Indirect cooled superconductive wiggler magnet

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Budker Institute of Nuclear Physics, Novosibirsk, Russia

The history of superconductive ID fabrication in the Budker INP

- 1979 – first in the world 3.5 Tesla superconducting 20 pole wiggler (SCW) for VEPP-3
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- 2009 – 4.2 Tesla 49 pole SCW for DLS, England
- 2009 – 4.1 Tesla 35 pole SCW for LNLS, Brasil
- 2010 - 2.1 Tesla 119 pole SCW for ALBA, Spain
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- 2013 - SCW for ANKA
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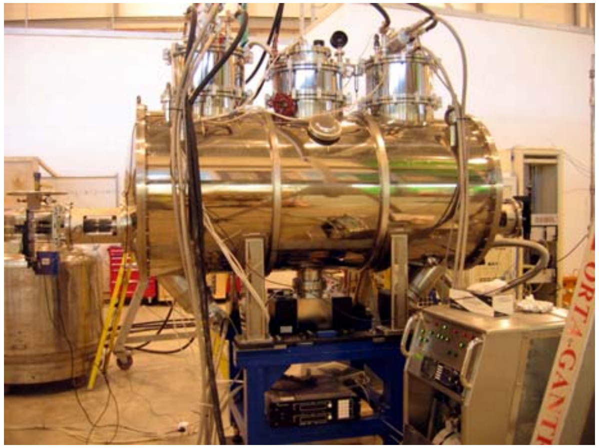
Fig. 2-4 Photo of 7 Tesla WLS inserted into BESSY-2 straight section.



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Long period SC multipole wigglers
(B_0 =7-7.5 Tesla, λ_0~150-200 mm)

Medium period SC wigglers
(B_0 =3.5-4.2 Tesla, λ_0~48-60 mm)

Short period SC wigglers
(B_0 =2-2.2 Tesla, λ_0~30-34 mm)

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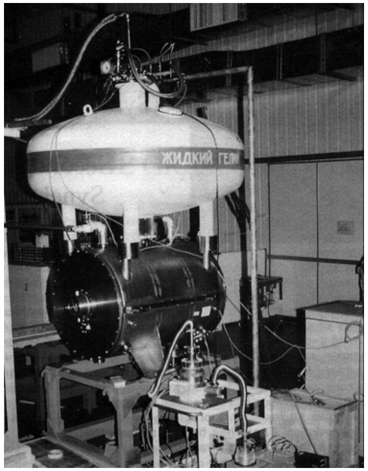

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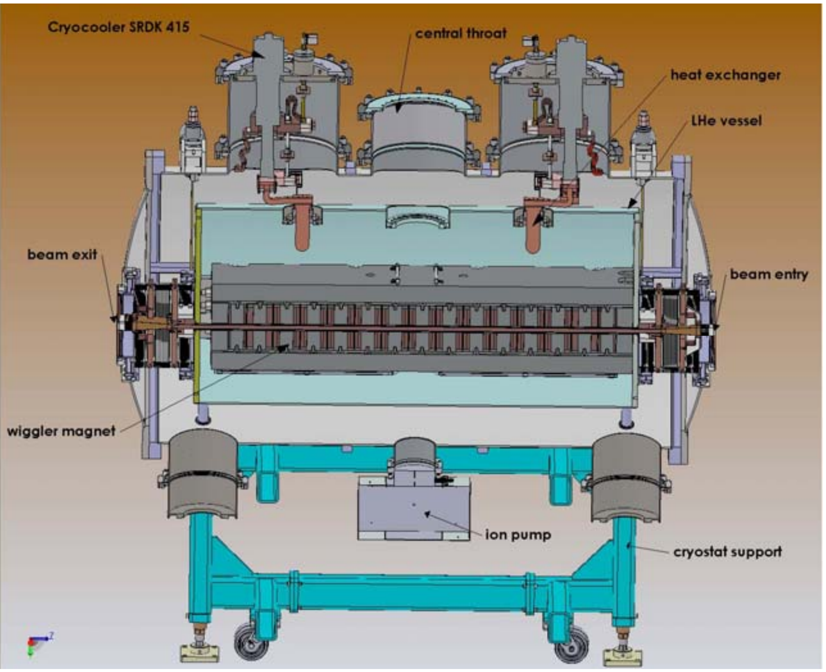
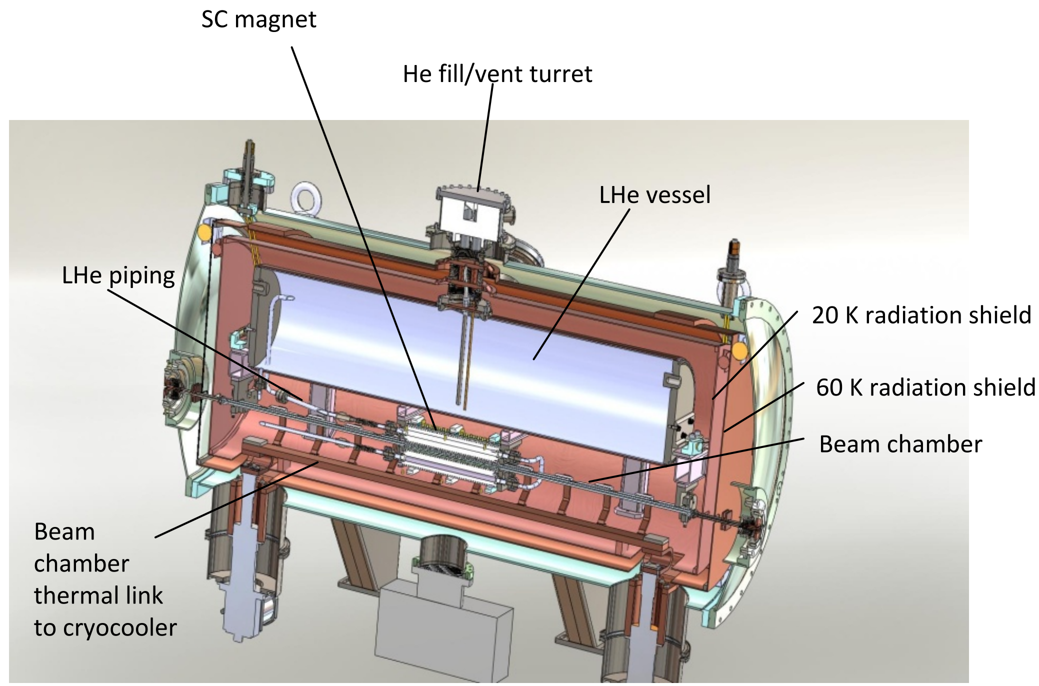
Indirect cooling conseption





Direct cooled magnet (magnet in bath cryostat)

