PETRA III
A High Brilliant Synchrotron Radiation Source in the Hard X-ray Regime

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for the PETRA III project team

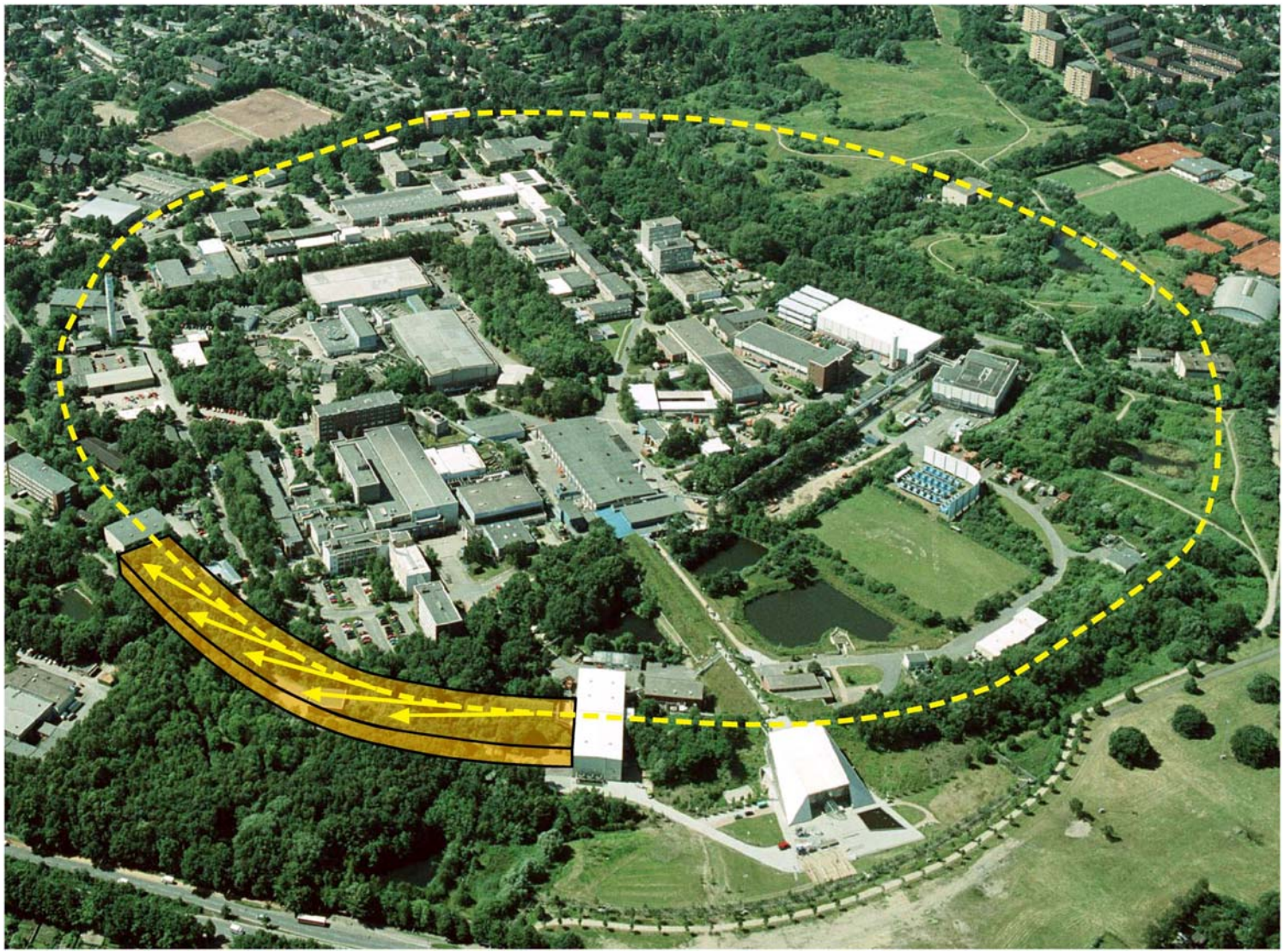
DESY

Parameters of PETRA III

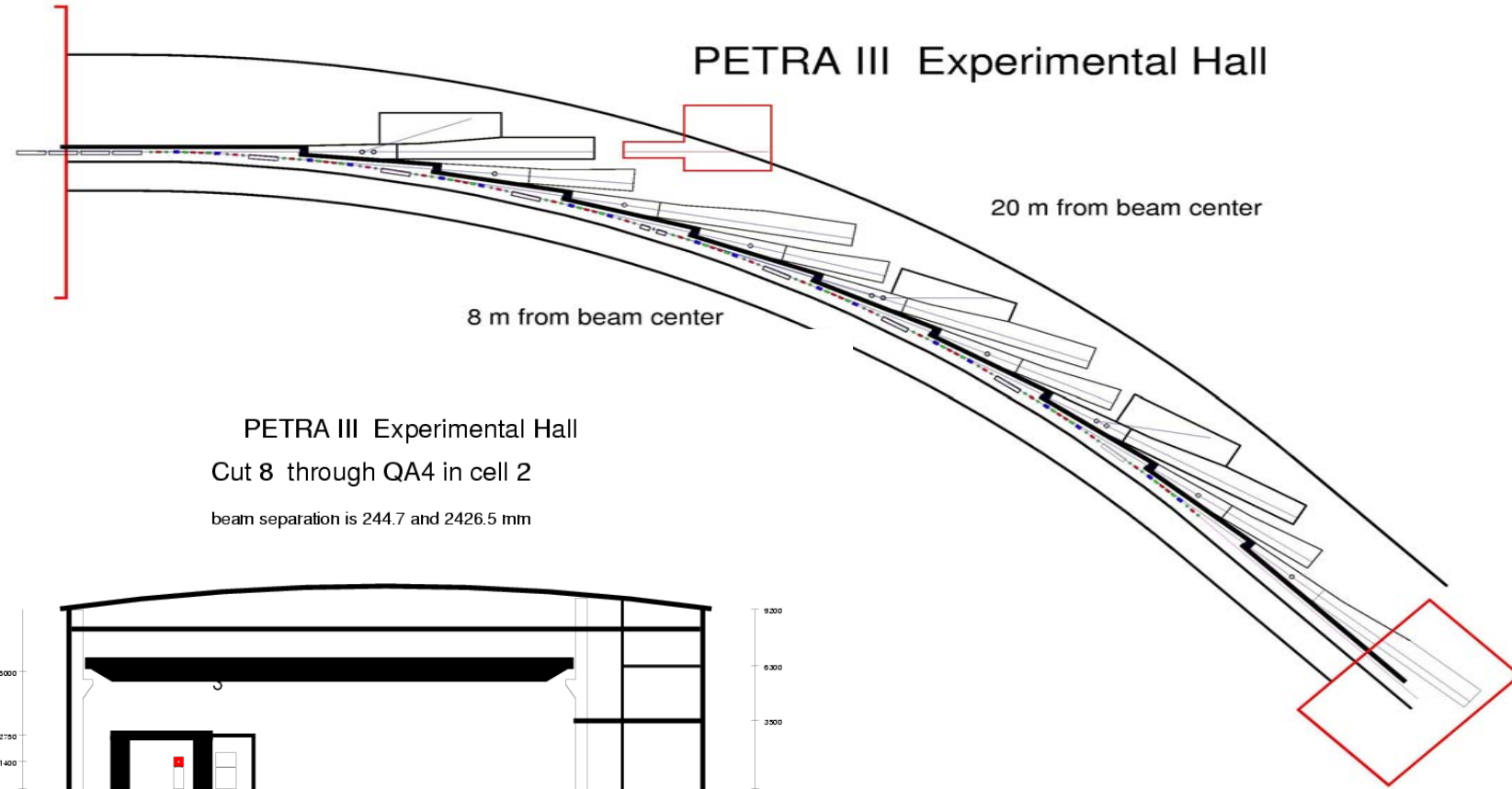
Design philosophy: cost effective (*)
and compatitive with high energy SR sources

