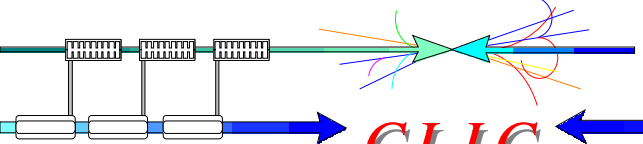
CLIC Damping rings Wigglers

Remo Maccaferri

Otober 14, 2009

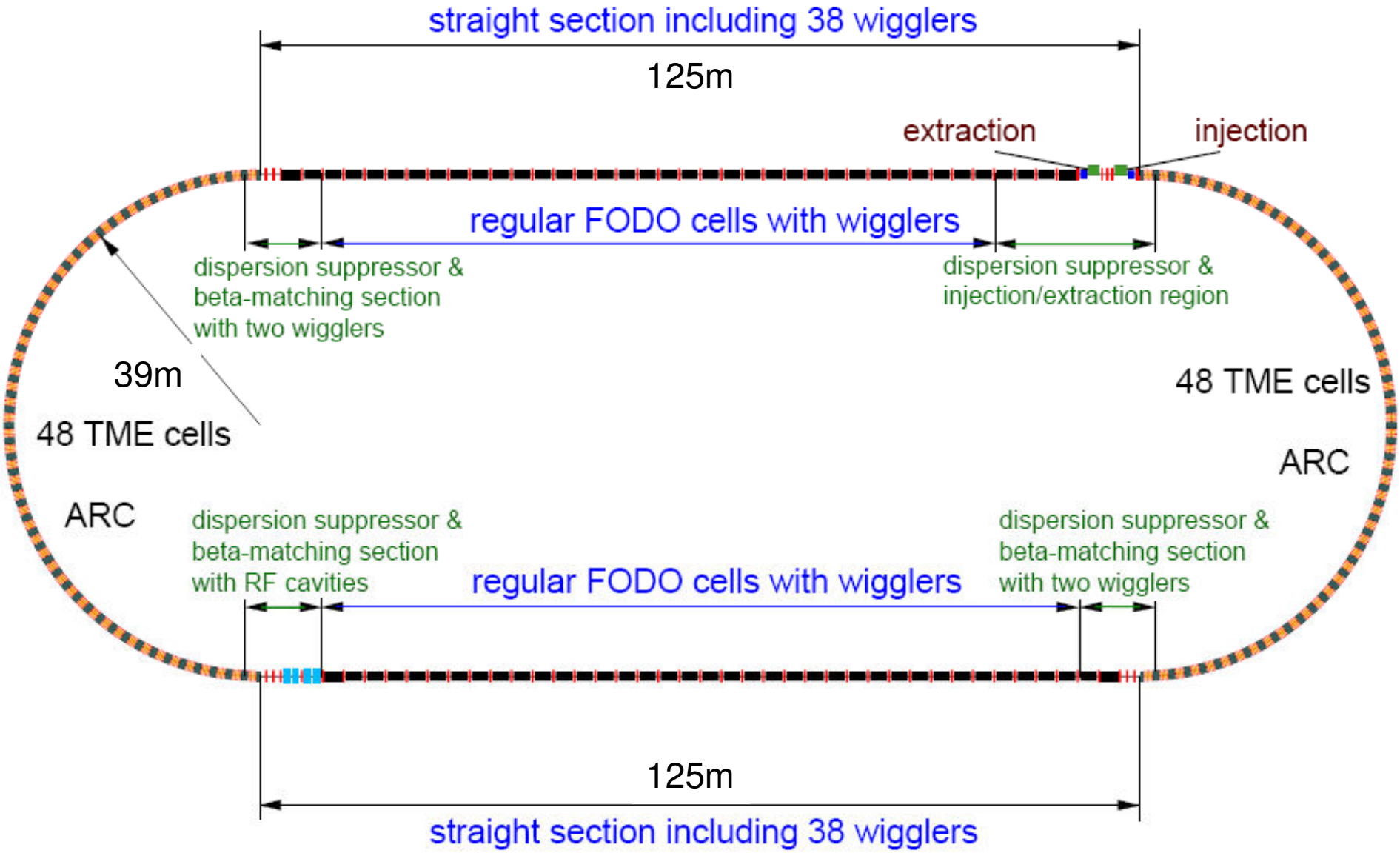
Injector complex



CLIC

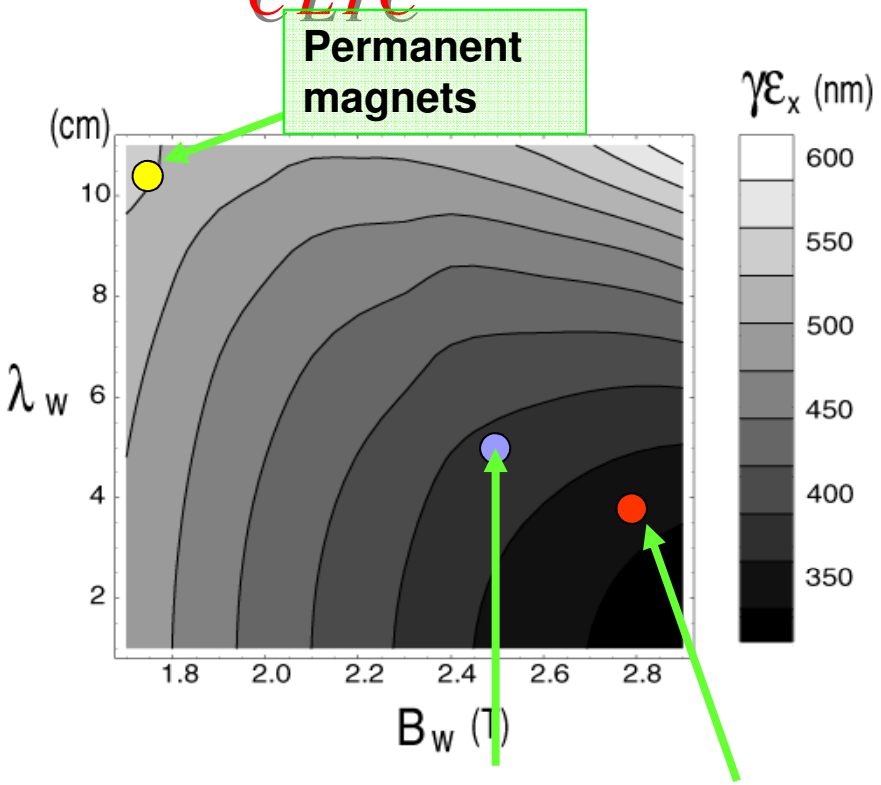
3 TeV Baseline configuration

DR layout


straight section including 38 wigglers
125m
extraction
injection
regular FODO cells with wigglers
dispersion suppressor &
beta-matching section
with two wigglers
dispersion suppressor &
injection/extraction region
