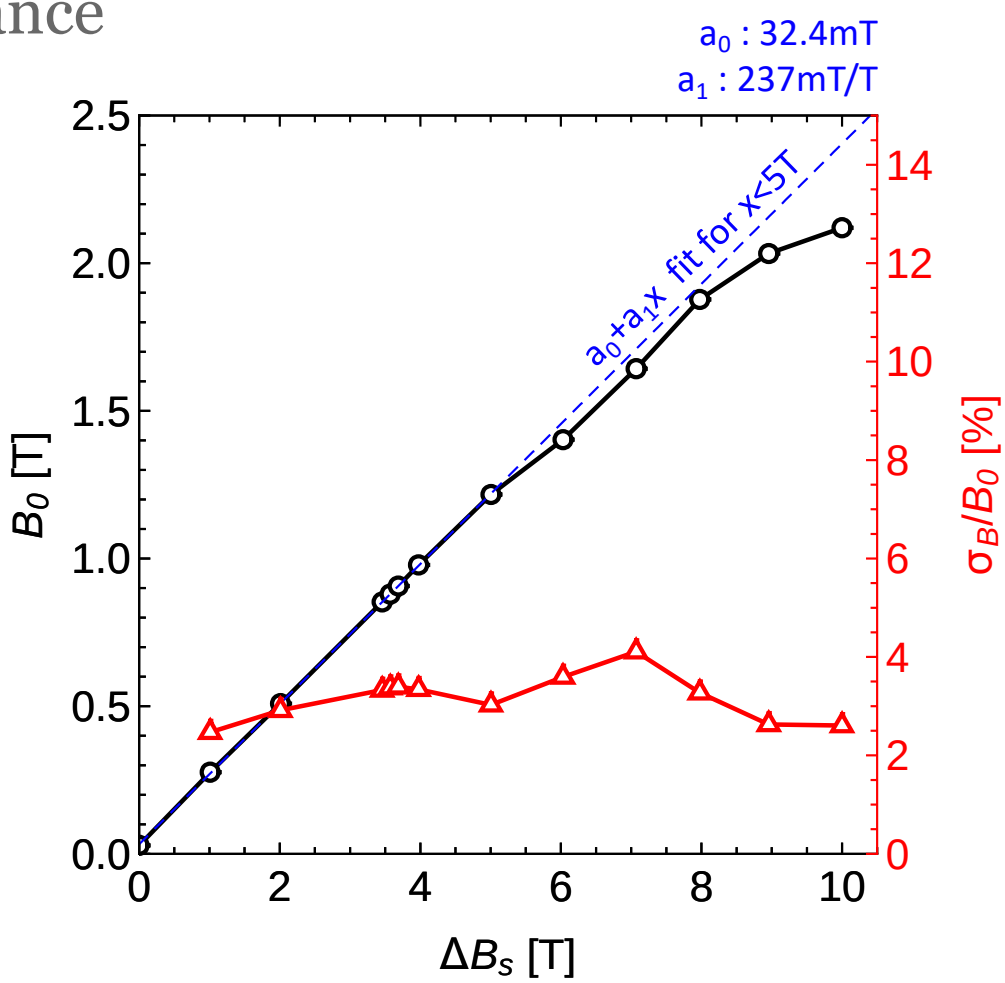


10 period sample measurement results

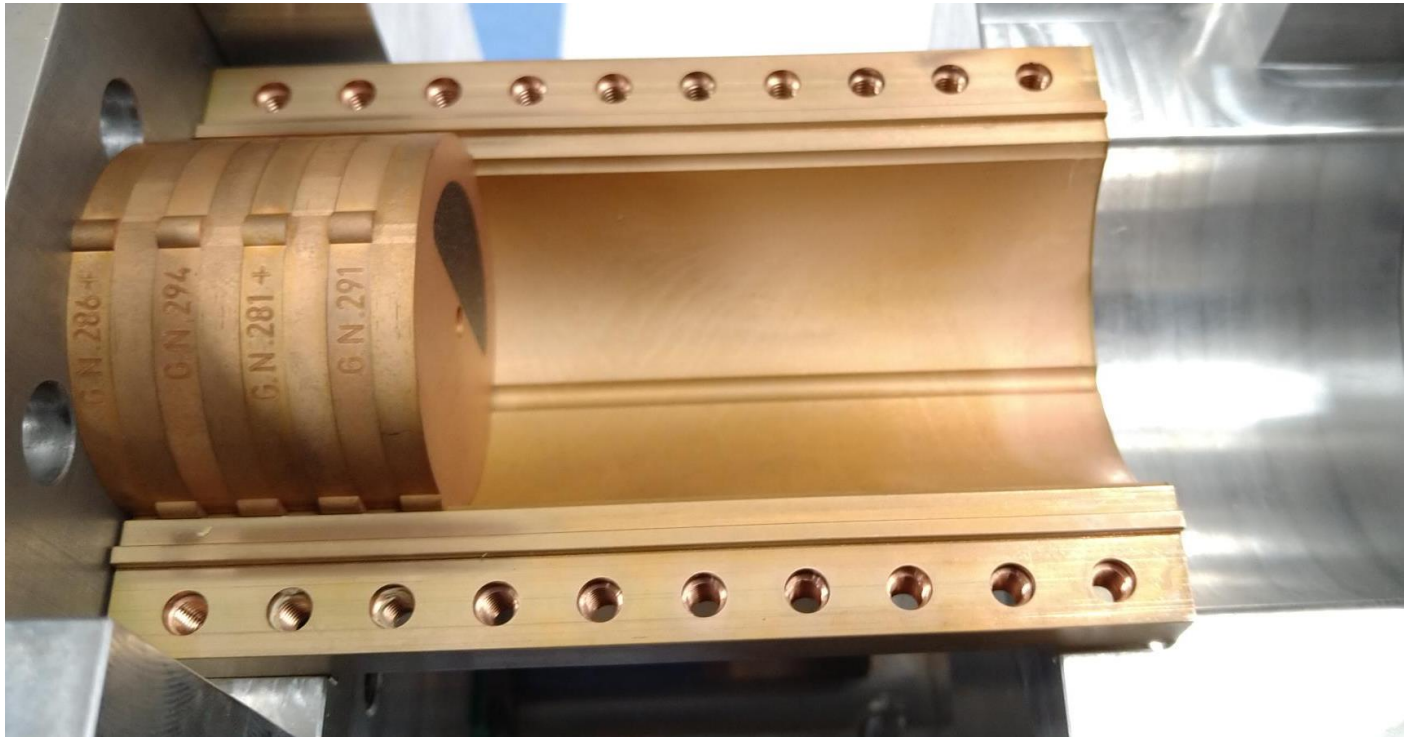


Performance

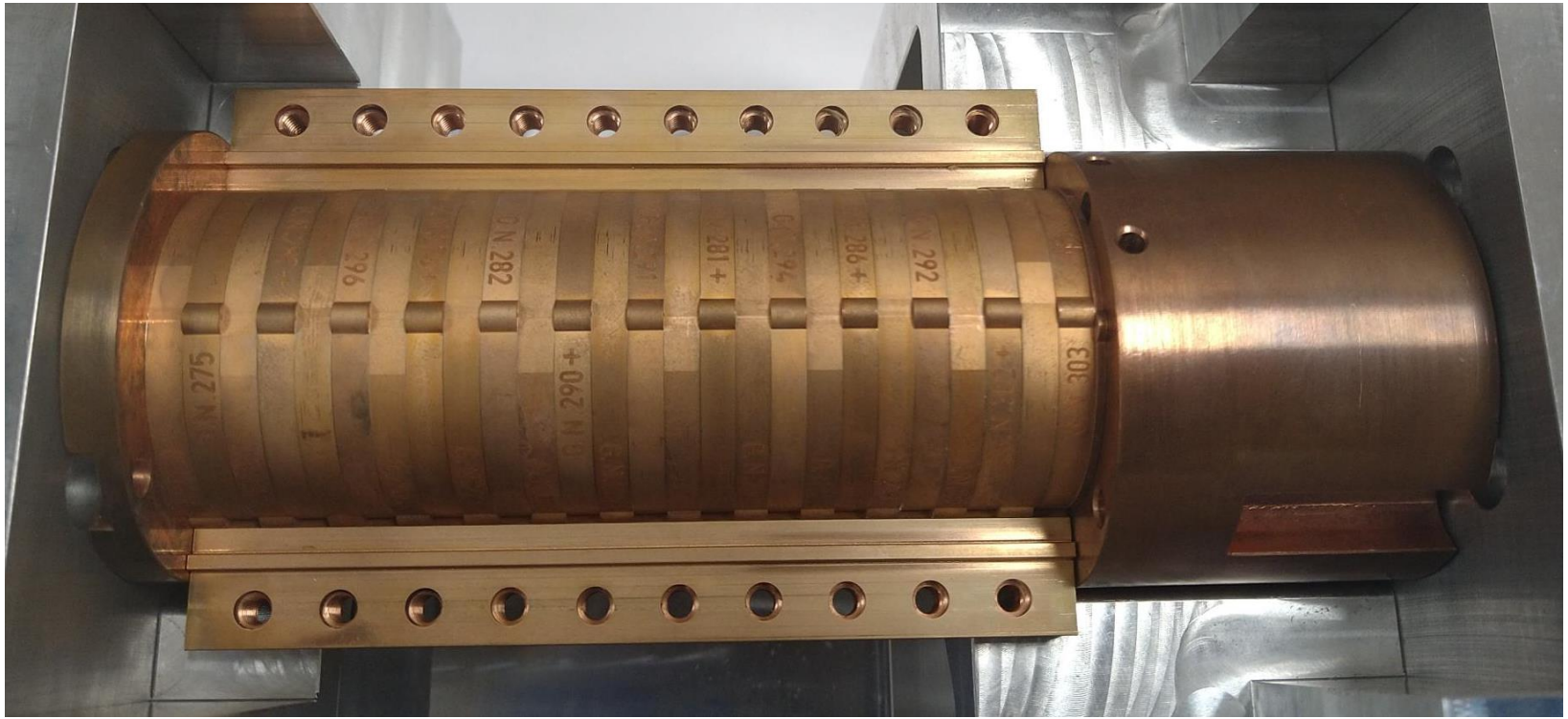
