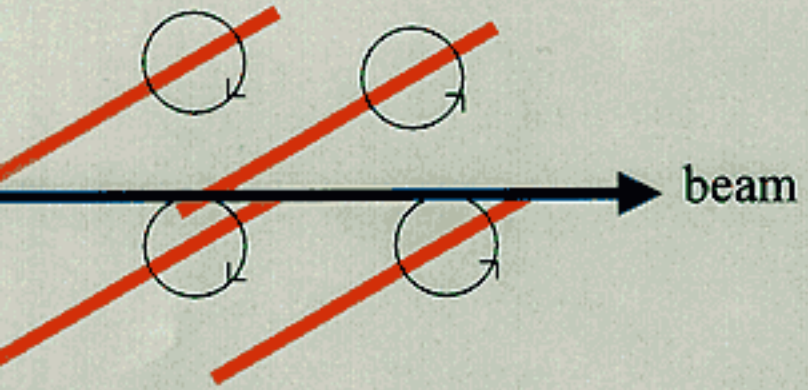
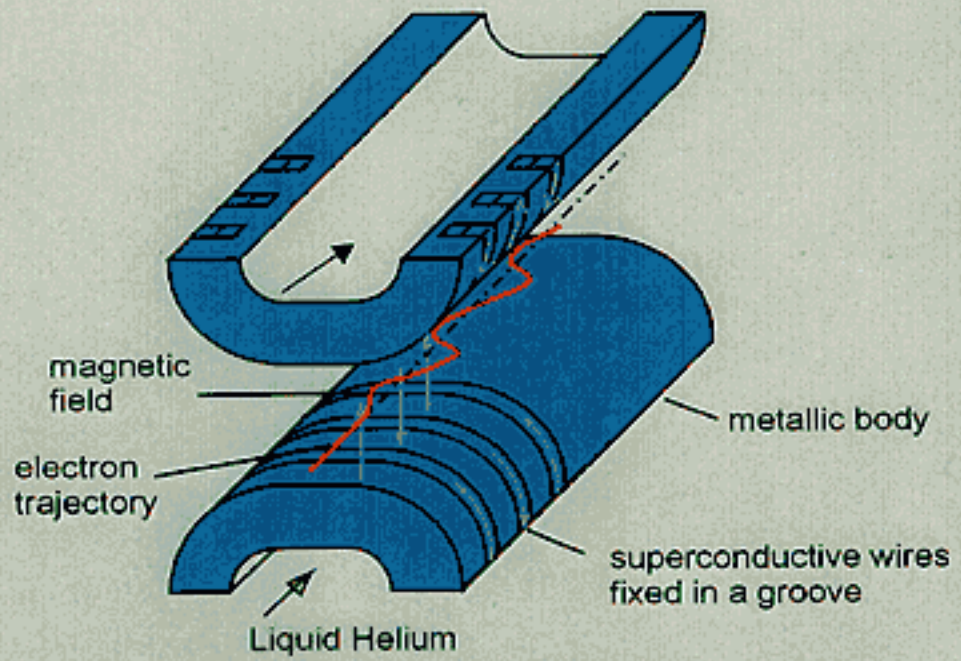
Superconductive cryogen-free Undulators for Storage Rings