Indirect cooled magnet (magnet in isolation vacuum)

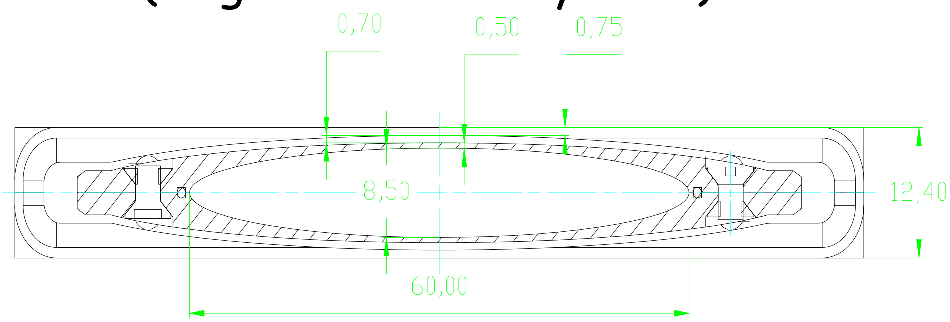
Advantages of indirect cooling

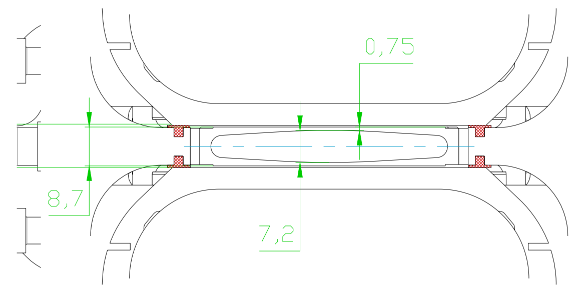
- Easy access to the magnetic system and to the beam vacuum chamber
- Possibility for exchanging of the elements of magnetic system (and whole system) without complex operation
- Possibility for exchanging the beam vacuum chamber
- Possibility for installing of the wigglers in the halls with lower ceilings
- Effective using of the magnetic gap

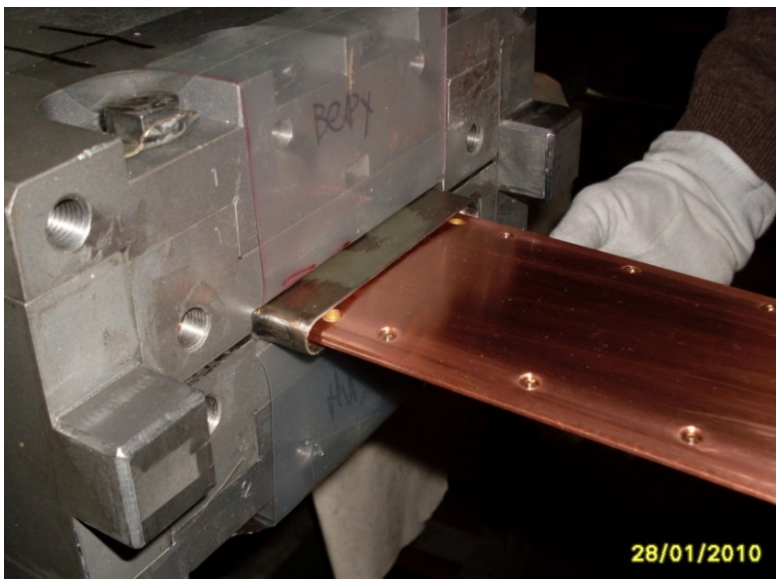
Pole gap g and electron beam vertical aperture

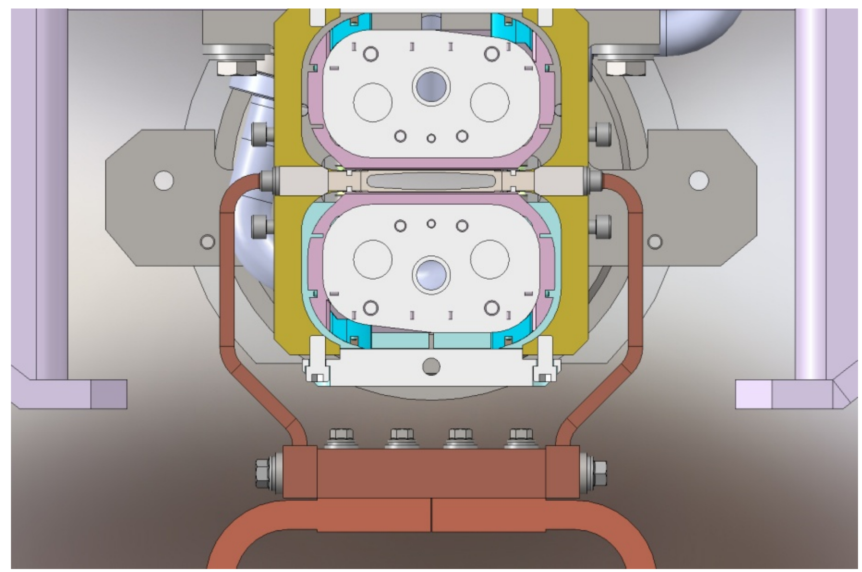
Direct cooling magnet with liquid helium (magnet in bath cryostat)

