MAGNETS
for the DESY accelerators
HERA –TTF – PETRA – XFEL

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18.05.2005

HERA
PETRA

Length of HERA 6.3 km

Magnets for HERA:

560 dipoles

788 quadrupoles

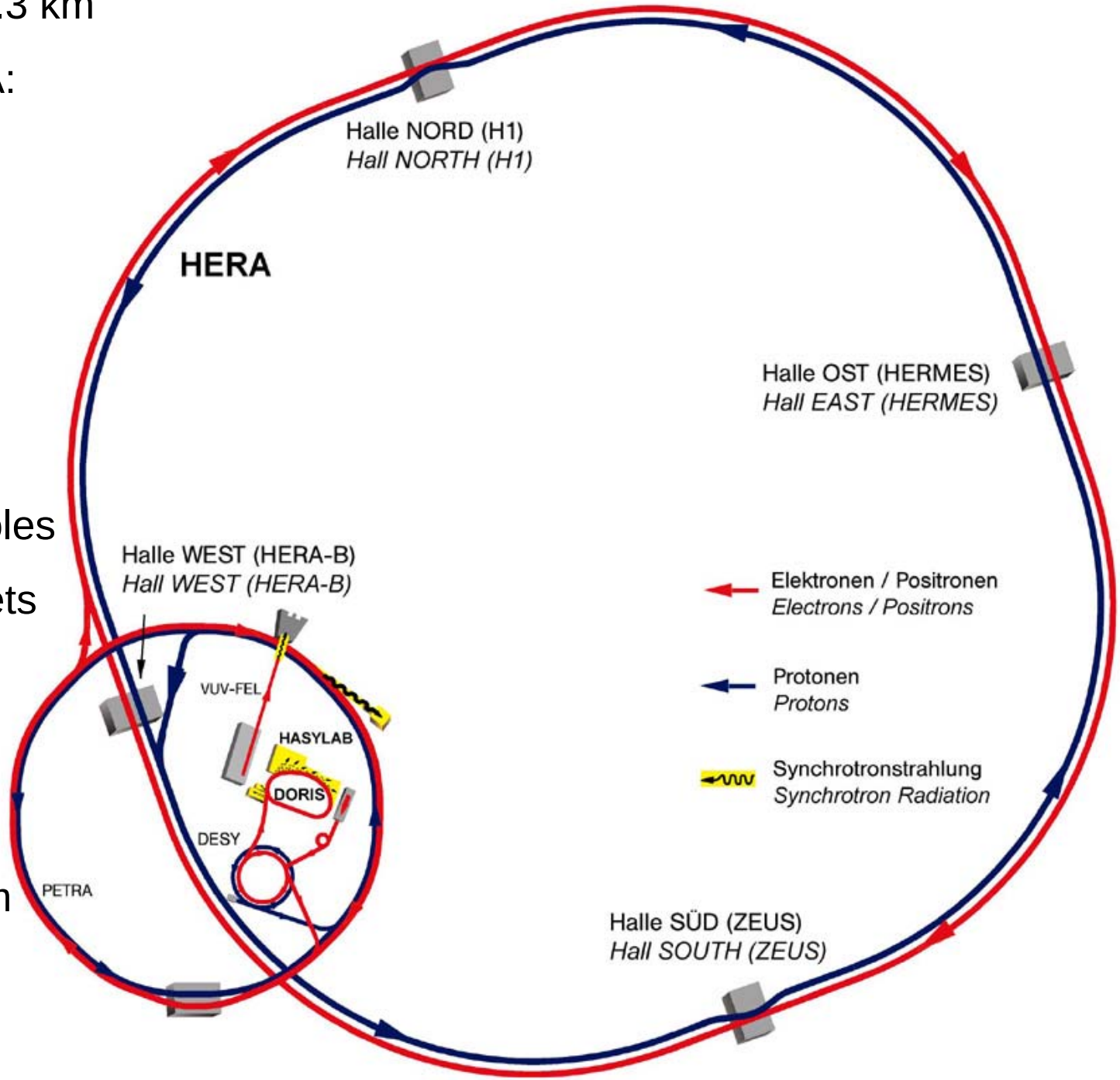
422 sextupoles

32 correctors

453 cold dipoles

252 cold quadrupoles

Total 2500 magnets



particle momentum

e 27.5 GeV/c

p 920 GeV/c

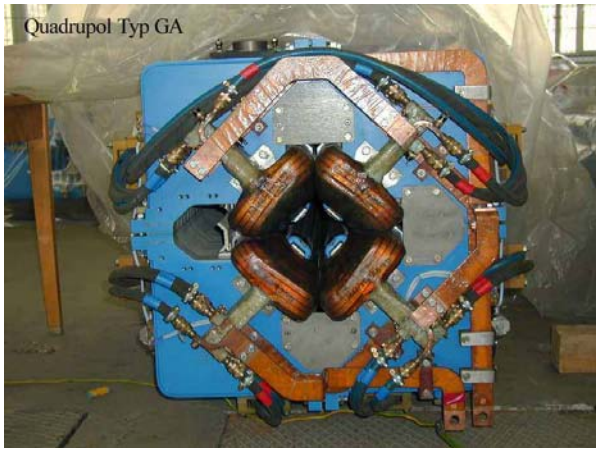
In 2000 HERA Lumi Upgrade new magnets at interaction zone

