XFEL
X-Ray Free-Electron Laser

DESY

XFEL Collimation Section Geometry

XFEL Beam Dynamics 4.9.2006

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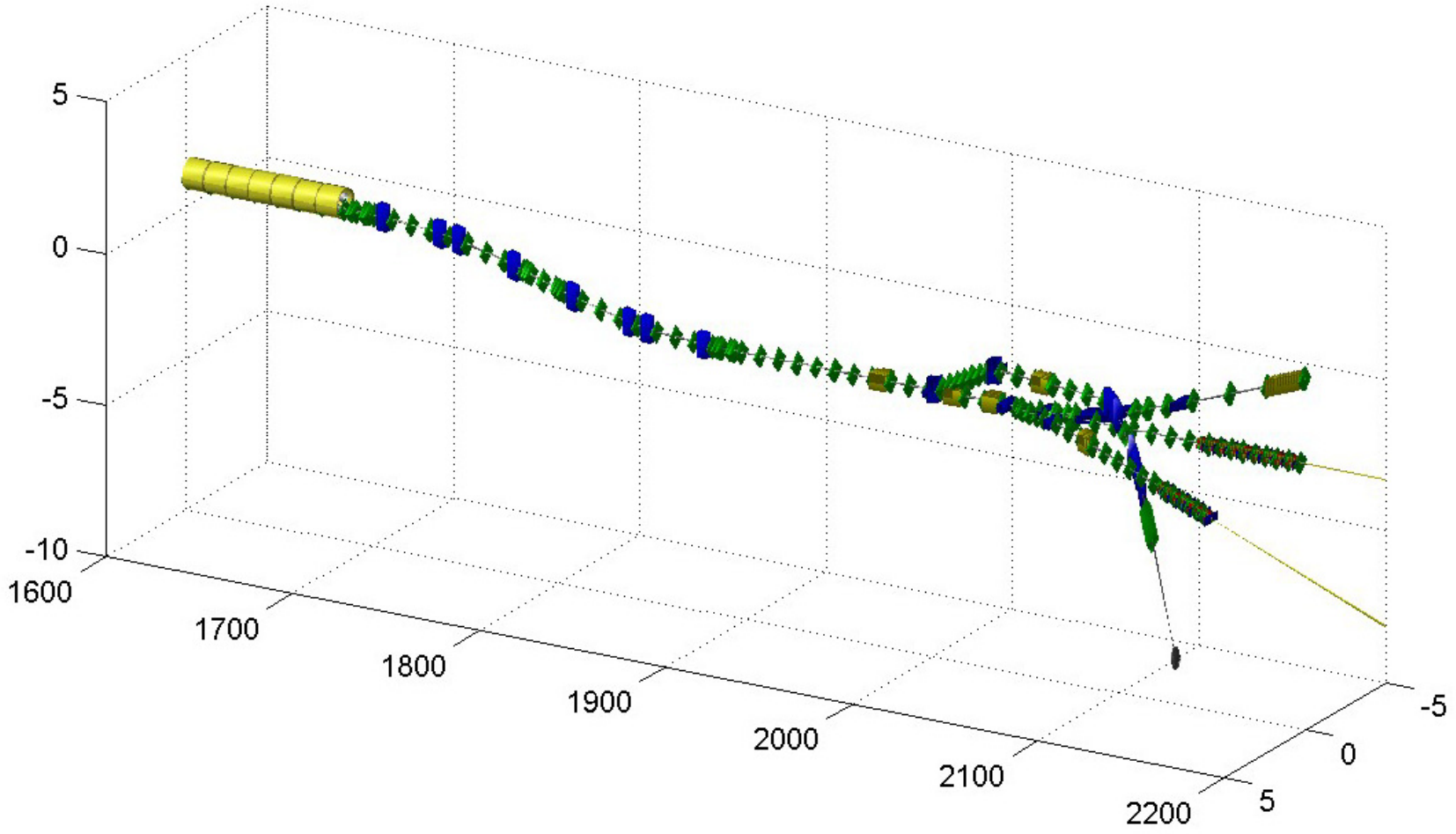
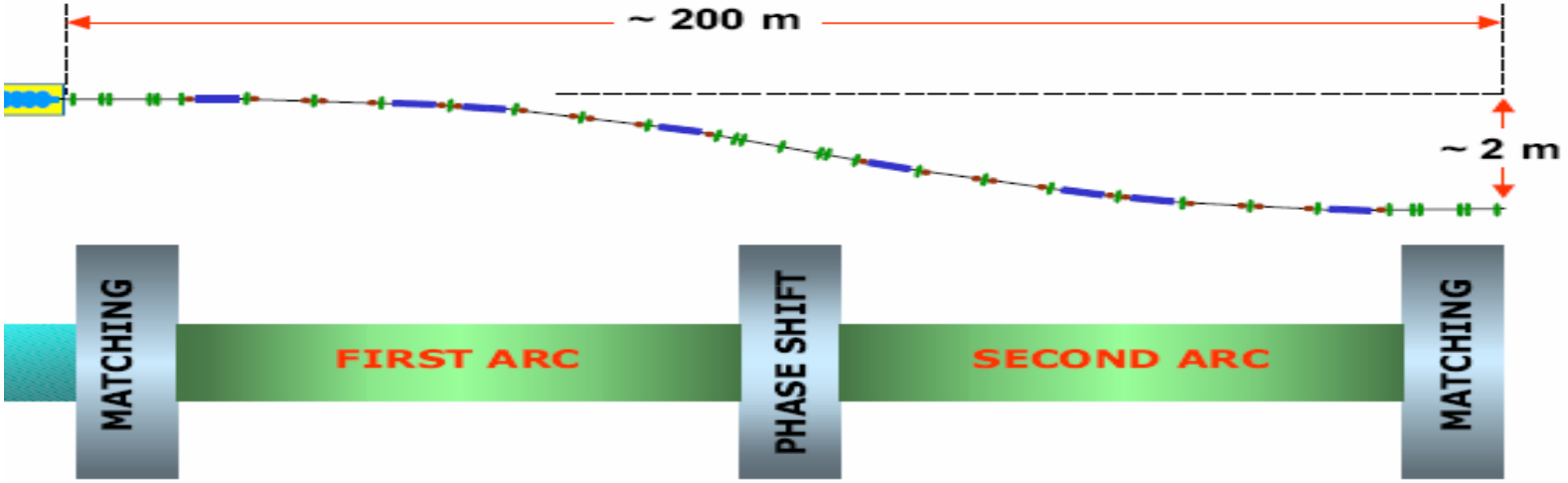