Indirect cooling magnet
Magnet in insulating vacuum





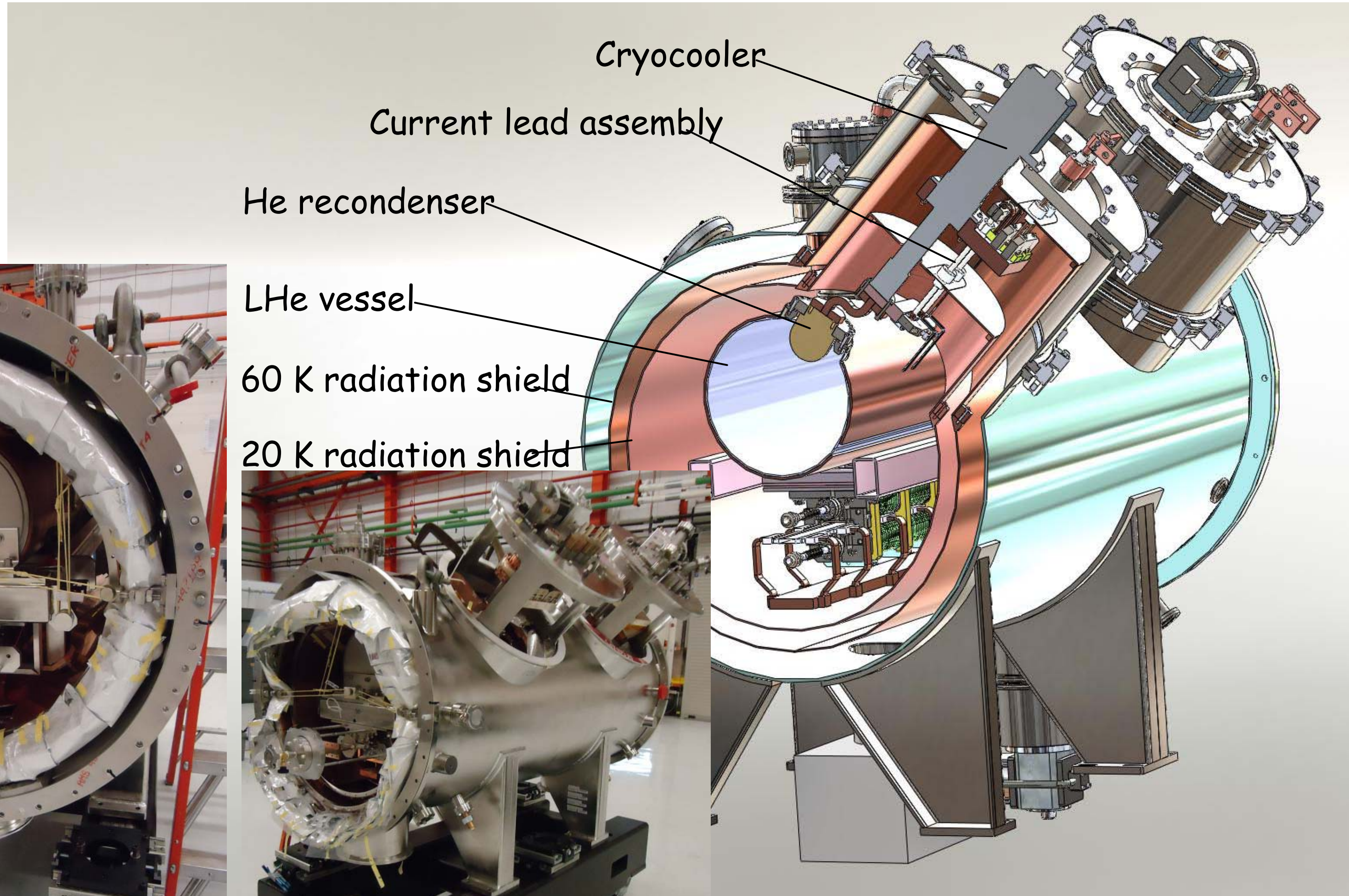


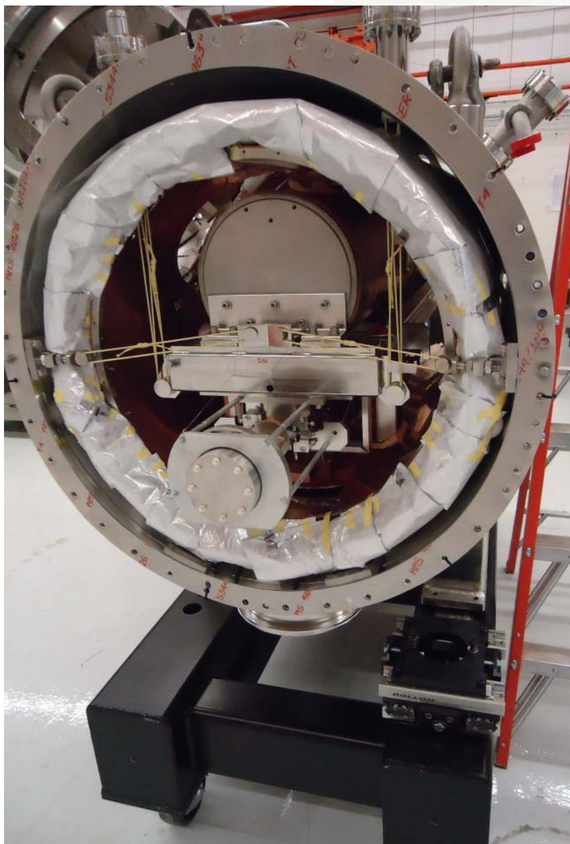


Pole gap= V aperture + 4 mm

Pole gap = V aperture + 1.5 mm

Superconductive undulator for APS

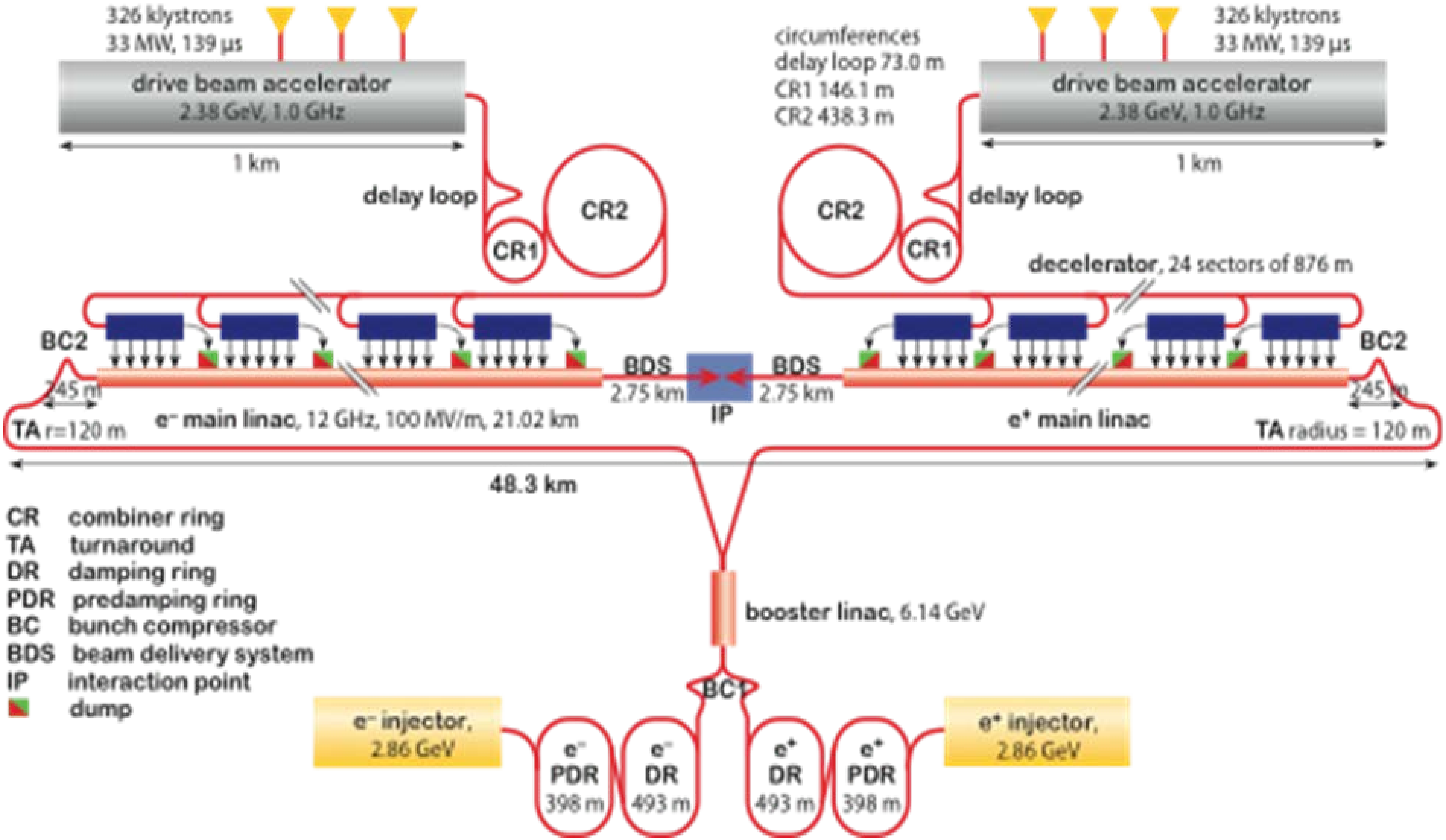




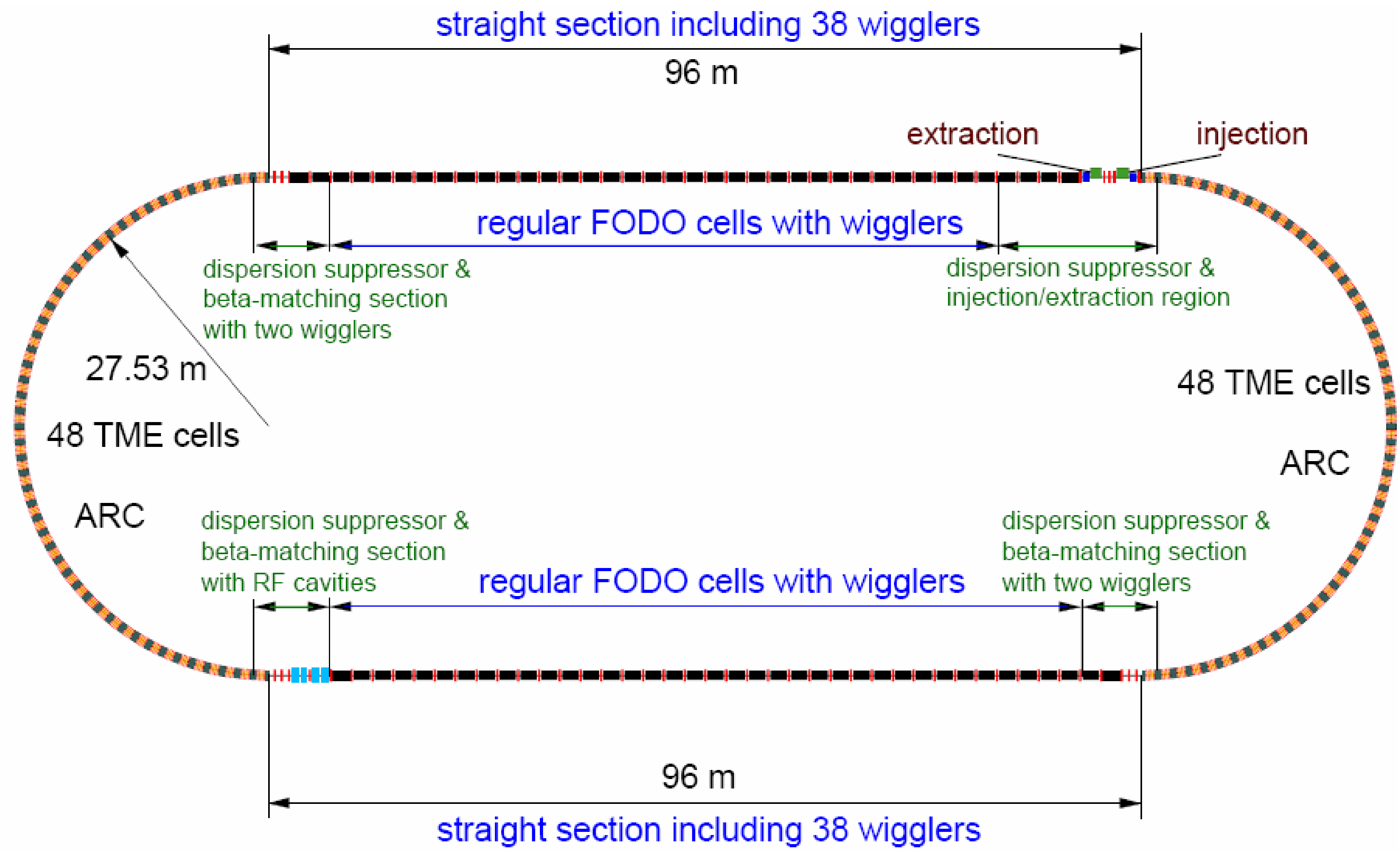
Wiggler destination

ANKA (KIT)	CLIC (CERN)	Budker INP
SR generation for users on the IMAGE beamline	Test facility for CLIC damping wiggler prototype Dumping wiggler design optimization for mass production •Choice of the wiggler type •Choice for beam pipe coatings •E-cloud experiments	Development of the new cooling conception Economical profit

CLIC project (CERN)