39m
48 TME cells
ARC
48 TME cells
ARC
dispersion suppressor &
beta-matching section
with RF cavities
regular FODO cells with wigglers
dispersion suppressor &
beta-matching section
with two wigglers
125m
straight section including 38 wigglers

Wigglers effect with IBS

CLIC



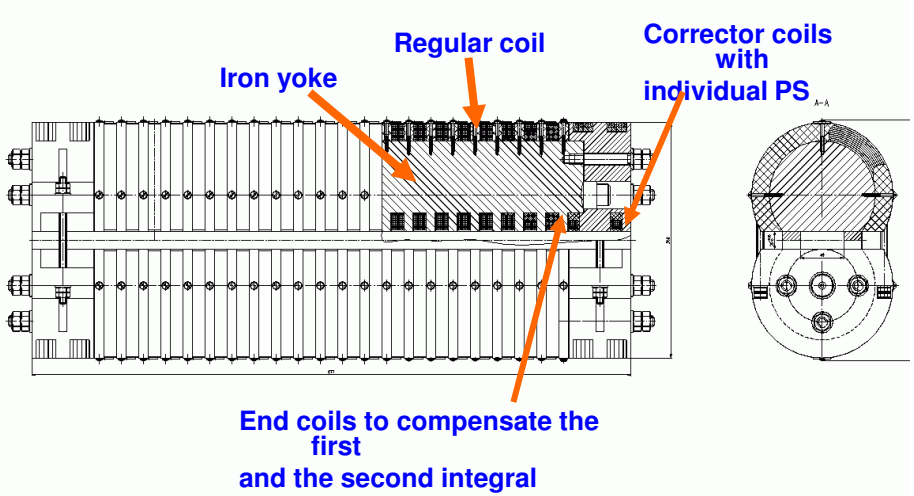
Parameters	BINP	CERN
B_{peak} [T]	2.5	2.8
λ_W [mm]	50	40
Beam aperture full gap [mm]	13	13
Conductor type	NbTi	Nb_3Sn
Operating temperature [K]	4.2	4.2

