SUPERCONDUCTIVE DAMPING WIGGLER DEVELOPMENT

Robert Rossmanith

for

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Numerous contributions from many colleagues and institutions

Starting point: emittance vs. wiggler period and field

MOPLS134 Proceedings of EPAC 2006, Edinburgh, Scotland

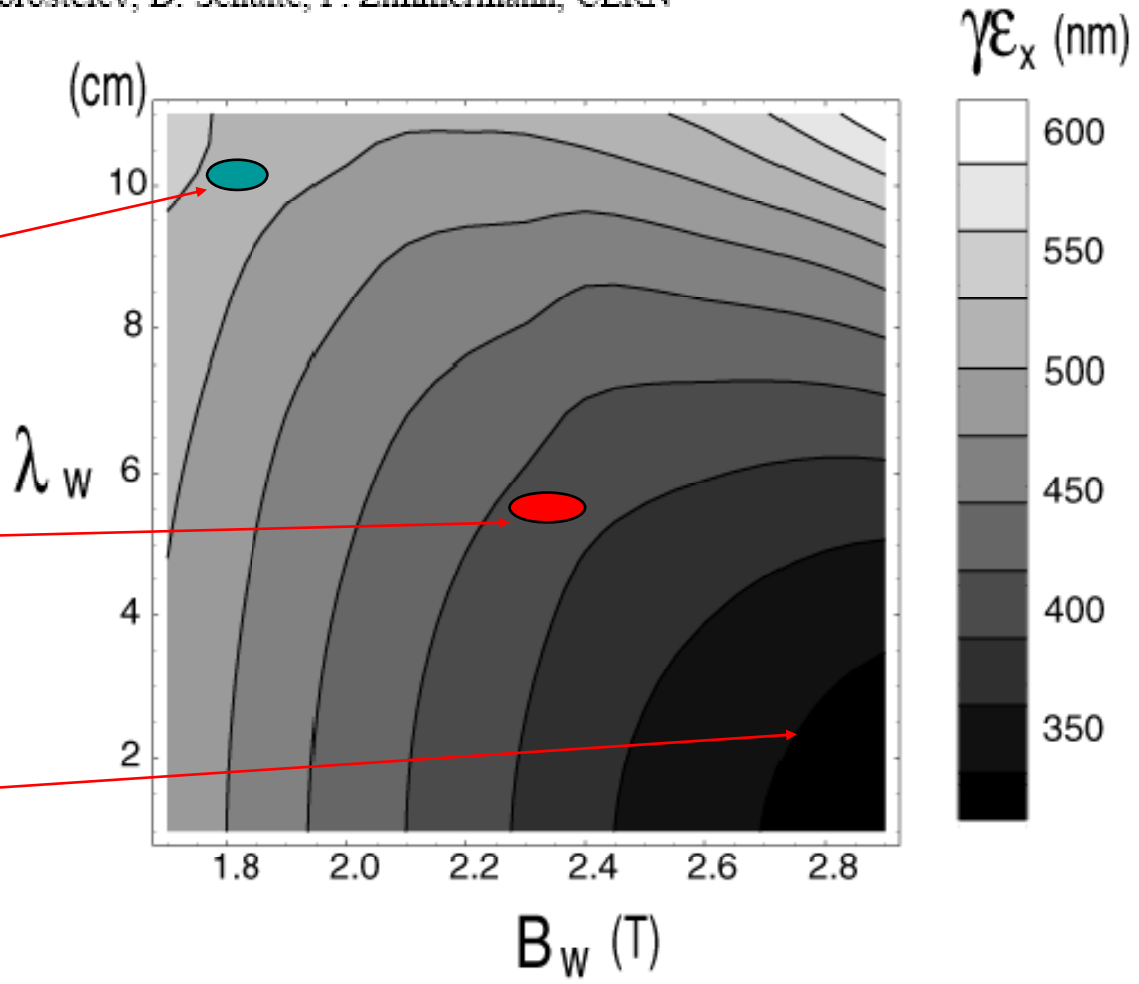
MINIMIZING EMITTANCE FOR THE CLIC DAMPING RING

E. Levitchev, P. Piminov, S. Siniatkin, P. Vobly, K. Zolotarev, BINP
H.H. Braun, M. Korostelev, D. Schulte, F. Zimmermann, CERN