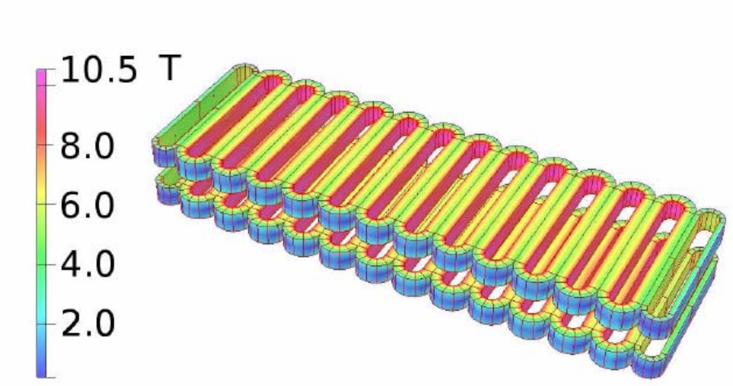


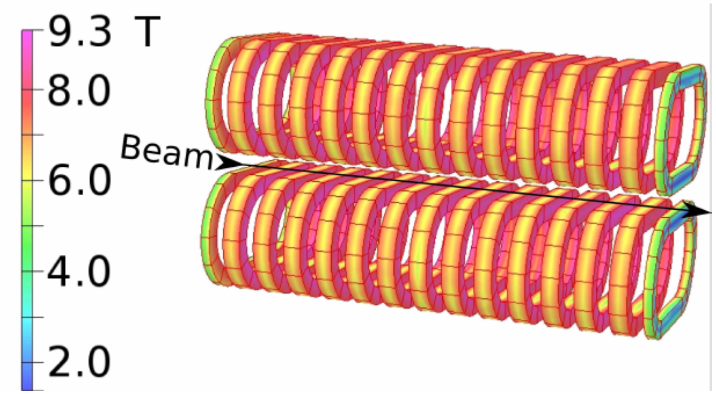
CLIC Damping ring



Choice of the technology for CLIC damping wiggler

Wiring type





Superconductive technology

NiTi **Nb_3Sn**

Vacuum pipe coating, e-cloud mitigation

NEG, C, NiB etc

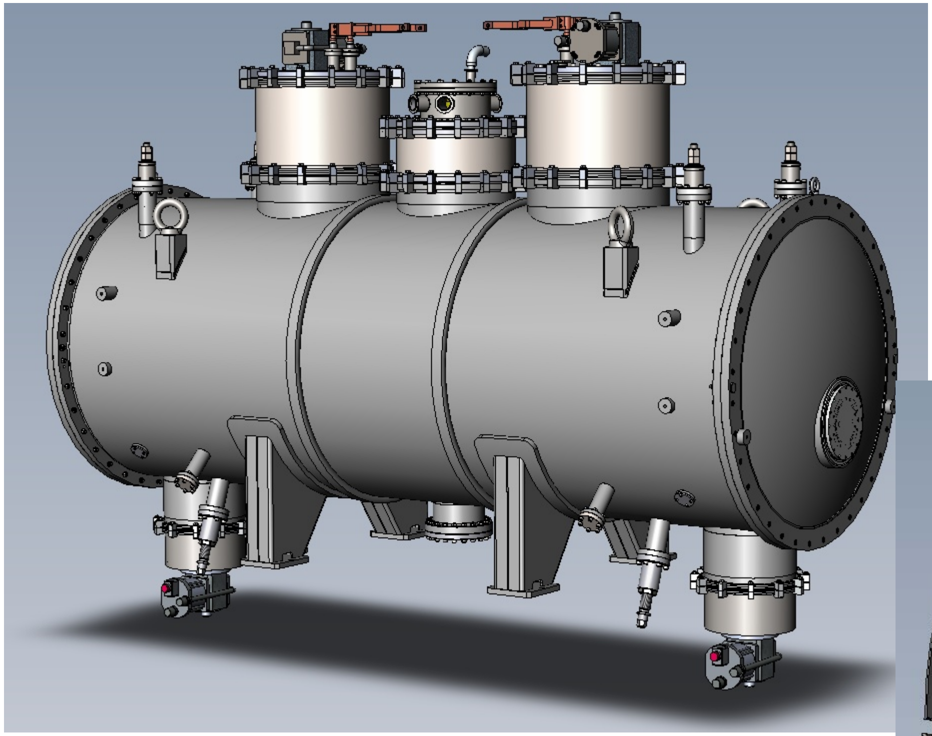
Wiggler parameters

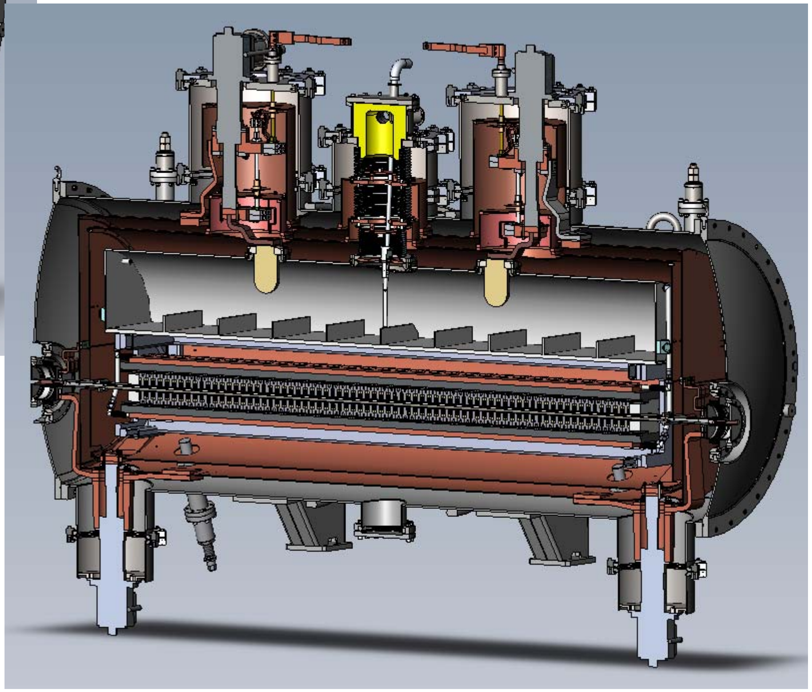
Total number of poles	72
Number of main poles	68
Number of additional poles	4
Period	51 mm
Magnetic gap	18 mm
Peak magnetic field on the main poles	3 T
Currents	243 A x4
Stored energy	60 kJ
Aperture	13 mm x

Additional requirements

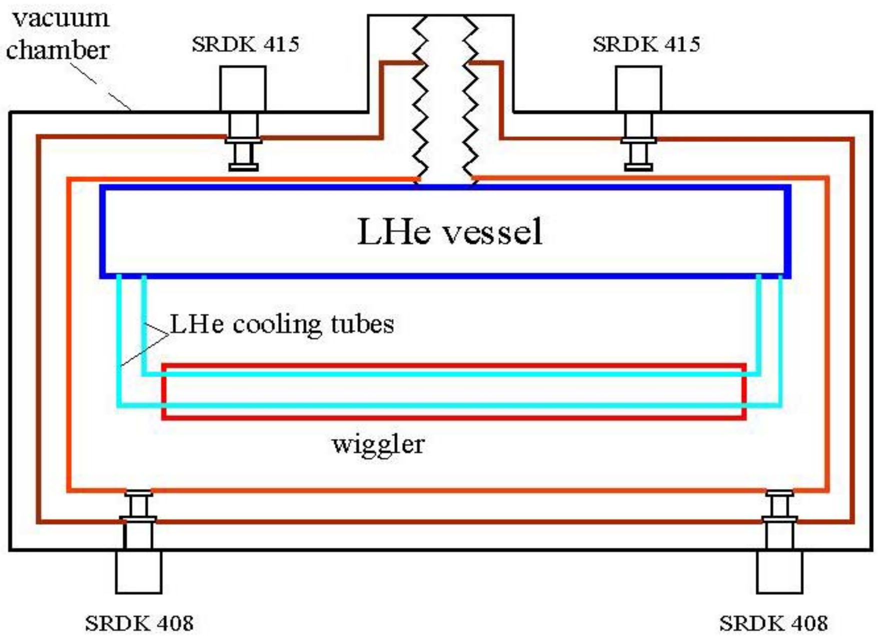
- Possibility for exchanging of the magnetic system in future
- Possibility for exchanging of the beam vacuum pipe
- Heating vacuum pipe till 90 K
- Heating vacuum pipe with power load up to 50 W (with keeping temperature about 40 K)
- Possibility of activation of the NEG-coating (up to 200° C)