- Stronger wiggler fields and shorter wavelengths necessary to reach target emittance due to strong IBS effect
- Two wiggler prototypes
  - 2.5T, 5cm period, built and currently tested by BINP
  - 2.8T, 4cm period, designed by CERN/Un. Karlsruhe
- Current density can be increased by using different conductor type
- Prototypes built and magnetically tested (at least one by CDR)
- Installed in a storage ring (ANKA, CESR-TA, ATF) for beam measurements (IBS/wiggler dominated regime)

NbTi Wiggler BINP Design

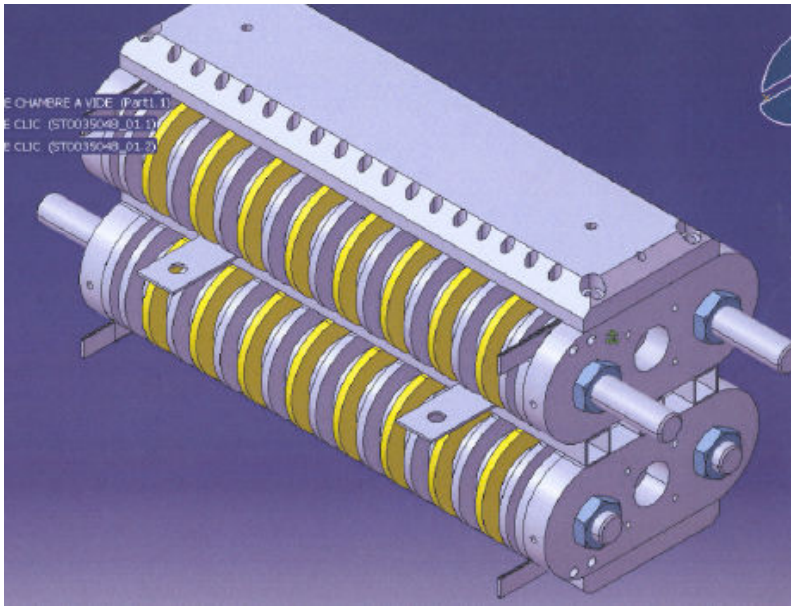
P. Vobly, et al., 2008

- Present design uses NbTi wire in separate poles clamped together (2.5T, 5cm period)
- Wire wound and impregnated with resin in March
- Prototype assembled including corrector coil and quench protection system by end of April
- Field measurements started at in June showing poor performance (50% of the expected current)
- Waiting for delivery at CERN to investigate the problems and possibly to fix-its.

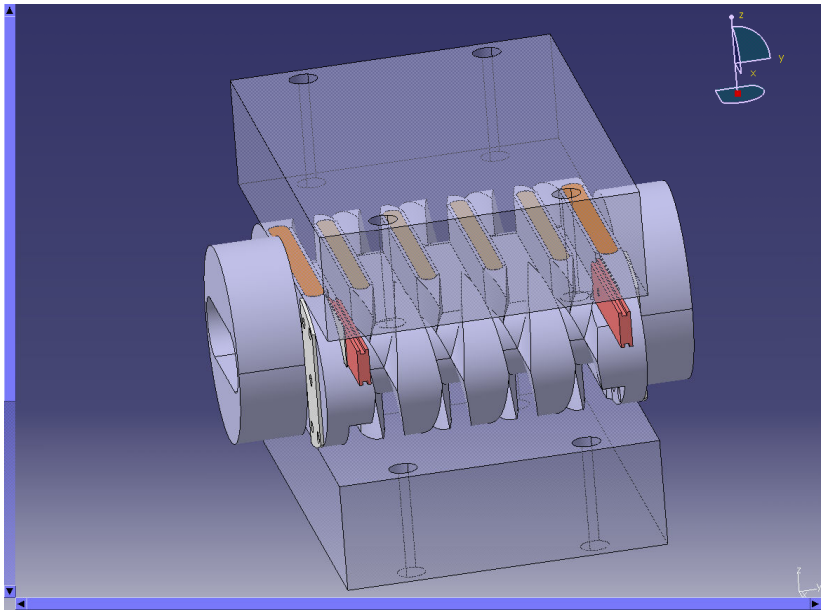


Nb_3Sn Wigglers CERN Design

Two short models are under study and construction….

