WIGGLE 2005 Programme

Monday, February 21

09:30	Introduction - S. Guiducci	Aula Div. Acceleratori
Session 1 - **Wiggler Parameters & Experiences** Session Chairs: S. Guiducci, W. Decking		
09:40	Review of Wiggler Parameters - E. Levichev, BINP	Aula Div. Acceleratori
10:05	Beam Measurements with Wigglers at DAFNE - M.E. Biagini, INFN-LNF	
10:30	DAFNE Wiggler Modifications - M. Preger, INFN-LNF	
10:55	Discussion	
11:10	*Coffee Break*	
11:30	1st Experimental Results on ATF Wigglers - J. Urakawa, KEK	Aula Div. Acceleratori
11:55	CESR-c Wiggler & Beam Measurements - D. Temnyk, Cornell Univ.	
12:20	Operating Experience of Insertion Devices at Spring-8 - K. Soutome, Spring-8	
12:45	Discussion	
13:15	*Lunch*	
Session 2 - **Wiggler Technology** Session Chairs: J. Urakawa, F. Zimmermann		
14:30	Superconductive Undulators/Wiggler, Status-quo and Development in the Near Future - R. Rossmanith, Karlsruhe	Aula Div. Acceleratori
14:55	Wiggler Design Based on a Cryogenic pm ID - T. Hara, RIKEN	
15:20	Scaling Laws & Field Quality - E. Levichev, BINP	
15:45	Discussion	
16:00	*Coffee Break*	
Session 3 - **Nonlinear Wiggler Fields, Modeling & Beam Dynamics Studies** Session Chairs: M. Biagini, D. Schulte		
16:20	Linear and Non-linear Modeling of the Modified DAFNE Wiggler - C. Milardi, INFN-LNF	Aula Div. Acceleratori
16:45	Wiggler Field Calculation - P. Vobly, BINP	
17:10	Methods & Application to the ILC Damping Rings - M. Venturini, LBNL	
17:35	Petra3 Wigglers - W. Decking, DESY	

Tuesday, February 22

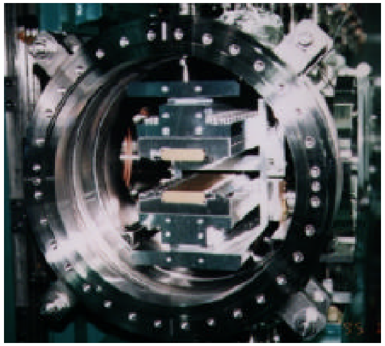
Session 3 - **Nonlinear Wiggler Fields, Modeling & Beam Dynamics Studies** Session Chairs: tbd		
09:00	LNF Director	Aula Div. Acceleratori
09:10	ID Simulation Tools - G. Wuestefeld, BESSY	
09:35	Undulator Models and the Use of Long Straight Sections in the Spring-8 Storage Ring - K. Soutome, Spring-8	
10:00	Dynamic Aperture in Damping Rings - Y. Cai, SLAC	
10:25	Modeling & Simulation for CESR-c and ILC Wigglers - J. Urban, Cornell Univ.	
10:50	Discussion	
11:10	*Coffee Break*	
11:30	Requirements & Studies for CLIC - M. Korostelev, CERN	Aula Div. Acceleratori
11:55	Electron Cloud in Wigglers - F. Zimmermann, CERN	
12:20	Wigglers vs. Undulators - H. Braun, CERN	
12:45	Discussion	
13:00	*Lunch*	
Session 4 - **Round Table Discussion on Wiggler Optimization** Session Chairs: M. Venturini, H. Braun		
14:00	Discussion and New Ideas	Aula Div. Acceleratori
16:00	*Coffee Break*	
16:30 17:30	Conclusions	Aula Div. Acceleratori

Operation Experience of Insertion Devices at SPring-8

K.Soutome, H.Tanaka, M.Takao, J.Schimizu, H.Yonehara
on behalf of SPring-8 Accelerator Group

Insertion Devices

Up to now 26 insertion devices are installed.



In-Vacuum ... Total 20

Standard Type ... Total 12

(λ= 32mm, N=140, Min.Gap=8mm, K_{max}=2.5)

ID24: Figure-8

ID19: 25m-Long Planner (λ= 32mm, N=780)

* Minimum gap value (full) is 7mm for ID20.

Out-Vacuum ... Total 6

ID08: Elliptical Wiggler (λ= 120mm, N=37, K^y_{max}=10)

ID15: Revolver (Planner/Helical)

ID17: Combination of Permanent Magnets and Electromagnets with Iron-Poles
Fast Switching of Helicity, Figure-8 (Symmetric/Asymmetric)... under tuning

ID23: APPLE-II (Planner/Helical/Vertical)

ID25: Helical Tandem, Fast Switching with Bump Orbit (1-10Hz)

ID27: Figure-8

* Vertical aperture (full) is 15mm.