Permanent magnet wiggler

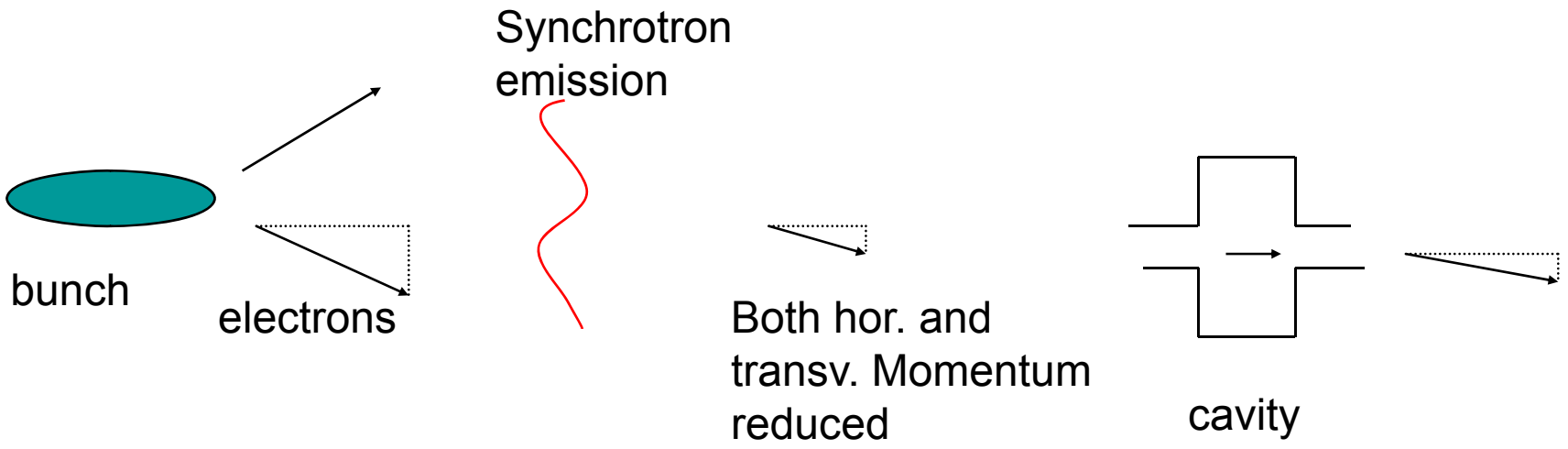
Sc wiggler from BINP

Why not here?



Both damping and excitation of emittance in wiggler

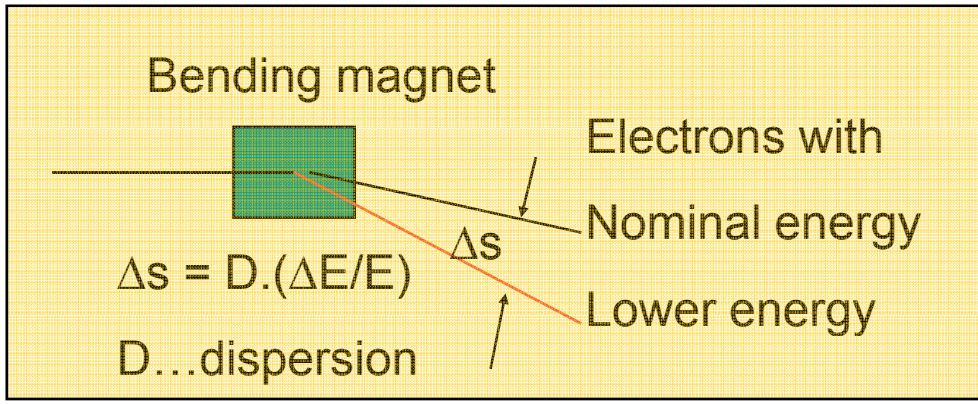
Damping:

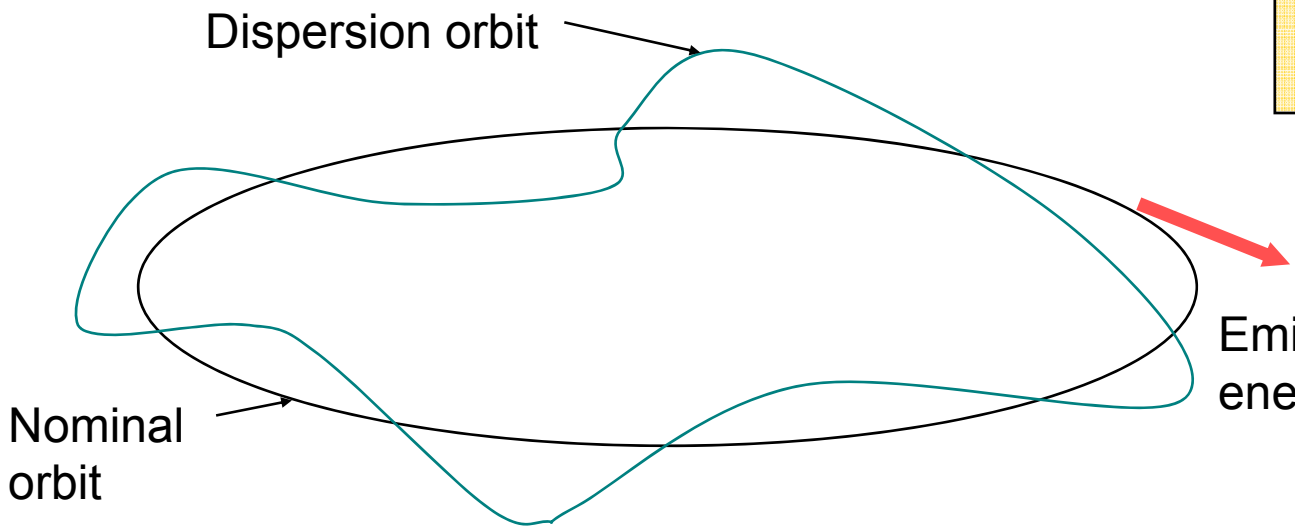


Naive approach: damping the better the higher wiggler field, but

Excitation in wiggler

What defines emittance?



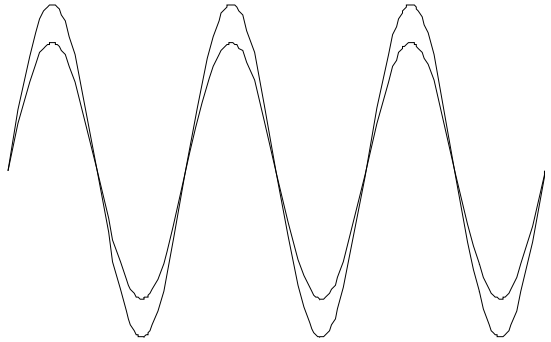


Emission of photons ⇨ electrons lose energy and oscillate around dispersion orbit

Inside the wiggler

Trajectory for lower energy particle

Trajectory for on-energy particle



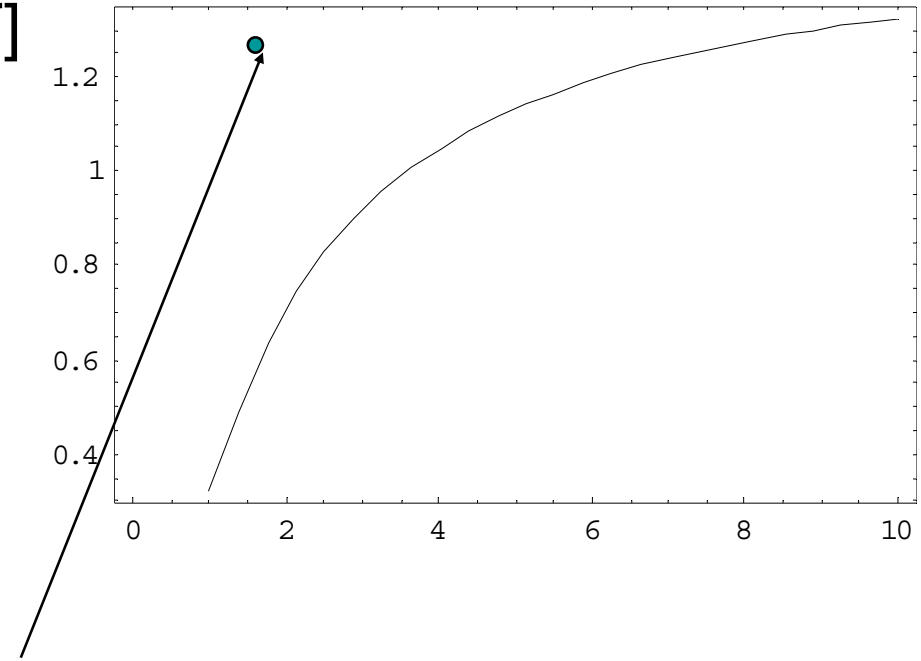
Dispersion the higher the larger period length

SUMMARY: High wiggler fields and short periods are ideal (but a contradiction)

Example $SmCo_5$ Wiggler

$$B[T] = 1.55 \exp(-\pi g / \lambda)$$

B[T]