Nippon sample



Bulk helical undulator



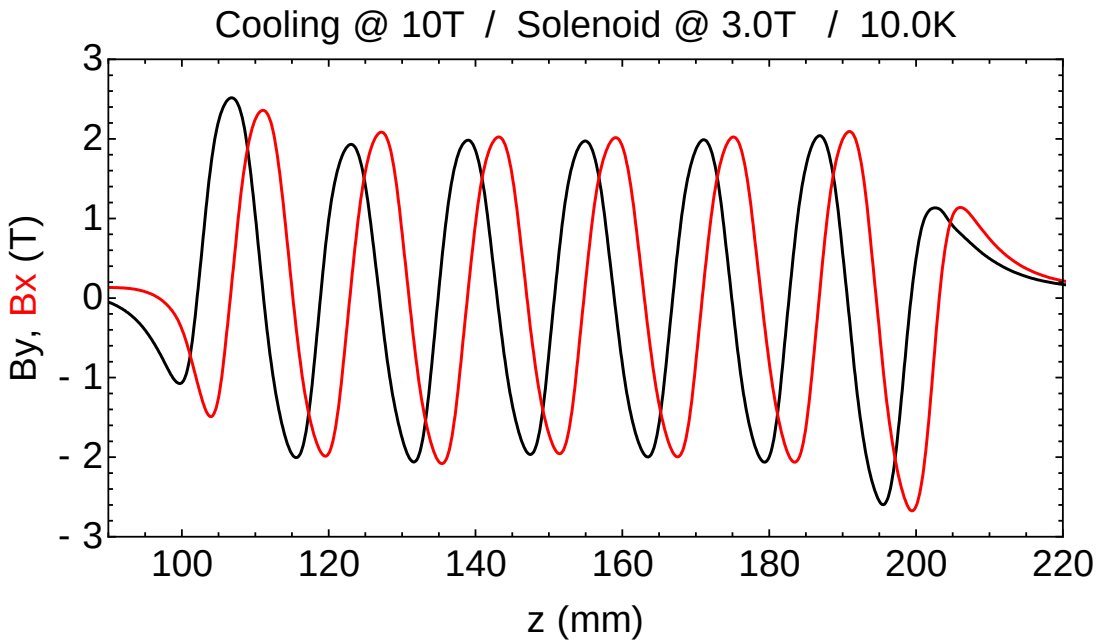
Bulk helical undulator

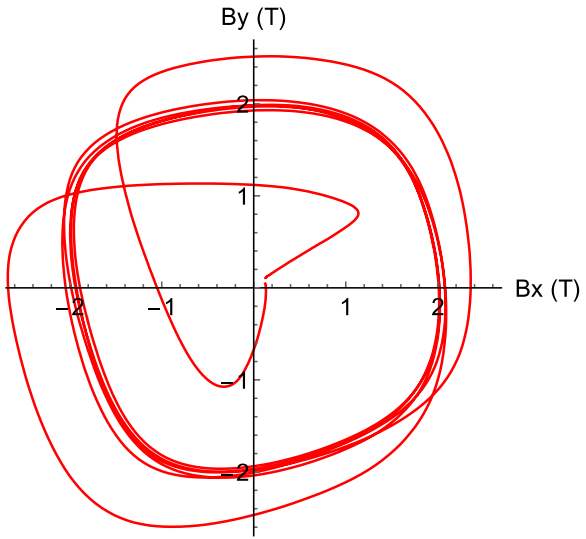


Bulk helical undulator