Parameter	
# insertion devices (*)	**13**
energy (GeV)	**6**
max. current (mA)	**>100**
ε_x (nmrad)	**1**
ε_z (nmrad)	**0.01**

PETRA III
Conversion of PETRA II (2304 m circ.)



PETRA III
New Experimental Hall



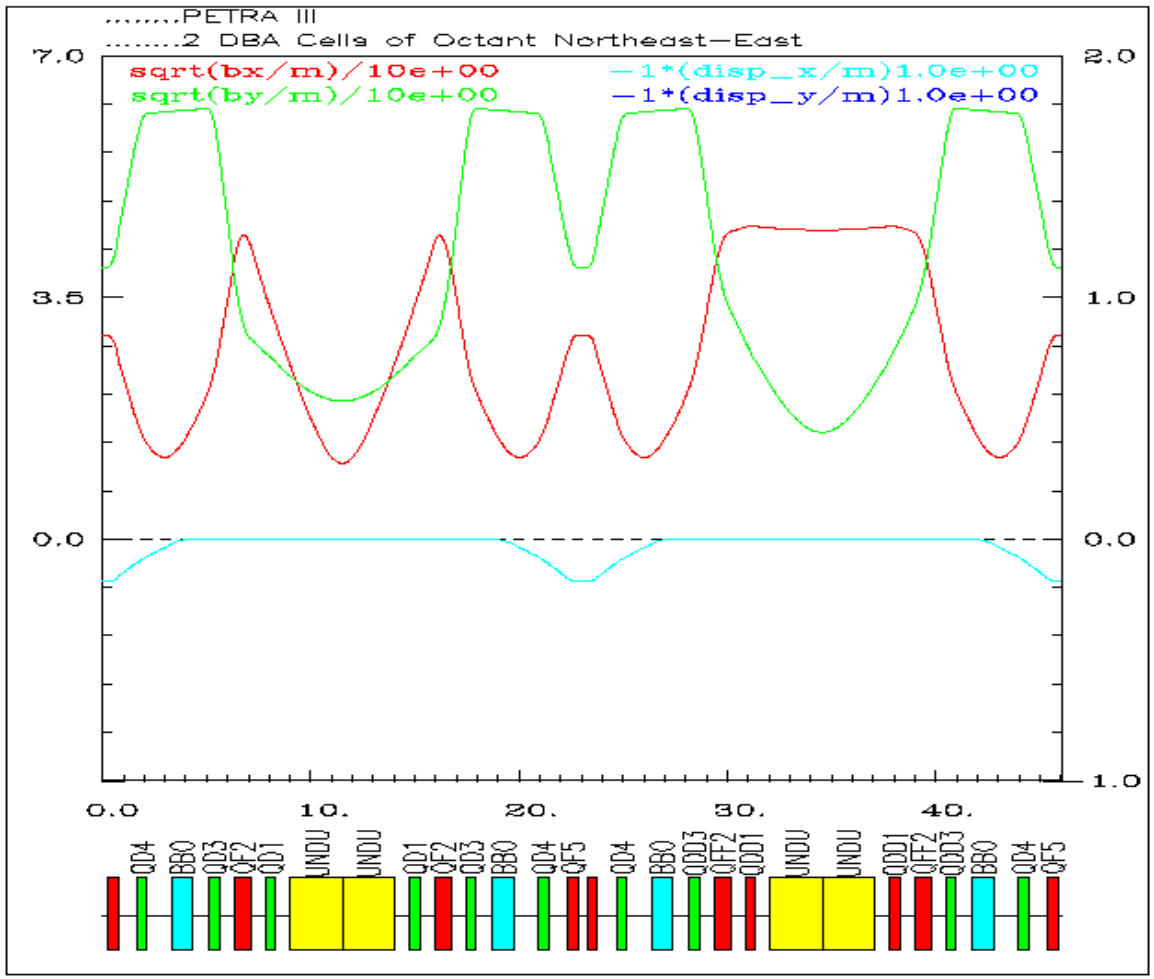
PETRA III Experimental Hall

Cut 8 through QA4 in cell 2

beam separation is 244.7 and 2426.5 mm

HF, Version 20.2.2003

PETRA III
Low & High β_x Cell (β_x=1.2m & β_x=20m)



