Work Progress in April 2013

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MPY, DESY

Contents

- The plan for last month
- Achieved progress in the work
- The plan for this month

The plan for last month

1. S2e simulation for SASE3 with 0.5nC (30%)
2. S2e simulation for FLASHII with 1.0nC and 0.5nC (50%)
3. Radiation calculation for FLASHII (0.1nC case and 0.25nC case) (100%)
4. Continue writing the internal report for the completed work (75%)

Achieved progress

1. Start to end simulation for SASE3 with 0.5nC **(55%)**

(1) Getting the elegant lattice files for EXFEL

(2) Input files conversion from Elegant to Astra and CSRTrack **(100%)**

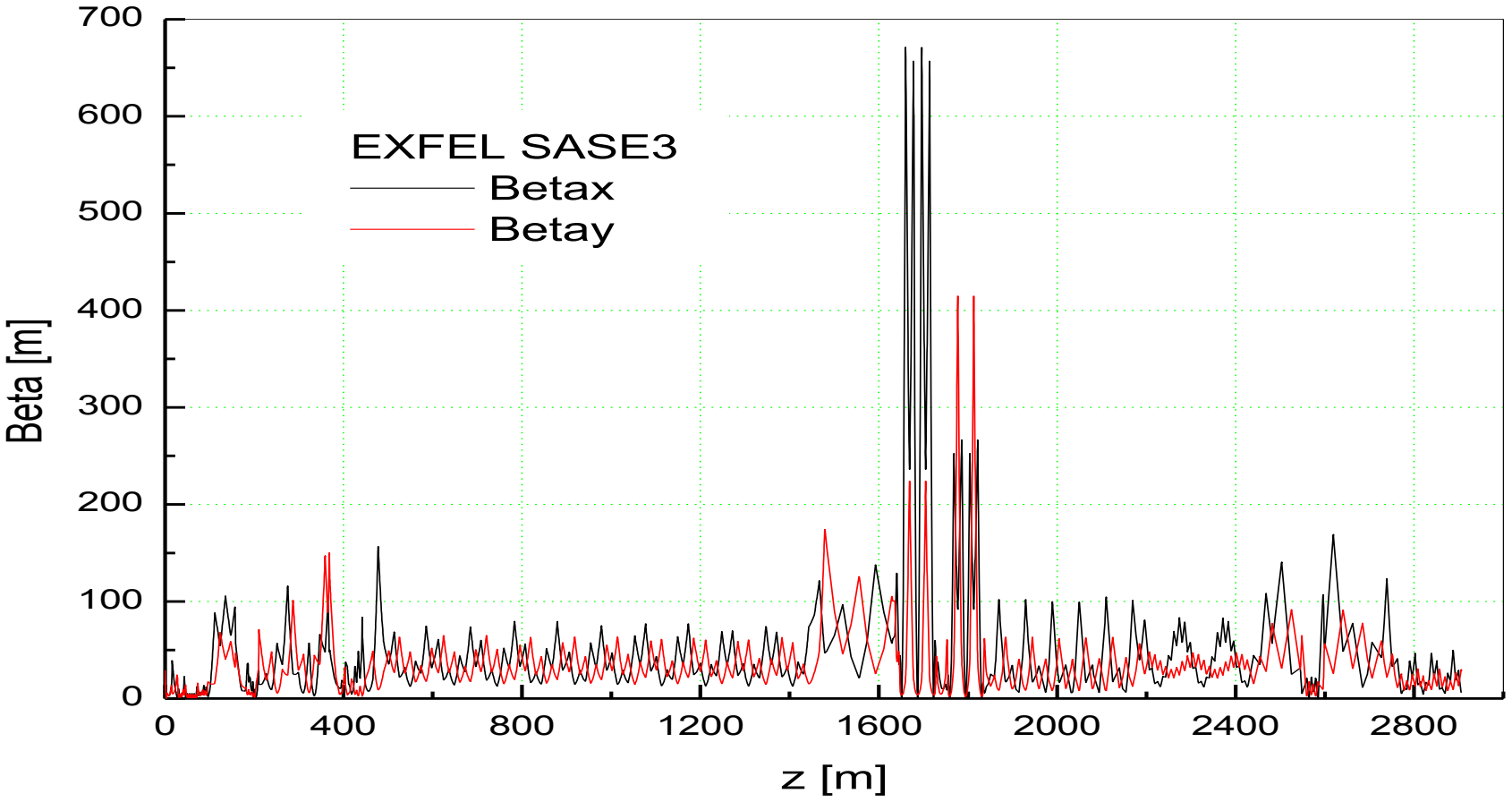
(3) Checking field strength and elements positions in the input files based on the beam optics of elegant results **(100%)**