Period length, λ_U: 16mm

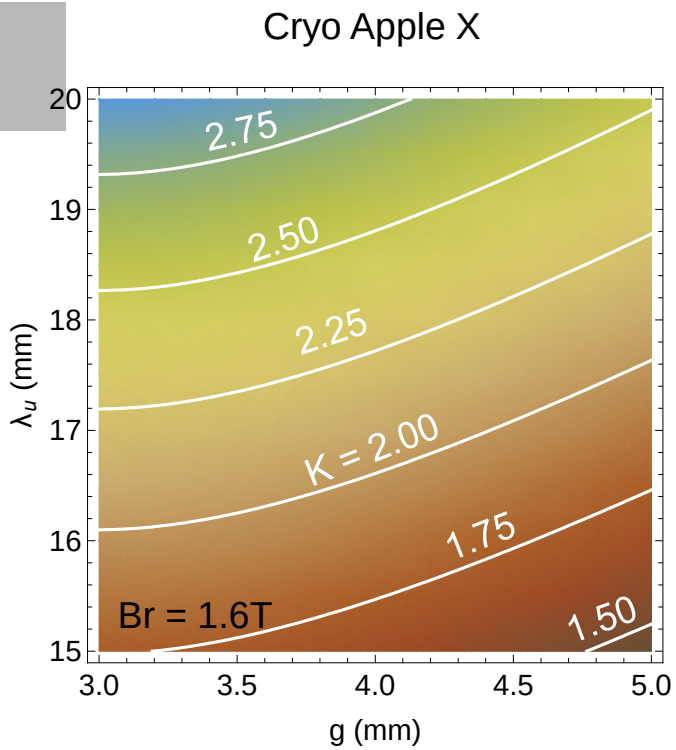
Aperture: 4mm

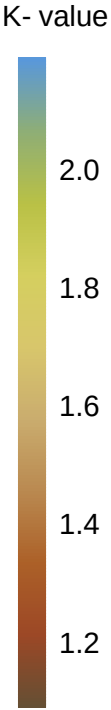


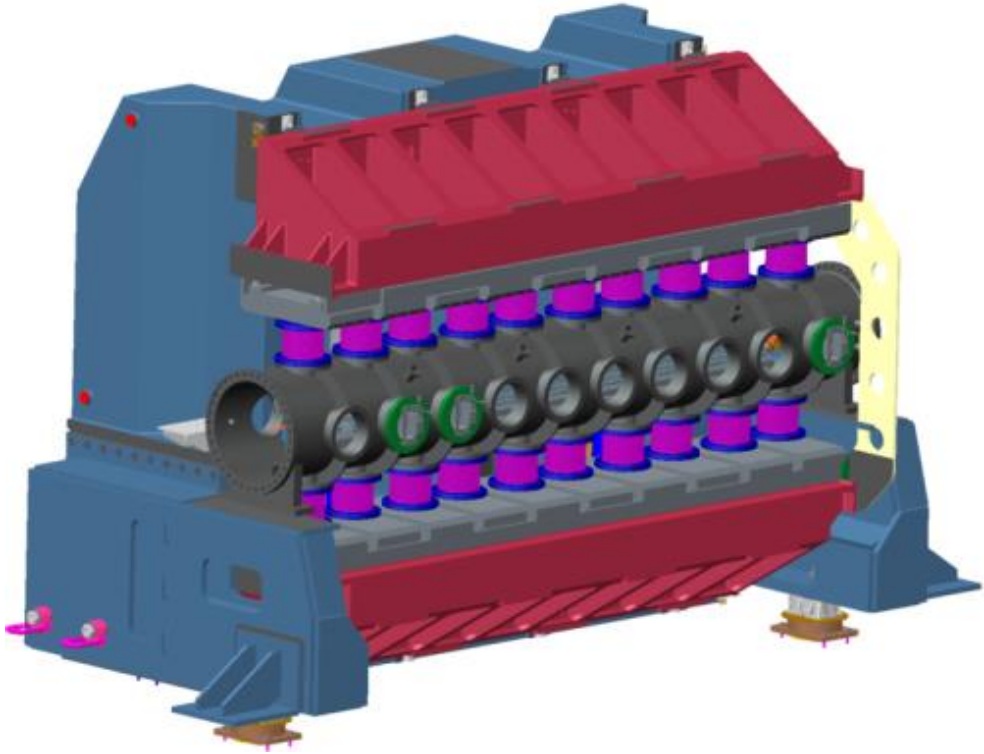


!!!!! Charging in progress… we