4 * 5 m undulator

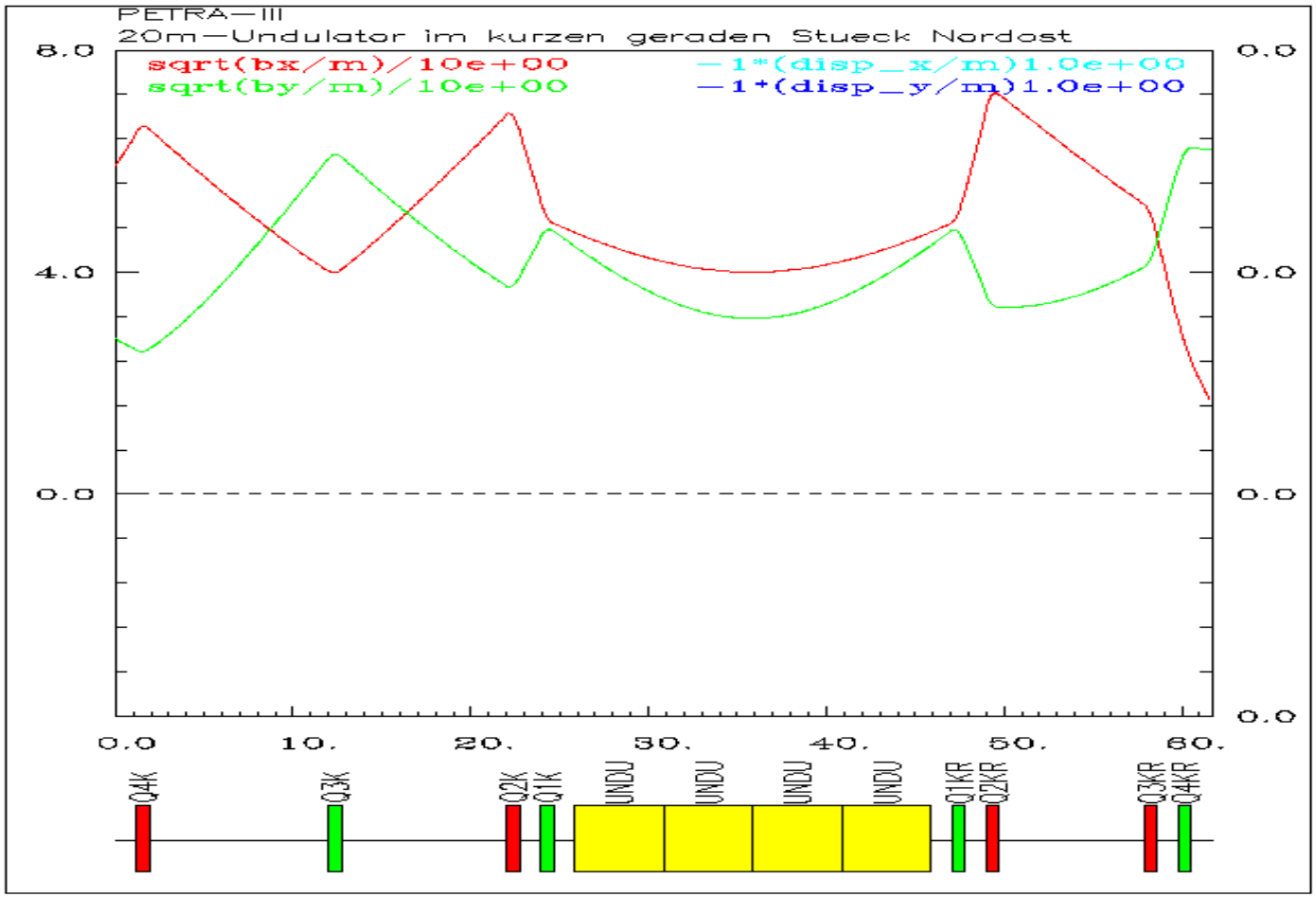
8 * 2 m undulator

12

ID properties		unit
λ	2.8	cm
B	0.9	T
cham. Height	7	mm
cham. Mat.	Al	

D_x small → no sextupols here

PETRA III
long (20m) undulator in short straight



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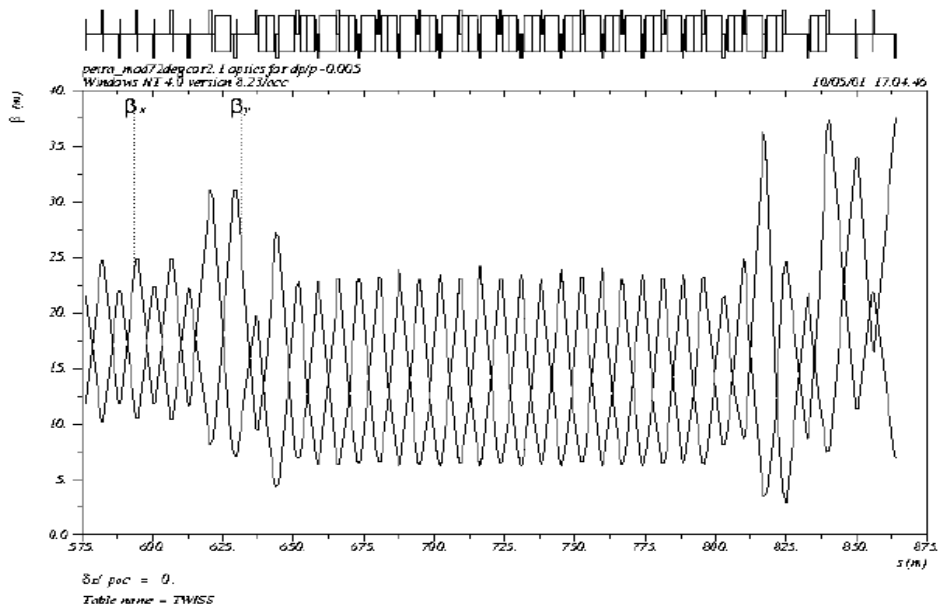
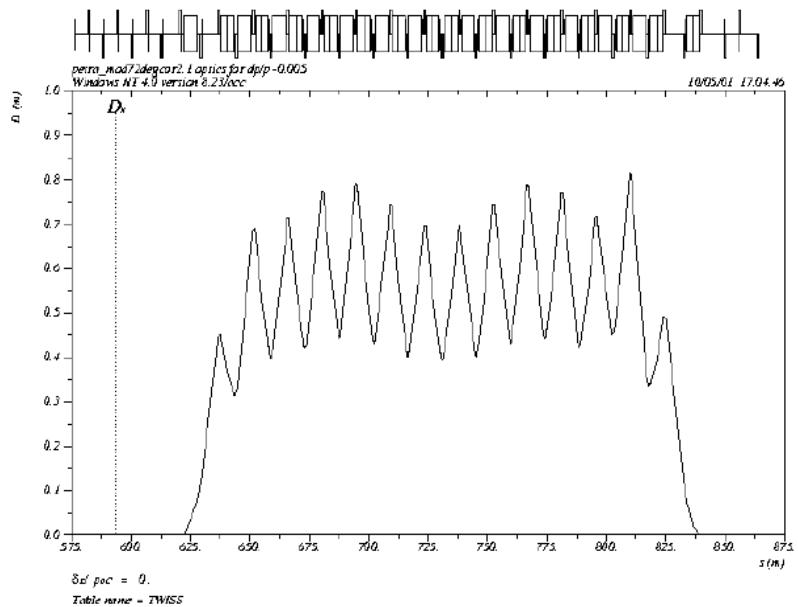
PETRA III
optics of old octant