Robert Rossmanith

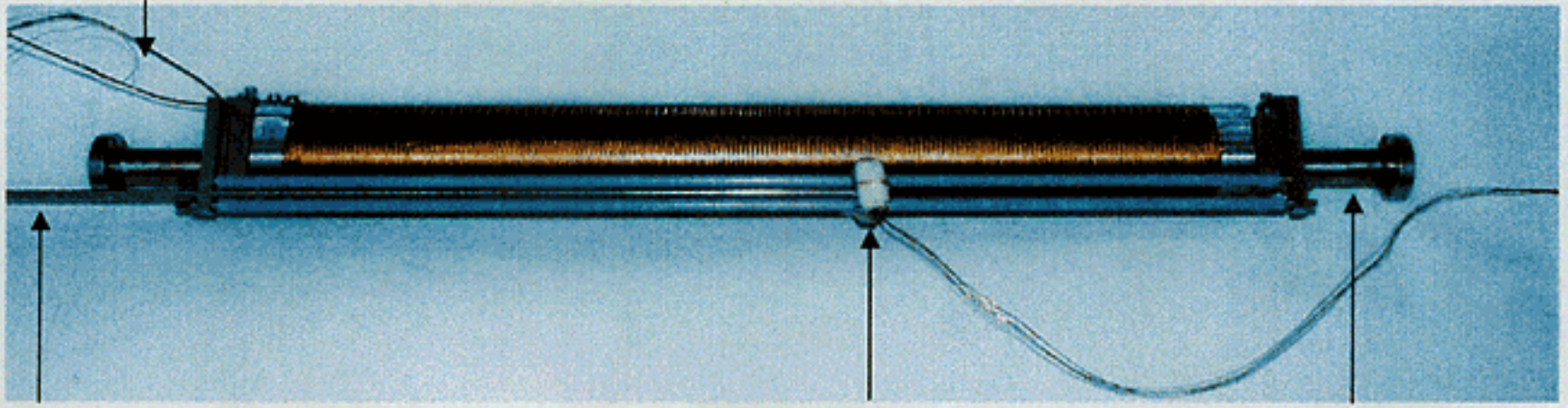
Institute for Synchrotron Radiation, (ANKA), Karlsruhe

I. Experiment in Mainz 1999 with beam


beam

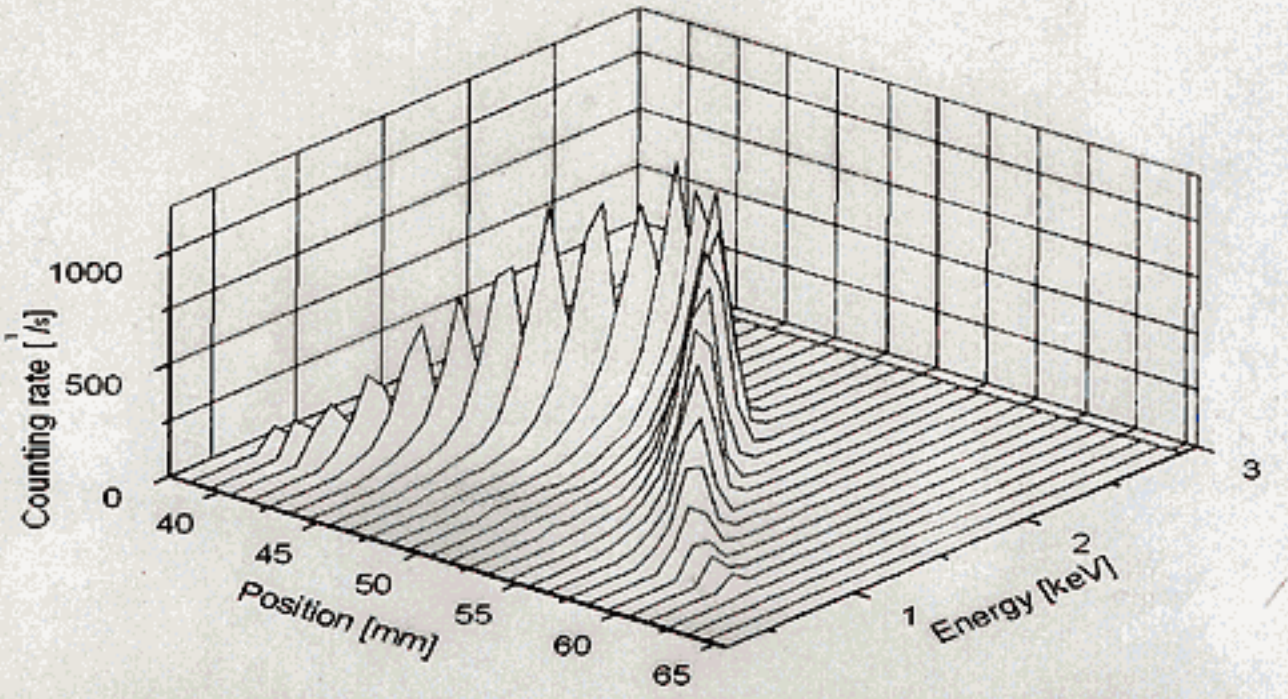

magnetic field
electron trajectory
metallic body
superconductive wires fixed in a groove
Liquid Helium