Long Undulator

Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft

SUPERCONDUCTIVE UNDULATORS/WIGGLERS STATUS-QUO AND FUTURE DEVELOPMENTS

(THE ANKA SC UNDULATOR PROGRAM)

R. Rossmanith (ANKA) for the collaboration

T. Baumbach, A. Bernhard (University of Karlsruhe)
B. Kostka, M. Hagelstein (ANKA)
E. Steffens, M. Weisser (University of Erlangen-Nürnberg)
M. Kläser, M. Schneider (ITP, Research Center Karlsruhe)
D. Dölling, D. Krischel, A. Hobl, S. Kubsky (ACCEL Instr. GmbH)

MOTIVATION

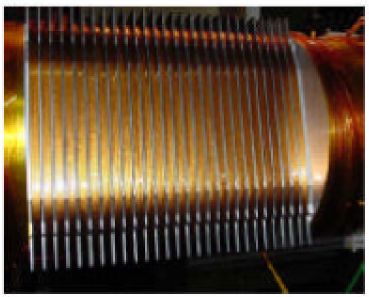
- Higher field for given period length
  - (or larger gap for same period length and field)
  - (or shorter period length for same field)
- Electrical tunability (no mechanically moving parts)

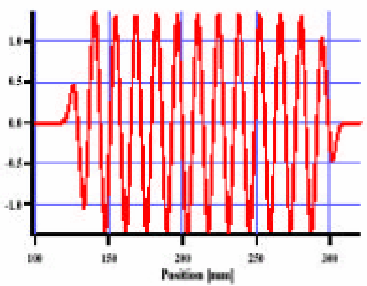
What fields were (and can be) achieved?

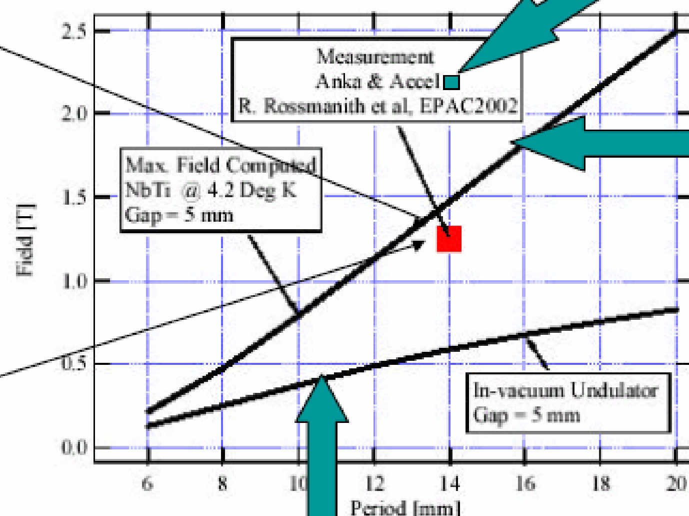
Superconductive 14 mm Period Undulators , EPAC 02,