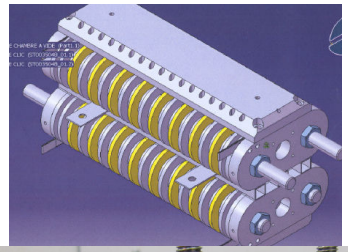


Vertical Race-track coils (WR)



Double Helix-like coils (WH)

Vertical Race-track coils (WR)



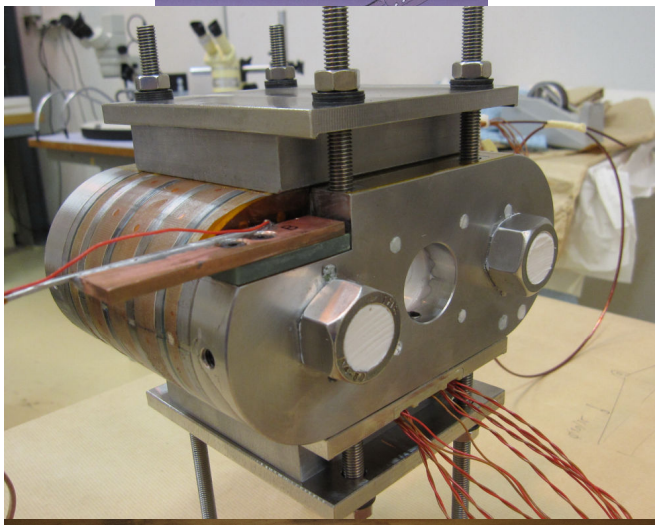
Modeling:

-Magnetic 2D : Done (Maccaferri, Schoerling)

-Forces calculations : Done (Maccaferri, Schoerling)

-Magnetic 3D : On going (Schoerling, Bernhart)

-ANSYS : To be done (Schoerling end 2009)

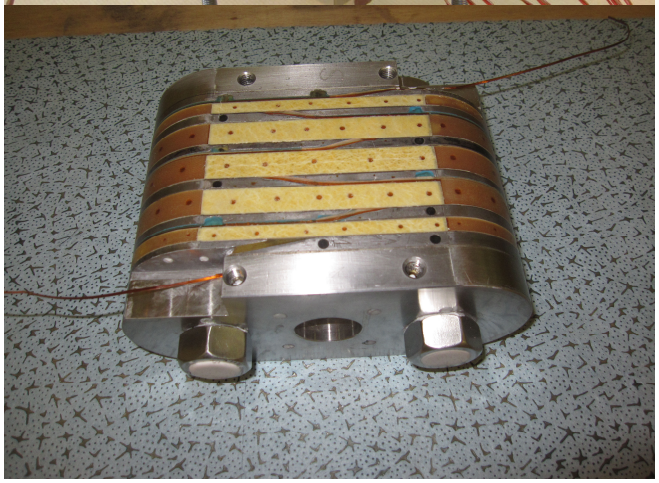


Prototyping:

-Mechanical design : Done(to be updated)

-Winding and impregnation : Done (J.Mazet, JC Clement)