GA

726mm H

790mm W

4070mm L



GN

850mm H

666mm W

2090mm L

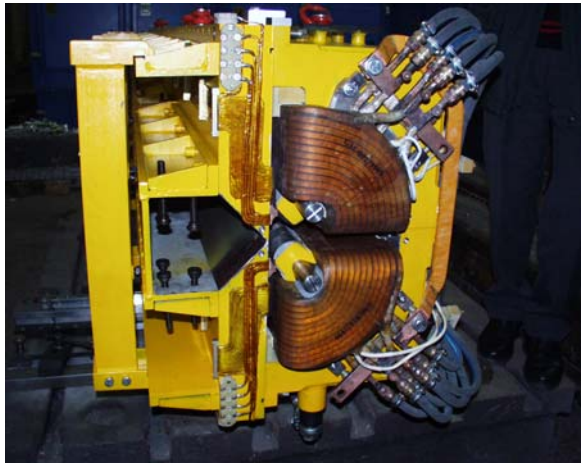
Lumi Upgrade Magnets

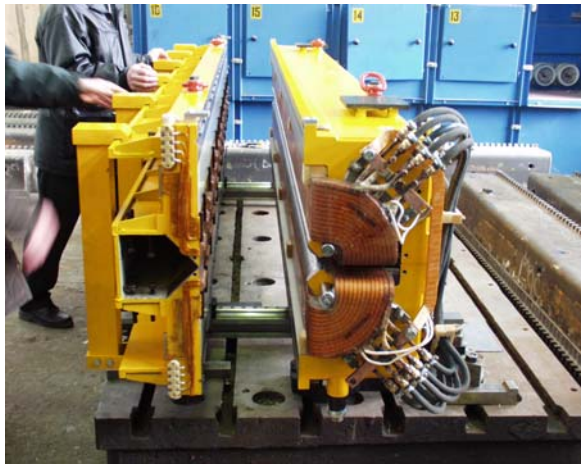
GM

744mm H

752mm W

3565mm L

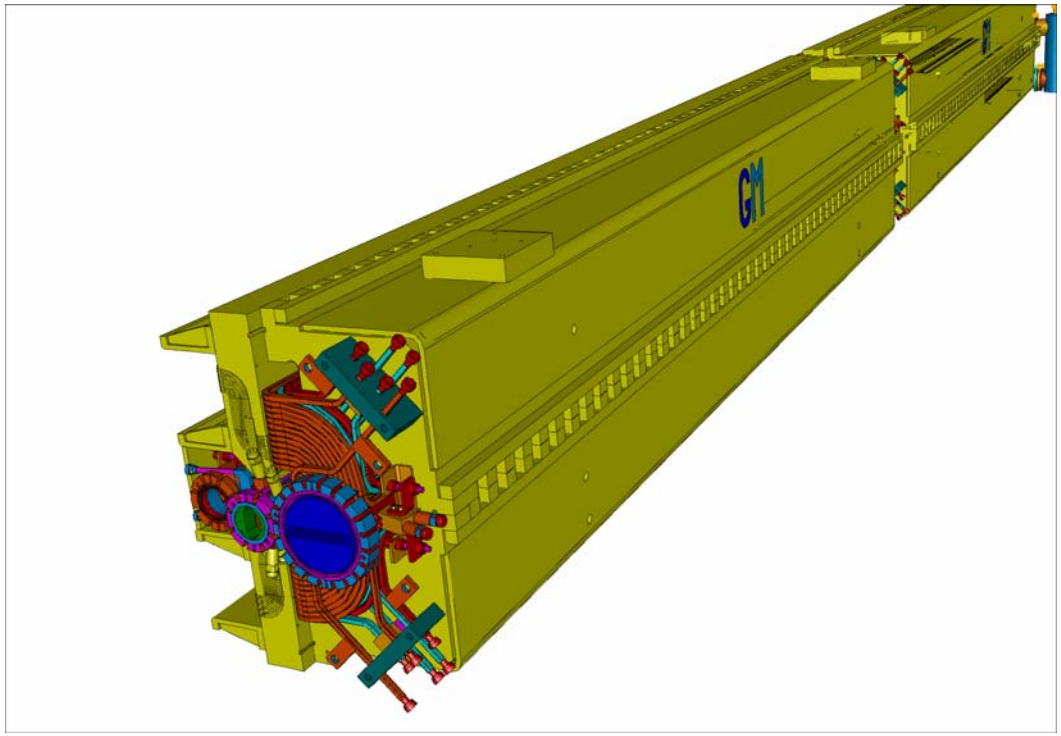


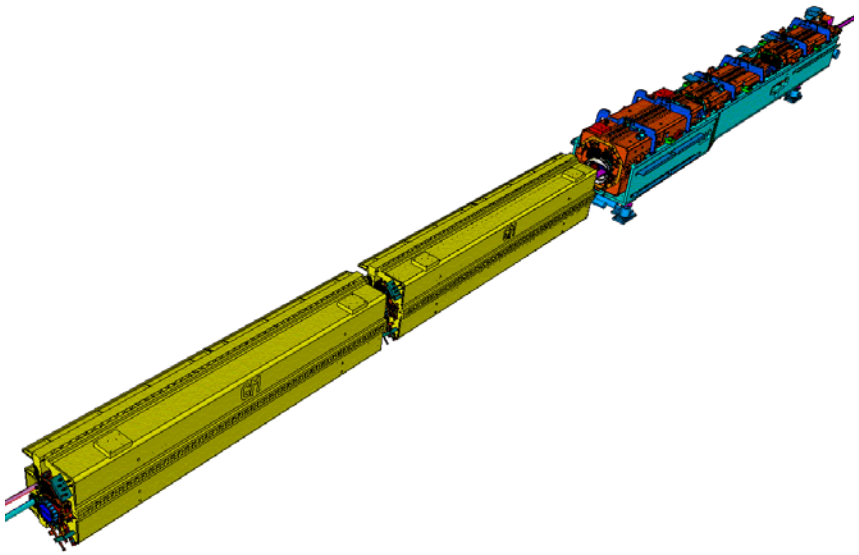


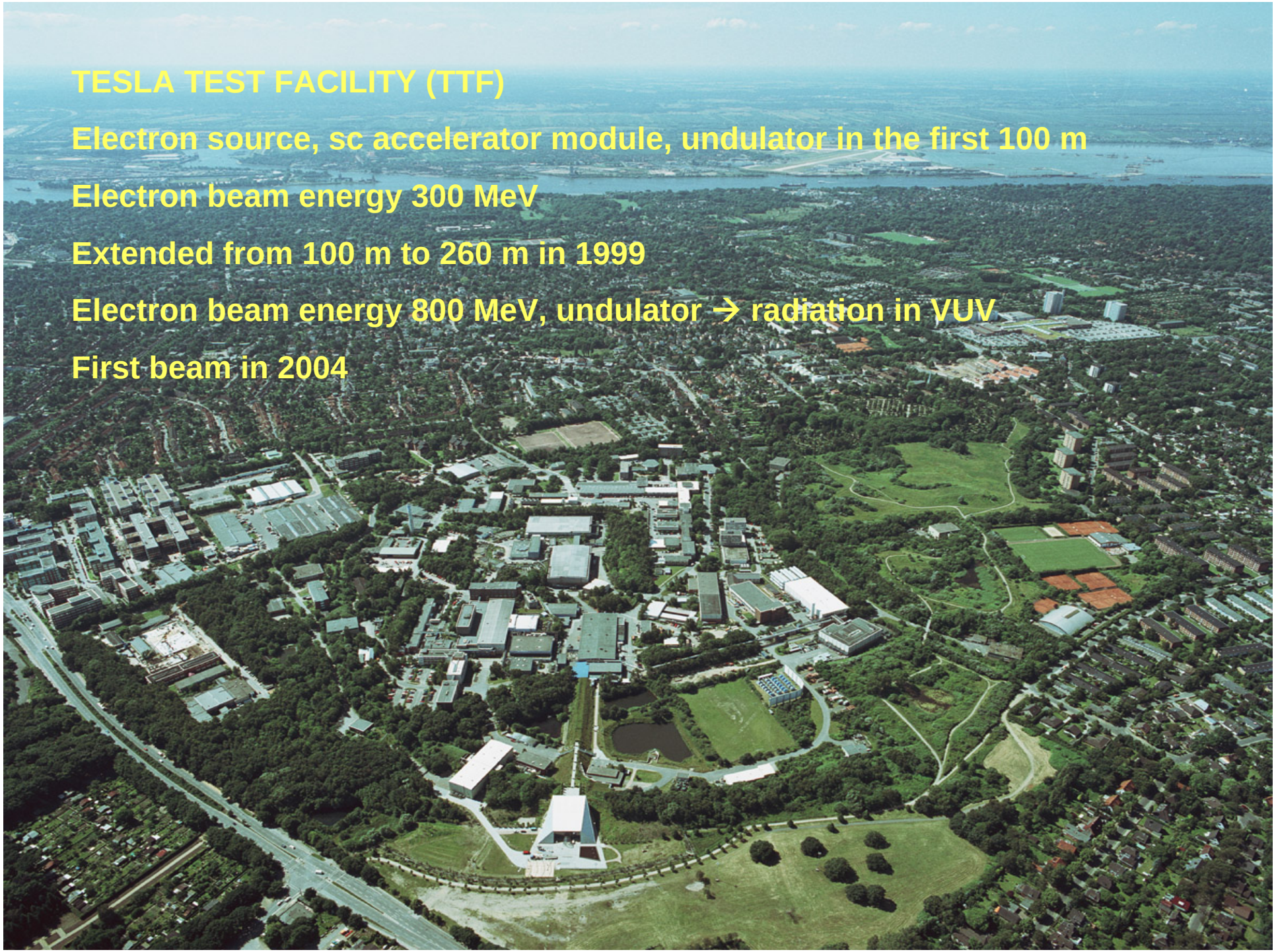
- **For the Upgrade 52 magnets were built**
- **05 GA (aperture 70mm, Gradient 26 T/m)**
- **13 GB (aperture 70mm, Gradient 26 T/m)**
- **07 GI (aperture 74mm, Gradient 28 T/m)**
- **05 GJ (aperture 100mm, Gradient 18 T/m)**
- **13 GN (aperture 70mm, Gradient 30 T/m)**
- **09 GM (aperture 37mm, Gradient 25 T/m)**
- **magnetic field quality at radius 25 mm better than 5.0E-04 (GI and GJ < 1.0E-04).**
- **their design was developed with MAFIA and OPERA2d.**

