Specifications for CERN Nb-Ti wiggler and SC wiggler activity planning

Daniel Schoerling

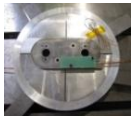
November 15th, 2010

CERN

Nb_3Sn Technology

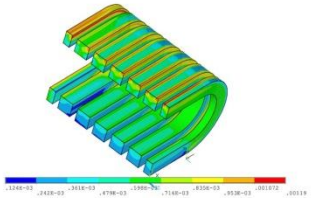
First Tests Short Model

- Conceptual Design for Short Model (Design Office Support needed!)
- 5 Test Coils for Insulation and Heat Treatment tests
- One Vertical Racetrack Coil ready to be tested
- 2-period wiggler in mirror and full configuration (planned)



Small Prototype

- Modules, Design and Test
- Joint Testing
- Field Quality Measurements at CASPER at ANKA



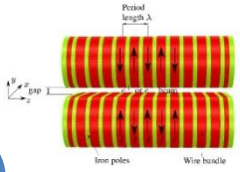
Full-Scale Prototype

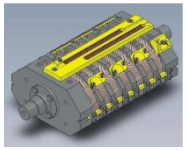
- Full Scale Nb_3Sn Prototype with cryogenics to be tested at ANKA
- Design and manufacturing at CERN but with synergies from Nb-Ti wiggler!

Nb-Ti Technology

First Tests Short Model

- Conceptual Design for Short Model
- 2-Period Short Model, successful tested at CERN in mirror configuration
- Short Model at BINP successful tested

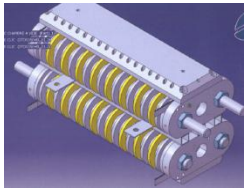




CDR

Small Prototype

- Modules, Design and Test
- Joint Testing
- Field Quality Measurements at CASPER at ANKA



Full-Scale Prototype

- Full Scale Nb-Ti Prototype with cryogenics to be tested within the collaboration framework with ANKA, Karlsruhe, Germany
- Design: Collaboration of ANKA, BINP and CERN.
- Manufacturing at BINP

SCU14 in ANKA

TDR

DEPENDING ON APPROVED FUNDING!

Nb-Ti Prototype Purpose and Strategy

- Small workshop on 3rd December will be the kick-off of a new collaboration between BINP, CERN, and KIT to resolve all technological challenges of CLIC damping wigglers. It will address:
  - SC coil design
  - Magnetic measurements
  - Quench protection and magnet protection
  - Cooling (Cryogenic liquids and cryostat)
  - Vacuum
  - Coating
  - Current leads, etc.
- Vertical Racetrack Coils: 1) Mass production possible, 2) Winding scheme ideal for Nb_3Sn because of favourable force distribution
- Cryostat can be opened non-destructively: Nb-Ti coils will be tested first. When, coils can be exchanged with Nb_3Sn coils, whole infrastructure will be Nb_3Sn ready (current leads and PC up to 1100 A, etc), almost no extra investment for testing the Nb_3Sn coils.

Nb-Ti Prototype

- Tentative Parameters:

Vacuum-Gap	13 mm
Magnet-Gap	18 mm
Period	56 mm
Maximal magnetic field	3.6 T
Operating magnetic field	3 T
I_{op}/I_c	83%
Inductance	1.6 H
Stored Energy at 600 A	250 kJ

Nb-Ti Prototype Tentative Schedule

2010	December	Conceptual Design of ANKA Wiggler
2011	February	Contract signed
	May	Technical review of manufacturing drawings
	October	Manufacturing of parts are completed
2012	March	SC coils are wound, potted and assembled
	May	SC coils are trained, and first magnetic acceptance test performed. Cryostat, beam-pipe and auxilaries are ready
	August	SC Coils are assembled in cryostat, magnetic acceptance test at BINP performed
	September	Wiggler at ANKA, cryoplant ready
	October	Wiggler installed in ANKA

Nb-Ti Prototype Tentative Budget

- The costs are based on estimates from the corresponding experts at CERN and BINP (± 20%):

Budget (kCHF)	2011	2012
Cryoplant	400	400
Cryo-Magnet including beam-pipe, PC, current leads, measurements at BINP	390	390
QPS	30	0
Infrastructure ANKA	70	100
Misc (Travel)	25	25
TOTAL	**915**	**915**
ANKA Participation	**300**	**300**
CERN Participation	**615**	**615**

Nb_3Sn Advanced Design

- In parallel with the Nb-Ti wiggler prototype we will advance with the Nb_3Sn design, first tests have shown the feasibility of Nb_3Sn.
- Nb_3Sn technology for wiggler is less demanding than for accelerator magnets (inner triplets, LHeC, 11 T dipole projects) because of modular geometry, force distribution, and short unit lengths of wire.

Open issues:

- Nb_3Sn short model testing (unavailability of Block 4 until April 2011).
- For a first full prototype around 20 km strand are needed (approx. 200 kCHF). Strand procurement has a long lead time; first discussions were made for wire procurement. Funding has to be ensured.
- Nb_3Sn prototype design is planned to be finished by the end of 2011, but production delay due to LHC consolidation in 2012.

Nb_3Sn Wiggler Budget

Budget (kCHF)	2010	2011	2012	2013
Material	20	220	60	30
Design Office	18	45	55	25
Workshop	32	30	50	80
FSU	50	50	50	100
Misc (Travel)	24	5	5	25
TOTAL	**144**	**350**	**220**	**260**

Total CERN/CLIC Damping Wiggler Budget

Budget (kCHF)	2010	2011	2012	2013
Nb-Ti wiggler	0	615	615	0
Nb_3Sn wiggler (relies on Nb-Ti spending)	144	350	220	260
TOTAL	**144**	**965**	**835**	**260**