Technical Realization: 100x(3.8 mm period), 4 layers of wires
Connecting wires (high current in-out, potential wires for quench protection)



Beam test at Mainz Microtron MAMI: X-ray spectrum in 12 m distance

Beam energy	885 MeV
Max. beam current	50 µA cw
Period length	3.8 mm
Number of periods	100
Field	0.15 T
Current	300 A
Gap	2 mm



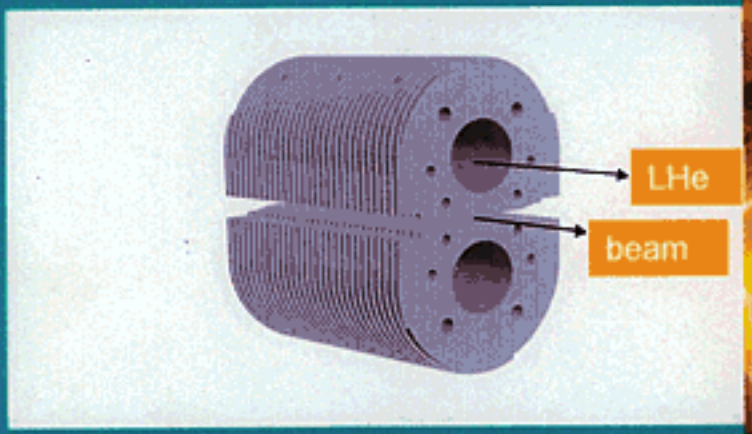
Authors: T. Hezel, M. Homscheidt, H. O. Moser, R. Rossmanith, FGS, FZ Karlsruhe; Th. Schneider, ITP, FZ Karlsruhe, H. Backe, S. Dambach, F. Hagenbuck, K.-H. Kaiser, G. Kube, W. Lauth, A. Steinhof, Th. Walcher, Inst. Nucl. Phys., Univ. Mainz
published at PAC99, NY, NY: Workshop on Future Light Sources, Argonne, IL, 99: NSLS User Meeting, Upton, NY, FEL99, Hamburg, etc