magnets were installed 70 m before and after the interaction point

GB-GB-GB-GA-GN-GN-GN-GM-GM-GJ-GI-GI-sc-EXP-sc-GI-GJ-…







TESLA TEST FACILITY (TTF)

Electron source, sc accelerator module, undulator in the first 100 m

Electron beam energy 300 MeV

Extended from 100 m to 260 m in 1999

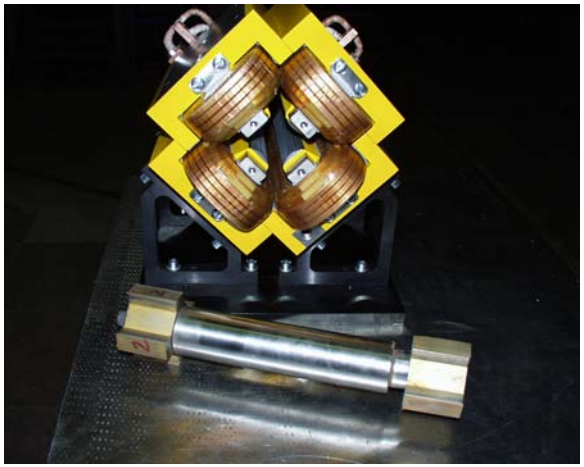
Electron beam energy 800 MeV, undulator → radiation in VUV

First beam in 2004

Magnets for the TTF (linear accelerator)