R. Rossmanith, H. O. Moser, A. Geisler, A. Hobl, D. Krischel, M. Schillo,

ESRF







NbTi 1.8 K
Nb3Sn
Future option

NbSn: Berkeley,

NbTi @ 1.8 K ANKA

NbTi 4.2 K
achieved

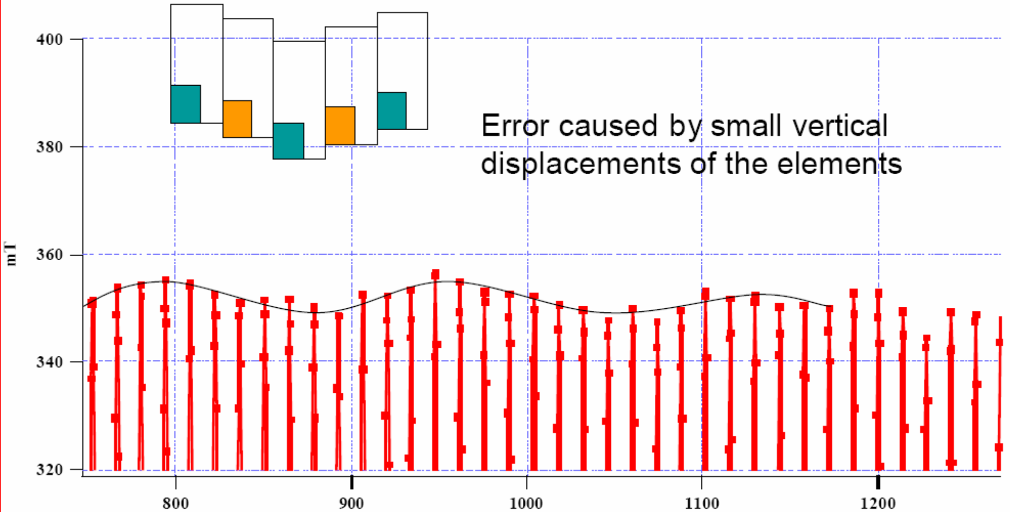
ANKA, Argonne

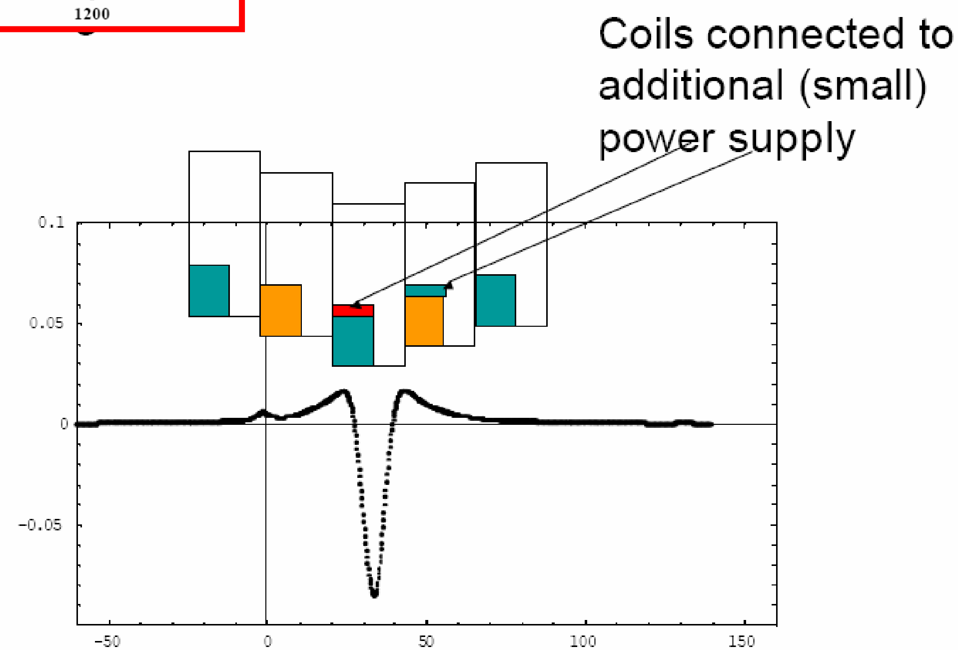
Permanent magnet

For comparison
YBCO <1.0 kA/mm2 @ 77 K *

* Critical current density with external field = 0

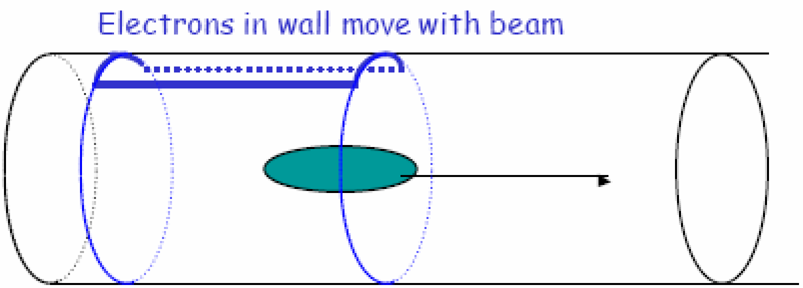
Blow-up of the measurements of one of the built undulators.





First undulator equipped with electrical shimming will be EU project.
ESRF undulator (ANKA – ELETTRA – MAXLAB - ESRF collaboration)

b.) Resistive wall beam heating



Inner wall:

Cu or HTSC

$R_{room\ temp}/R_{4K}$ = RRR-factor

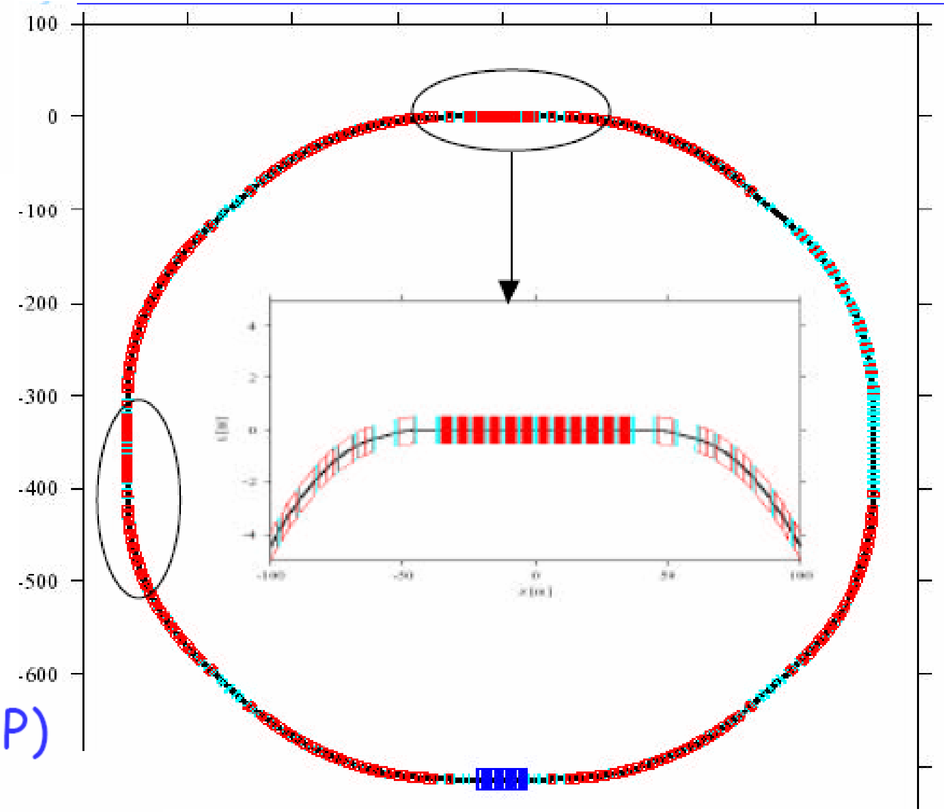
(typically 60 -100)

Damping Wigglers in PETRA III

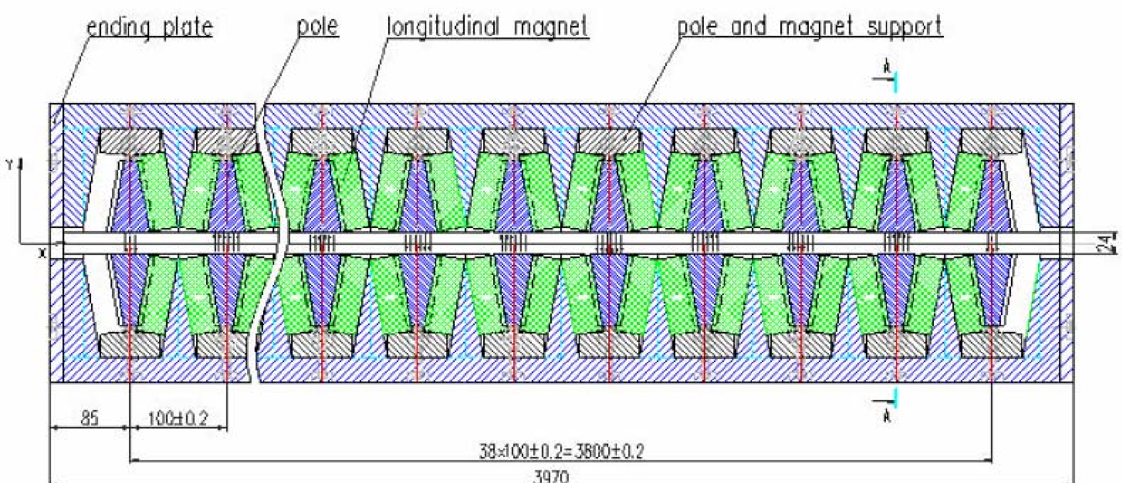
WIGGLE2005, Frascati 21-22.2.2005

Winni Decking, DESY-MPY

Period:	20 cm
Field amplitude:	1.56 T
Field quality @ 1 cm:	<10-3
Total length:	80 m
Total radiation power:	887 kW



