

XFEL Simulation Results

for various Focusing Lattices

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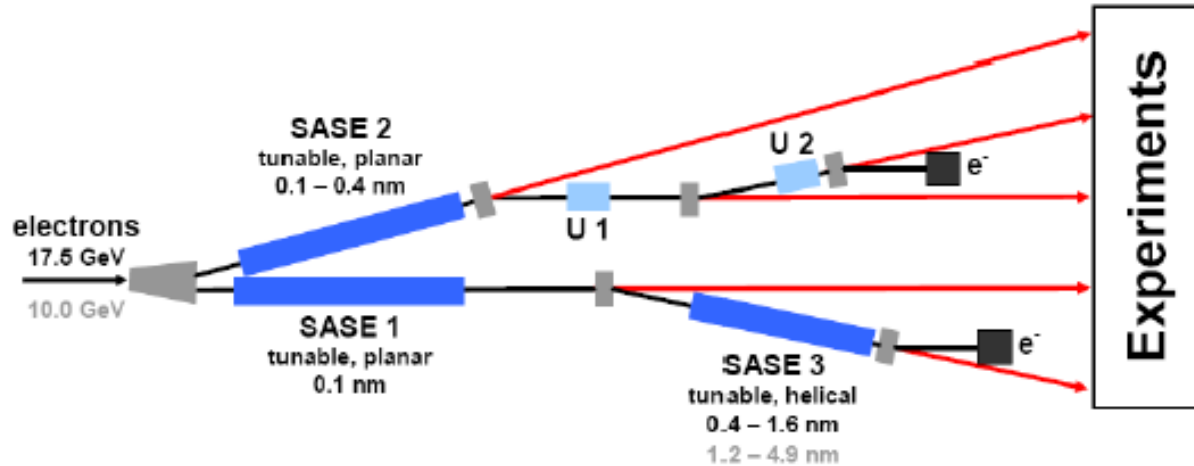
Contents

- Introduction
- SASE1 simulations
- SASE2 simulations
- SASE3 simulations
- Summary

The purpose of the simulation study:

the investigation of the impact of focusing lattice various arrangements with the reduced number of the quadrupole magnets on the SASE FEL performance.

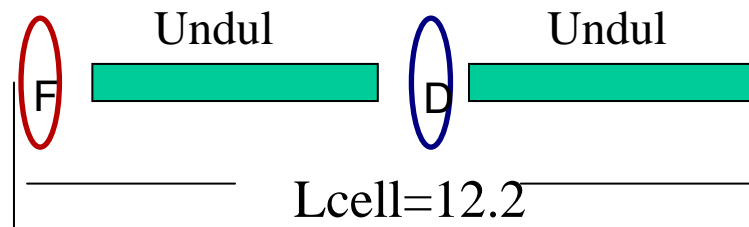
Introduction



	Wavelength	Beta-average	Phase Adv.	Ncell
SASE1	$\lambda=0.1$ nm	$\beta=32$ m	$\mu=22.4^\circ$	17
SASE2	$\lambda=0.1$ nm	$\beta=46$ m	$\mu=15^\circ$	24
SASE2	$\lambda=0.4$ nm	$\beta=15$ m	$\mu=54^\circ$	24
SASE3	$\lambda=0.4-1.6$ nm	$\beta=15$ m	$\mu=54^\circ$	11