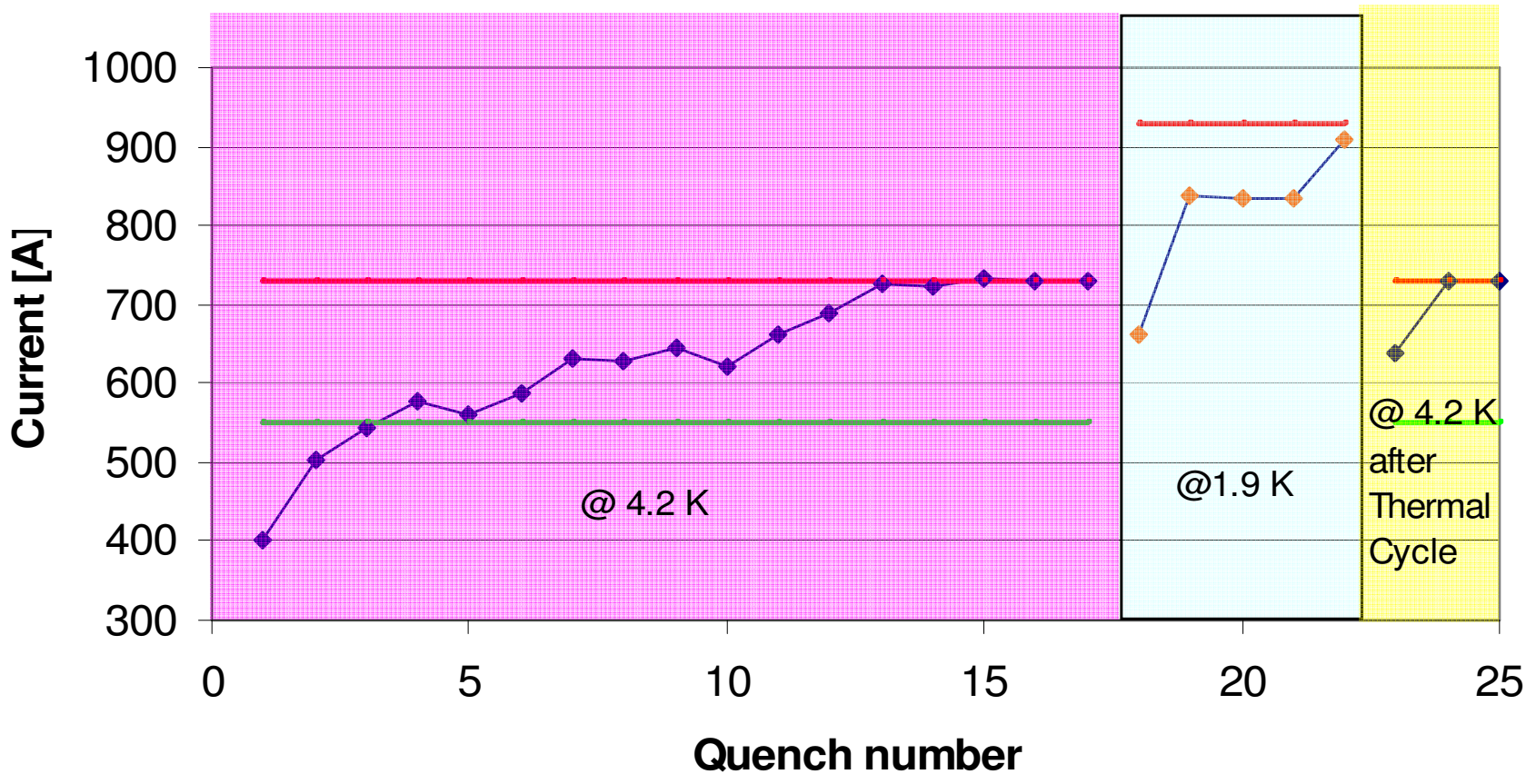
-Cold test : Done week 41 (09)



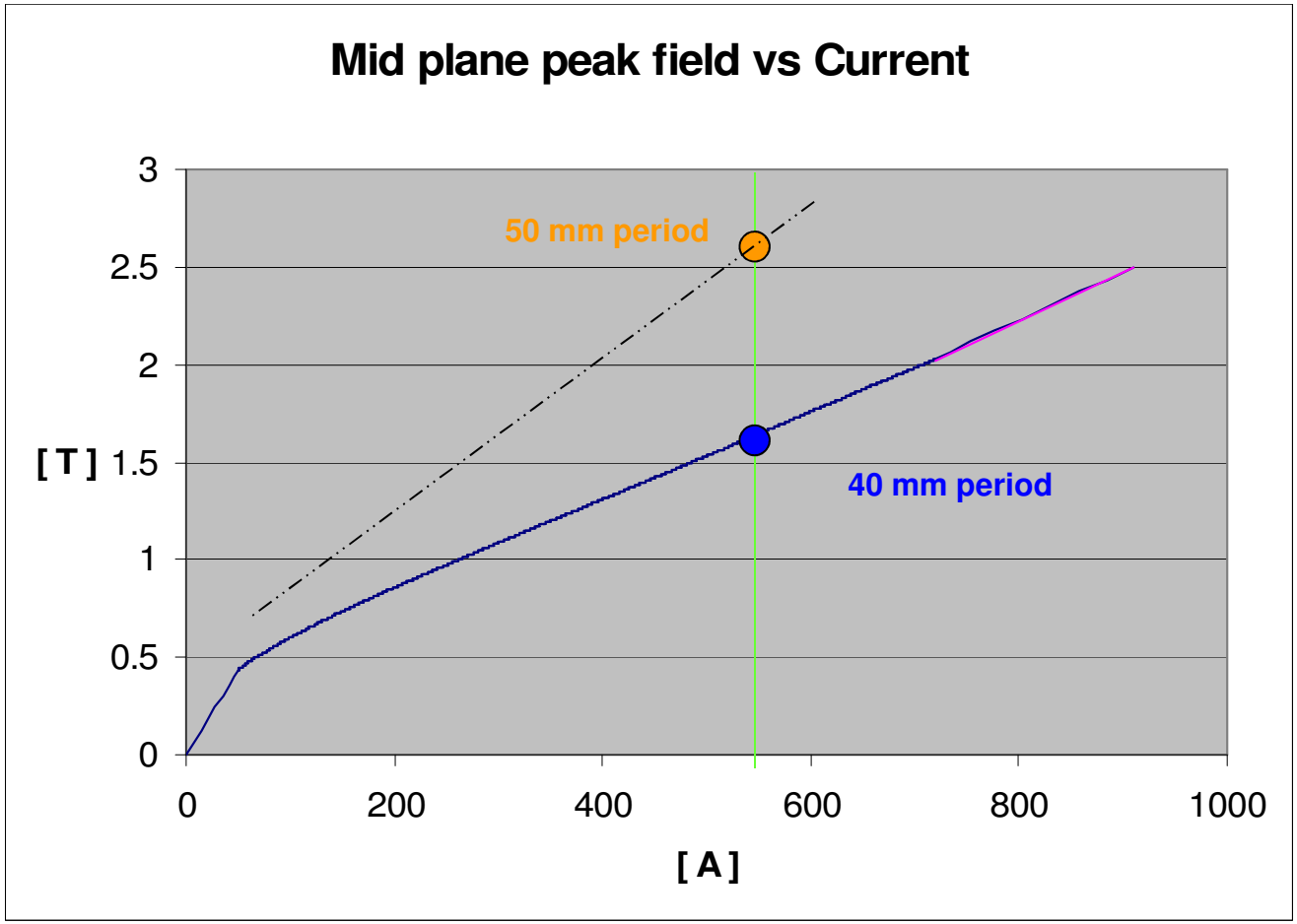
BUT…we have used NbTi wire.