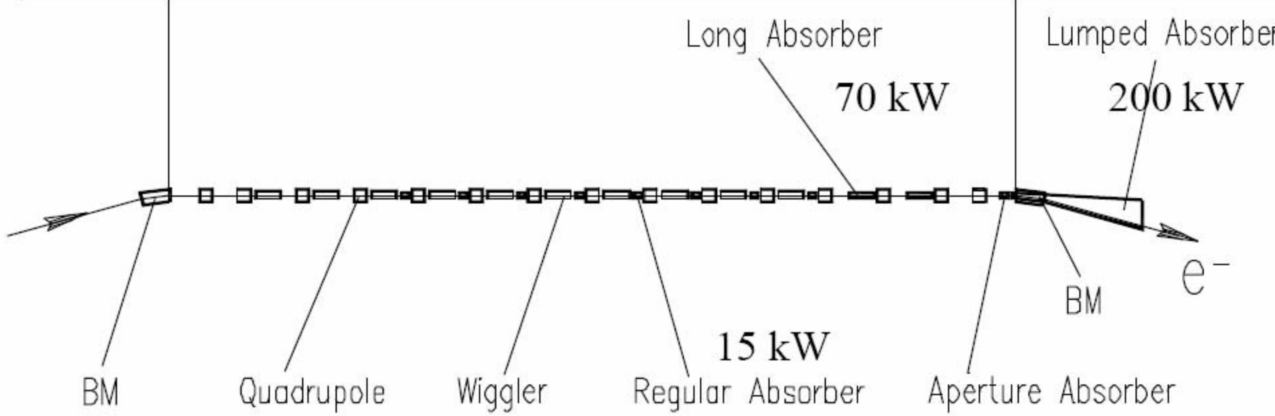
Wiggler Magnet Design (P. Vobly, BINP)

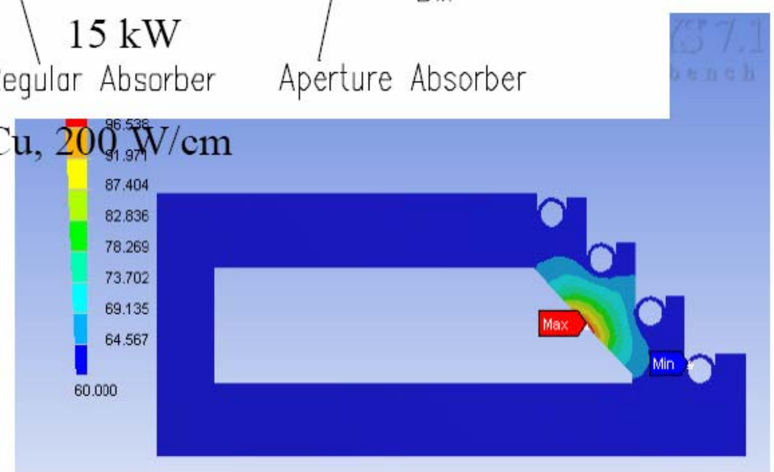


Blue - iron, **Green** - permanent magnets

Operational Issues: Wiggler SR Power Absorbers (BINP)

440 kW @ 200 mA, E_c=36 keV
Opening angle: 5 mrad horizontal, 0.085 mrad vertical





- PETRA III closes the gap between DESY's DORIS III and existing high energy 3rd generation light sources, Ideal partner for the X-FEL project

- **Ideal test bed for LC damping ring issues**
  - **Wiggler dominated**
  - **Large injected beam with frequent injection**
  - **Small vertical emittance**
  - **State of the art beam stability**
  - **State of the art diagnostics**
  - **e^+/e^- possible**

- **BUT: Synchrotron radiation facility**

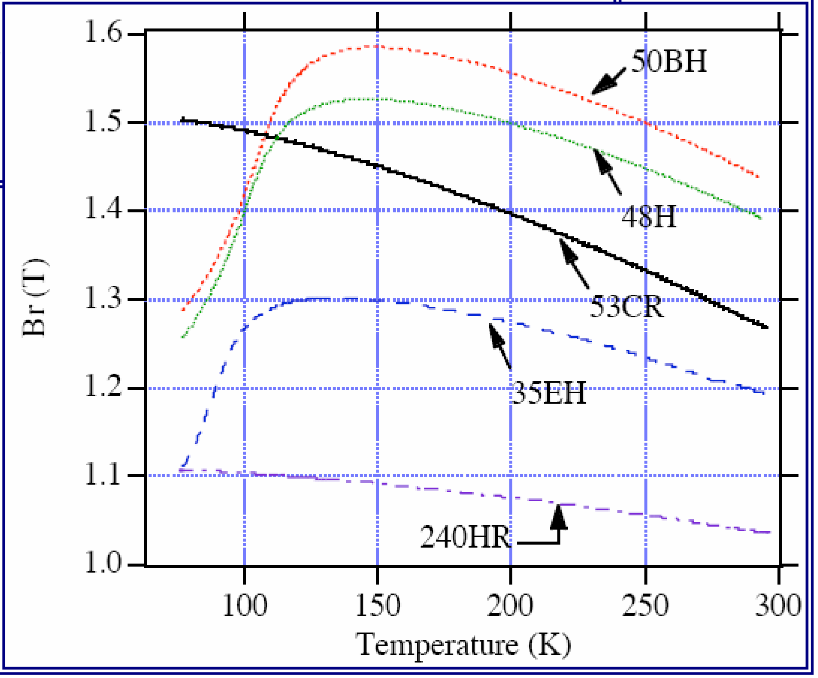
Wiggler Design Possibility Based on a Cryogenic Permanent Magnet Insertion Device