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Focusing lattice -design

- Reduction of quadrupole fields
- Reduction of quadrupole misalignment effects

SASE1 Simulations

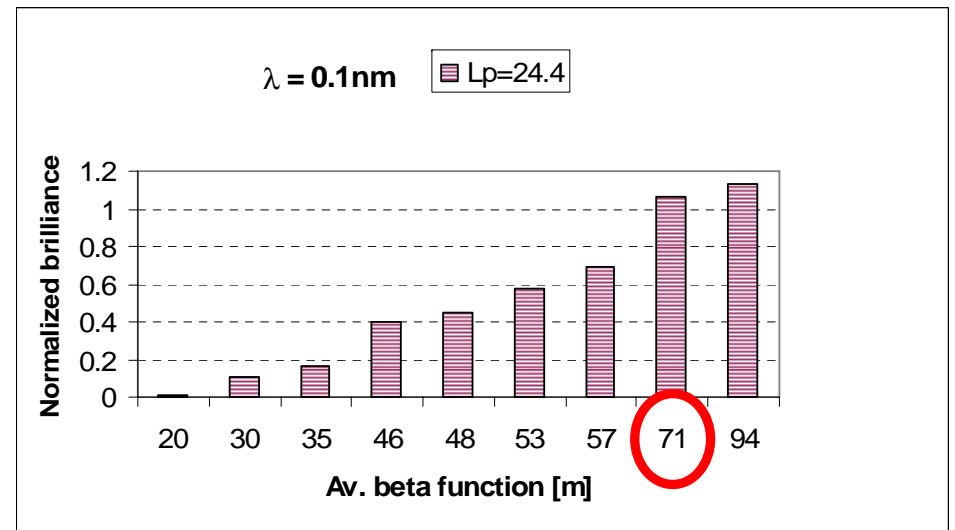
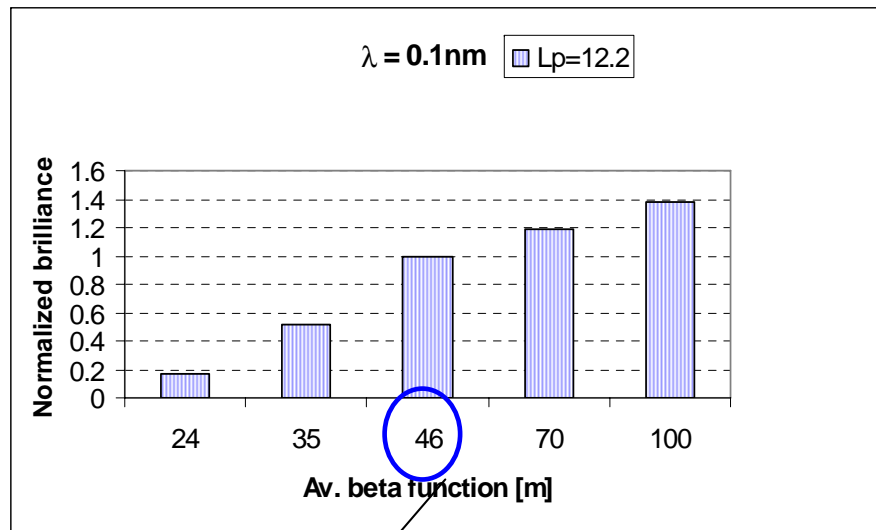
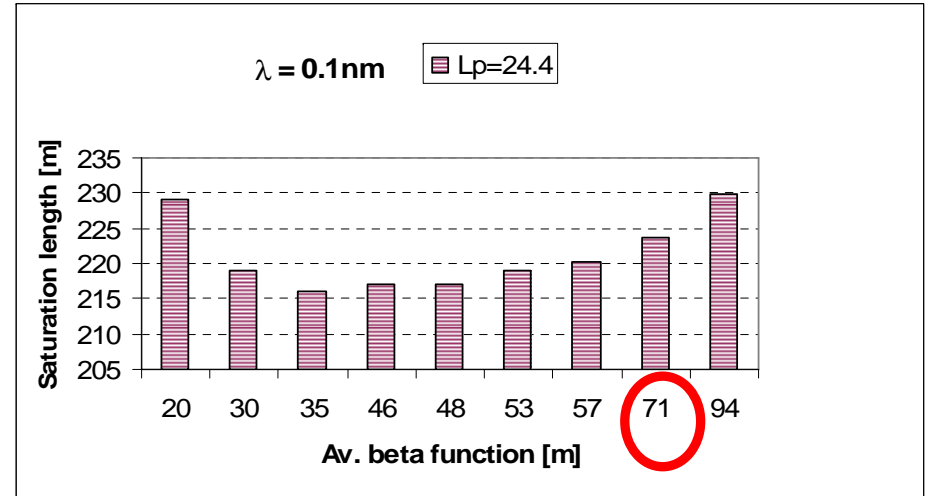
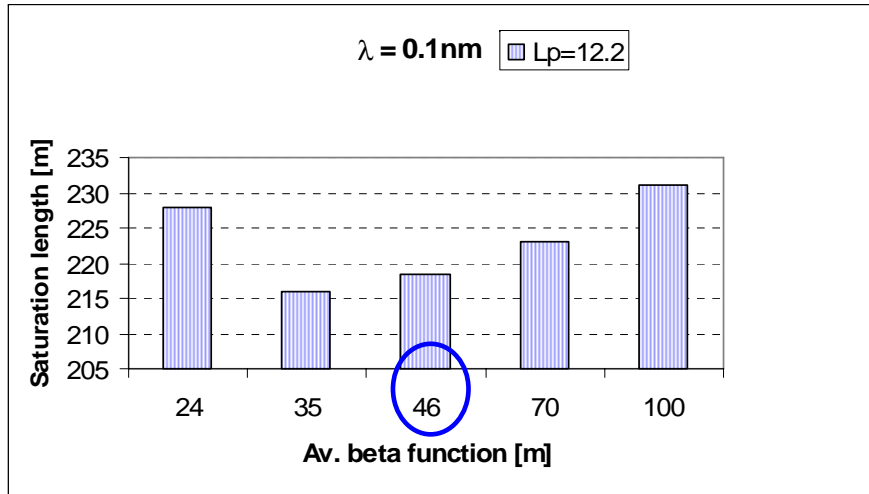
Dependence of the normalized radiation parameters on the number of quadrupole magnets and the average beta function