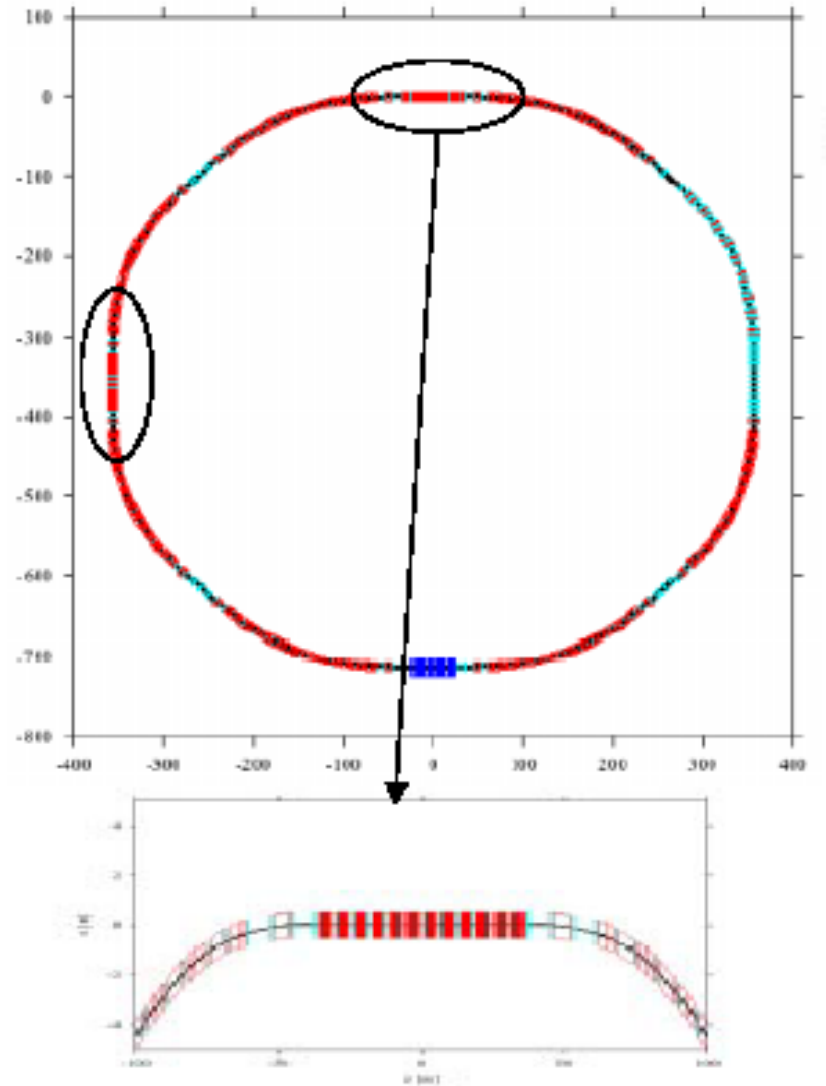


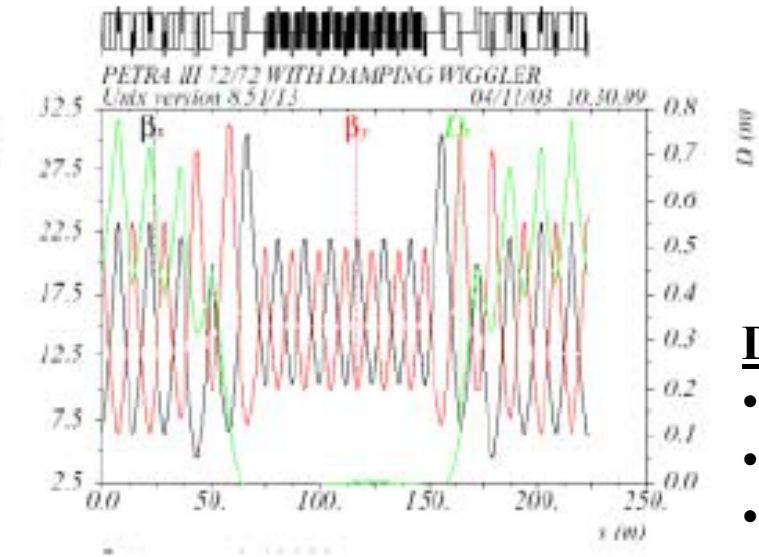


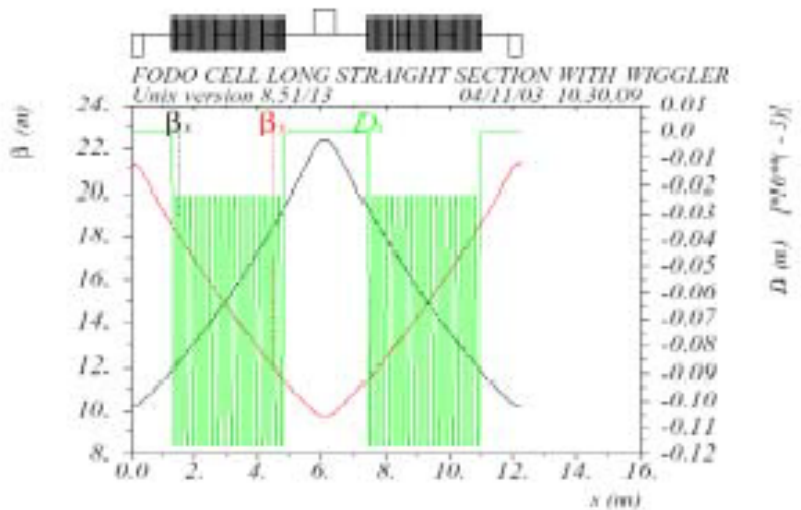
1) Phase advance per FODO cell $\mathbf{72^0}$: compromise between small emittance and sufficiently large dynamic aperture
2) Chromaticity correction in old octants
3) Minimization of 1-st order sextupol effects
4) Alignment tolerances comparable to present status (1/4 mm)