Nb_3Sn need more time & resources..

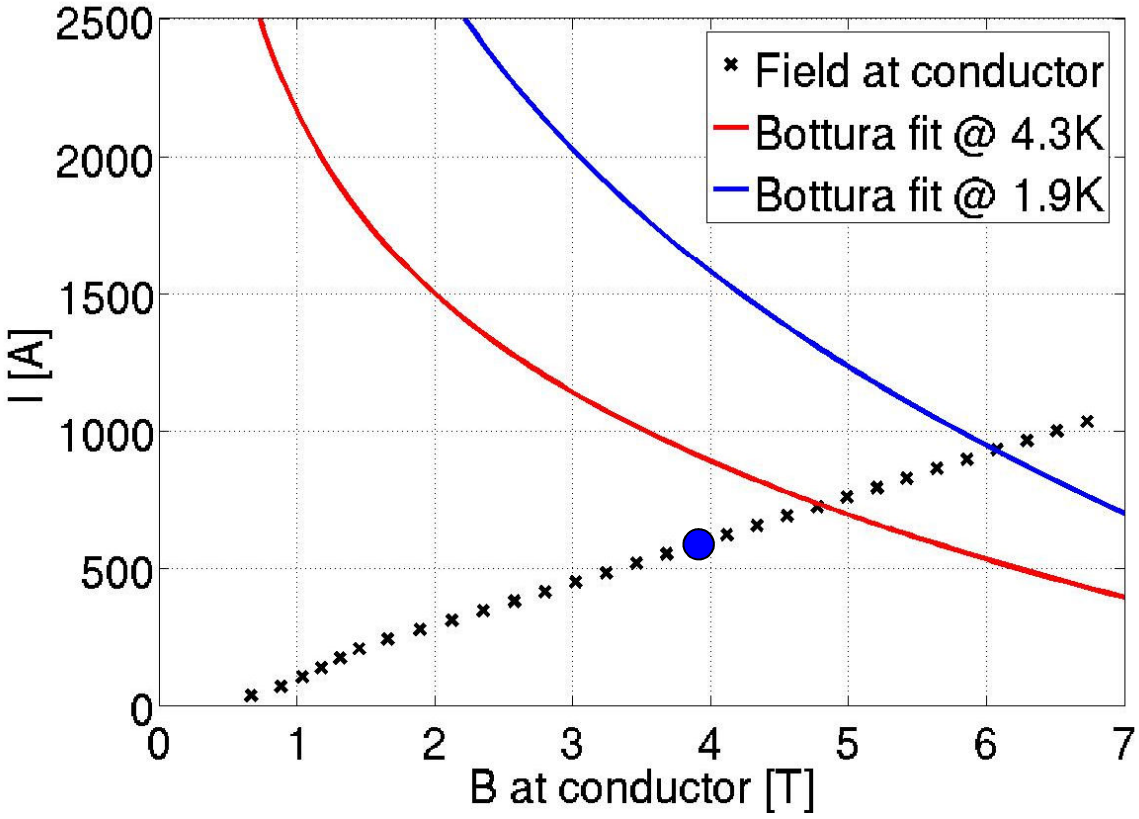
Training of the CLIC wiggler short model (2 periods 40 mm & 16mm gap)