(Time-dependent simulation with the GENESIS).

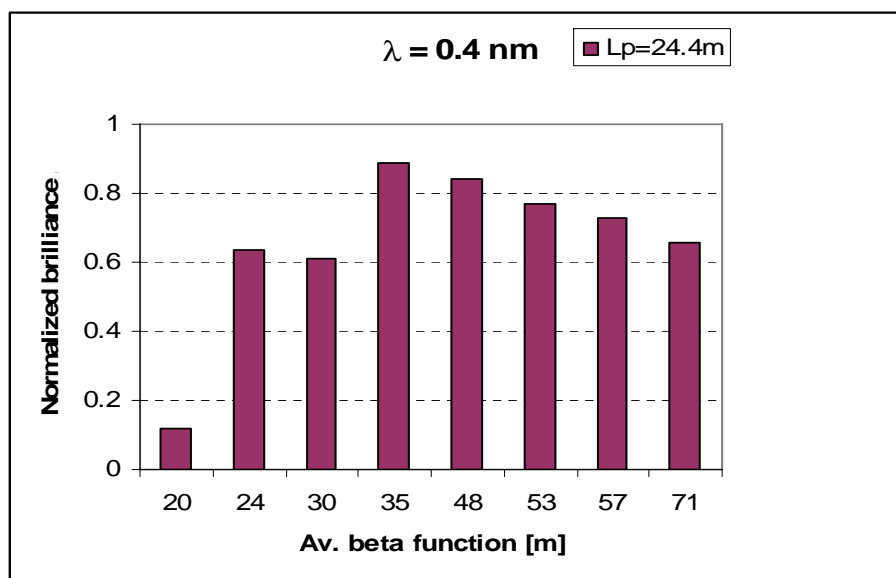
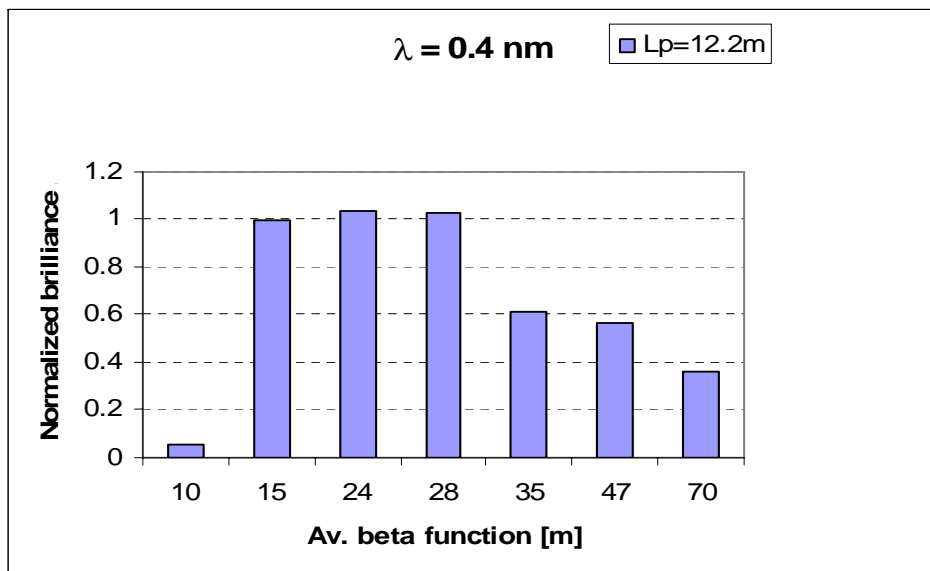
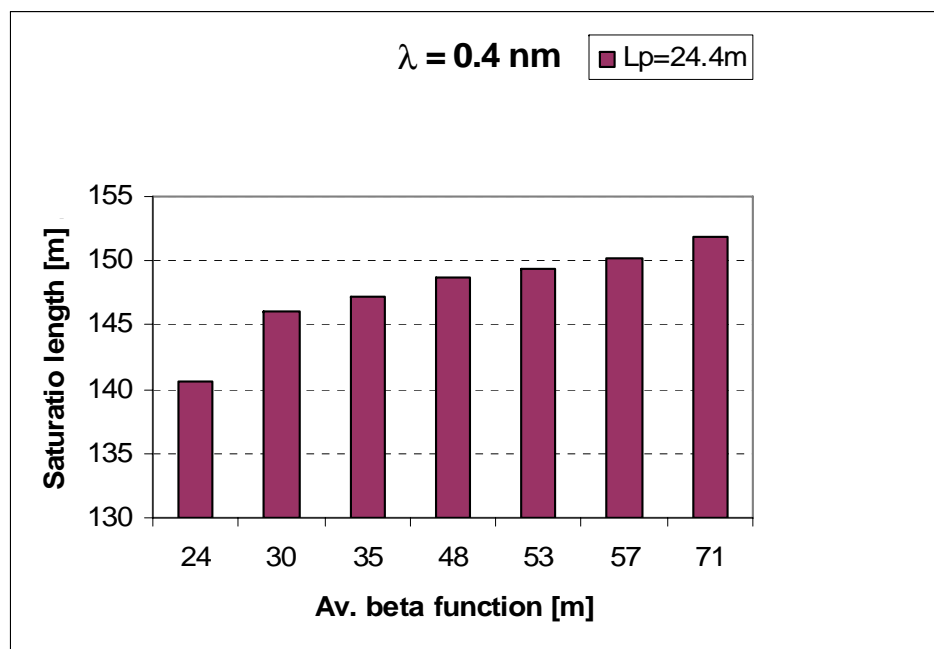
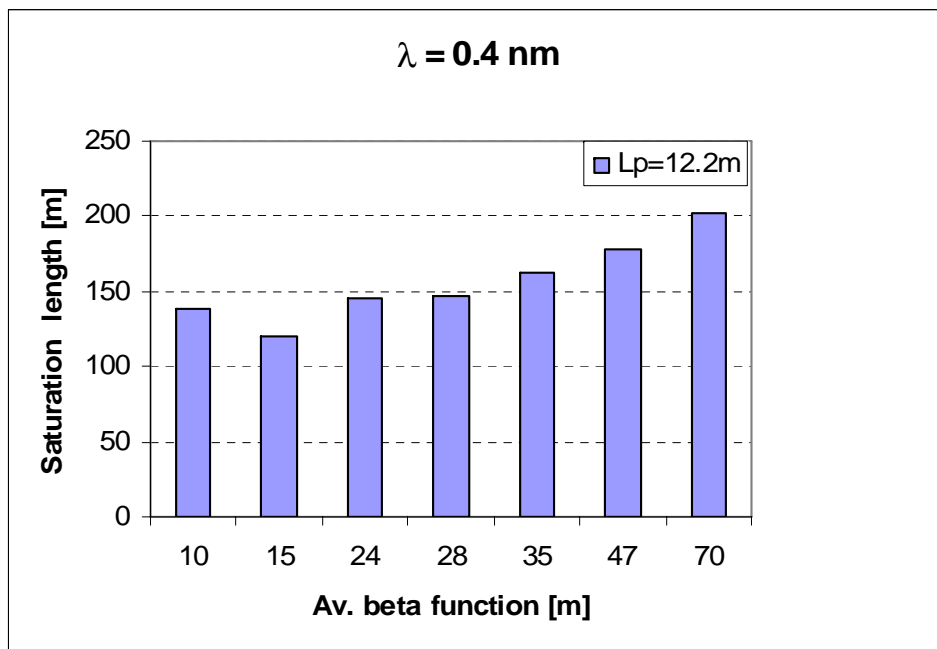
Number of Quads	Beta function [m]	Maximal Power	Spacial size	Divergence	Bandwidth	Brilliance
34	32	1	1	1	1	1
18	32	0.91	1.05	1.03	1.04	0.745
18	64	0.971	1.07	0.855	1.02	1.14
18	128	0.557	1.33	0.64	1.07	0.716
10	128	0.624	1.23	0.608	1.07	1.03

SASE2 Simulations

The study was conducted for the two extreme values of the wavelength range 0.1nm and 0.4nm. Dependence on mean beta function of the saturation length and radiation brightness for the two different arrangements of the focusing lattice was investigated.