g = gap in cm, 0.5 cm

λ = Period length

Period length in cm

In comparison: sc wiggler 14 mm period length, 5 mm gap, 1.33 T

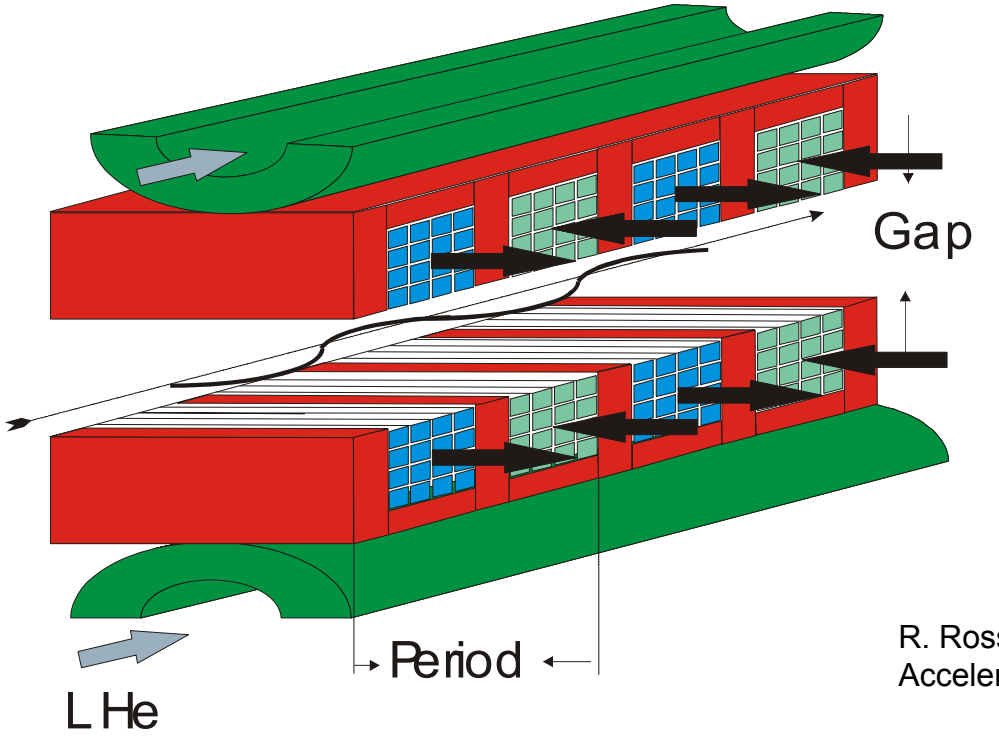
(A. Geisler et al., IEEE Trans. Applied Superconductivity, Vol. 13, No. 2, June 2003, p. 1217)

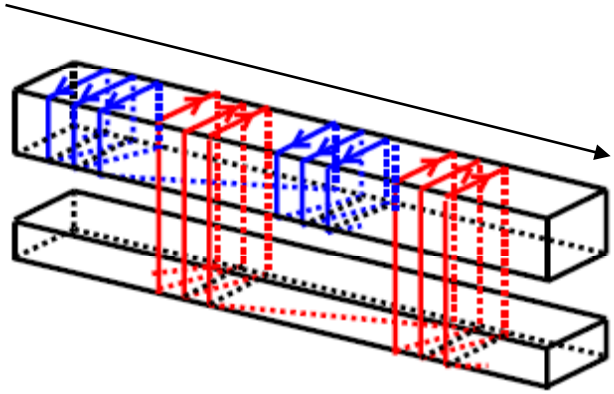
Summary: superconductive wigglers are better for damping rings

Optimized in-vacuum insertion devices developed at ANKA

Wires as close as possible to the beam:

indirectly cooled





R. Rossmanith, H. O. Moser, Proc. European Particle Accelerator Conference 2000, Vienna, Austria

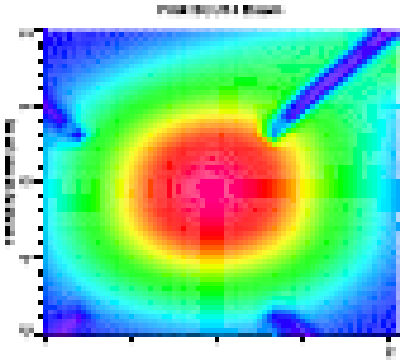
Nowadays established technology: ANKA, Argonne, Berkeley, MAXLAB, ACCEL Instr., Taiwan… (everybody slightly different)