SPring-8 insertion device group
presented by Toru HARA

Concept of cryogenic insertion devices

- Increased coercivity at cryogenic temperatures (> 77K) => choice of high B_r material, high resistance against demegnetization.
- Increased remanent field (B_r) by ~ 10 %.

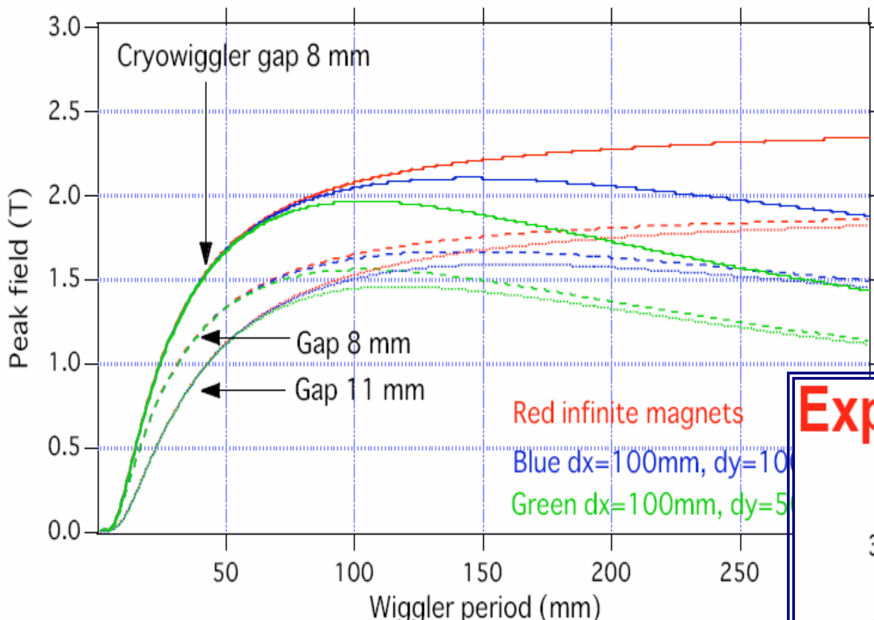
Short period undulators



Expected performance of ppm cryowiggler

- Magnet assumption

For room temperature device, B_r = 1.25 T, ${}_iH_c$ ~ 2000 kA/m,
For cryogenic device, B_r = 1.58 T, ${}_iH_c$ ~ 3000 kA/m@150 K,