are just at ΔB_s = 7.0 T !!!!!

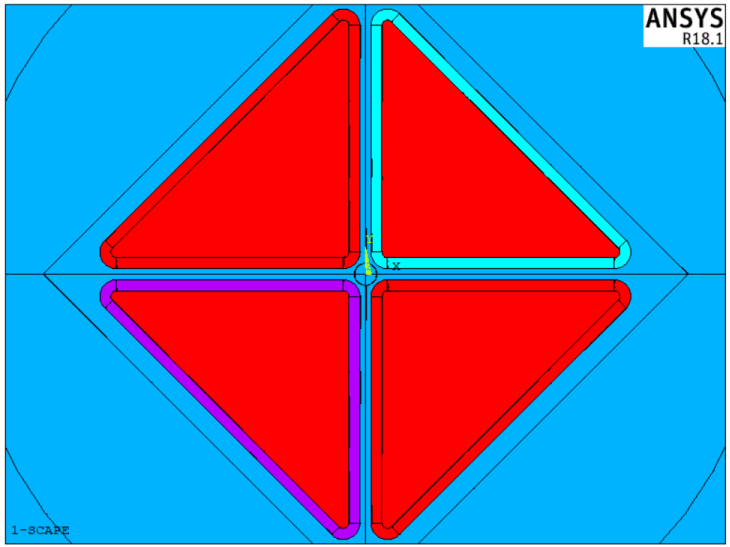
Apple versus SCU NbTi







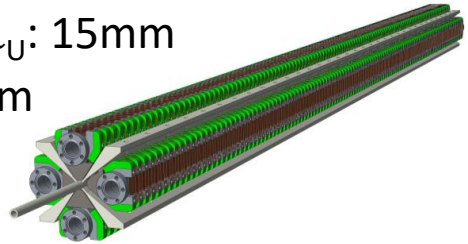
SCAPE – Argonne style (rotated 45°)