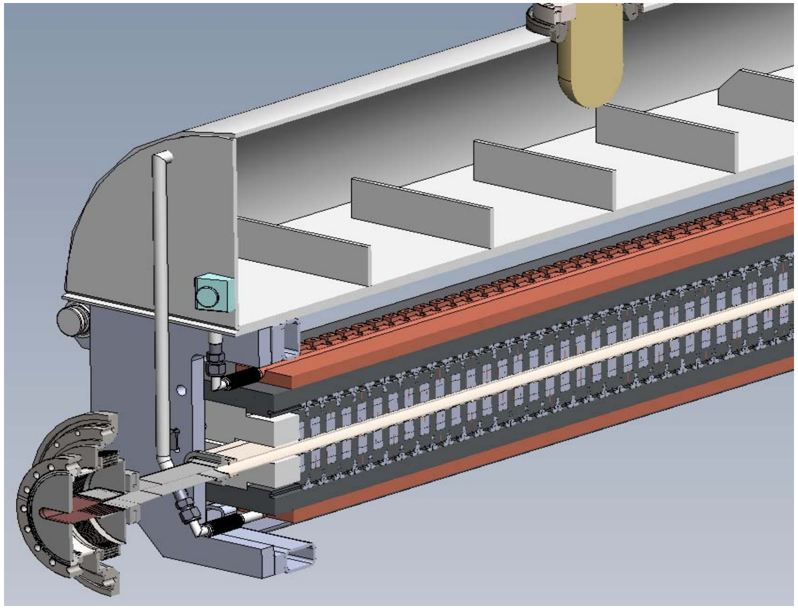
General view



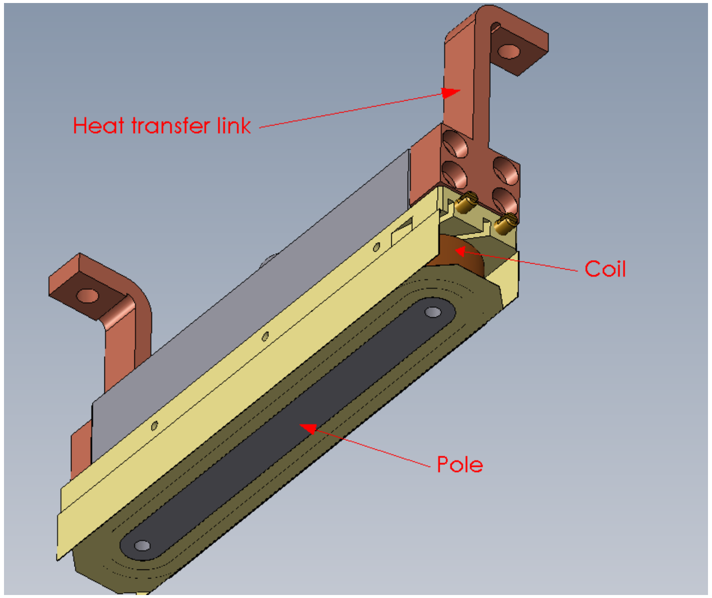


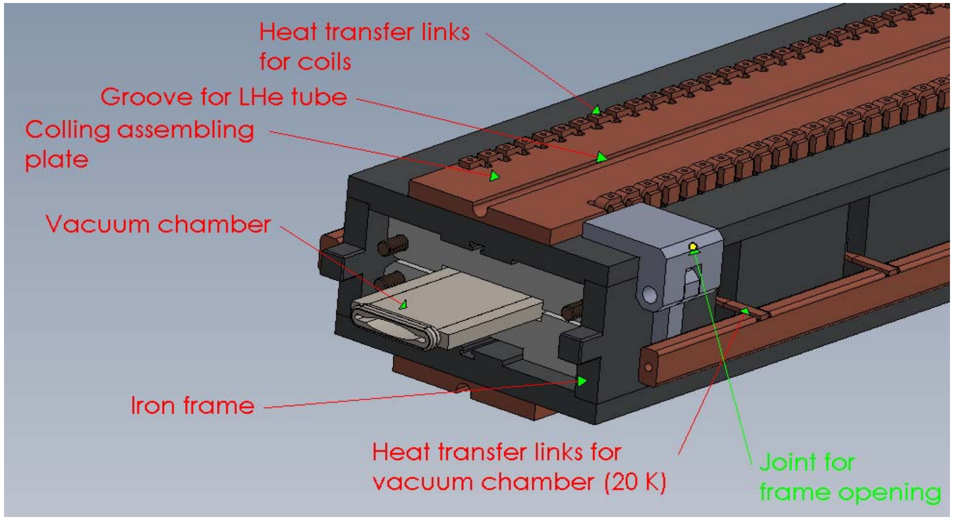
Принципы охлаждения магнитной системы

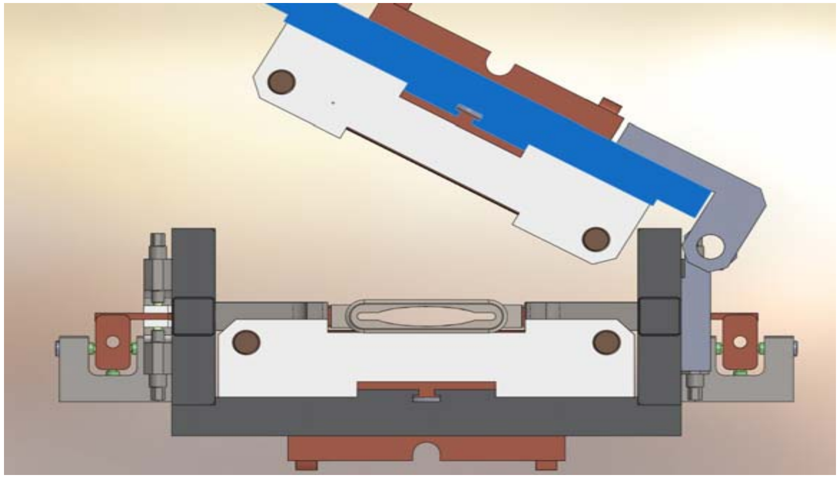




Design features

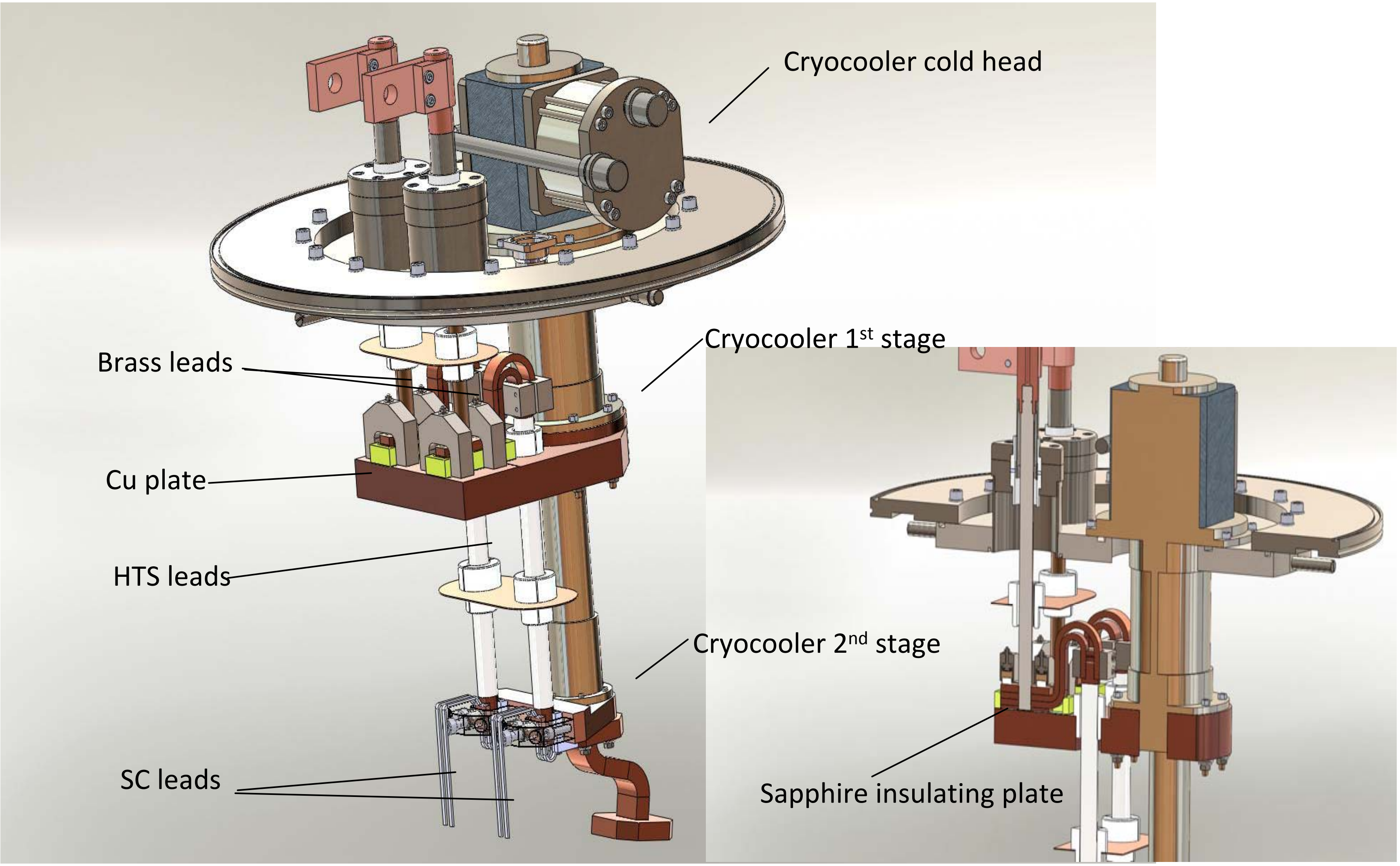