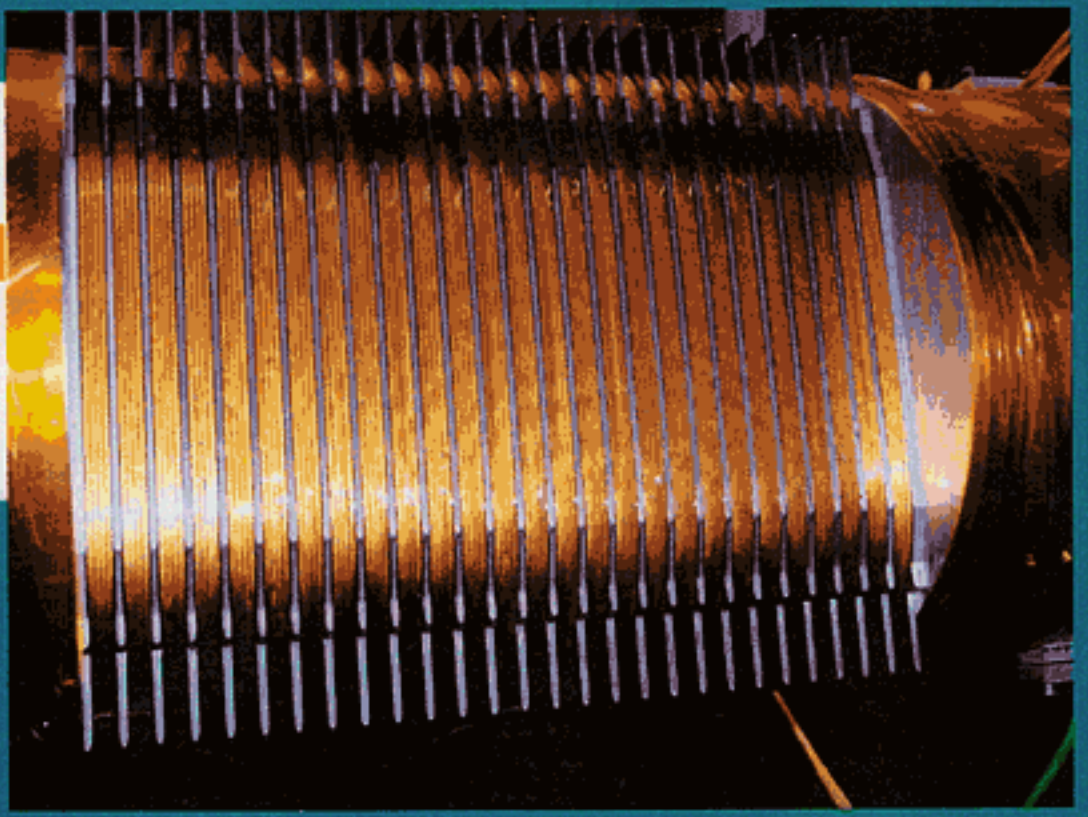
Specification

Period length [mm]	14
Number of periods of the final undulator	100
Number of periods of a prototype	8
Nominal gap-width [mm]	5
K at nominal gap-width	2

Changes from test device

a.) Matched particle trajectory at beginning and end of undulator
b.) Zero first and second integral of particle trajectory
c.) Low phase errors
d.) High quality field measurement
e.) Undulator-cryostat assembly which can be used in a storage ring (200 mA)



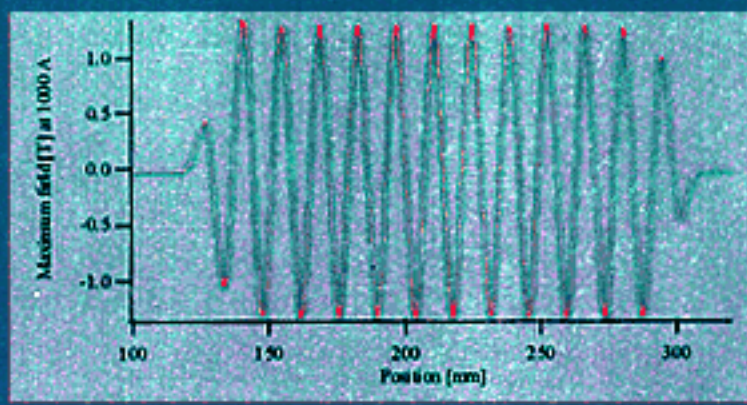


Test undulator

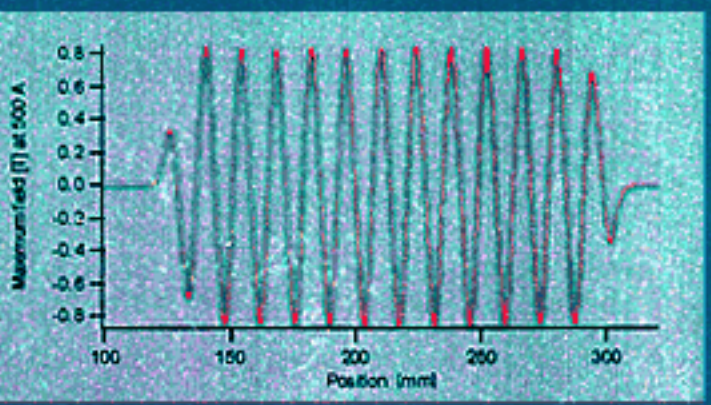
10 periods

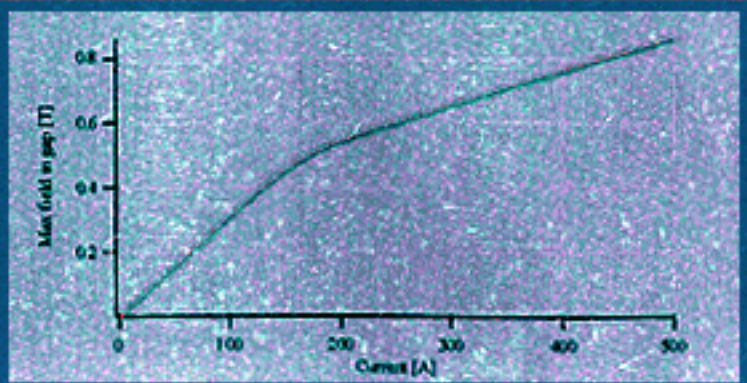
Field measurements in vertical Dewar with miniature Hall probes