Obtained Mid-plane peak field vs. current



Operating load line



Double Helix-like coils (WH)

Modeling:

-Magnetic 2D : Done (R.Maccaferri)

-Forces calculations : Done (R.Maccaferri)

-Magnetic 3D : Done (S.Bettoni)

-ANSYS calculations : Done (T. Renaglia)

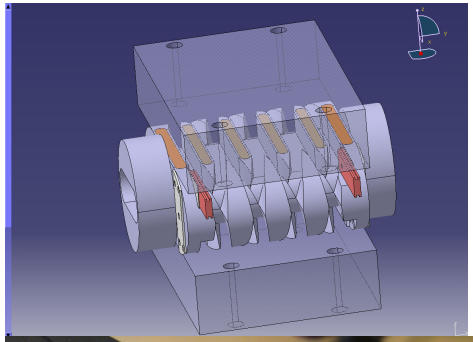
Prototyping:

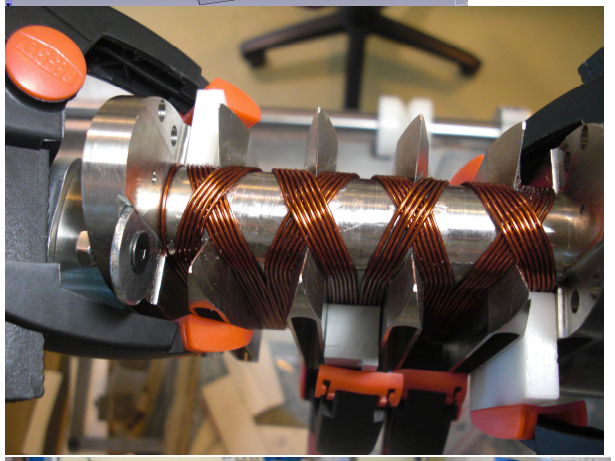
-Mechanical design : Done (Renaglia, Maccaferri)

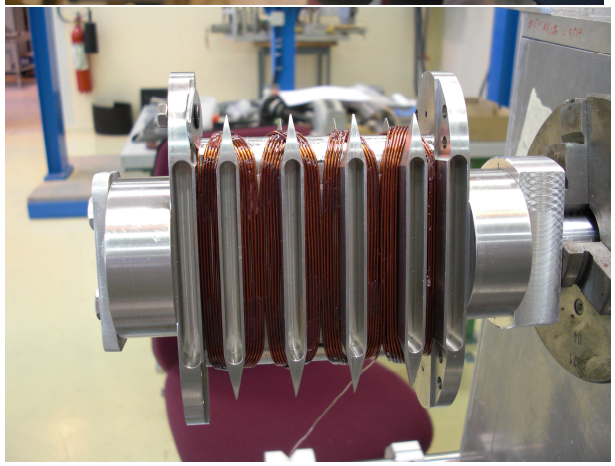
-Winding and impregnation : On going

-Cold test : Not yet defined

The winding process is not yet fully mastered (need time& resources)



