Karlsruhe Institute of Technology

Superconducting Wigglers and Experiments in ANKA

Axel Bernhard

Laboratory for Applications of Synchrotron Radiation (LAS)

KIT contributions to the CLIC collaboration

Karlsruhe Institute of Technology

Test of CLIC Damping Wiggler Prototypes

Studies on CSR / Microbunching Instabilities

Contracts, resources, 3rd-party funds

KIT contributions to the CLIC collaboration

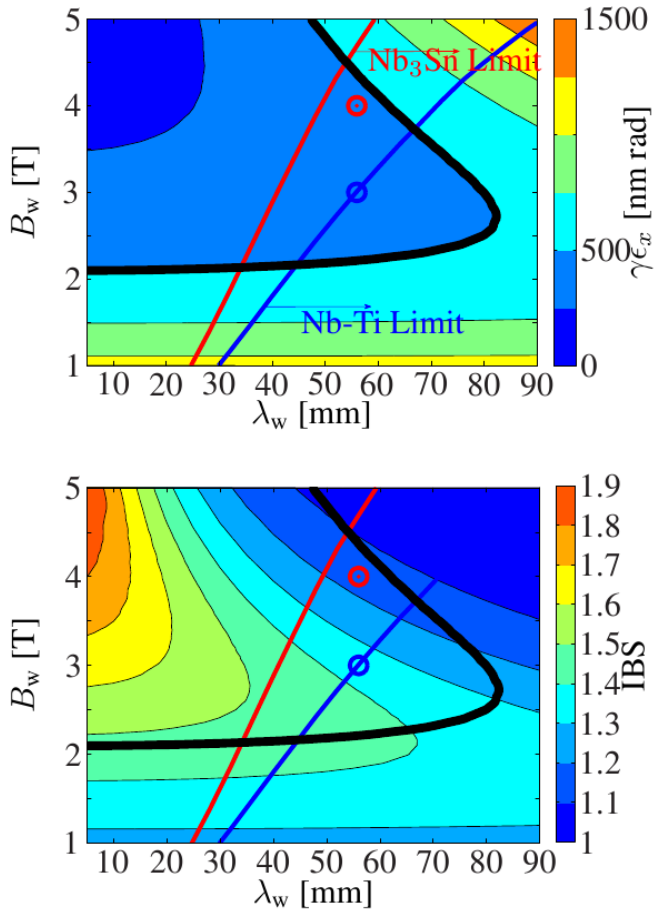
Karlsruhe Institute of Technology

Test of CLIC Damping Wiggler Prototypes

Studies on CSR / Microbunching Instabilities

Contracts, resources, 3rd-party funds

SC coil technology



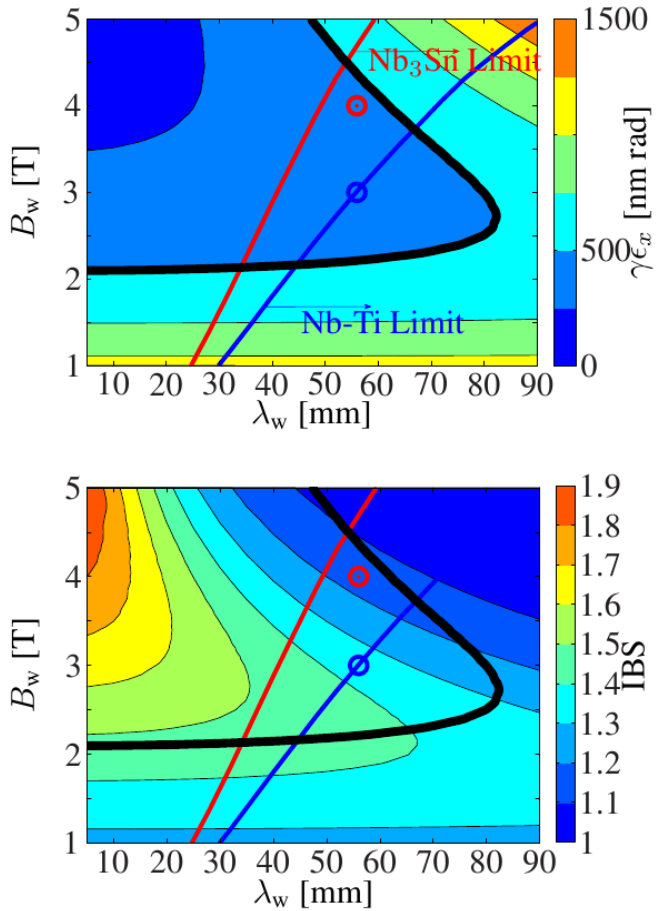
Courtesy: F. Antoniou/D. Schoerling

Figure: Equilibrium normalised horizontal emittance and IBS contribution

Technology Choice

- baseline: Nb-Ti horizontal racetrack coils
  - mature
- advanced: Nb_3Sn vertical racetrack coils
  - increased performance
  - increased heat tolerance
  - development required