Indirect cooling: no soldered joints ⟹ one wire

ANKA: storage ring 2.5 GeV, max. current 200 mA

NbTi SCU **Demonstrator**

Period length 14 mm, 100 periods, gap 8, 12, 16 mm



First beam March 29 2005

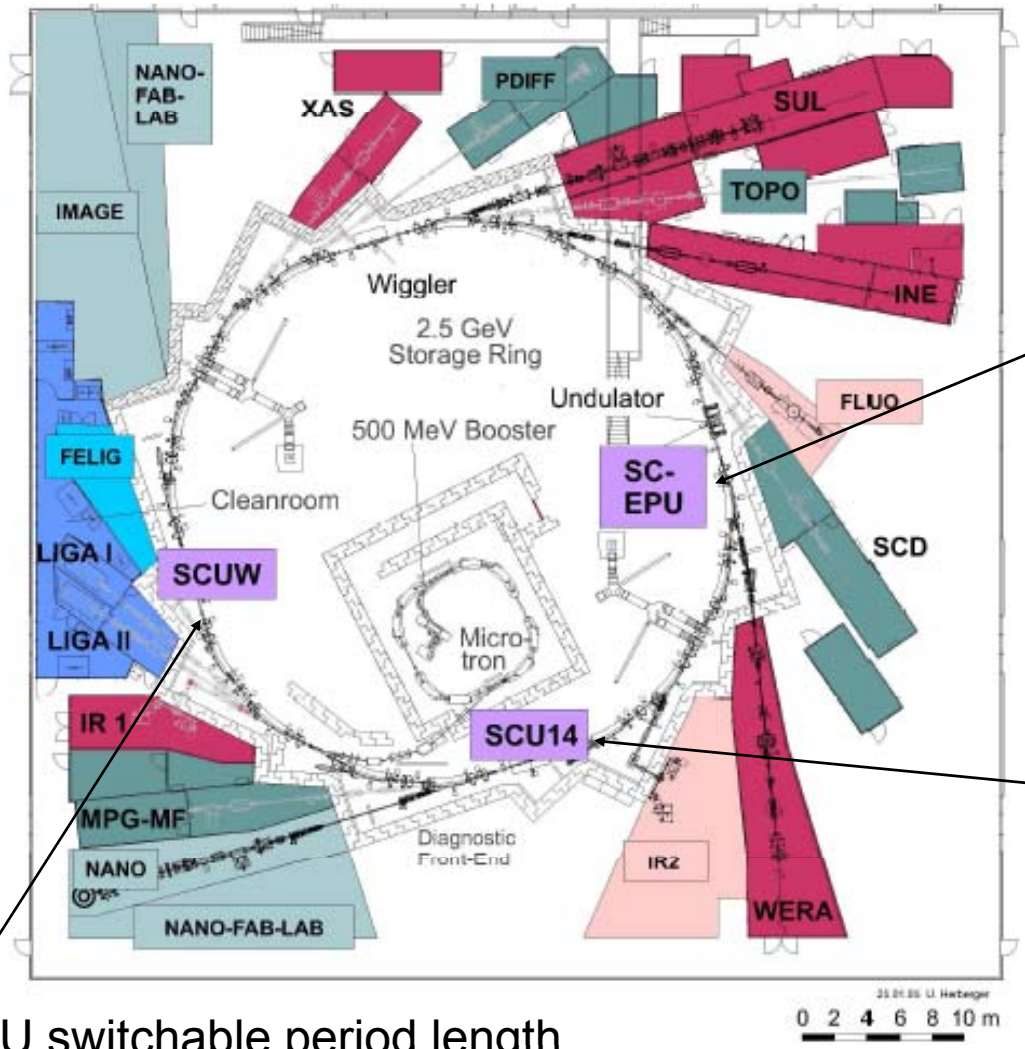
Since March 2005 cold in ANKA

(only routine maintenance of cryo-coolers)

Compatible with normal user operation

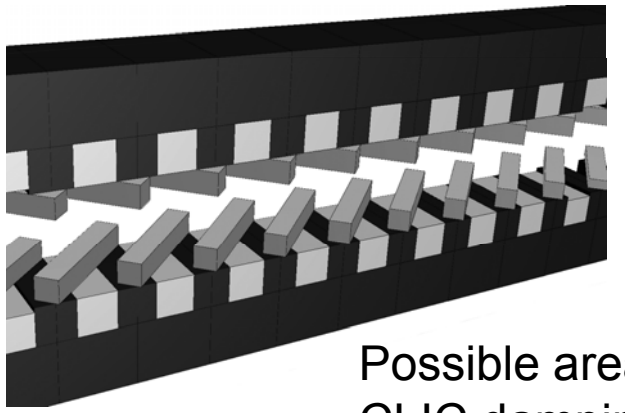
Built by ACCEL Instr. GmbH, Germany

Next generation of superconductive insertion devices at ANKA under design and construction