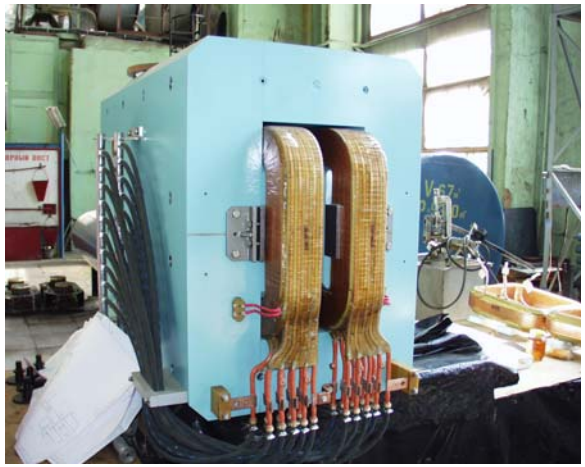
TQA

TQC



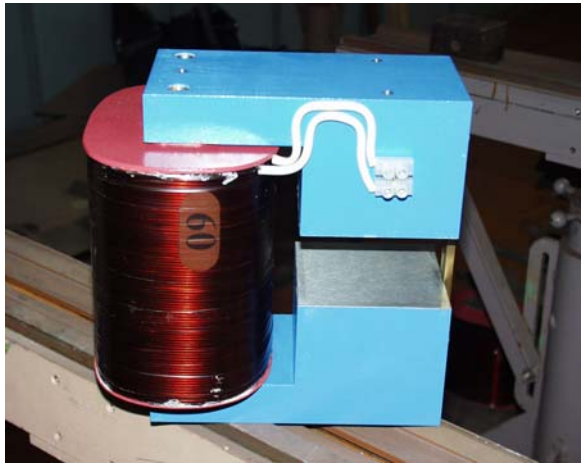
Magnets for TTF

TSB

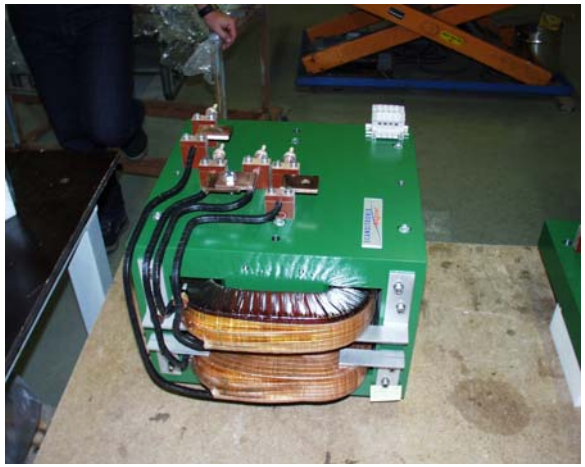


TDC

Magnets for TTF



TCA



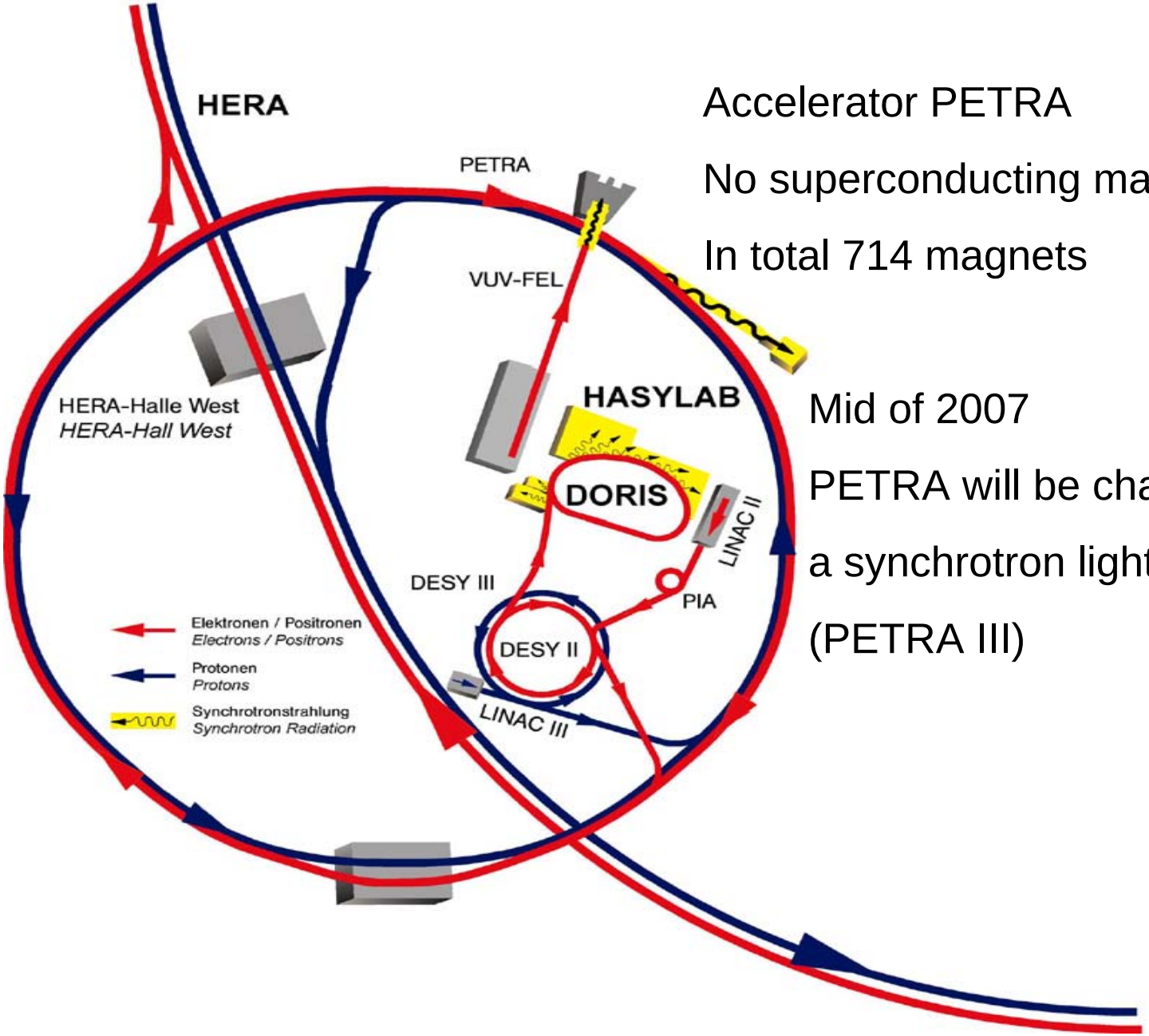
TDA

Short overview of the magnets for TTF

(all magnets were designed with OPERA2d and MAFIA)

Magnetname	Magnettyp	number	length [mm]	Gap height [mm]	Gap width [mm]	field [T]	current [A]	Field-quality
TDA	Dipol	11	400	40	160	0.16-0.86	335	5*E-04
TDB	Dipol	5	200	40	200	0.05-0.50	342	5*E-04
TDC	Dipol	3	1200	60	350	up to 1.60	372	5*E-04
TDD	Dipol	7	500	25	221	0.3775	90	
TQA	Quad	37	250	40	40	0.01-0.72	298	2*E-03
TQB	Quad	20	300	50	50	0.004-0.675	347	2*E-03
TQC	Quad	3	250	40	40	0.01-0.72	290	2*E-03
TSA	Sextupol	5	200	40	40	0.47	255	
TSB	Sextupol	6	200	50	50	0.34	225	
TCA	Dipol	2	91	20	100	bis 0.26	3	
TCA	Dipol	51	100	40	100	bis 0.15	3	
TCA	Dipol	21	100	50	100	bis 0.12	3	