PETRA III
damping wiggler

ε_x: 4 → 1 nmrad





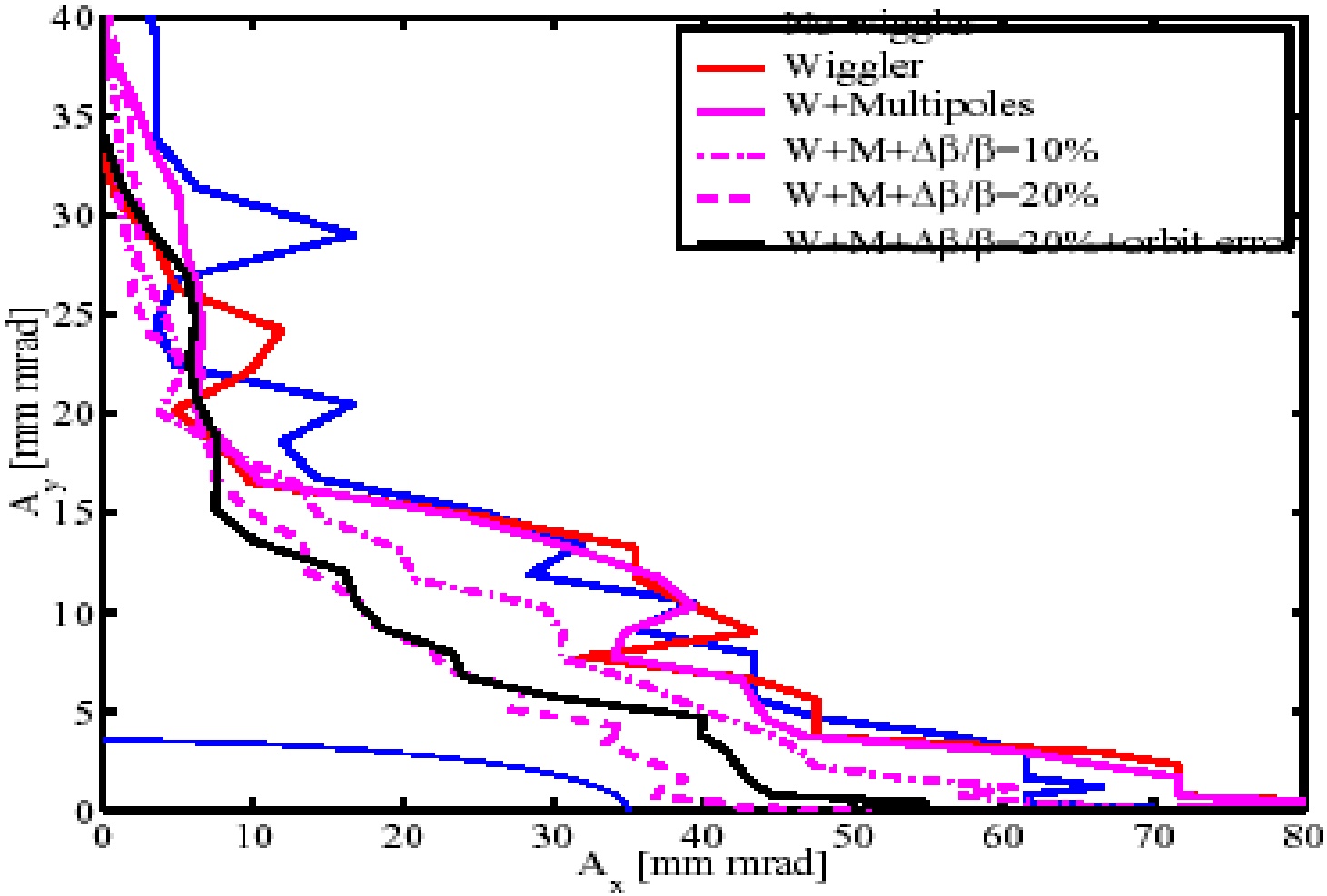


Damping wigglers

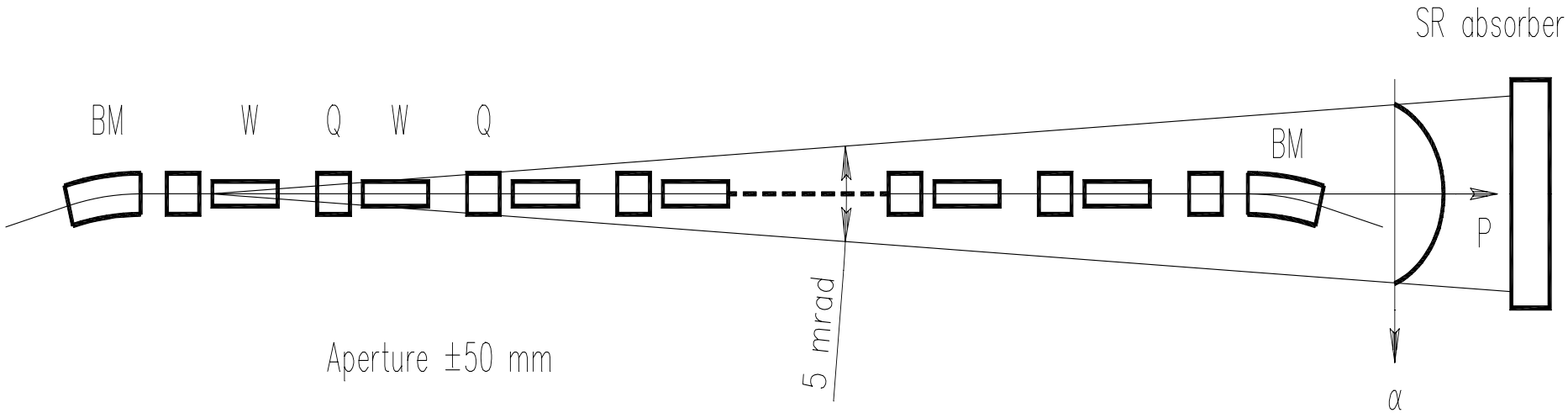
- **B = 1.5 T**
- **λ = 0.2 m**
- **h = 0.025 m**
- **L_{tot} = 80 m (2 x 40m)**