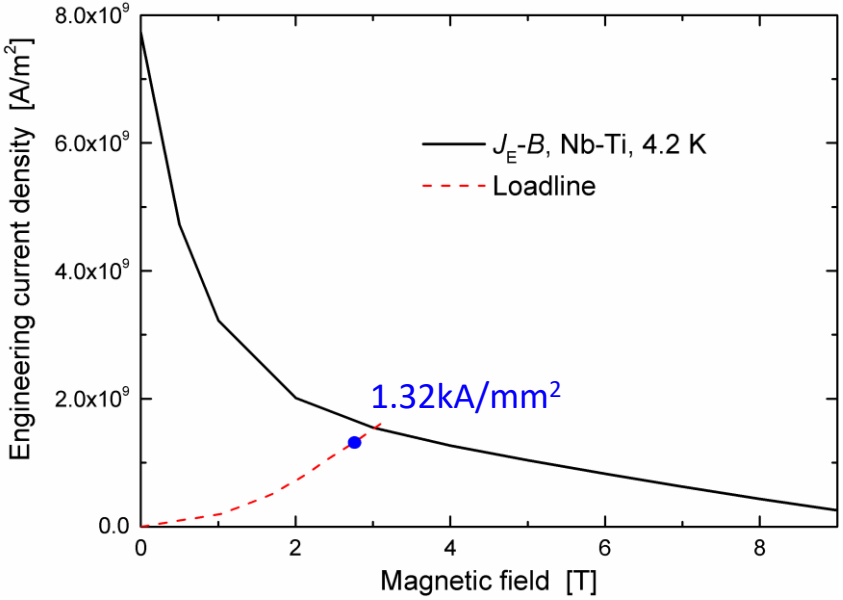


Period length, λ_U: 15mm

Aperture: 5.3mm

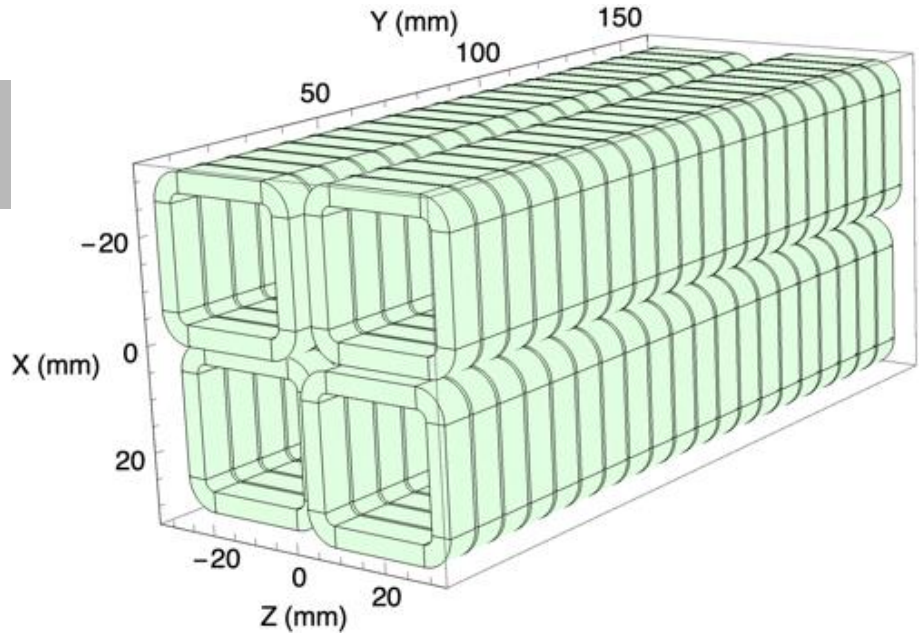
K-value: 1.70

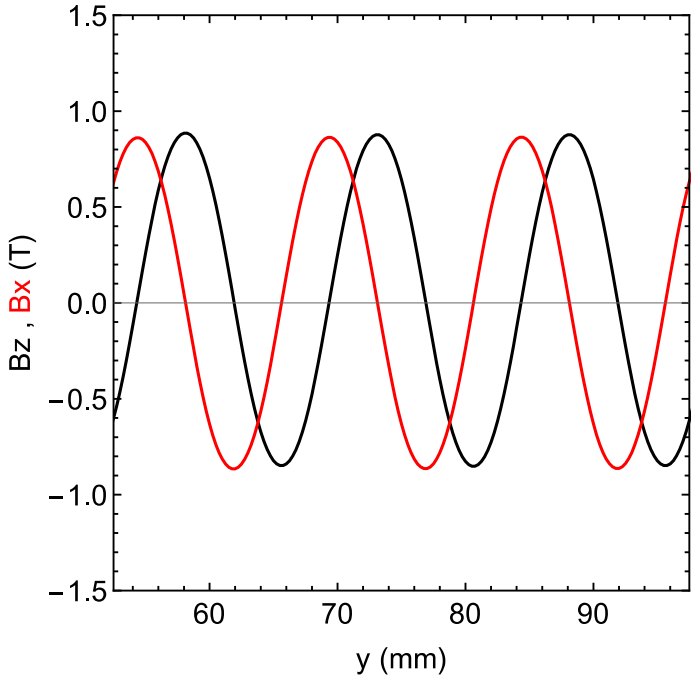




Courtesy of Kai Zhang

SCAPE – Berkeley style





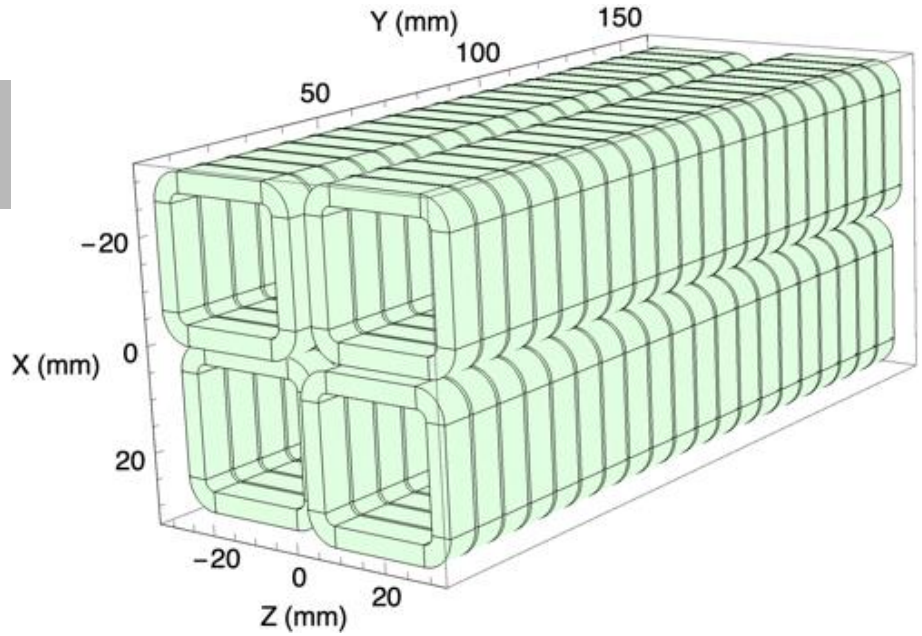
Period length, λ_U: 15mm