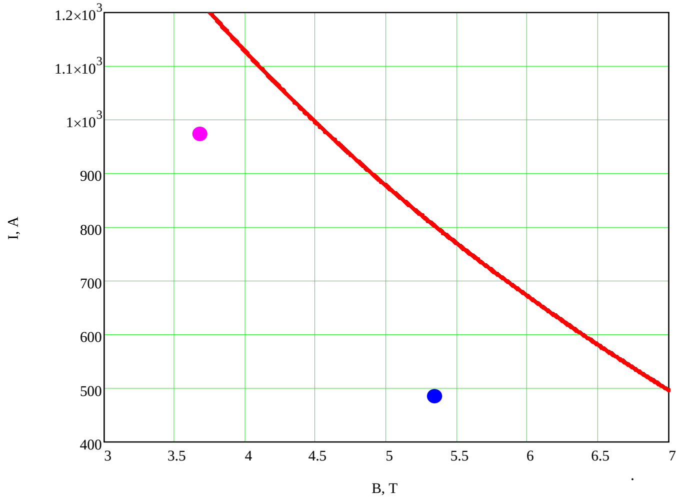
Возможность доступа и замены
Вакуумной камеры

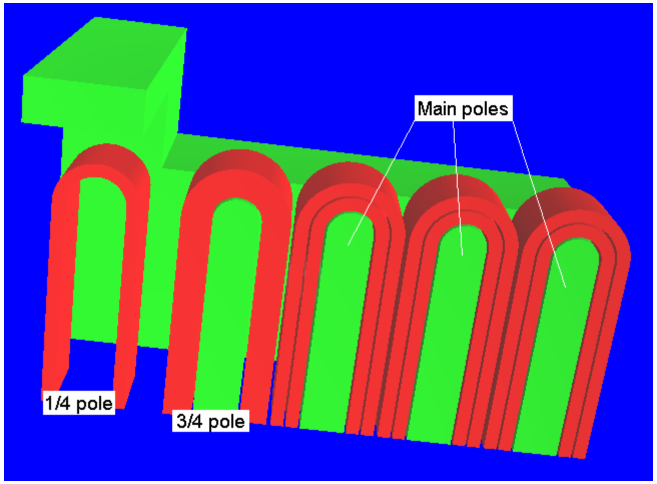
Current lead design



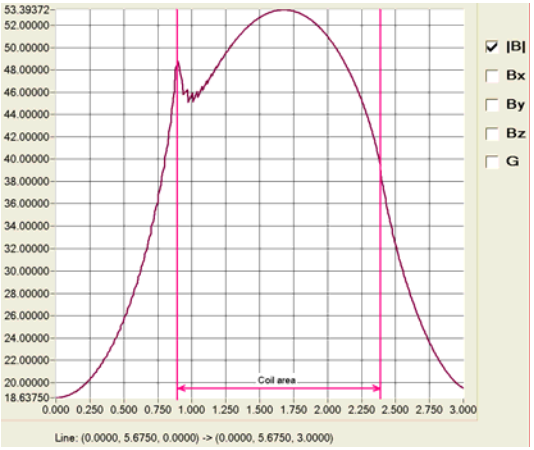
Superconsuctive wire parameters and calculated field profile