PETRA III

dynamic aperture including perturbations



PETRA III
Wiggler Section



350 kW
(60%)
for 200 mA

PETRA III
Toushek Lifetime

Parameter	
total current (mA)	100
# bunches	40
current / bunch (mA)	2.5
momentum acc. (%)	1.5
Touschek lifetime (h)	2

PETRA III
Lifetime – Topping up

User demand 12 h run time → total lifetime ≈ 24 h
→ Touschek lifetime ≈ 50 h

Way out

- increase the number of bunches (960) → new feedback system
- Top up (time resolved measurements with a small number of bunches)

➢ More precise: injection at a Hertz rate (constants of I_{tot} **≈ 1 ‰)**

Also attractive in case of many bunches

1. Fill appr. every minute (constants of Itot **≈ 1 ‰)**
2. → thermal equillibrium → relaxes burden of orbit stabilisation (SLS)

PETRA III
Orbit Stabilization

ε_x = 1nmrad **coupling 1%**

	Low β insertion			High β insertion			
	β(m)	σ(μm)	Amplification factor	β(m)	σ(μm)	Amplification factor	
Horizontal	**1.19**	**34.6**	**17.25**	**19.84**	**141**	**70.24**	
Vertical	**4.0**	**6.3**	**34.08**	**2.37**	**4.9**	**26.20**	

Stab. Requirement 0.1 * σ
→Sub micron orbit stability !!

PETRA III
Orbit Stabilization

Passive measures: improvement of magnet supports in old octants; careful girder design etc.

Aktive measures: Fast orbit correction (up to 100 Hz)

Orbit measurement

- button monitors and appropriate electronics: seems to be o.k.

Layout of system still work in progress

PETRA III
current limitations

- **Multibunch instabilities are a problem:**
  Present situation **PETRA II**

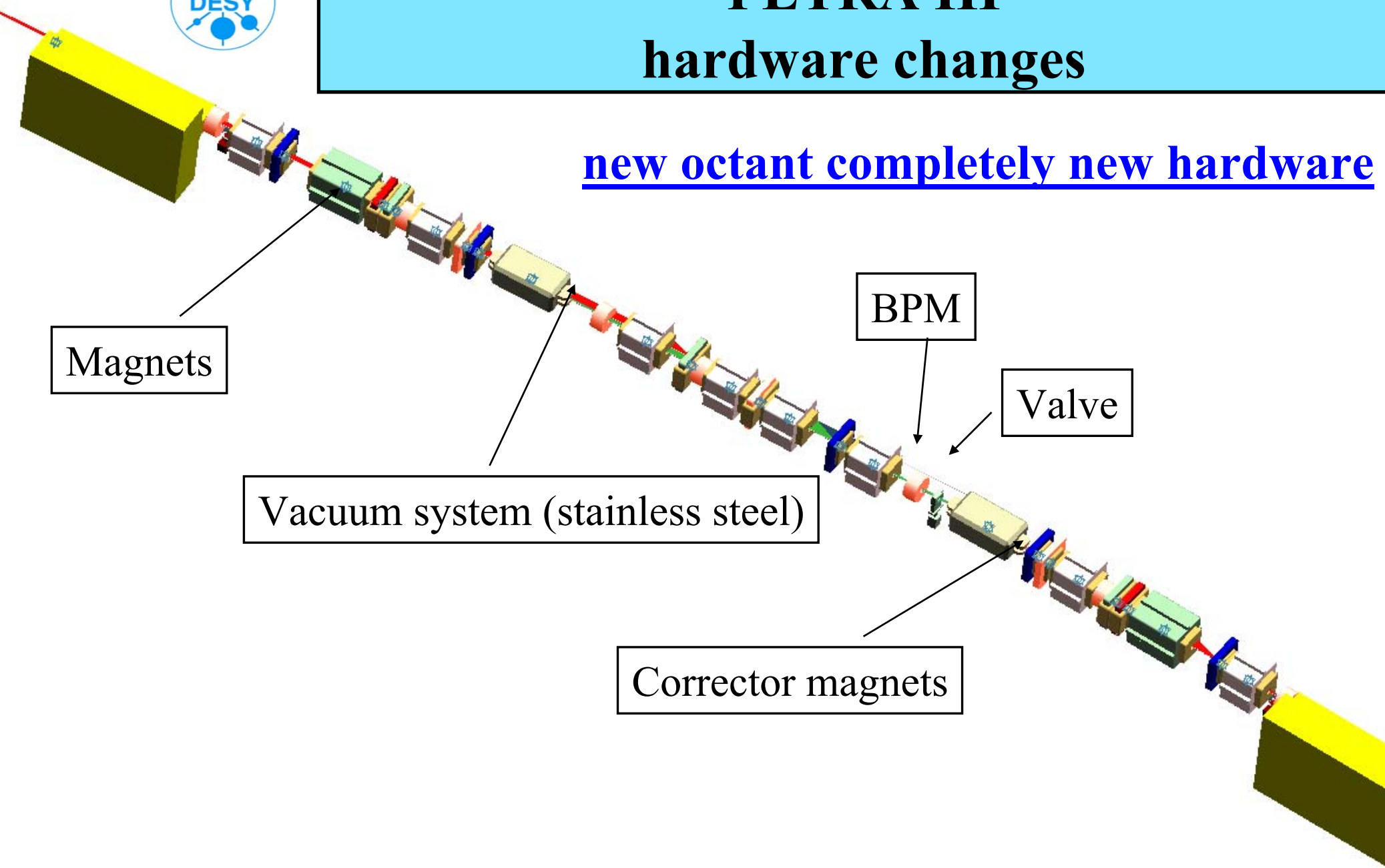
	longitudinal	horizontal	vertical
I_{thres} (mA)	7	6	6
$1/\tau$ (Hz)	35	50	60
Z_{eff}	3.6 MΩ	45 MΩ/m	54 MΩ/m