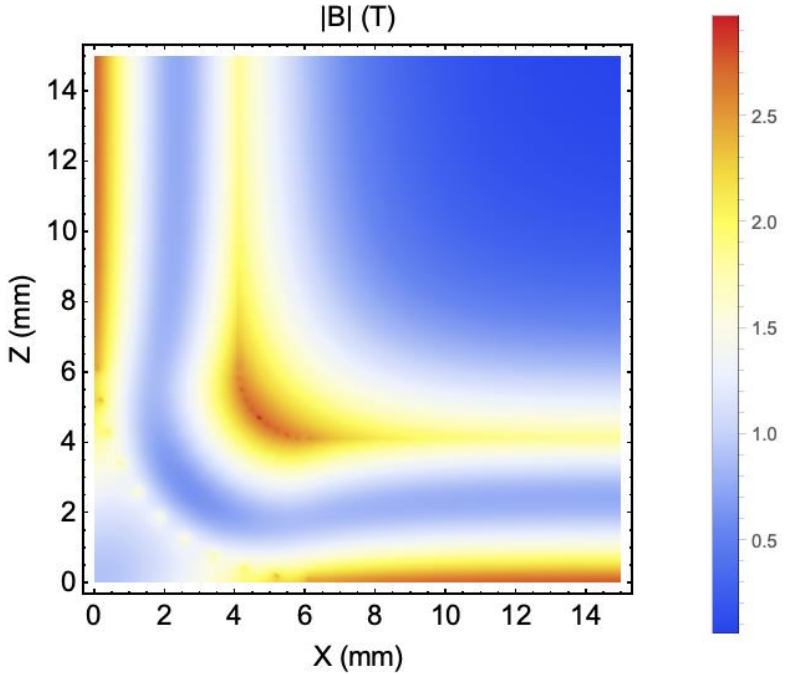
Aperture: 5.3mm

K-value: 1.72

SCAPE – Berkeley style

$B_{max} \simeq 3T$





Period length, λ_U: 15mm

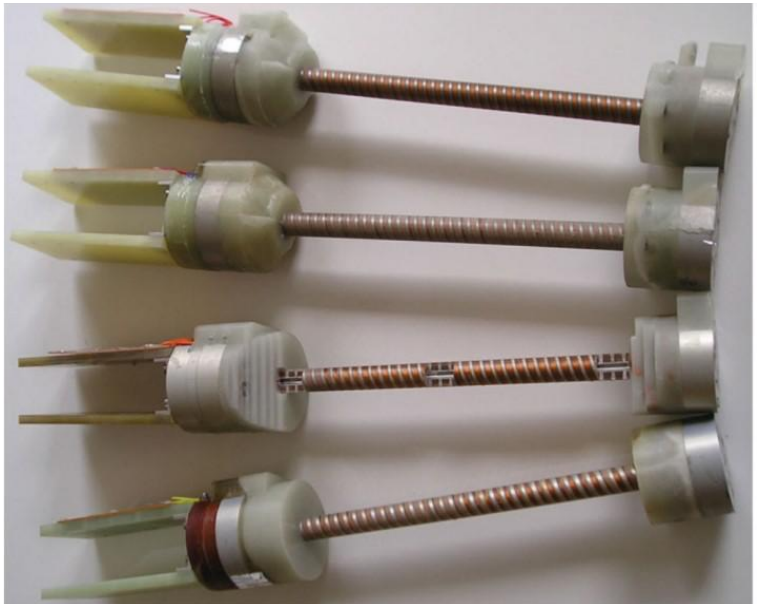
Aperture: 5.3mm

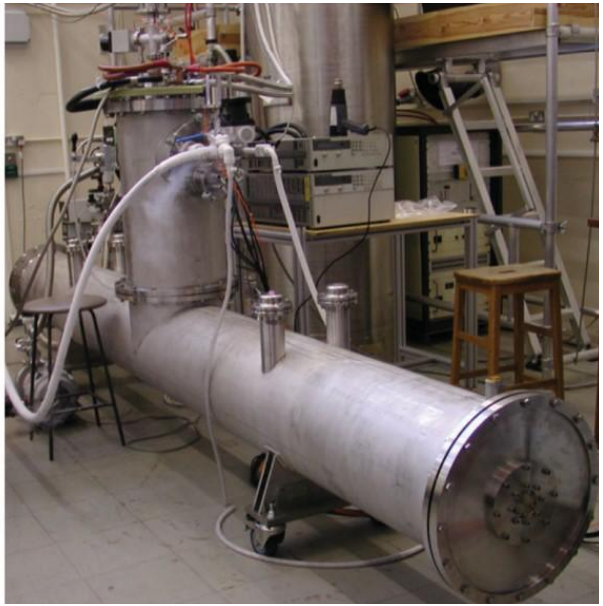
K-value: 1.72

Sc Helical undulator

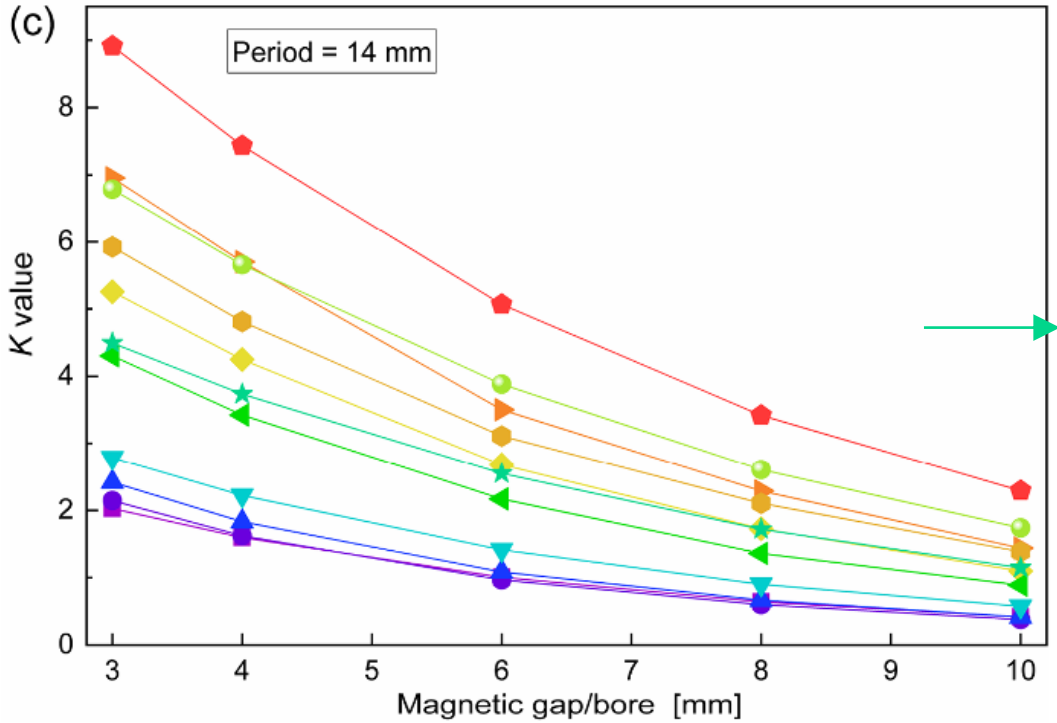