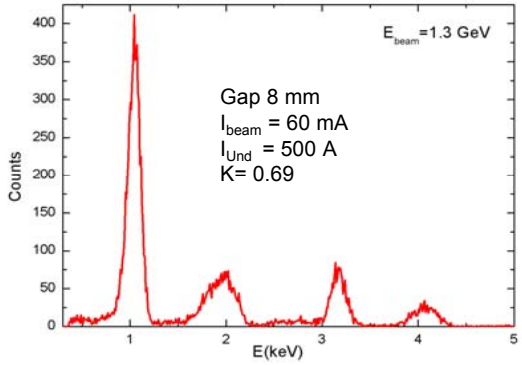


SCU switchable period length

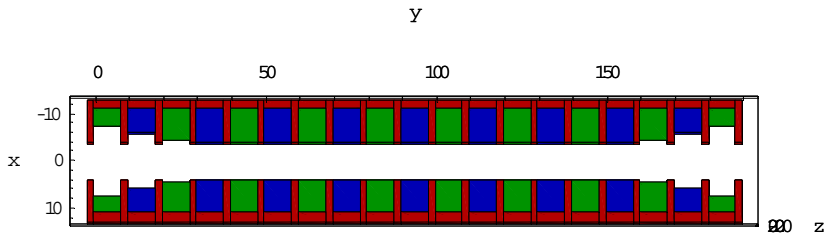
Helical undulator

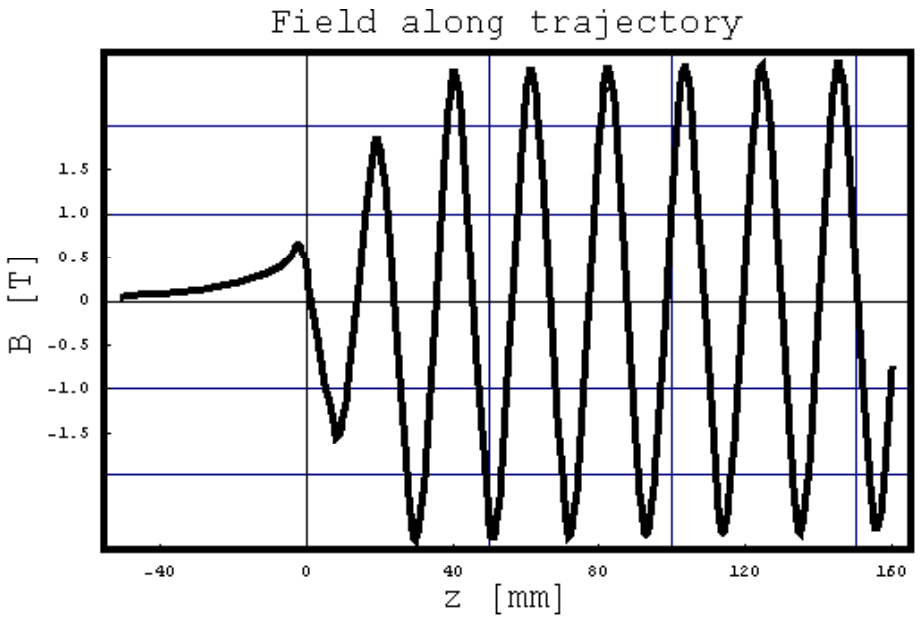


Possible area for testing CLIC damping wiggler



Short version of CLIC damping wiggler

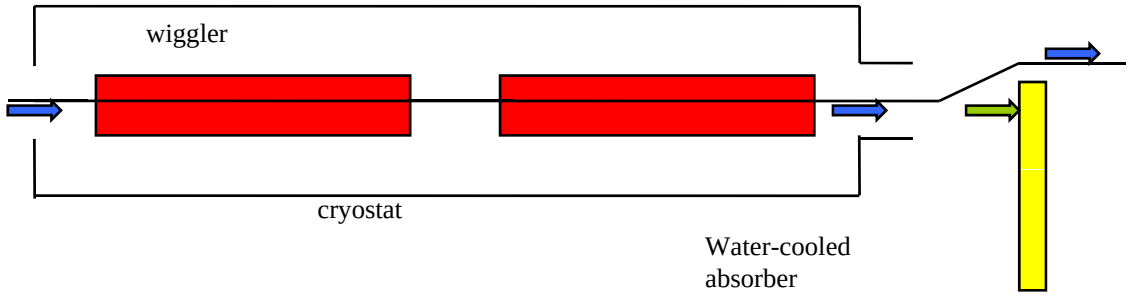