200



Accelerator PETRA

No superconducting magnets

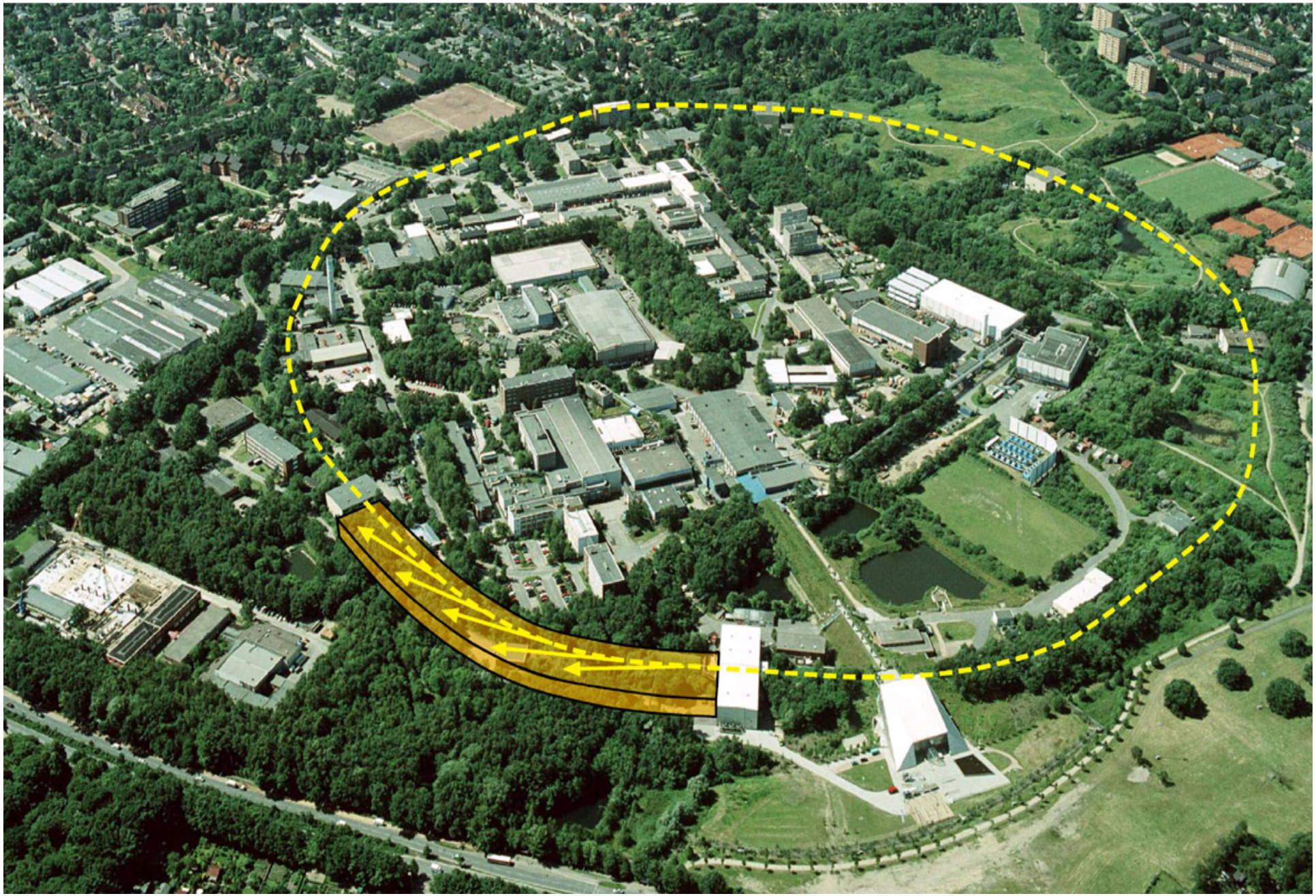
In total 714 magnets

Mid of 2007

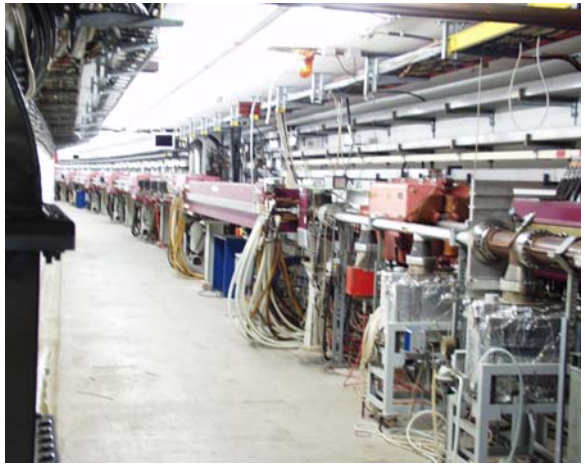
PETRA will be changed to

a synchrotron light source

(PETRA III)



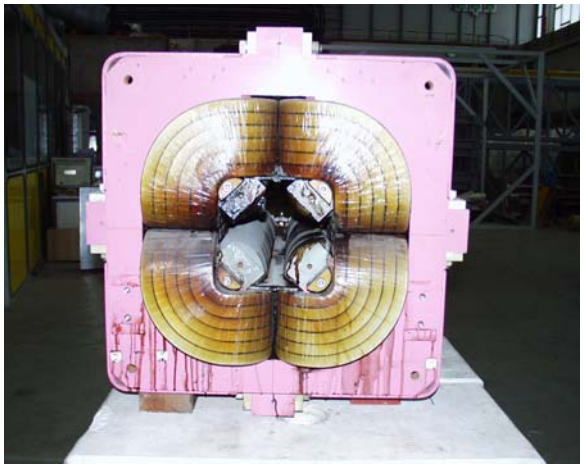
Magnets for PETRA-III



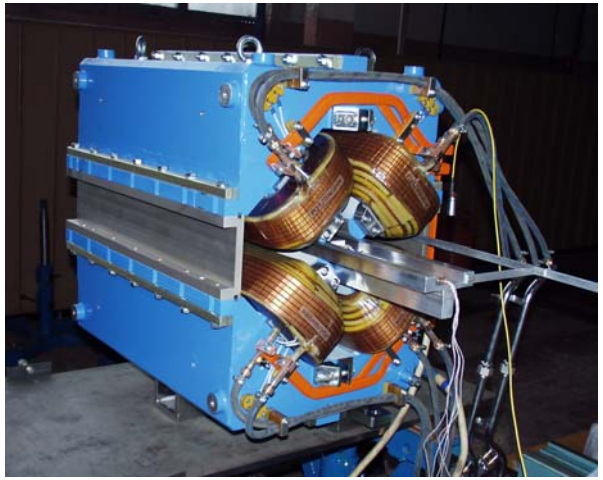
Existing machine is preaccelerator for HERA

Magnet

QA



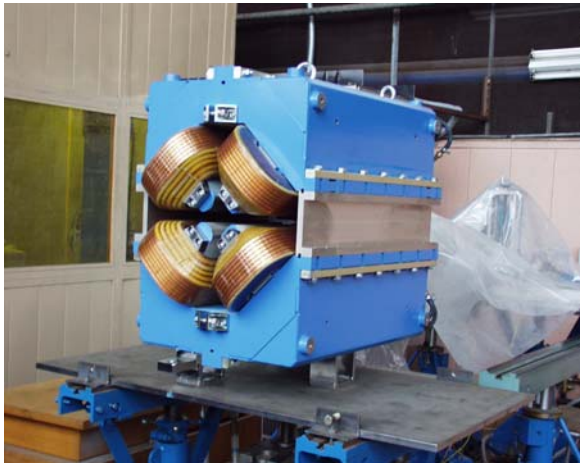
NEW Magnets for PETRA III

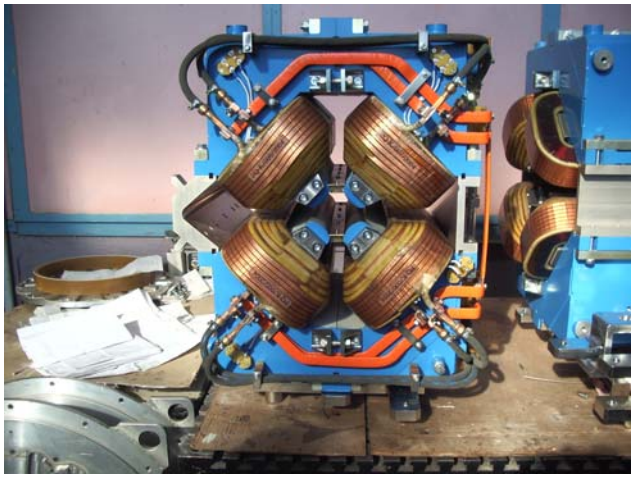


PQA

440mm L

720mm L



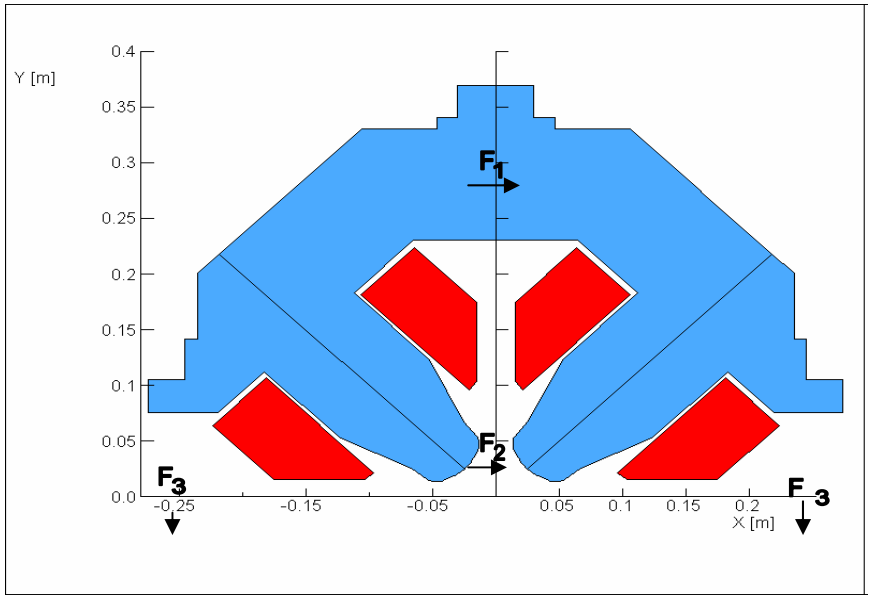


Quadrupole prototypes for testing the non-magnetic vertical spacers for the synchroton beam outlet.