(4) RF parameters calculation **(100%)**

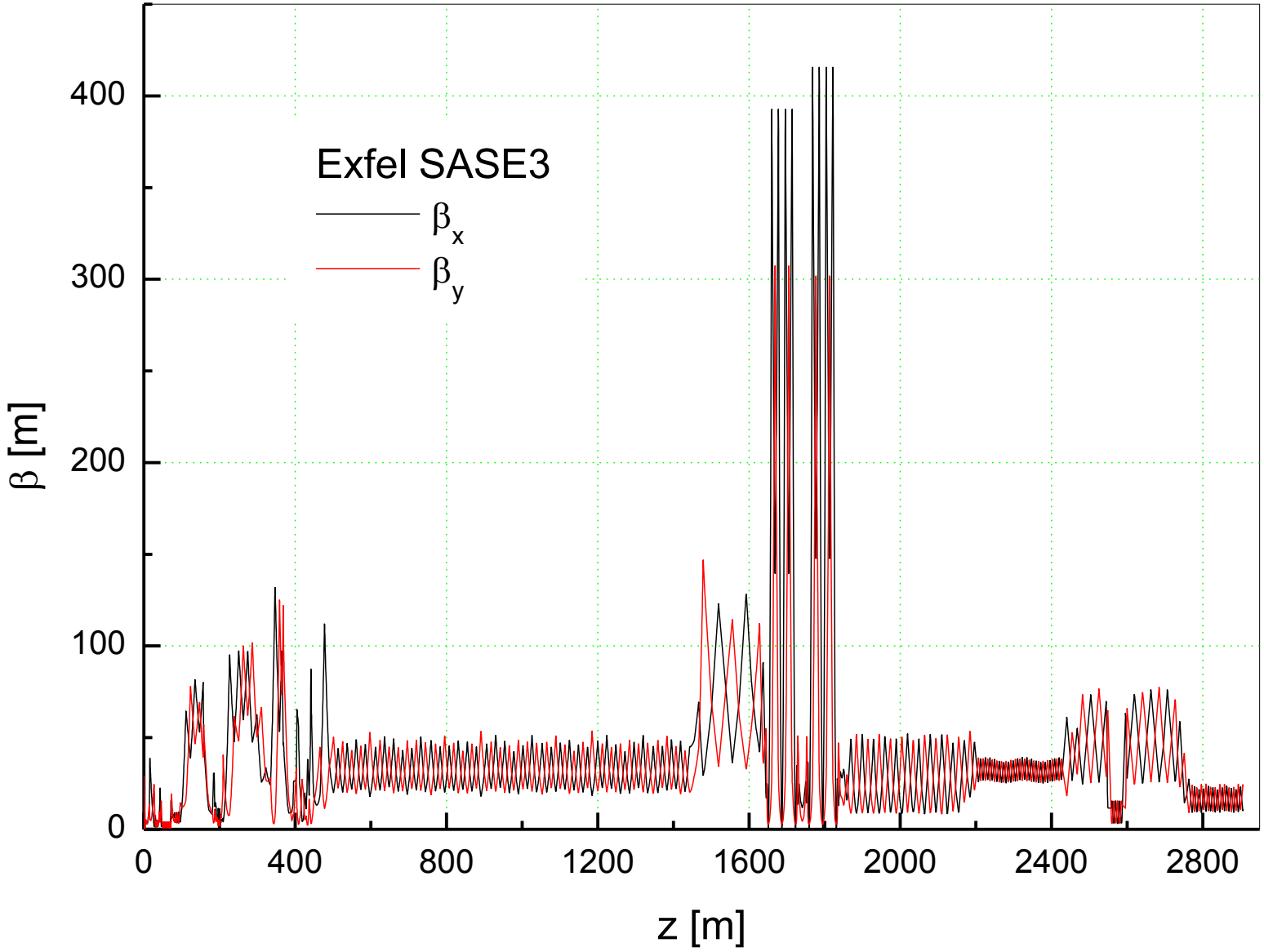
(5) Beam dynamics simulation (continued, 70%(from start to the entrance of SASE1))