Current design



SASE2 Simulations – 0.1 -0.4 nm (in process)

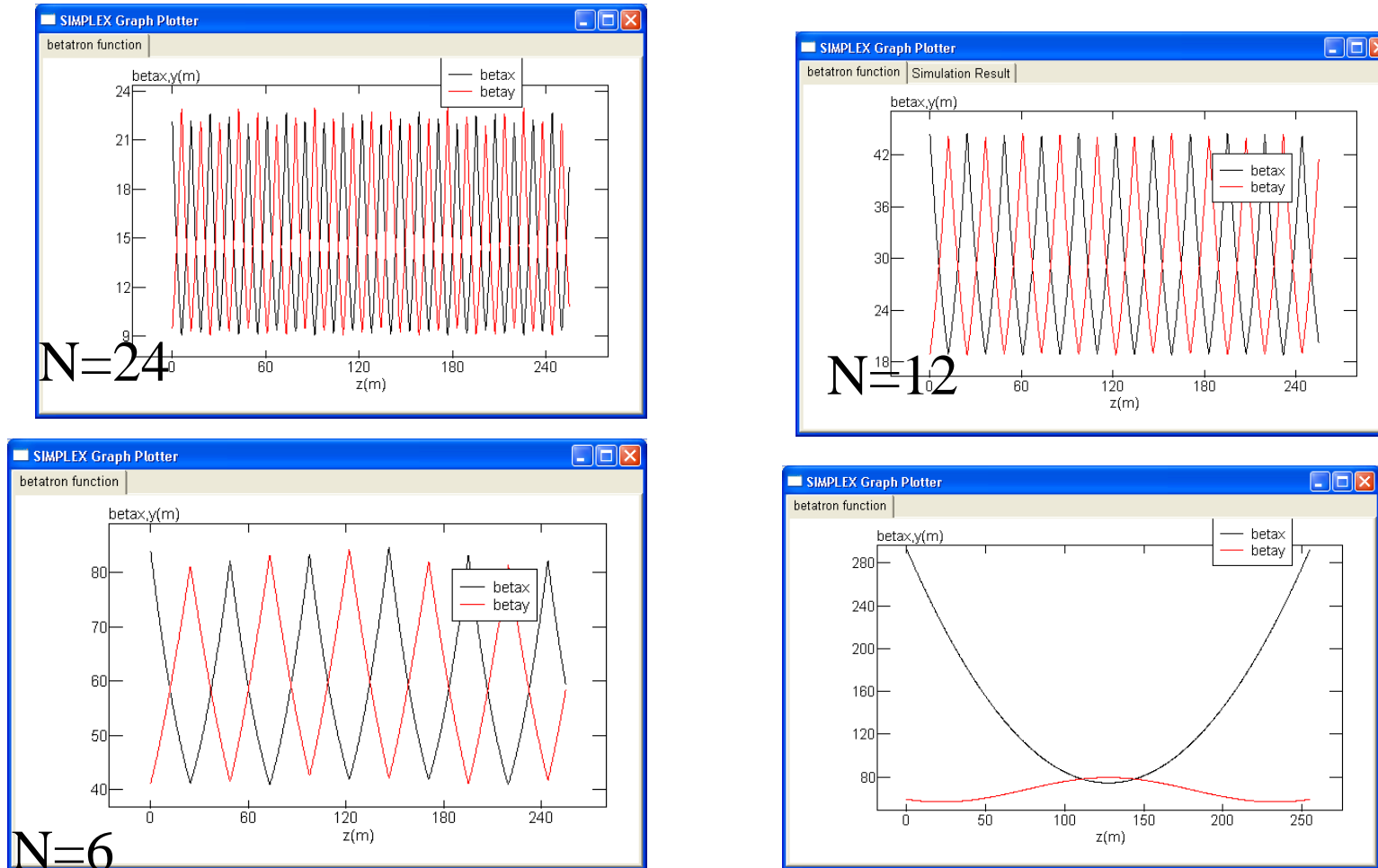
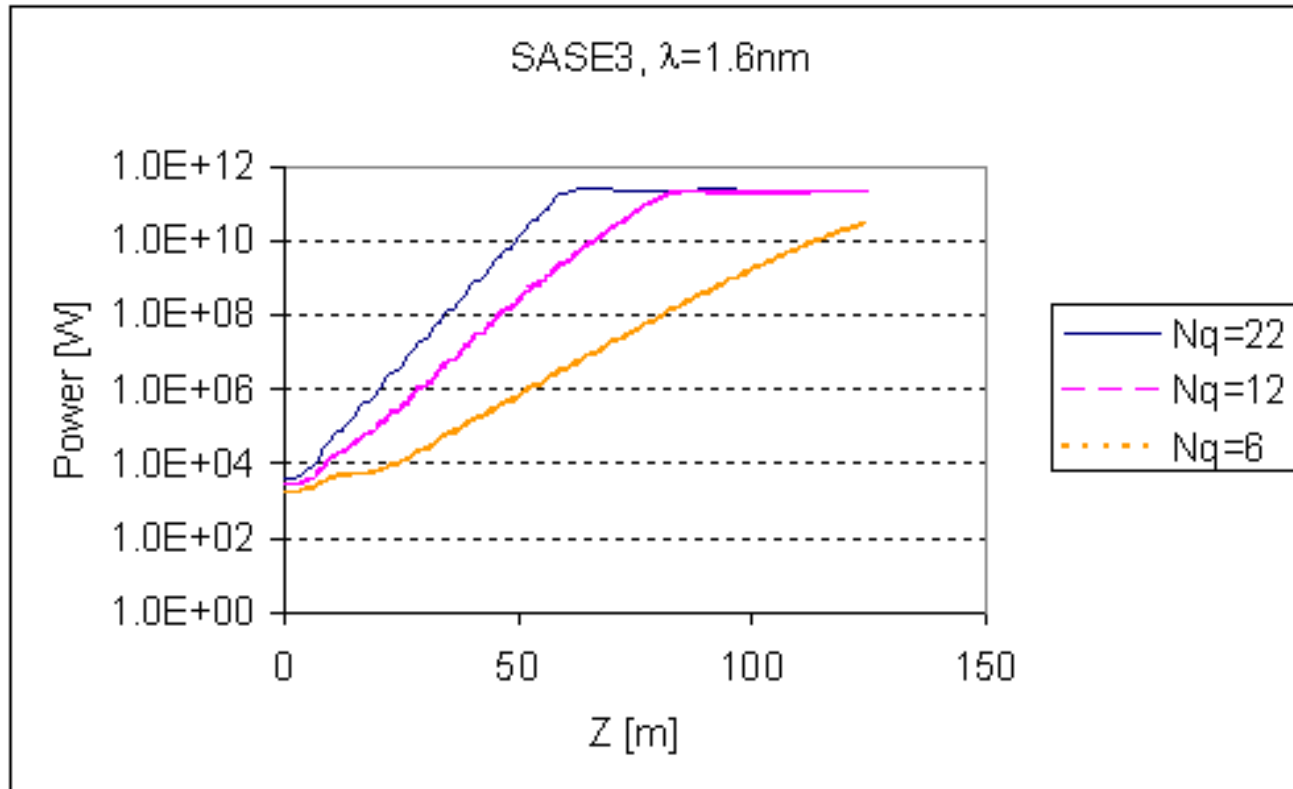