1 kA/mm²



0.5 kA/mm²

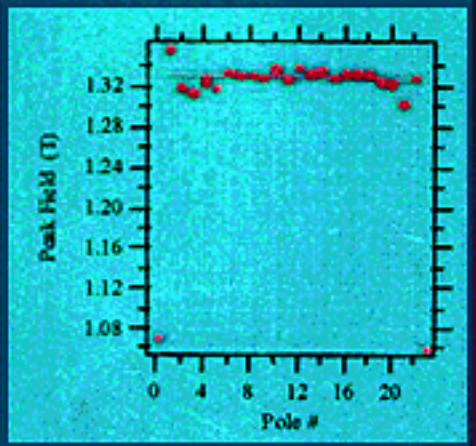




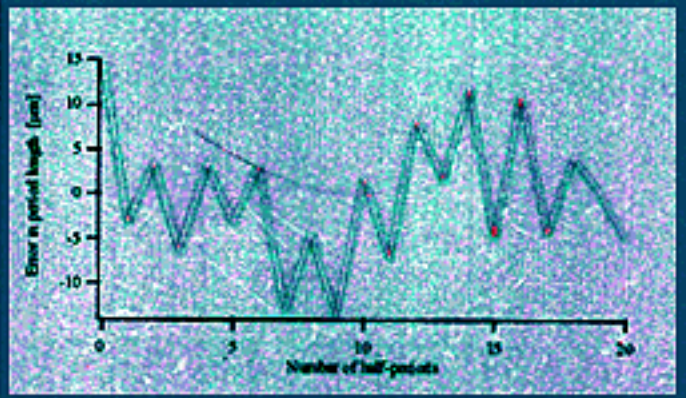
field vs. current

Field errors

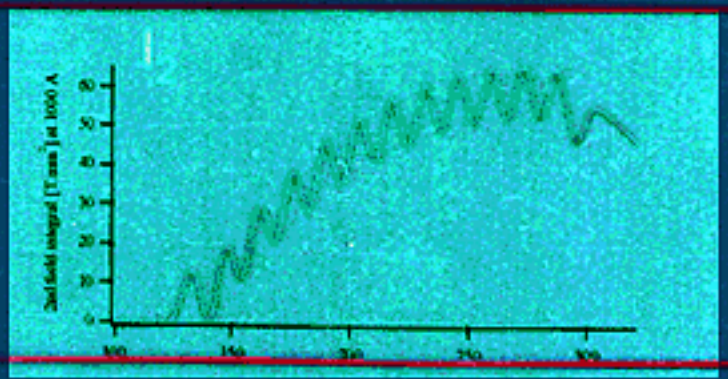
Deviation of max. field



Deviation of period length

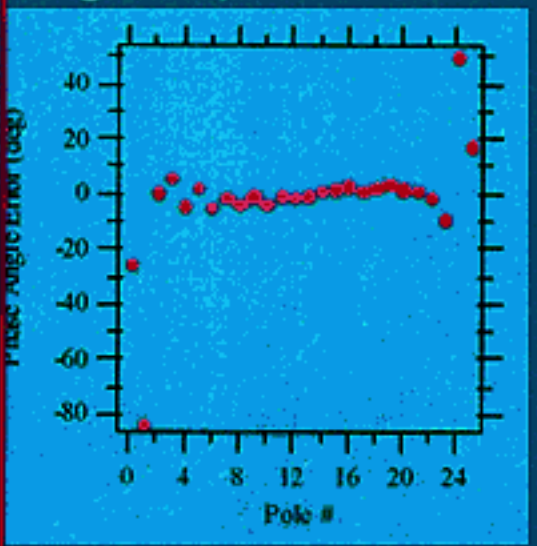


$$I_2 = \int\left(\int B\,ds\right)ds$$



Resulting phase error

(Deviation of sinusoidal motion in degrees)



Concept: cryostat for storage rings