(6) …

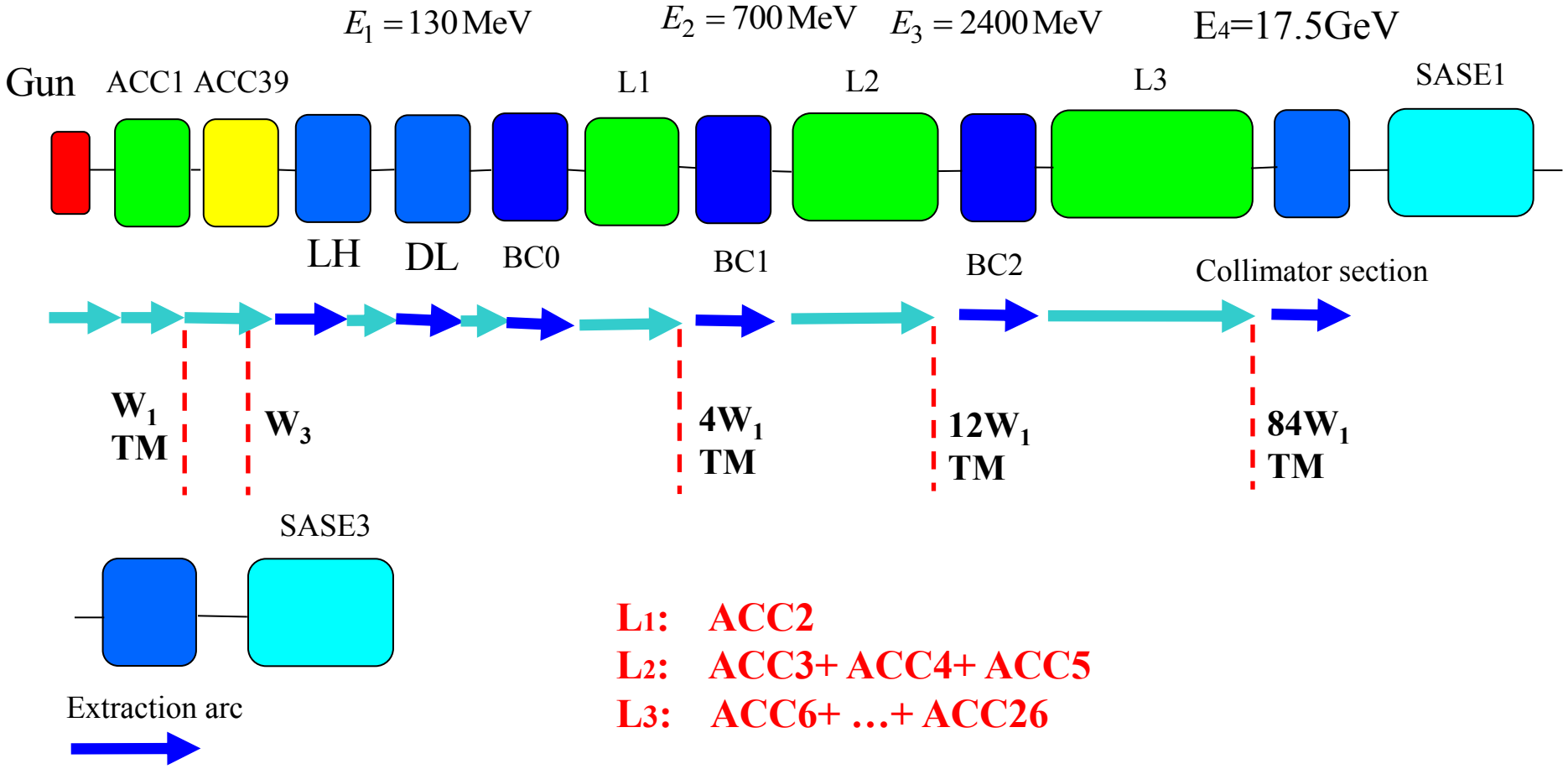
Start to end simulation for SASE3 with 0.5nC