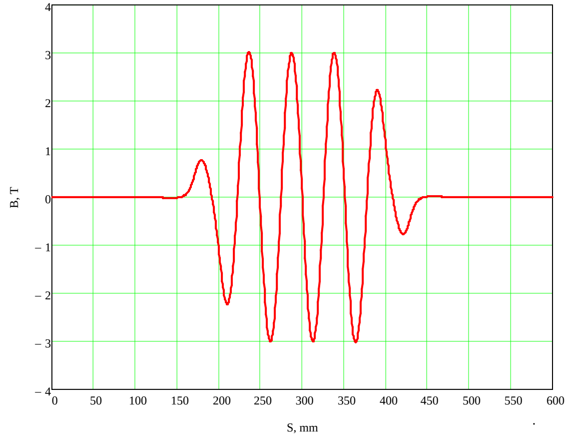
Diameter(mm)	0.85 (0.91 with insulation)
Ratio of NbTi:Cu	1.4
Number of NbTi filaments	312
Critical Current of modified/enhanced SC wire (A)	~520 (at 7 Tesla, 4.2K)

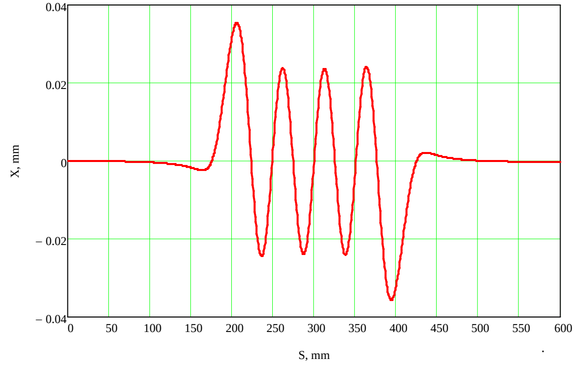




Общий вид расчетной модели и протипа

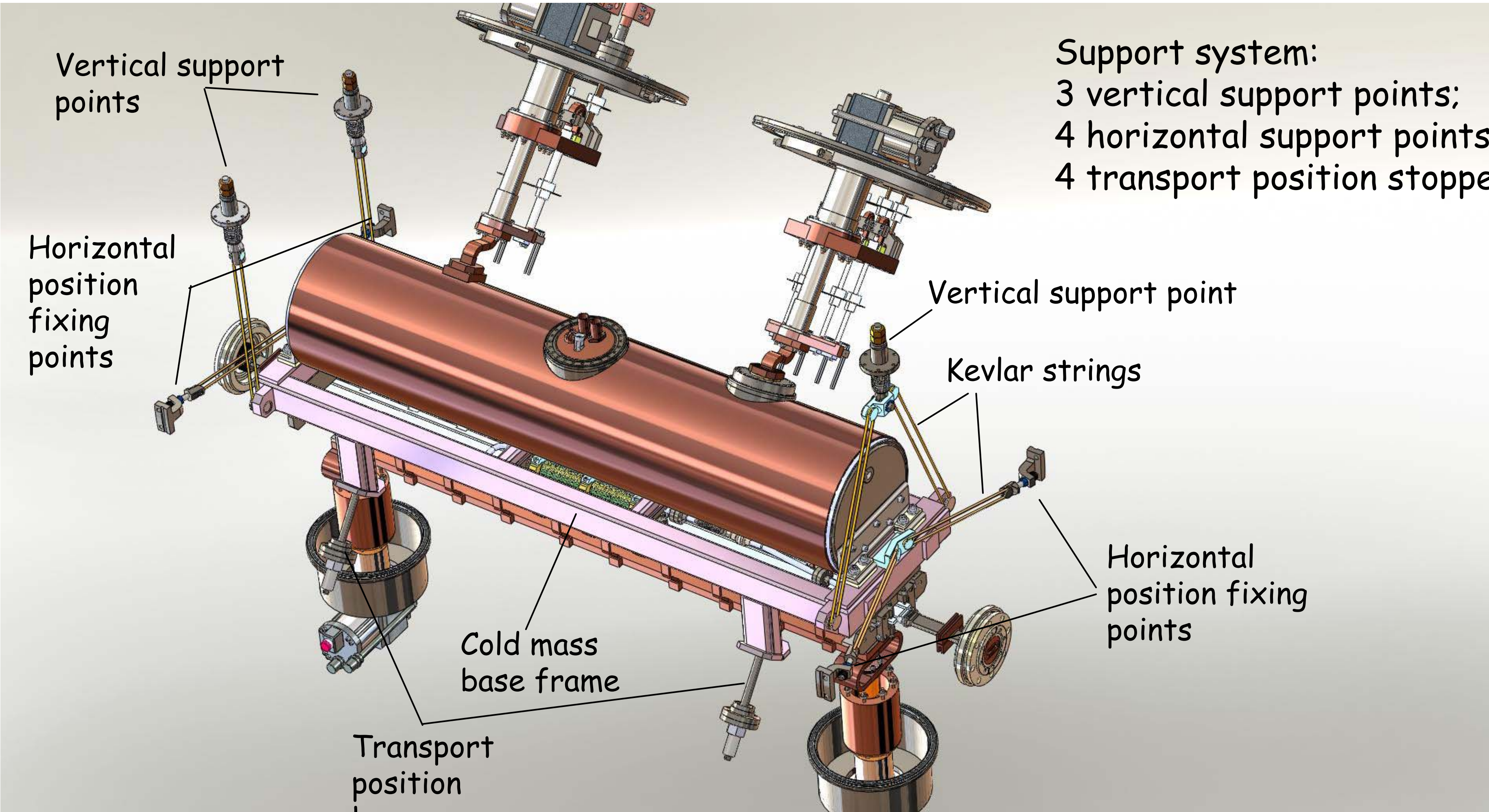






Cold mass support structure

Cold mass is hung on Kevlar strings attached to the cold mass support base on one side and to the vacuum vessel on the other.



Schedule and plans

ANKA/CLIC -wiggler

- Conceptual design report — May, 2012
- Short prototype testing — Oct., 2012
- Full design report — Oct., 2012
- Fabricating — June, 2013
- Factory acceptance tests — Aug., 2013
- Site acceptance test,
- commissioning — Sept., 2013

Common plan for cooling conception development

- Fabrication of the similar wiggler for light source “Siberia-2”
- Heat pipes cooling conception toward helium free ID
- Heat pipes as a heat keys for cooling commutation, effective initial cooling of the system