SC coil technology



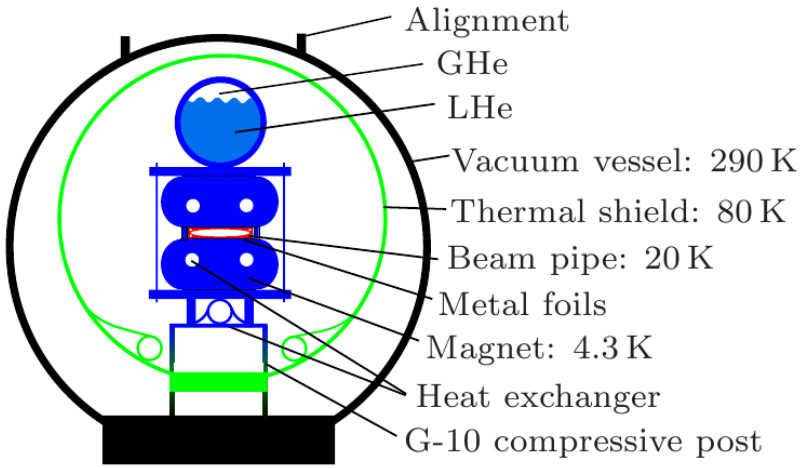
Courtesy: F. Antoniou/D. Schoerling

Figure: Equilibrium normalised horizontal emittance and IBS contribution

Technology Choice

- baseline: Nb-Ti horizontal racetrack coils
  - mature
- advanced: Nb_3Sn vertical racetrack coils
  - increased performance
  - increased heat tolerance
  - development required
- Nb_3Sn technology development at CERN
- Both coil technologies to be tested in ANKA

Cryo concept/component tests



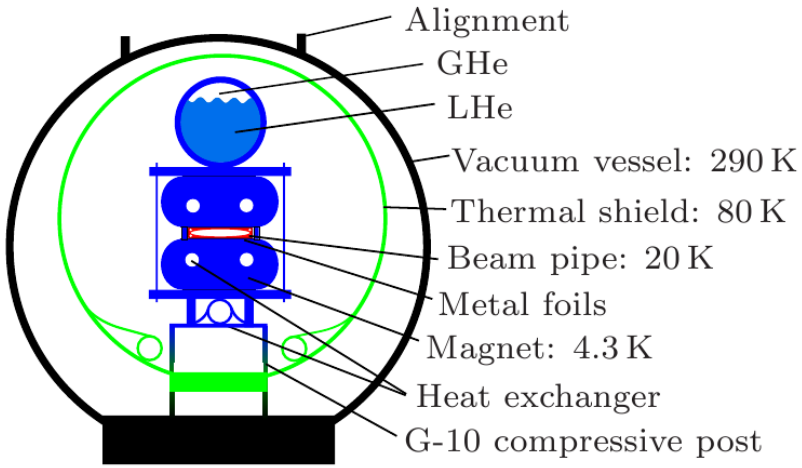
Courtesy: D. Schoerling

Figure: Schematic cryostat layout for the CLIC damping wigglers

CLICDW cryostat

- indirect cooling, forced flow He-circuits
  - adoption of existing concept (BINP/APS)
  - needs to be validated under real operation conditions
- modular design
  - “easy” exchange of coils and beam pipes
  - component tests possible (e.g. beam pipe coatings)

Cryo concept/component tests



Courtesy: D. Schoerling

Figure: Schematic cryostat layout for the CLIC damping wigglers

CLICDW cryostat

- indirect cooling, forced flow He-circuits
  - adoption of existing concept (BINP/APS)
  - needs to be validated under real operation conditions
- modular design
  - "easy" exchange of coils and beam pipes
  - component tests possible (e.g. beam pipe coatings)
- Procurement of two identical cryostats for quick exchange
- System test and component tests in ANKA

Timeline/experimental program

KIT

- CLICDW1 (Nb-Ti HR)

12/2011 Order (BINP)
06/2012 TDR
01/2014 First beam
- basic experimental program

CERN

- Nb_3Sn VR coil R&D
  - short model coils
  - R&D on splicing technique
  - 6-period model

decision on advanced experimental program

Timeline/experimental program

KIT

- CLICDW1 (Nb-Ti HR)