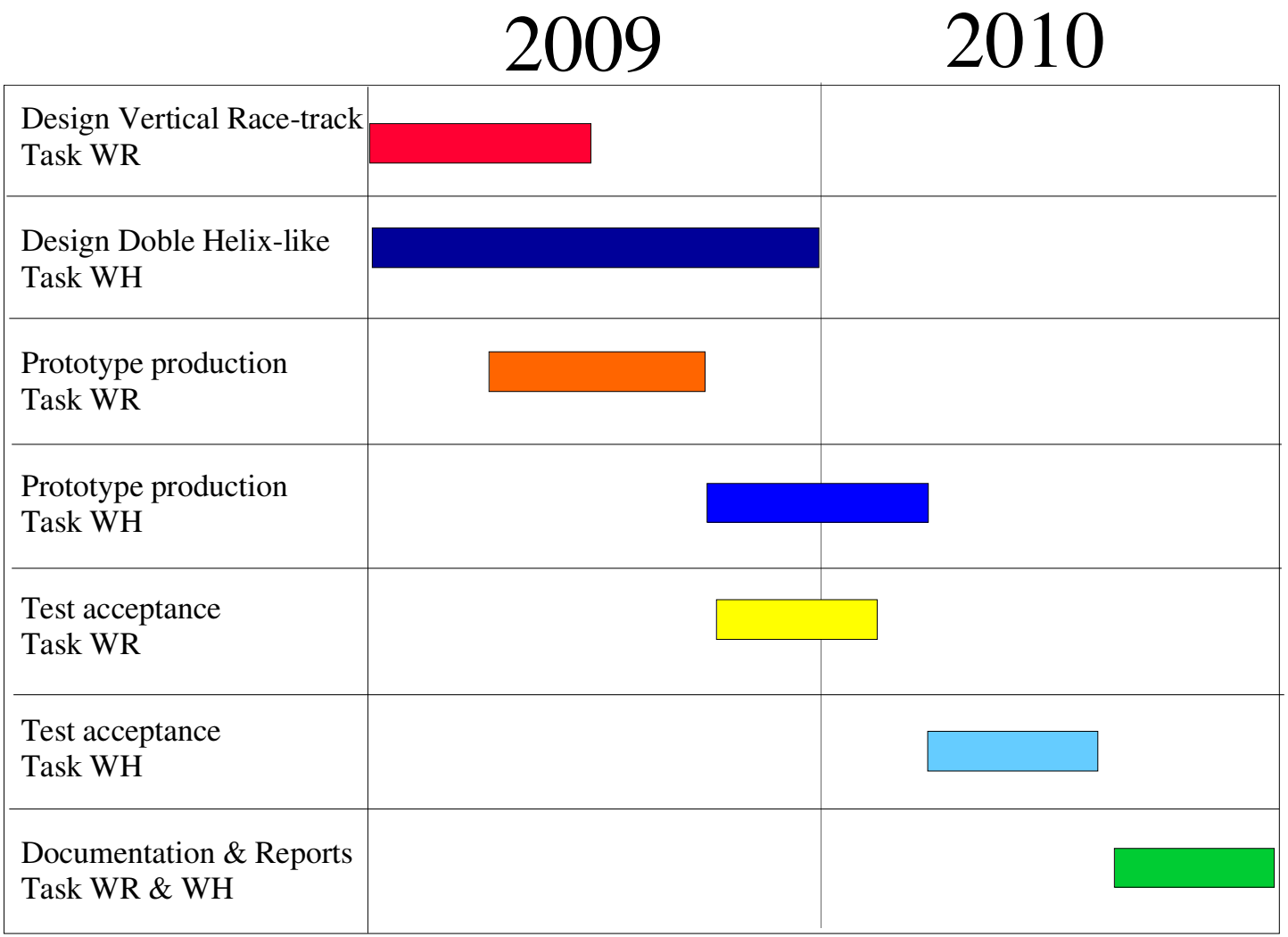


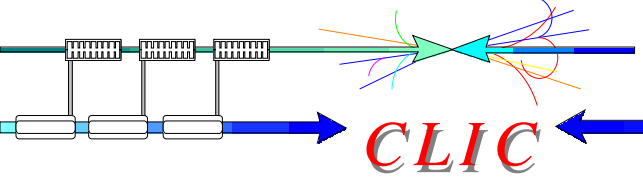


Summary

- **DR performance is based on super-conducting wigglers**
  - Prototype on "conventional Nb-Ti" wire technology built at BINP failed. CERN is asked to help for solution(to be defined).
  - The NbTi CERN Short model Fulfil the requested specifications
  - More challenging wire technologies and wiggler designs are under studied at CERN and Un. Karlsruhe/ANKA but not yet tested.
  - Final measurements from short prototypes to be expected by the CDR (October 2010).

Planning


2009
2010
Design Vertical Race-track
Task WR
Design Doble Helix-like
Task WH
Prototype production
Task WR
Prototype production
Task WH
Test acceptance
Task WR
Test acceptance
Task WH
Documentation & Reports
Task WR & WH



CONCLUSIONS

This project has been delayed by one year due to LHC repairs. Despite that we could carry on a crash NbTi program to demonstrate the feasibility of a 50 mm period 16 mm gap fulfilling the required specifications.

To complete our program, we need more support and follow-up from the laboratory side.