Daresbury lab
Rutherford lab
Argonne

future TeV-scale positron-electron linear collider (ILC)
positron sources





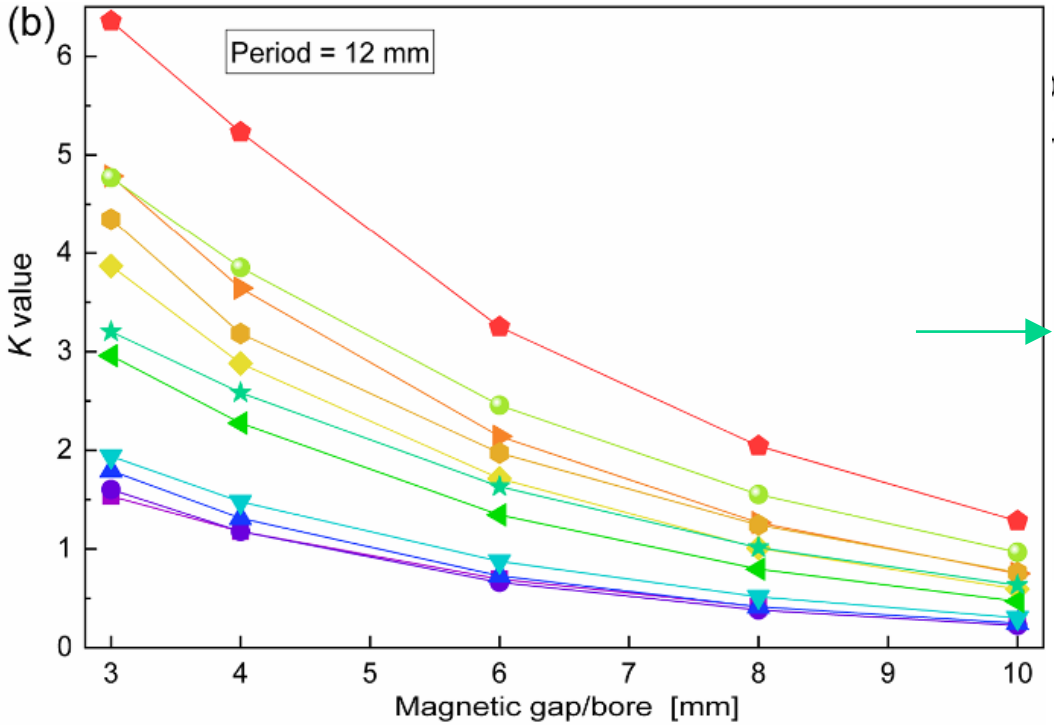
Helical



7 8 9 1(

ore [mm]

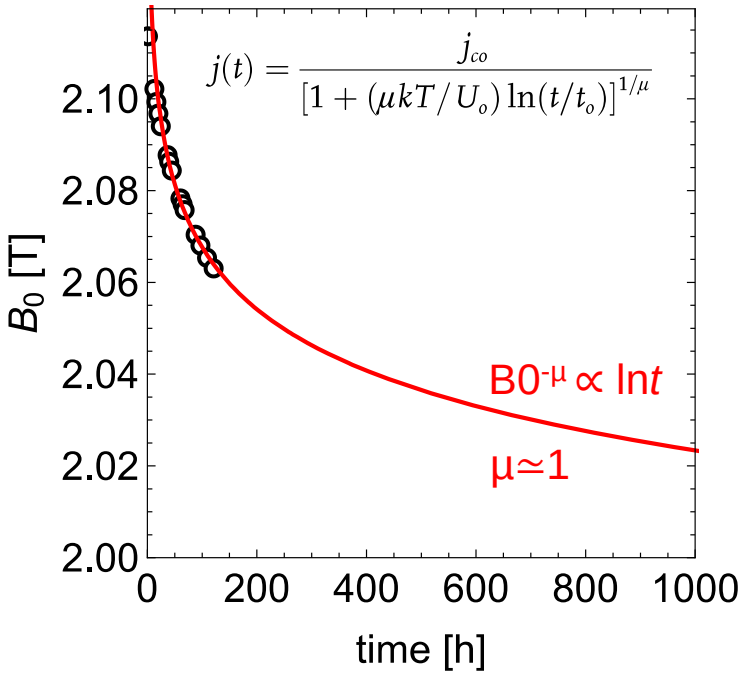
Helical

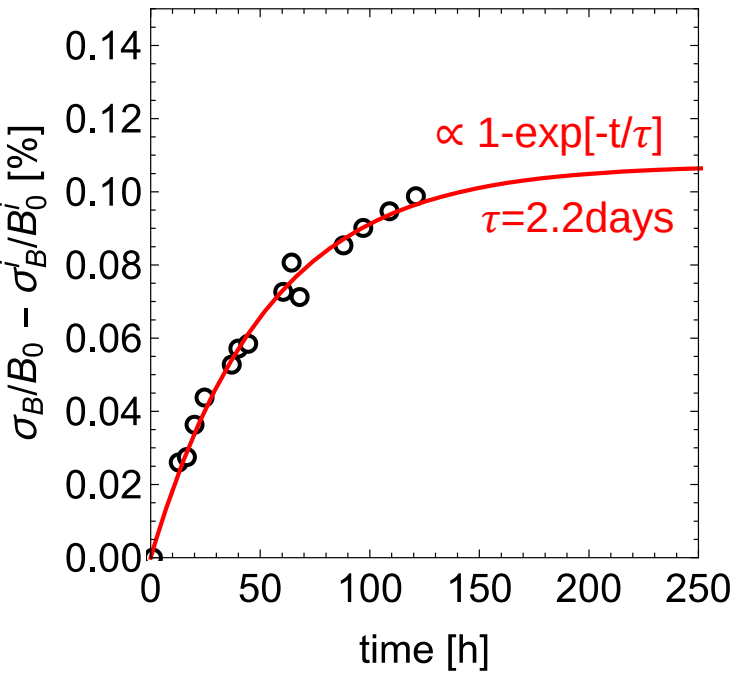


7 8 9 1(

ore [mm]

Flux Creep


$j(t) = \frac{j_{co}}{[1 + (\mu kT/U_o)\ln(t/t_o)]^{1/\mu}}$
B_0 [T]
2.10
2.08
2.06
2.04
2.02
2.00
0
200
400
600
800
1000
time [h]
B0$^{-\mu} \propto$ ln$t$
$\mu \simeq 1$


$\sigma_B/B_0 - \sigma_B^i/B_0^i$ [%]
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
50
100
150
200
250
time [h]
$\propto$ 1-exp[-t/τ]
τ=2.2days