12/2011 Order (BINP)
06/2012 TDR
01/2014 First beam
- basic experimental program

CERN

- Nb_3Sn VR coil R&D
  - short model coils
  - R&D on splicing technique
  - 6-period model

decision on advanced experimental program

- Cryostat CLICDW2

06/2014 revised technical design
04/2015 delivery and site acceptance

- Full-scale Nb_3Sn
  - manufacture (procurement) and test

06/2015 system integration

Timeline/experimental program

KIT

- CLICDW1 (Nb-Ti HR)

12/2011 Order (BINP)
06/2012 TDR
01/2014 First beam
- basic experimental program

CERN

- Nb_3Sn VR coil R&D
  - short model coils
  - R&D on splicing technique
  - 6-period model

decision on advanced experimental program

- Cryostat CLICDW2

06/2014 revised technical design
04/2015 delivery and site acceptance

- Full-scale Nb_3Sn
  - manufacture (procurement) and test

06/2015 system integration

09/2015 CLICDW2 first beam / start of extended experimental program:
- performance test/continuous operation Nb_3Sn
- vacuum chamber coatings

KIT contributions to the CLIC collaboration

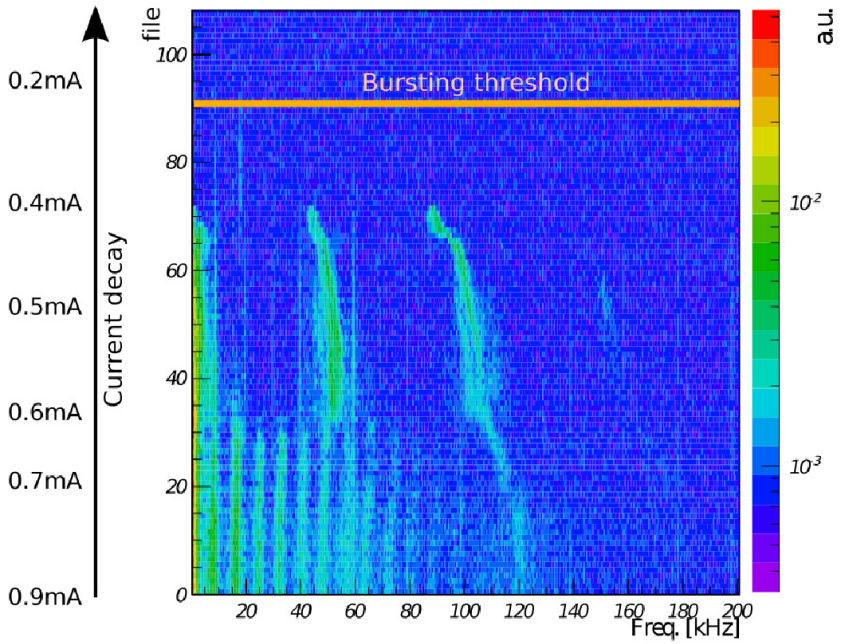
Karlsruhe Institute of Technology

Test of CLIC Damping Wiggler Prototypes

Studies on CSR / Microbunching Instabilities

Contracts, resources, 3rd-party funds

Studies on microbunching instabilities (CSR bursting)



Courtesy: V. Judin

Figure: Spectra of CSR power oscillations in bursting mode as a function of beam current. Bunch length: $\sim$6 ps

CSR studies at ANKA

- Experimental study of bursting instabilities over a wide range of bunch lengths
- Modelling and benchmarking of simulations
- Include identified effects in beam dynamics simulations for CLIC damping rings
- CSR effects in damping wigglers?

KIT contributions to the CLIC collaboration

Karlsruhe Institute of Technology

Test of CLIC Damping Wiggler Prototypes

Studies on CSR / Microbunching Instabilities

Contracts, resources, 3rd-party funds

Contracts, resources, acquisition

CLIC Damping Wigglers

- k-contract to be signed soon
- resources (installation, commissioning, basic R&D program):
  - investments: 1.0M€+ beam time (CERN contributes 2.3M€)
  - personnel: 4 scientists + 4 technicians part-time
- 3rd-party fund acquisition activities (extended R&D program)
  - joint application with BINP for a federal grant for German-Russian collaboration submitted (operation, SR/magnetic characterisation)
  - application for funding in the framework of the German *Verbundforschung* in preparation (beam instrumentation and experiments)

CSR studies

- legal framework to be discussed
- resources: personnel: 1 scientist + 1 PhD-student part-time