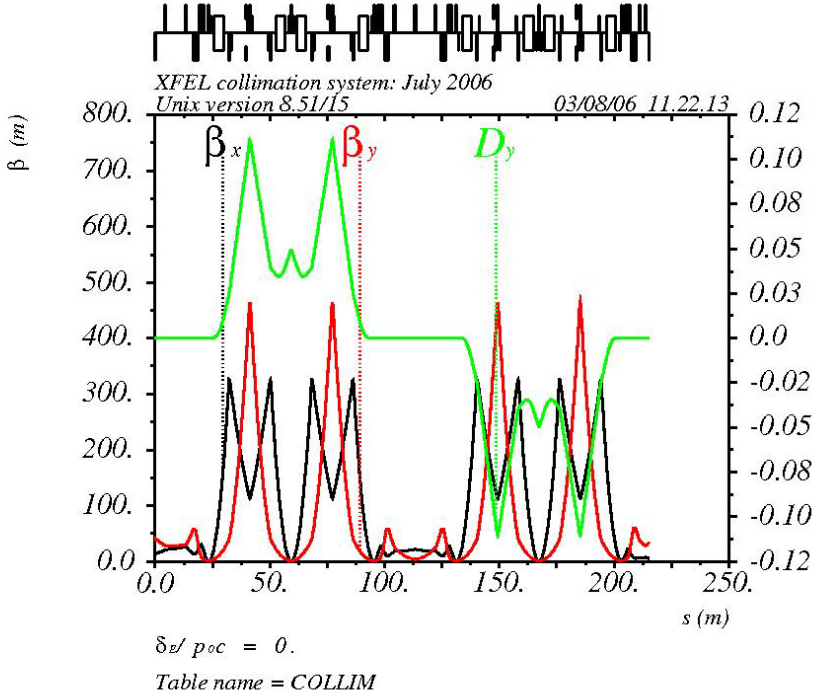
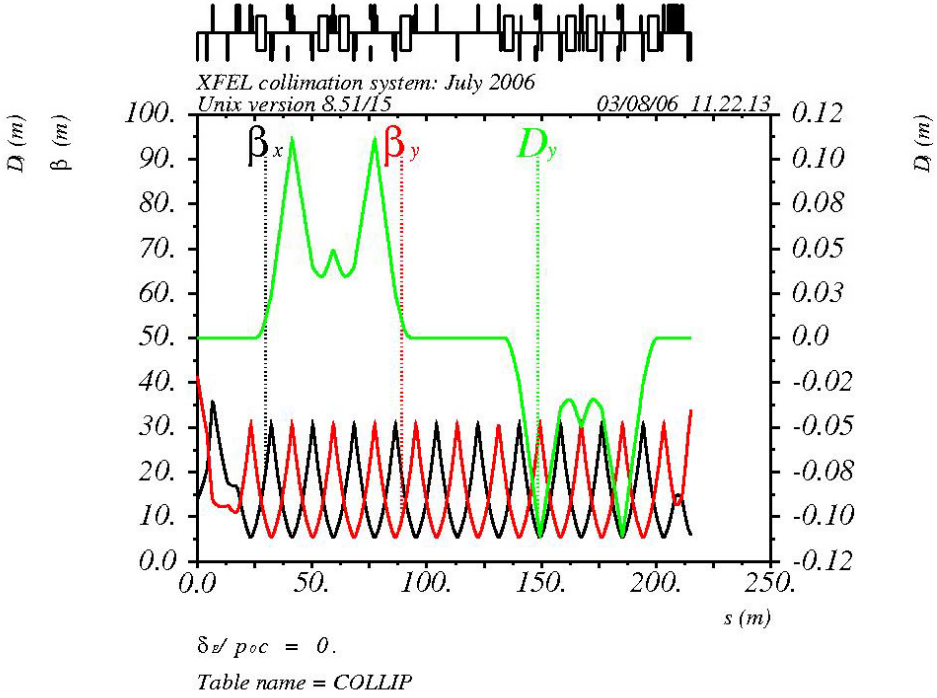
Beam Distribution