Calculations were done with

OPERA-2d and MAFIA.

Magnetic forces



Problem:

Octupole value b(4) is varying to much with increasing current.

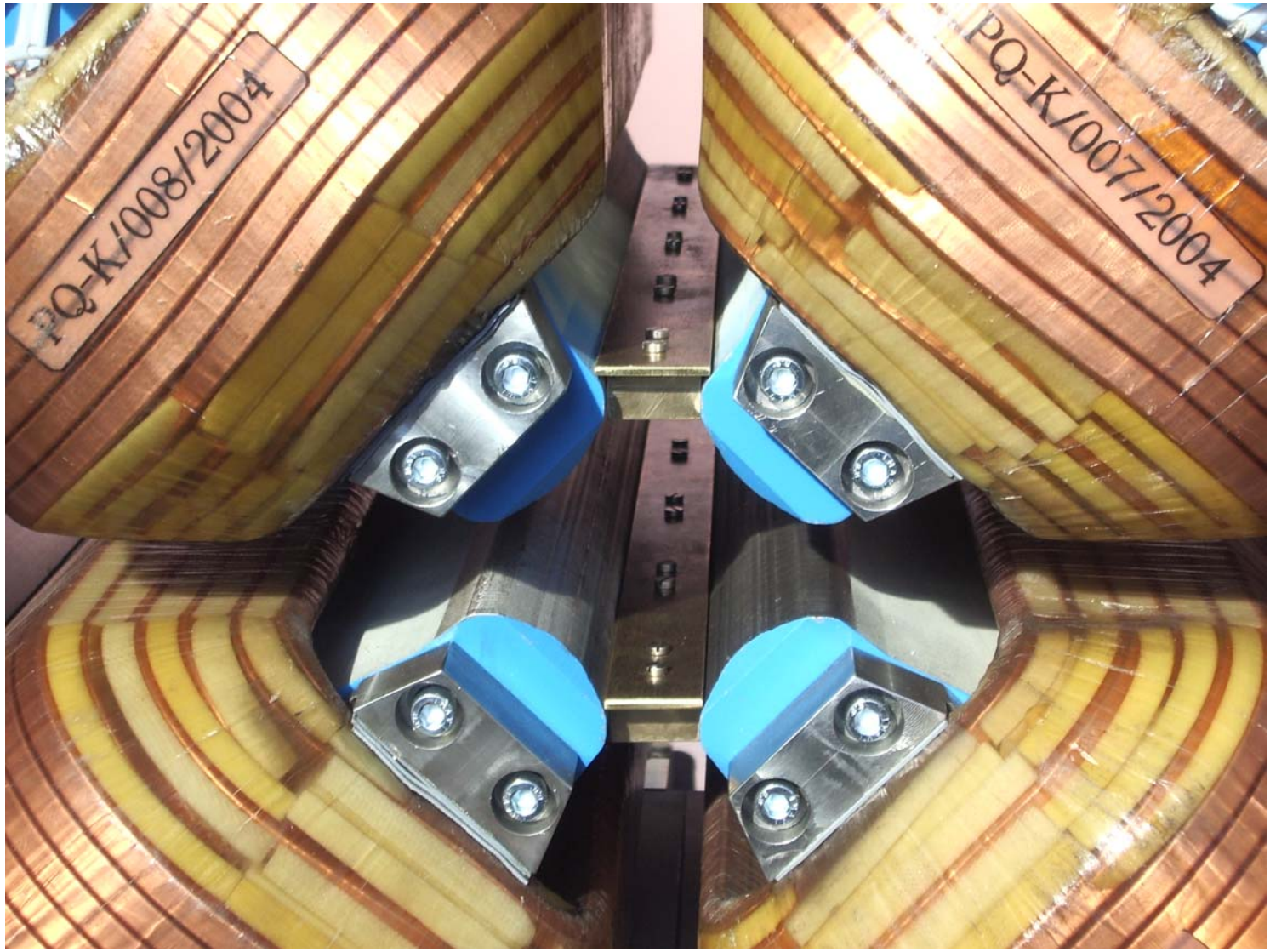
Solution:

Magnetic force analysis and human intelligence.

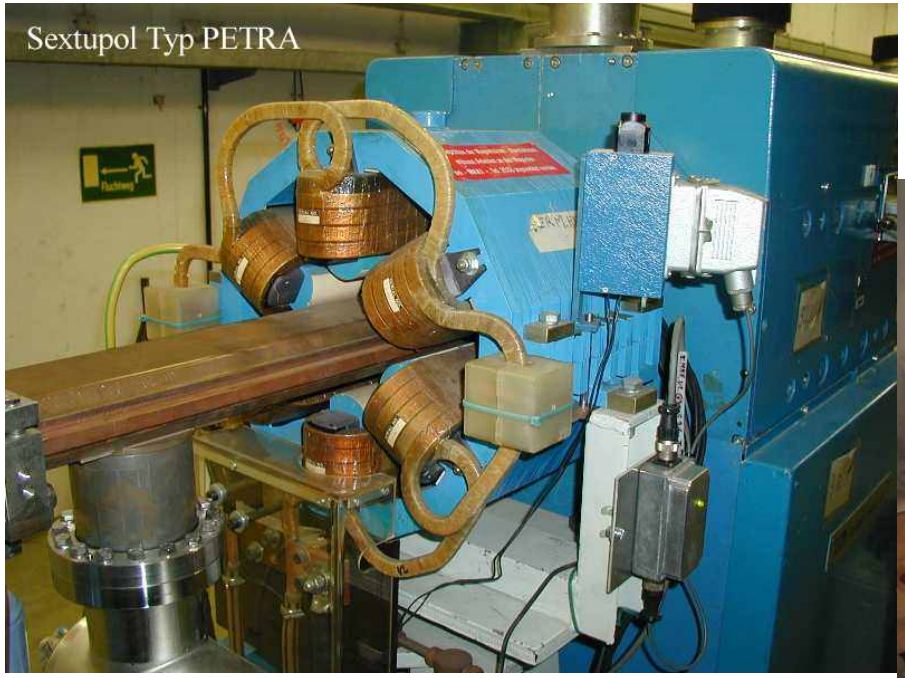
No help from OPERA-2d or MAFIA

Current [A]	Force [tons/m]		
	F_1	F_2	F_3
230	8	2	2*2
200	6.5	1.6	2*1.6
190	5.9	1.4	2*1.4
150	3.7	0.9	2*0.9
100	1.7	0.4	2*0.4
50	0.5	0.1	2*0.1
20	0.07	0.02	2*0.02
10	0.02	0.004	2*0.004

Distance piece between poles is the solution to get small b(4)