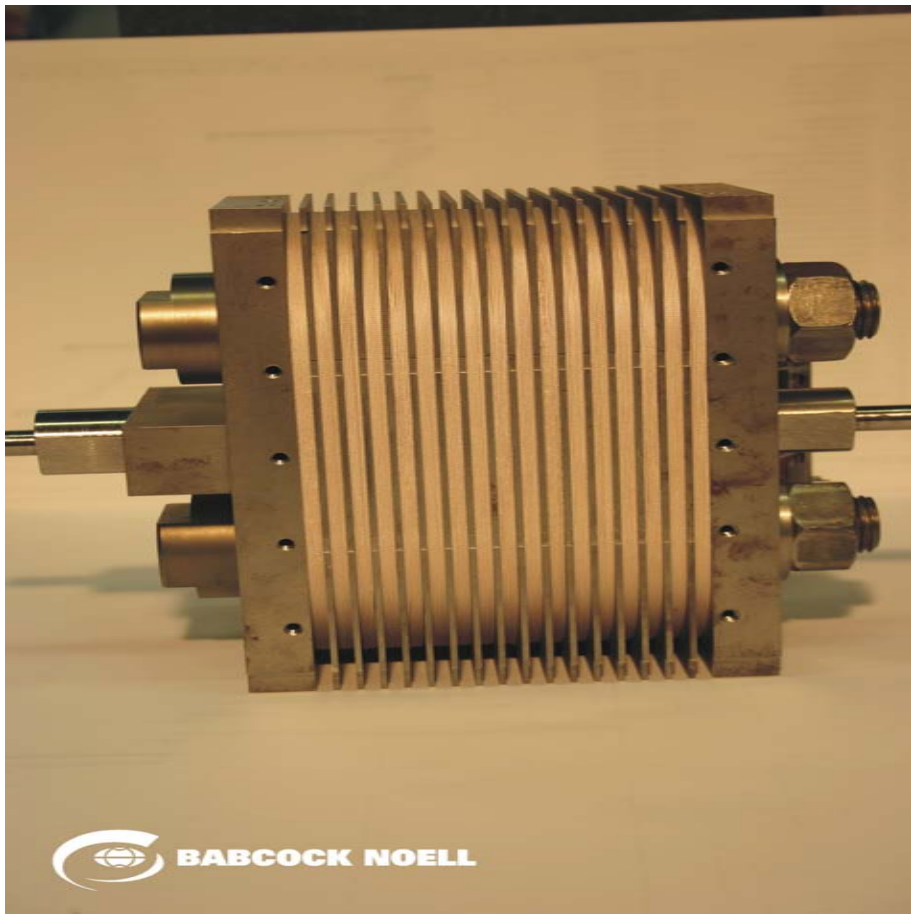
Gap: 5 mm, period length 2.1 cm, 2.7 T,

1 kA/mm^2, k = 5.26

Proposed undulator ensemble for damping rings



Further developments for damping wigglers



Nb_3Sn mock-up

Collaboration with CERN

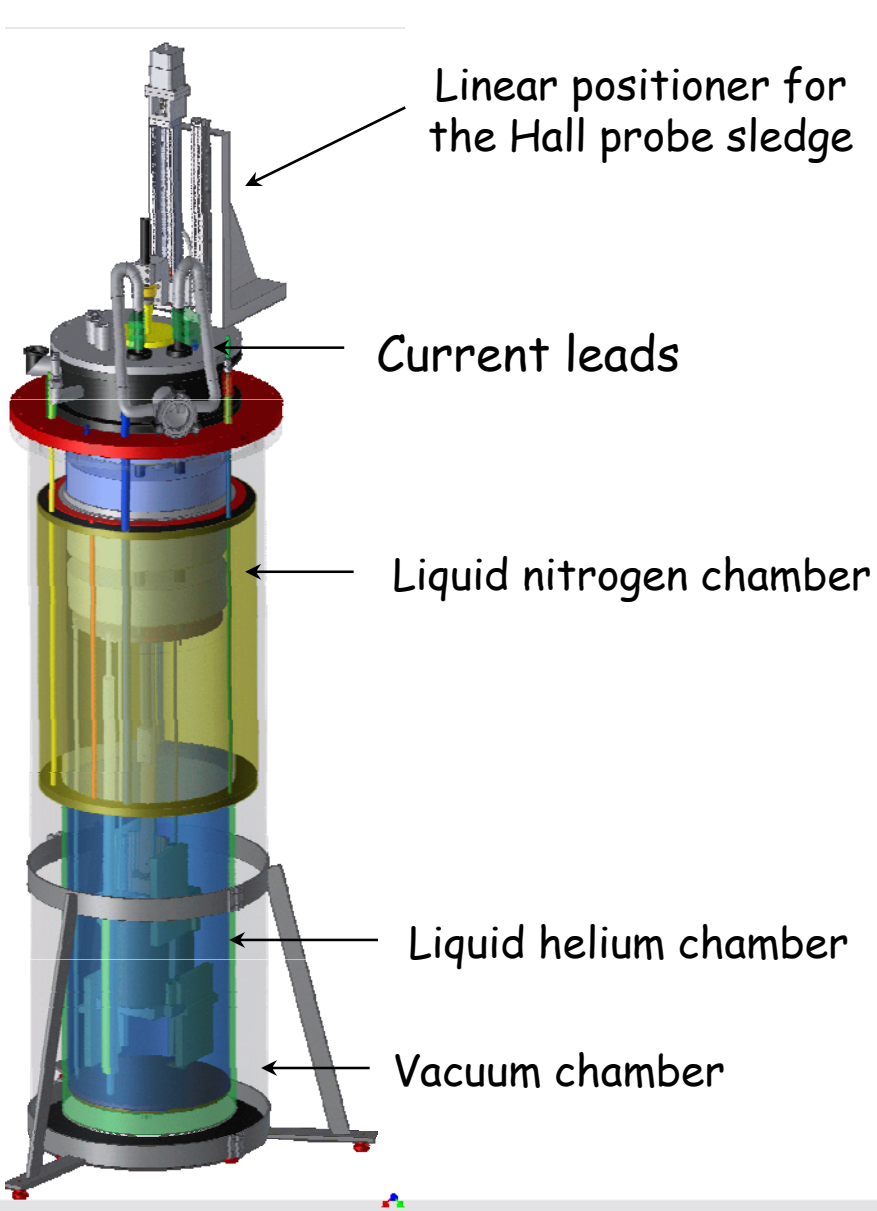
Wires which can tolerate higher heat load from the beam:

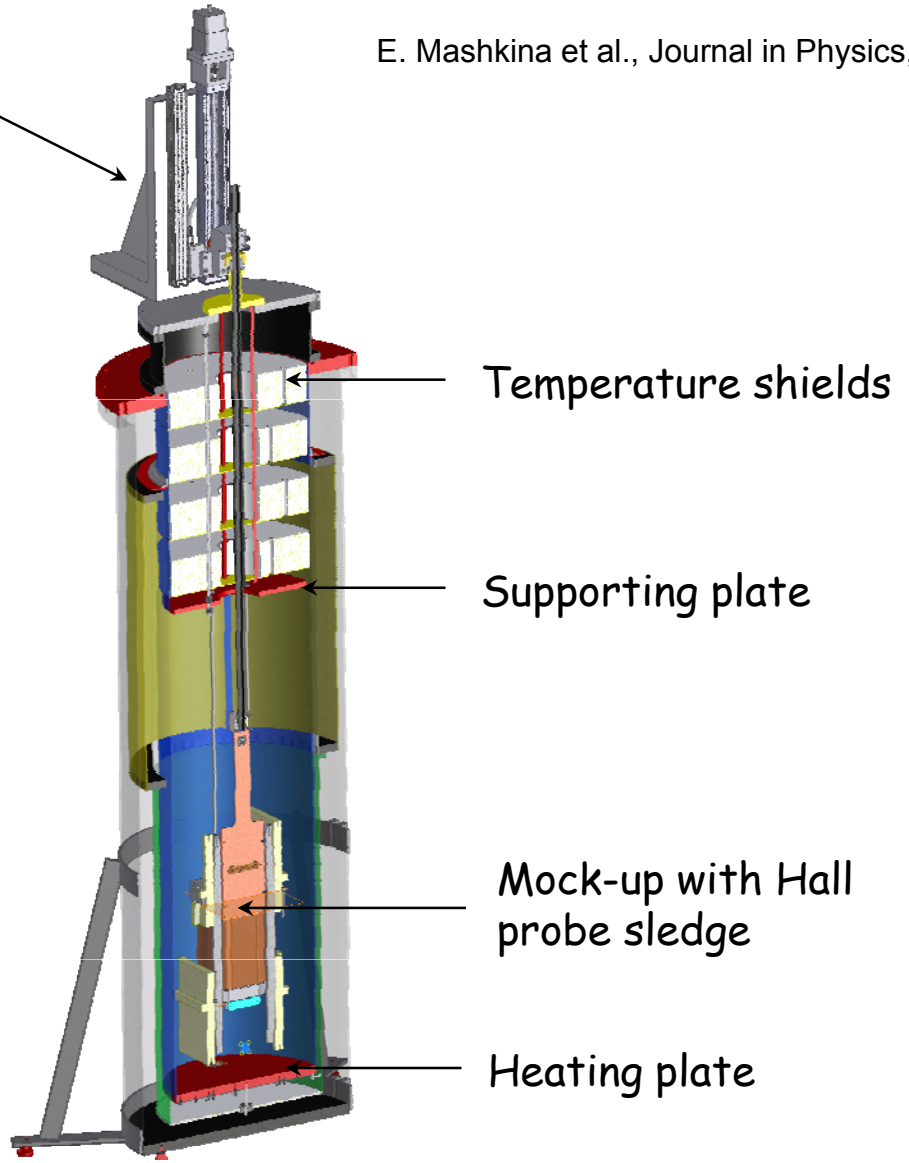
Nb_3Sn or

Magnesiumdiborid MgB_2

Field measuring Device for mock-ups

E. Mashkina et al., Journal in Physics, in print





Summary

a.) sc wigglers with short period and high field ideal for damping rings

b.) ANKA can build together with an industrial and/or scientific partner (CERN and/or BINP) a test device and

c.) test it with beam in ANKA