PETRA III: 12 instead of 16 cav. & larger long. (radiation) damping

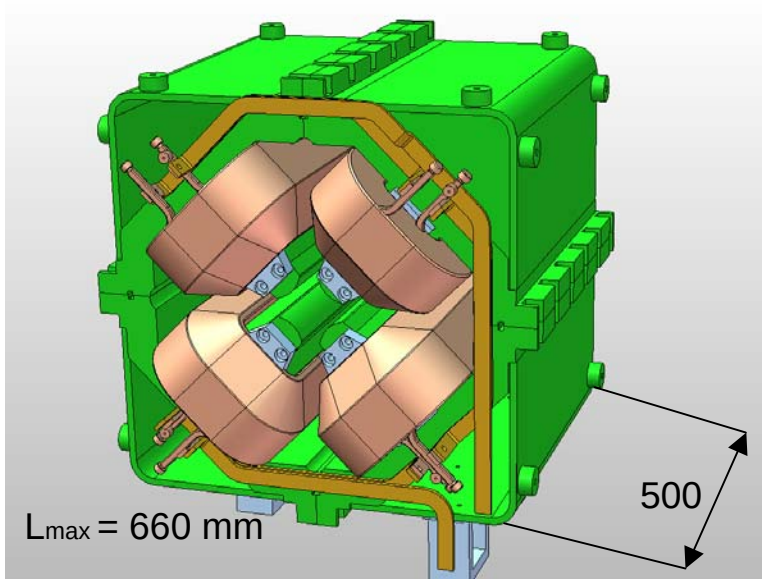
→ powerful broadband (BW≥ 60MHz) feedback neccessary