Figure 1. Beta function in x and y direction for XFEL lattices.

SASE3 Simulations



SASE3 FEL GENESIS Steady State Simulation Results; Power growth curves for focusing lattice arrangements with quadrupole magnets number equal to 22, 12 and 6.

Wavelength is 1.6nm (the highest value for 17.5 GeV beam energy).

SASE3 FEL simulations

N quads	22	12
Rad. Power at Saturation (GW)	280	207
Saturation length (m)	65.5	87
Pirce param. ($\times 10^{-3}$)	1.76	1.4
Brightness	1	1.3

Intermediate Summary

- **SASE 1**

Reduction of FODO cells by factor of 2 and beta 64 m

Brightness increase – 14%

Decrease of Power – 3%

- **SASE 2** - $\lambda = 0.1 \text{ nm}$

Reduction of FODO cells by factor of 2 and beta 70m.

Brightness increase - 10%

Saturation length increase – 2.7%

- **SASE 2** $\lambda = 0.4 \text{ nm}$

Reduction of FODO cells by 2 and beta 35m

Brightness decrease - 10%

Saturation length increase – 17% (247m)

- **SASE 3** - $\lambda = 1.6 \text{ nm}$

With reduced number of quadrupoles by factor 2

Brightness increase - 30%

Saturation length increase -32%