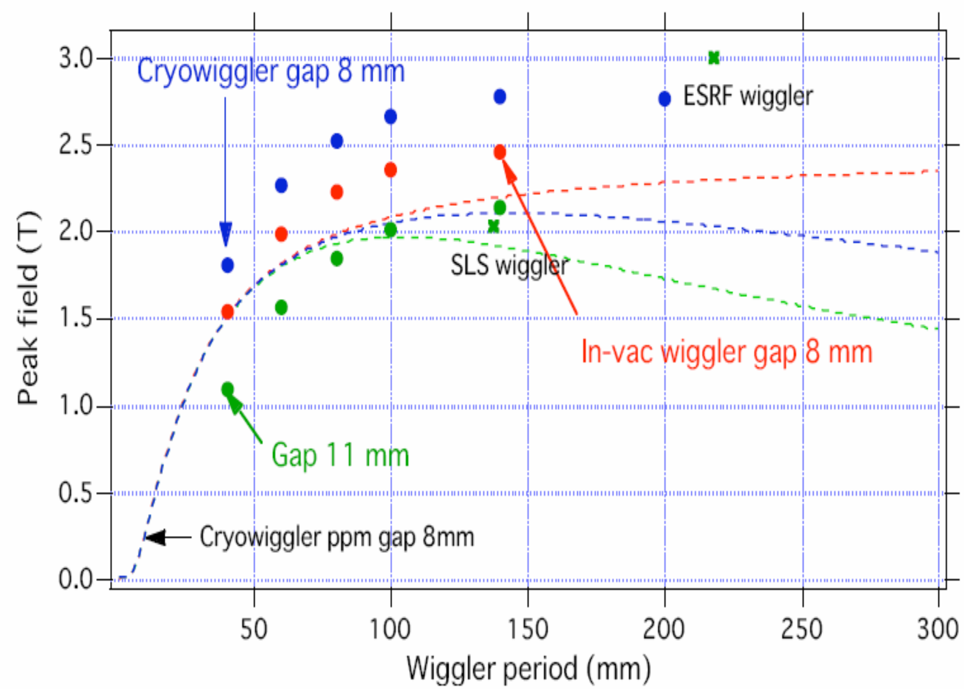


- Proof of principle experiment is carried out on the cryogenic insertion device. There still remains some engineering problems, but the expected field enhancement is confirmed.

- Cryogenic and in-vacuum devices show their advantages at small wiggler periods.
- For example,
  - 100 mm period
    out of vacuum ~ 2.0 T, in-vacuum ~ 2.3 T, cryogenic ~2.6 T,
  - 40 mm peirod
    out of vacuum ~ 1.1 T, in-vacuum ~ 1.5 T, cryogenic ~ 1.8 T,

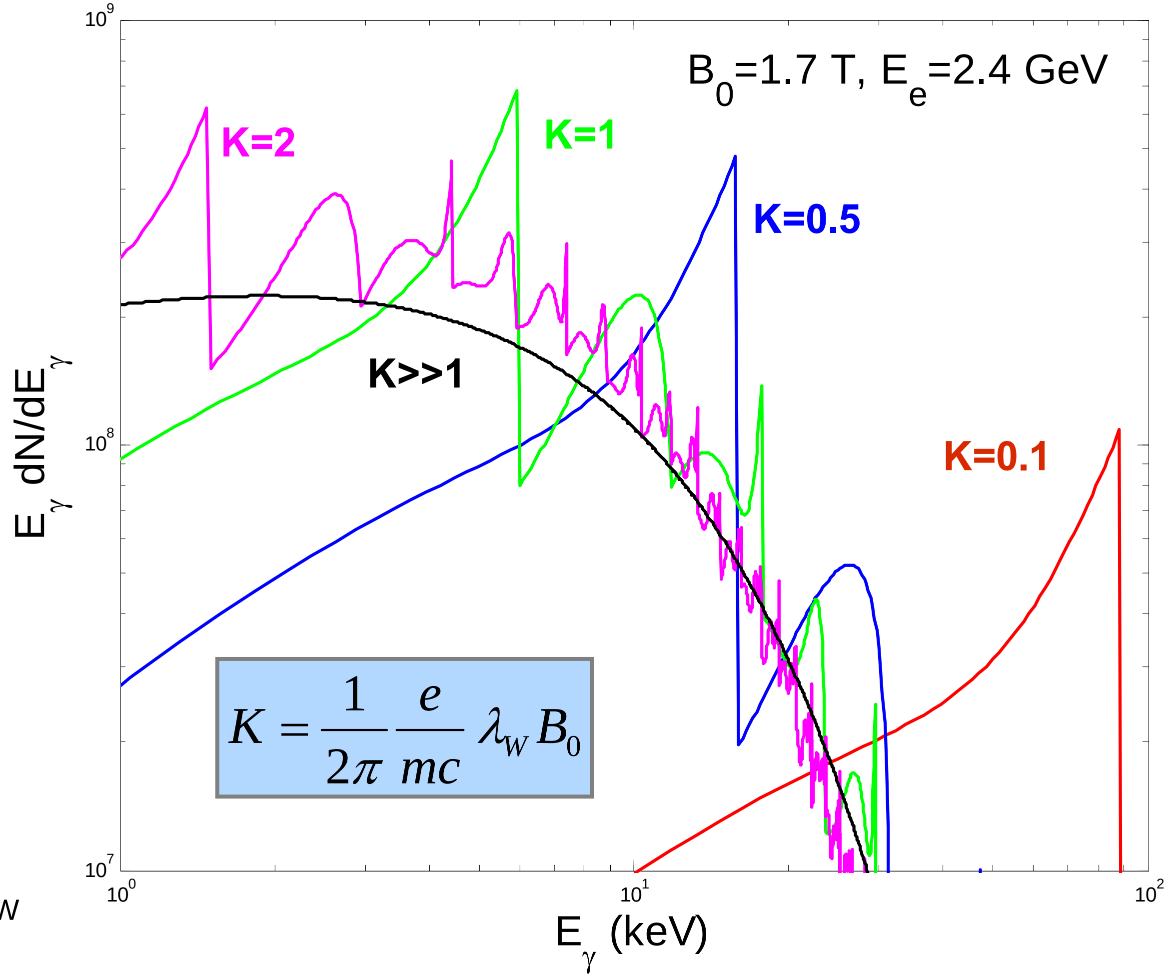
  (assuming 11 mm gap for out of vacuum and 8 mm for in-vacuum and cryogenic devices).