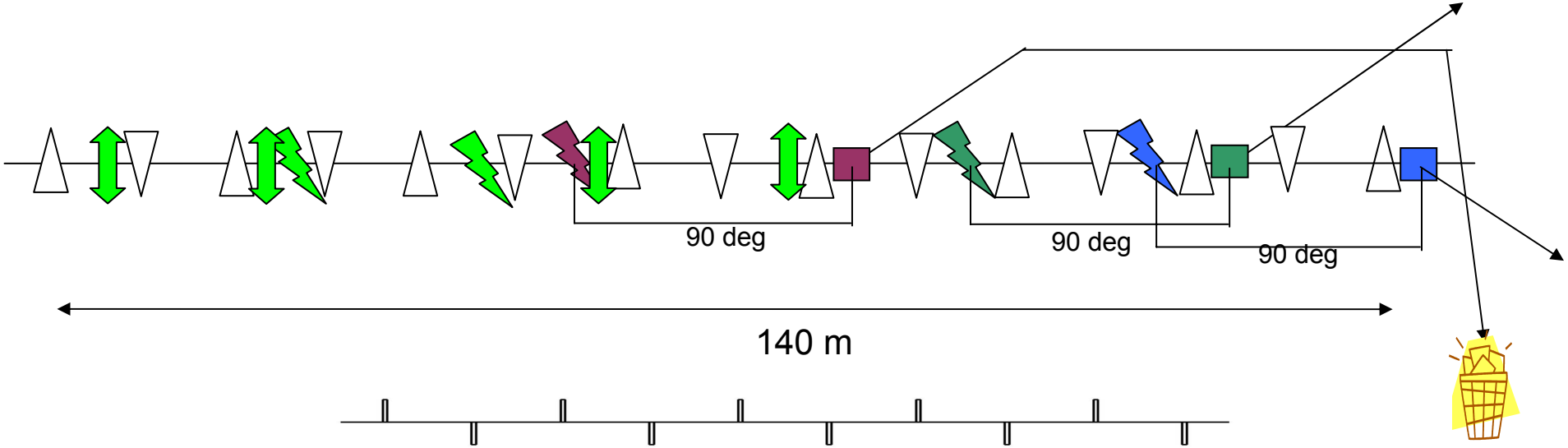


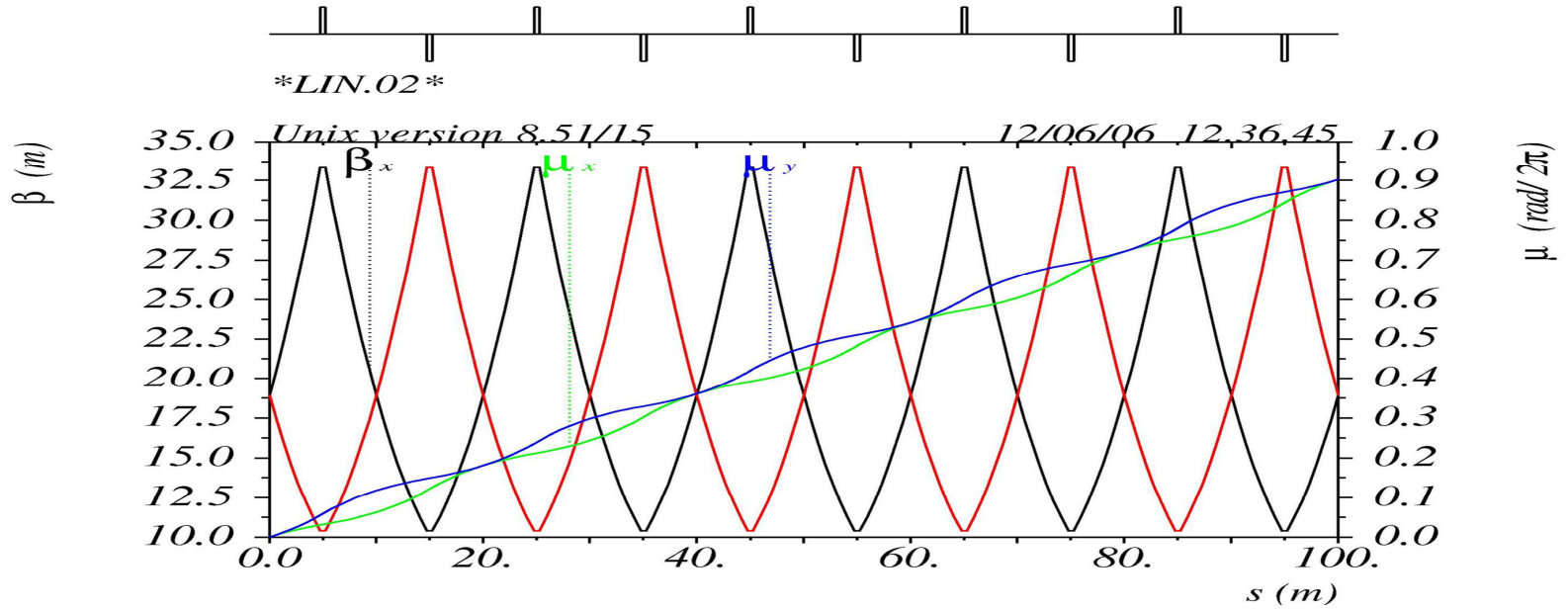
- Specification of beam offset:
  - defines height of shafts
- Specification of collimation length
  - defines height of shafts
  - defines start of experiments coordinate system (PD)


~ 200 m
~ 2 m
MATCHING
FIRST ARC
PHASE SHIFT
SECOND ARC
MATCHING


XFEL collimation system: July 2006
Unix version 8.51/15
03/08/06 11.22.13
β (m)
D (m)
βx
βy
Dy
s (m)
δE/ p0c = 0.
Table name = COLLIM


XFEL collimation system: July 2006
Unix version 8.51/15
03/08/06 11.22.13
β (m)
D (m)
βx
βy
Dy
s (m)
δE/ p0c = 0.
Table name = COLLIP


90 deg
90 deg
90 deg
140 m


LIN.02
Unix version 8.51/15
12/06/06 12.36.45
β (m)
μ (rad/2π)
s (m)
35.0
32.5
30.0
27.5
25.0
22.5
20.0
17.5
15.0
12.5
10.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
20.
40.
60.
80.
100.