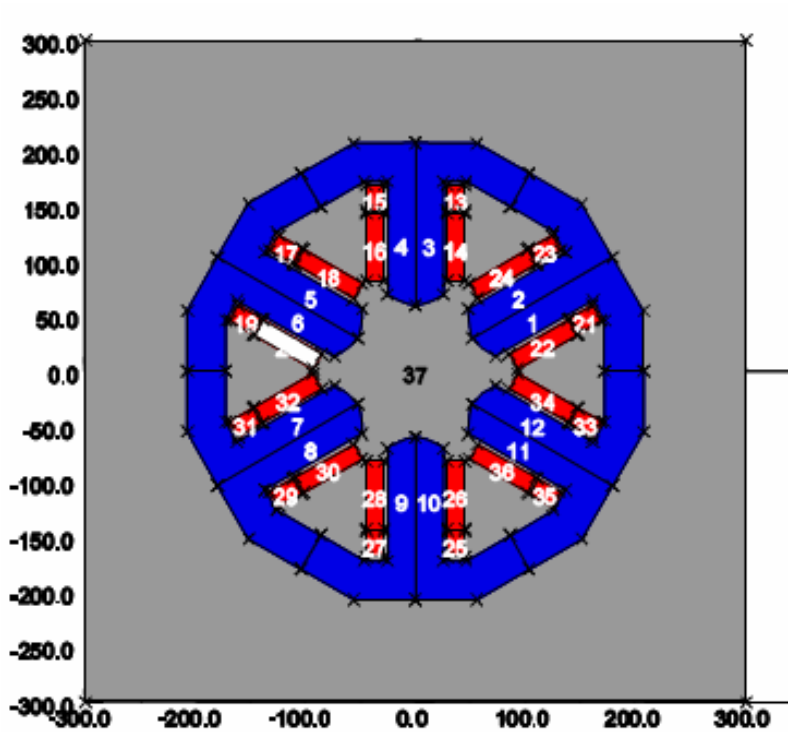
The PETRA Sextupole Magnet

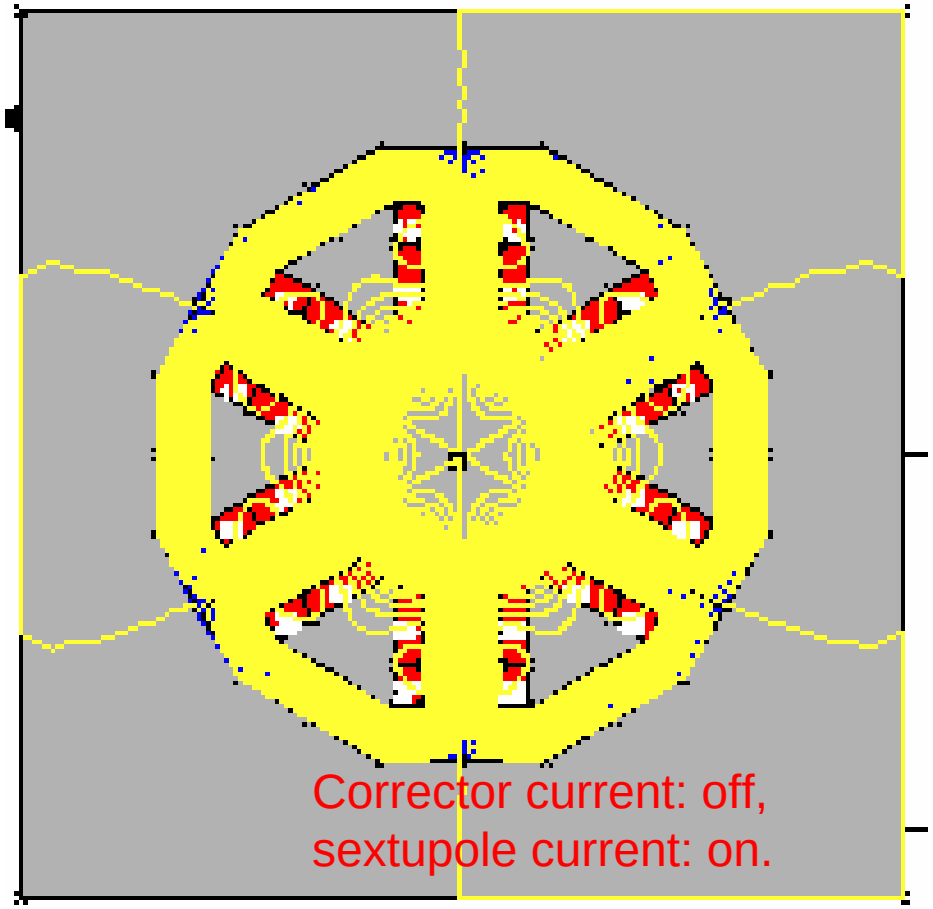


Existing Sextupole in the PETRA tunnel (today).

Sextupole with new aluminum coils for PETRA III.

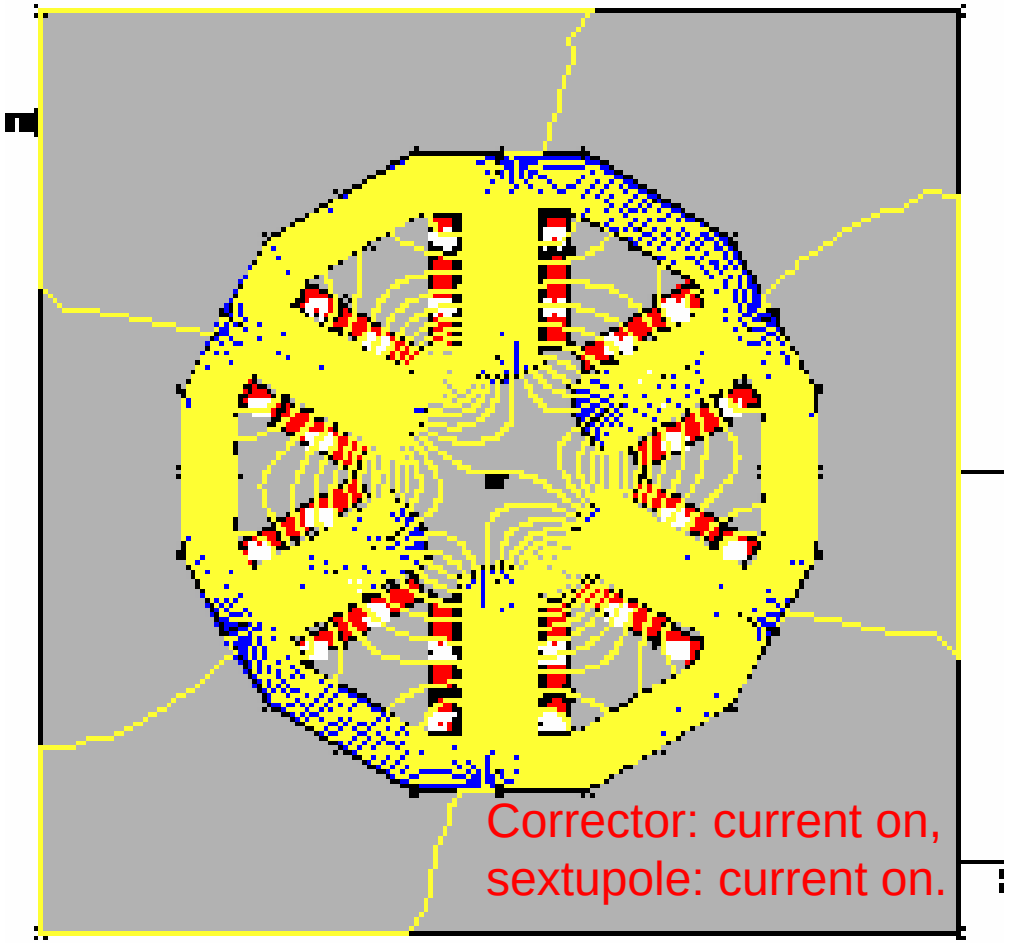
Can the existing sextupole magnet be a sextupole AND a vertical corrector magnet without changing the yoke?