Expected performance of hybrid cryowiggler



Wigglers vs. Undulators

H.-H. Braun, CERN



Mean radiated power

$$P_W = \frac{r_0 c^3 e^2}{3 m^3 c^6} E_e^{\ 2} B_0^{\ 2}$$

depends only on beam energy and B_0 but photon spectrum and number dependence on λ_W

$\longrightarrow$ damping time independent of λ_W , quantum excitation depends on λ_W

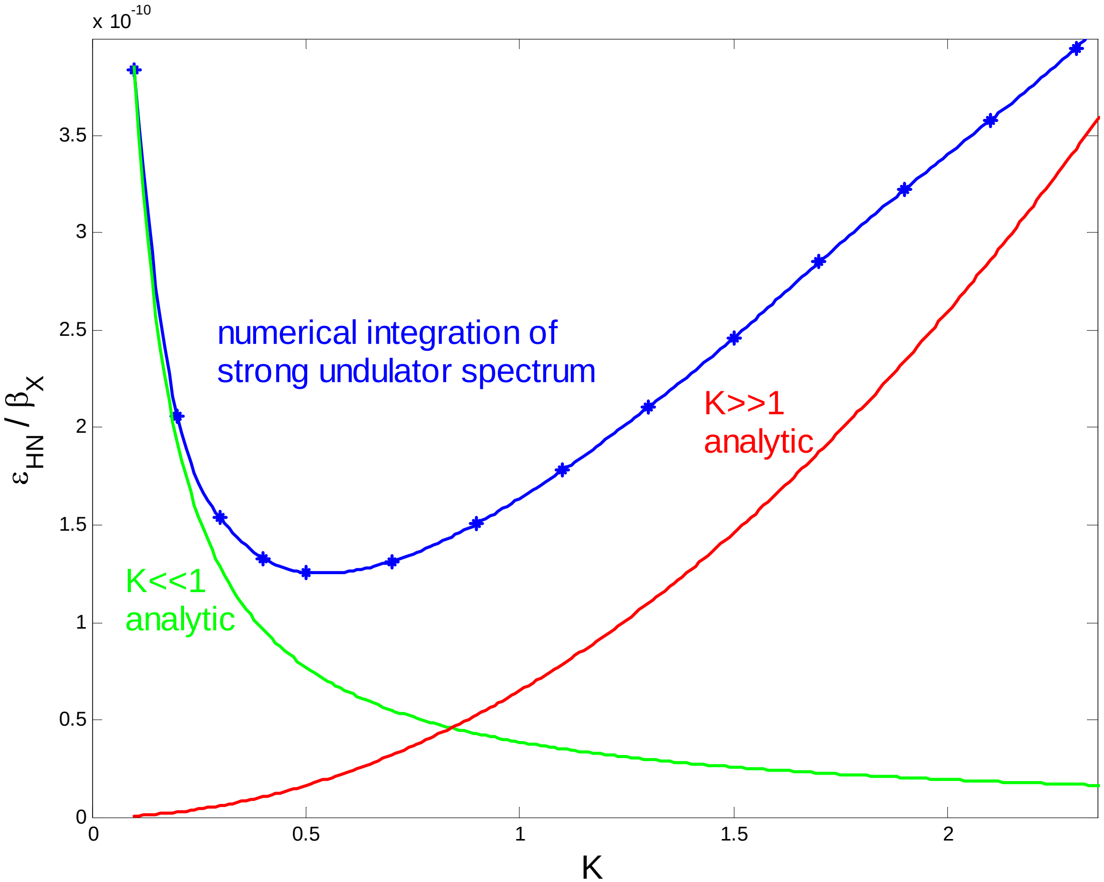
Horizontal Emittance

$$K >> 1$$

$$\varepsilon_{HN} = \frac{11}{12\sqrt{3}\pi} \frac{\lambda_C}{\lambda_W} \frac{\overline{\beta}_X K^3}{}$$

$$K << 1$$

$$\varepsilon_{HN} = \frac{\lambda_C}{10} \frac{\overline{\beta}_X}{\lambda_W}$$



Undulator regime:
Z. Huang and R. Ruth, PRL Vol 80, p. 976, 1998

$$\lambda_{W\ Opt} = \frac{2\pi\, m\, c}{e} \frac{K_{Opt}}{B_0}$$