Available length for collimation, feedback, distribution and diagnostic: 343 m

Collimation:	210 m
	(Offset 2.16 m)
Distribution:	70 m
Feedback (270 deg FODO with 20 m cell):	60 m

Offset

- Layout of optics such that FODO like transport is possible
- Length of phase shifter in between dispersive arcs is a multiple of arc cell length
- With this definition:
  - Dispersion and offset of the system proportional

- Present collimator aperture approx. 3.2 mm, collimates 3.5 % energy bandwidth
- Tighter collimation needs more dispersion or smaller aperture (or both)

Length

- Increasing length of system relaxes magnet strength, improves chromatic behavior, adds space
- Have to include feedback into collimation
  - suitable positions within one collimation arc (Vladimir)
- Drawbacks:
  - vertical dispersion may affect the measurement for energy varied bunches
  - apertures of BPM's and kickers have to stay large
  - BPM's and kickers maybe hit by beam losses
  - the available longitudinal space is limited

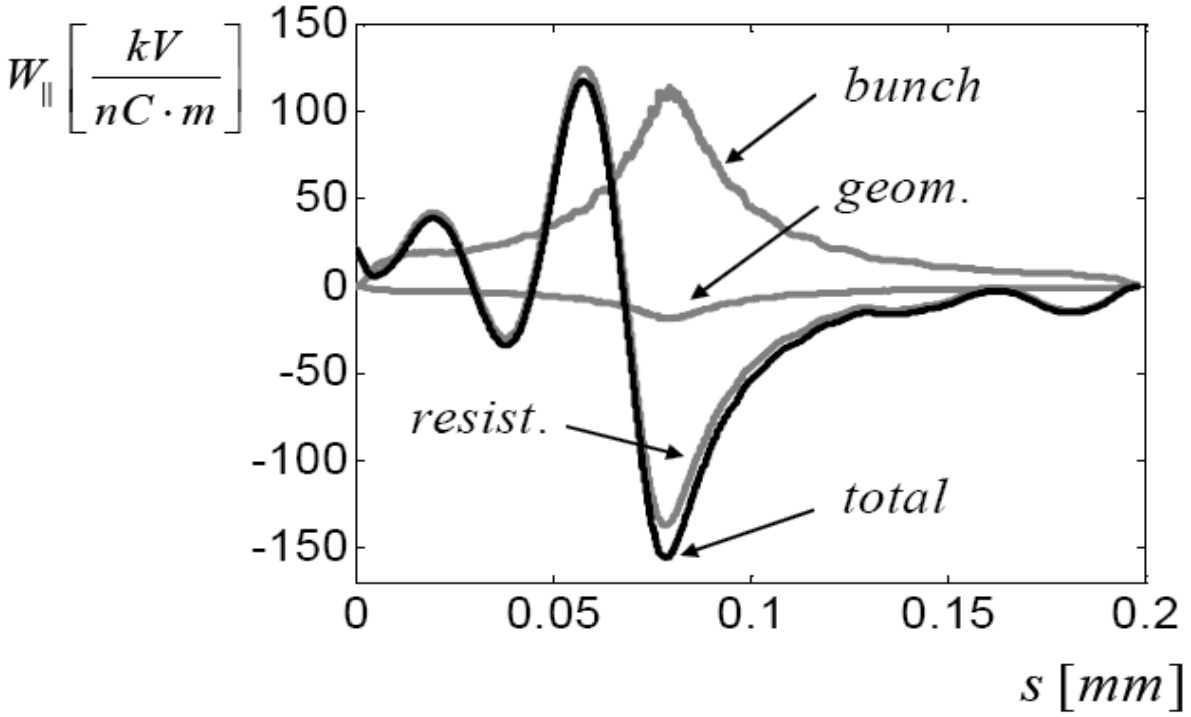
XFEL Warm Beamlines Impedance Budget
A Start

XFEL Beam Dynamics 4.9.2006

Winni Decking

Impedance budget for warm XFEL beamlines

Longitudinal undulator wake



Wake from warm beam lines should not add more than 20 % (to what?)
Transverse Effects?