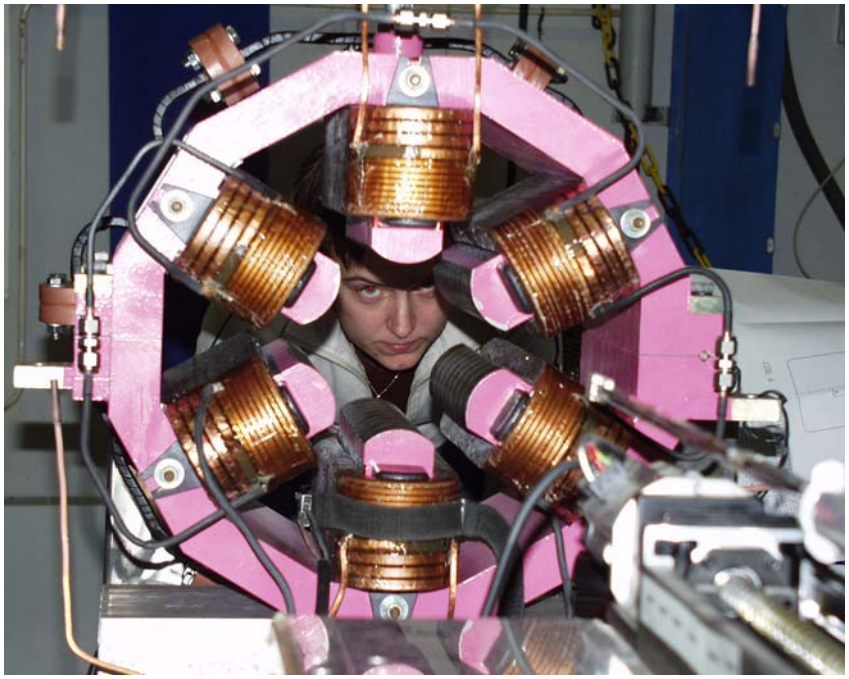




Put 2 copper coils powered separately in the space where one aluminum coil is sitting.

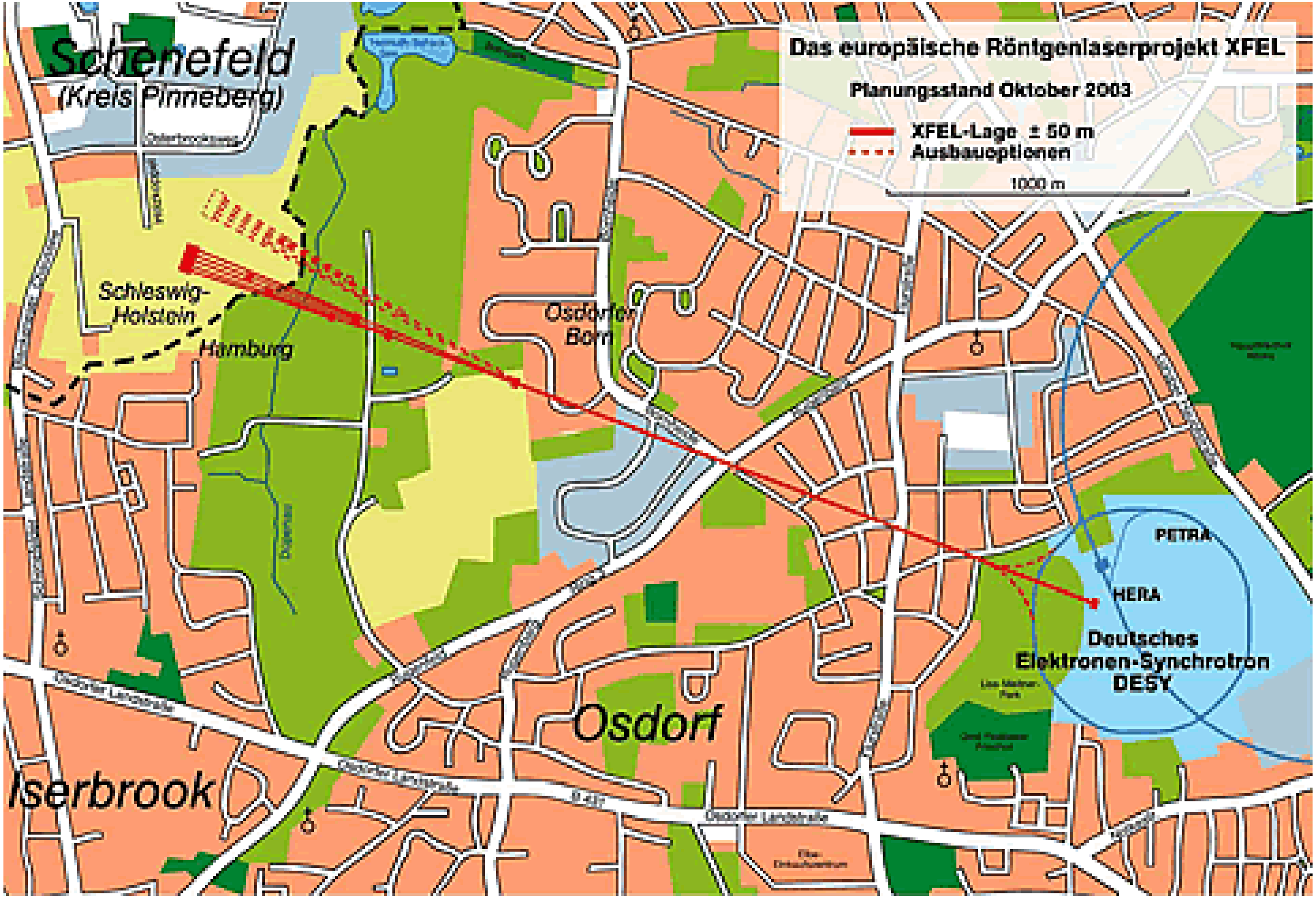
Opera2d and measuring results are consistent!





Future Project XFEL

- Total length approx. 3.3 km.
- Length of accelerator tunnel 2.1 km, 6 m to 25 m below earth‘s surface.
- Electron energy 10 to 20 GeV.
- Experimental hall with 5 beam lines and 10 measuring stations.
- Approx. 800 warm magnets are needed.


Das europäische Röntgenlaserprojekt XFEL
Planungsstand Oktober 2003
XFEL-Lage ± 50 m
Ausbauoptionen
1000 m
Schenefeld
(Kreis Pinneberg)
Schleswig-
Holstein
Hamburg
Osdorfer
Born
PETRA
HERA
Deutsches
Elektronen-Synchrotron
DESY
Osdorf
Iserbrook