PETRA III
hardware changes

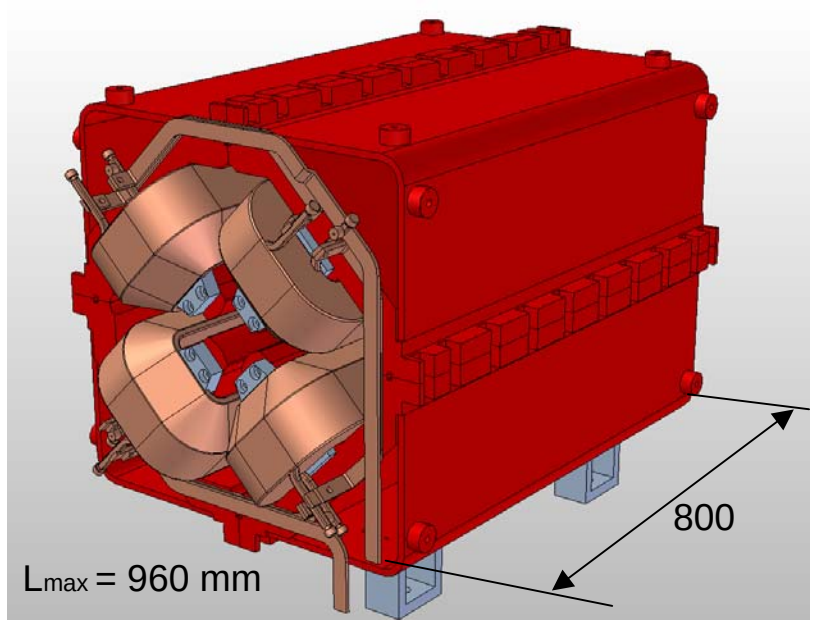
new octant completely new hardware



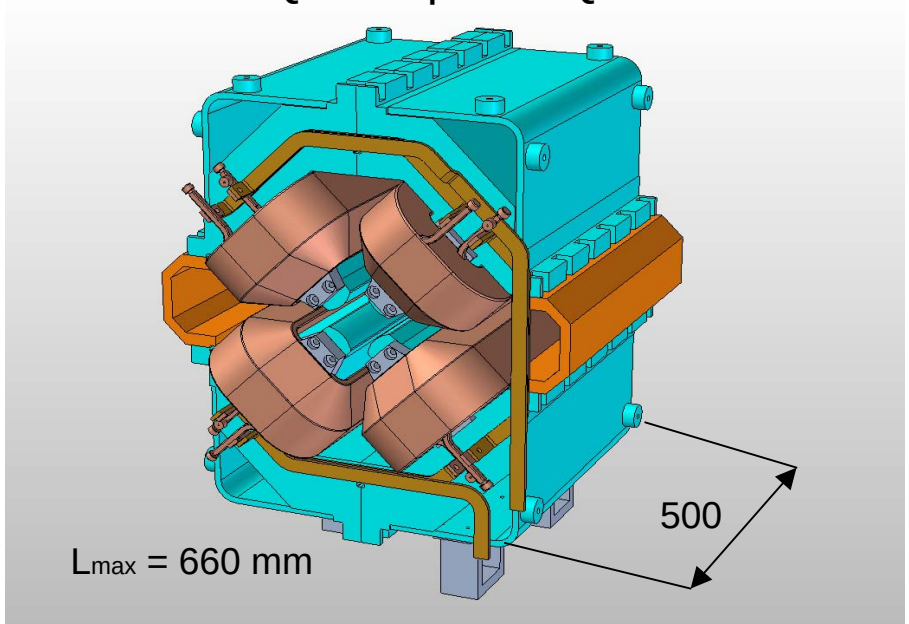
Quadrupole PQA



Quadrupole PQB

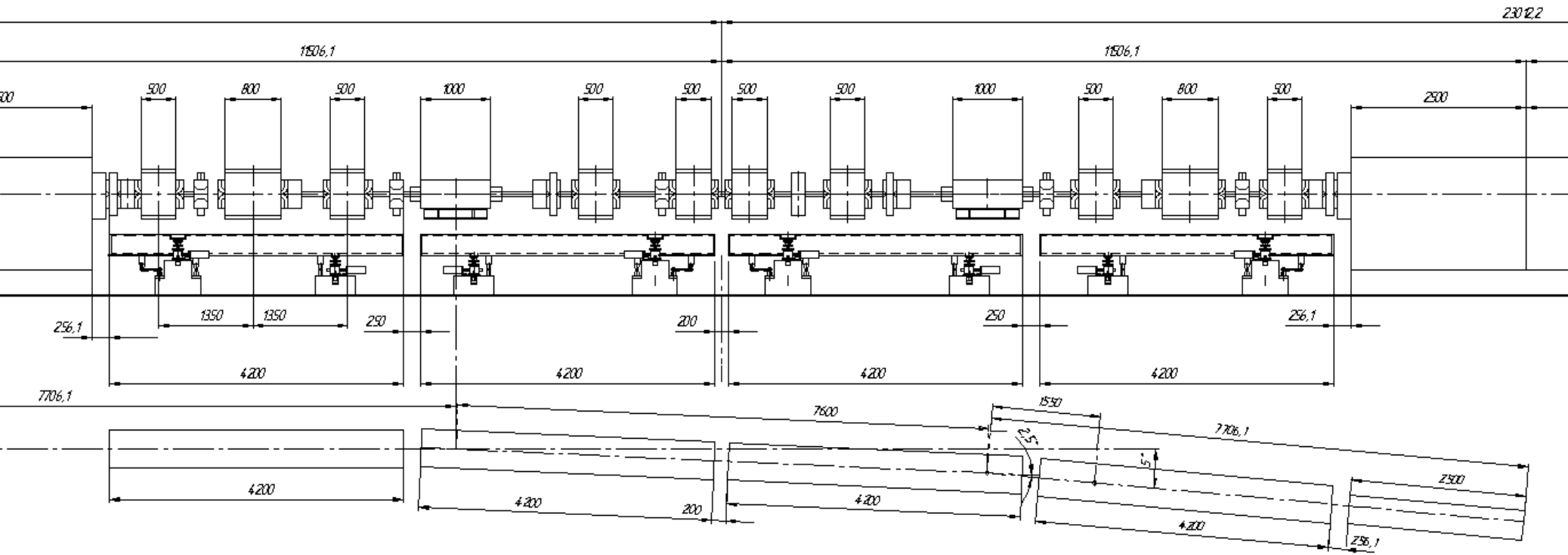


Quadrupole PQC



PETRA III
preliminary girder design

side view

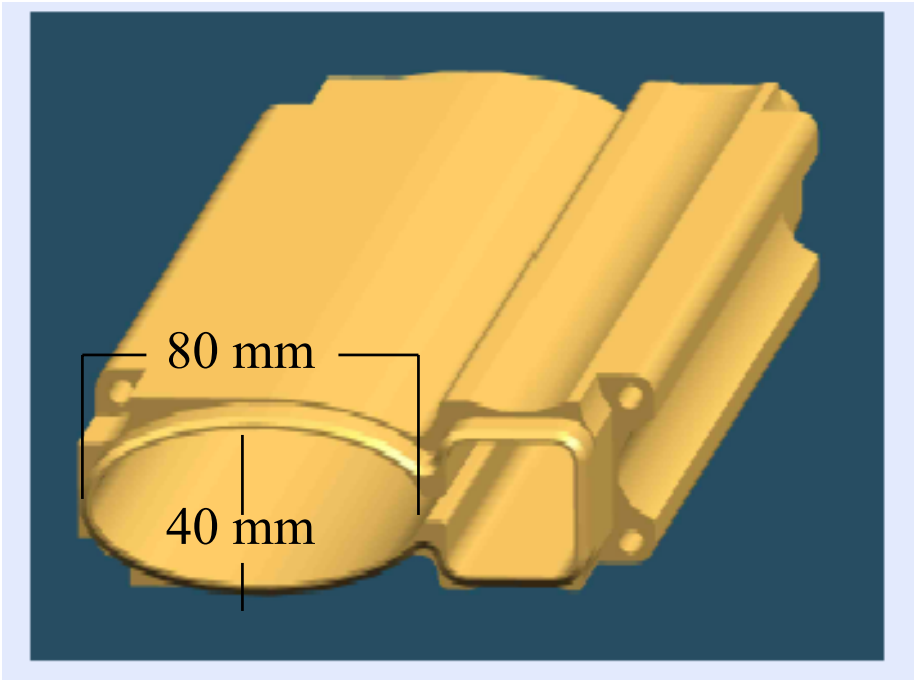


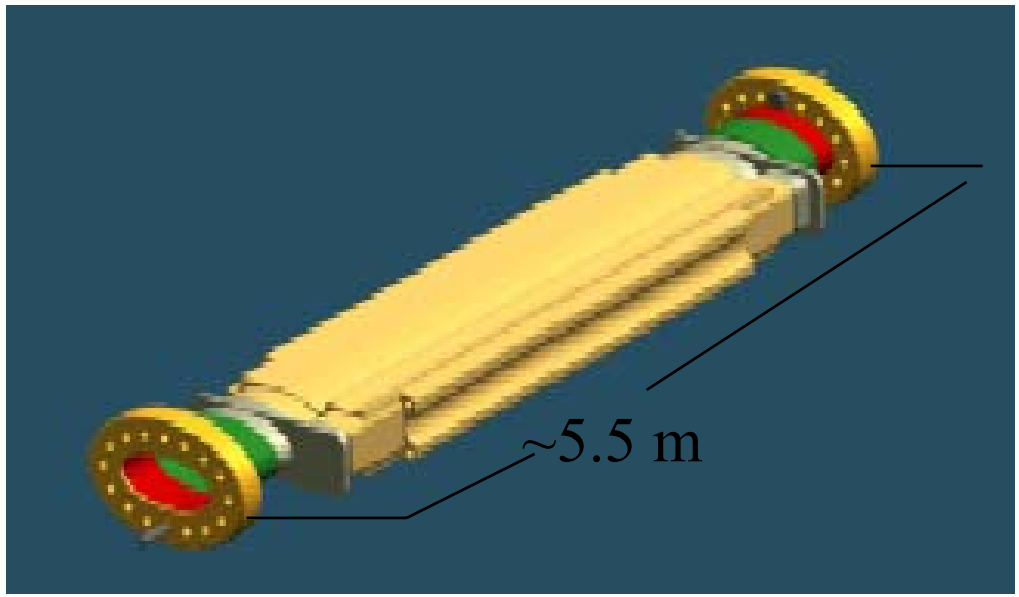
top view

PETRA III
hardware changes

- Old octant:
  - make use of existing hardware whenever possible
  - **To ensure reliable machine operation**
    - **New vacuum system**
    - Installation of more and new correctors and beam position monitors
    - Replace radiation damaged coils of magnets (experience!)
    - Modernize rf system
    - New coupled bunch feedback system
    - Diagnostics: wire scanner, parasitic bunch detection etc.

PETRA III
dipole chamber old octant





Decoupling of vacuum chamber and quadrupoles
NEG pump because of small magnetic dipole field

PETRA III
schedule

Schedule:

- completion of TDR end of 2003
- approval in the first half of 2004
- final design of comp. and ordering of hardware in 2005/2006
- rebuilding of PETRA in 2007
- start of commissioning of PETRA III and beam-lines in 2008
- start of routine operation in 2009