Element Count for Beam 2

	Length [m]	# of Quads	Aperture Radius [mm]	Other Insertions
Linac to SASE1	486	62	25	4 Collimators (2-4 mm aperture) 30 m Ceramic (10 mm aperture) 3 bifurcation/septum chambers
SASE1	200		4	
SASE1 to SASE3	426	39	25	1 bifurcation chamber
SASE 3	132		4	
SASE3 to DUMP2	175		25	

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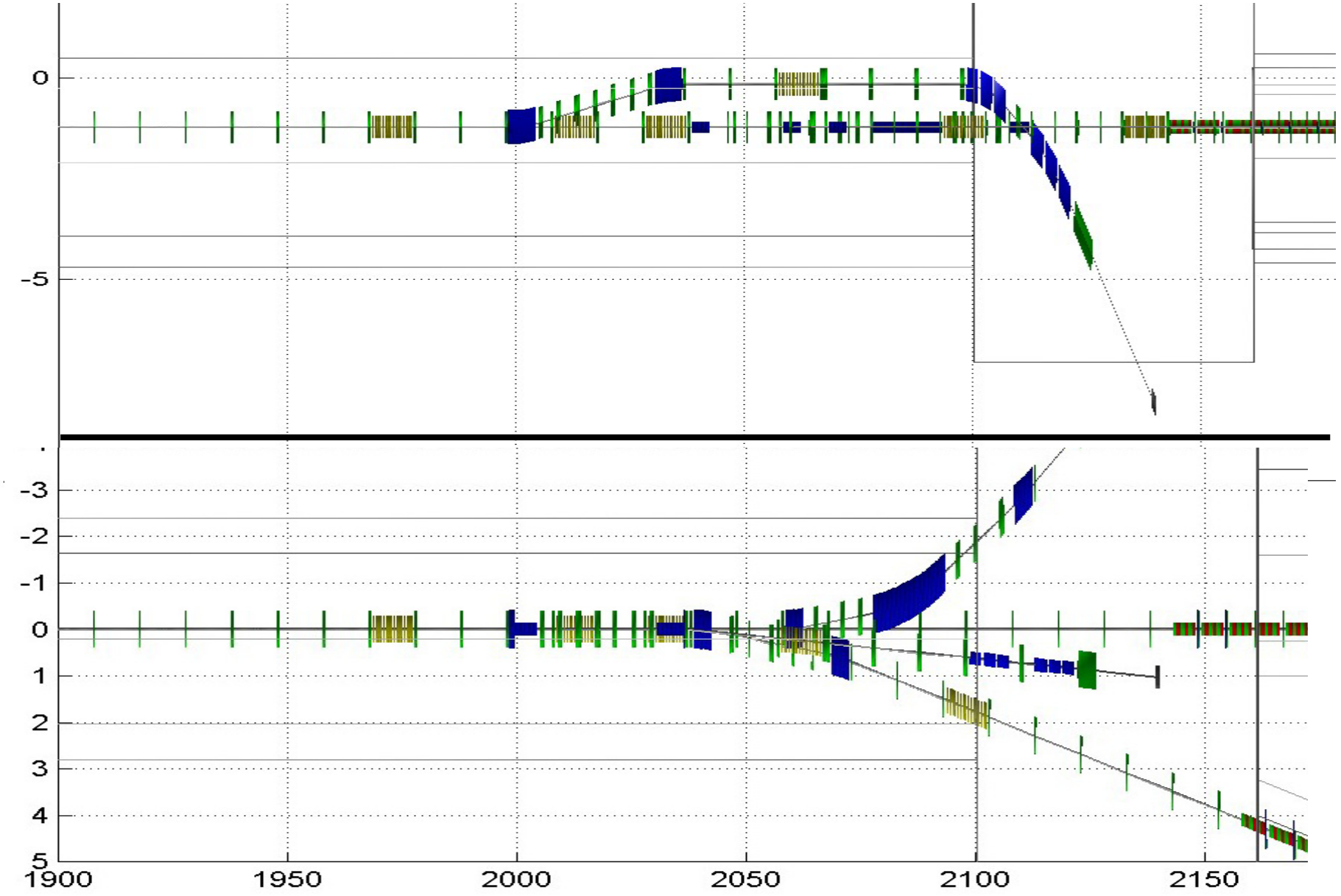
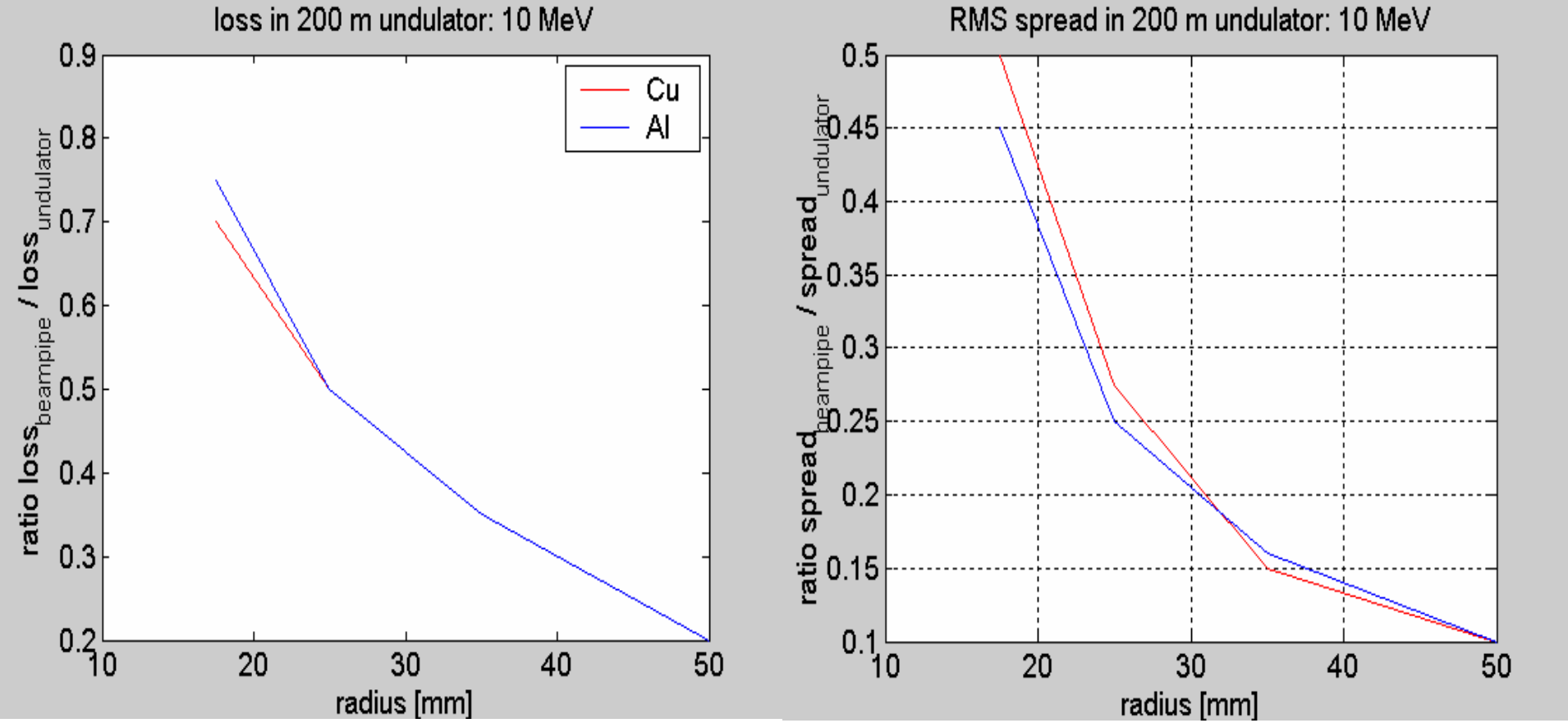
Side View / Top View of XS1 Beamlines

DESY



ing

Ratio of loss/spread in 500m warm beam pipe to undulator



With 20% energy spread contribution from warm beamline: **radius ≈ 30 mm**

- Is 20% the right criteria?
- What with other contributions (Collimators, BPM, Taper, etc.) ?
- Non-Gaussian distribution?

Element Count for Beam 1

	Length [m]	# of Quads	Aperture Radius [mm]	Other Insertions
Linac to SASE2	486	63	25	4 Collimators (2-4 mm aperture) 30 m Ceramic (10 mm aperture) 2 bifurcation/septum chambers
SASE2	255		4	
SASE2 to UND1	257	25	25	1 bifurcation chamber
UND1	60		4	
UND1 to UND2	240	23	25	1 bifurcation chamber
UND2	60		4	
UND2 to DUMP1	146		25	

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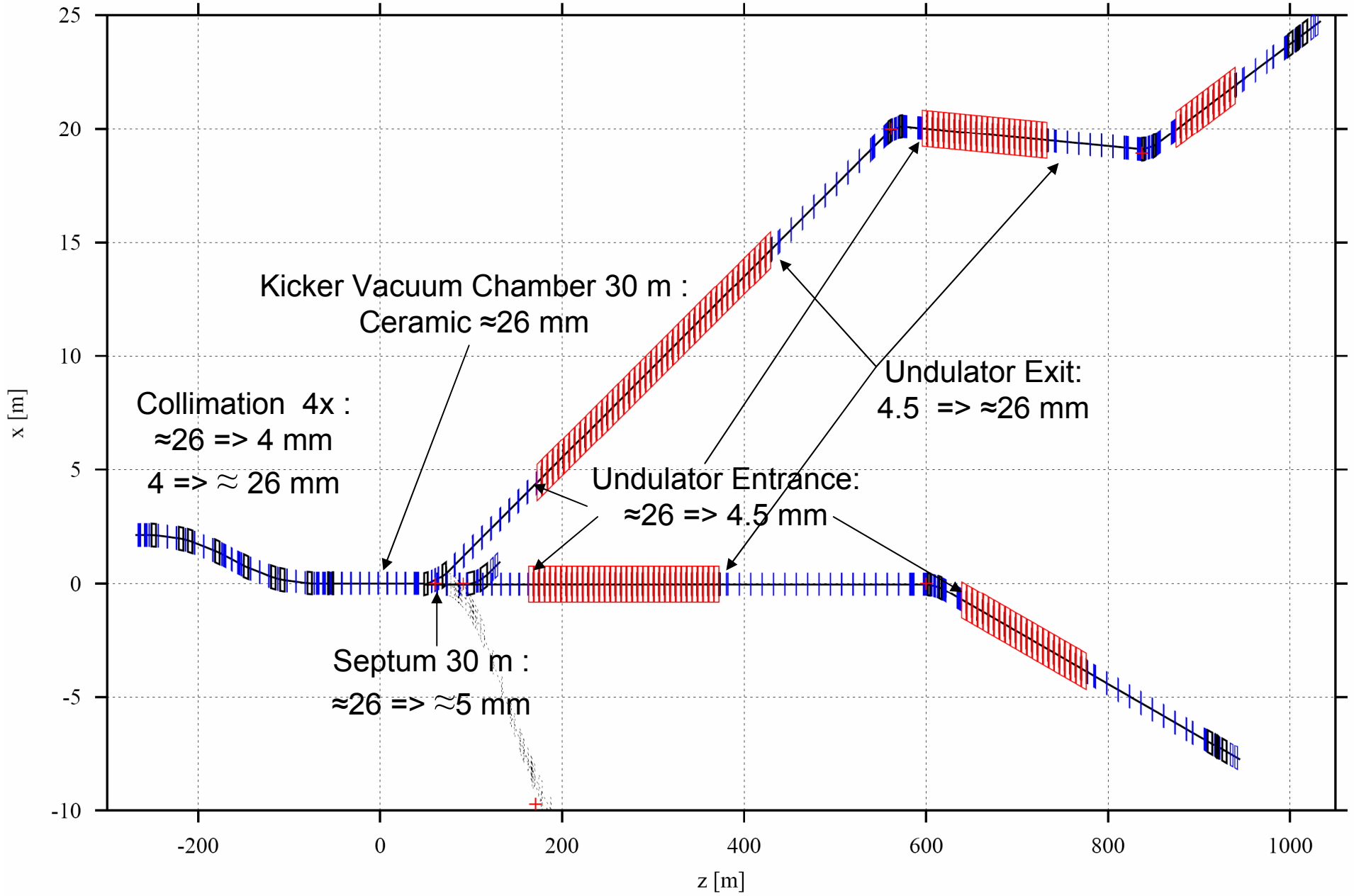
Step Changes I

DESY



Other Components

- Quadrupole (approx. 250)
  - BPM (Stripline, Button, Cavity BPM), 1 per Quadrupole
  - Flanges: 3 per Quadrupole
  - Pumping: 1 per Quadrupole