Beam optics for EXFEL SASE3



New beam optics for EXFEL SASE3 (10.05.2013)



ASTRA (tracking with space charge effects)

CSRtrack (tracking with CSR effects)

W1 -TESLA cryomodule wake (TESLA Report 2003-19, DESY, 2003)

W3 - ACC39 wake (TESLA Report 2004-01, DESY, 2004)

TM - transverse matching to the design optics

Start to end simulation for SASE3 with 0.5nC

Parameters for the bunch compressors*

Charge Q, nC	Momentum compaction factor in BC_0 , $R_{56,0}$, [mm]	Compr. In BC_0 C_0	Momentum compaction factor in BC_1 , $R_{56,1}$, [mm]	Compr. in BC_1 C_1	Total compr. C
0.5	-89	3.5	-50	8	217

Dogleg section R_{56}=-30.1mm, C=1.21

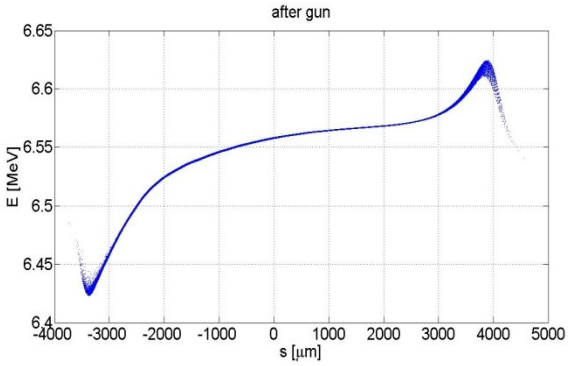
RF parameters of accelerating modules

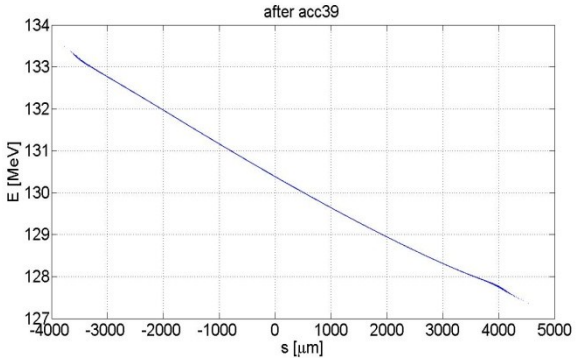
Element	**Phase shift**	**V_{max}**
ACC1	-2.097968°	145.63006MV
ACC39	152.78271°	24.690445MV
L1: ACC2	32.319209°	674.73239MV
L2: ACC3-5	4.5964467°	1706.0582MV
L3: ACC6-26	0.0°	15108.175MV

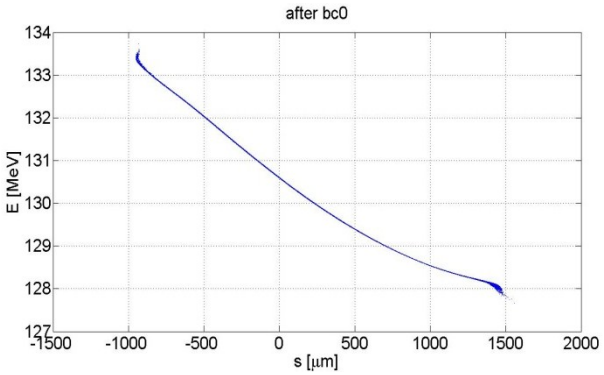
* Igor Zagorodnov, Beam Dynamics Simulations for XFEL, BD meeting, 2011

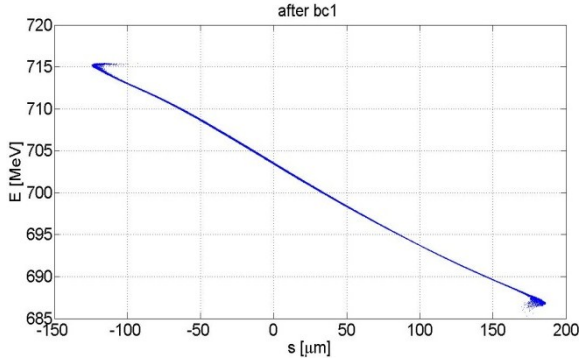
Start to end simulation for SASE3 with 0.5nC

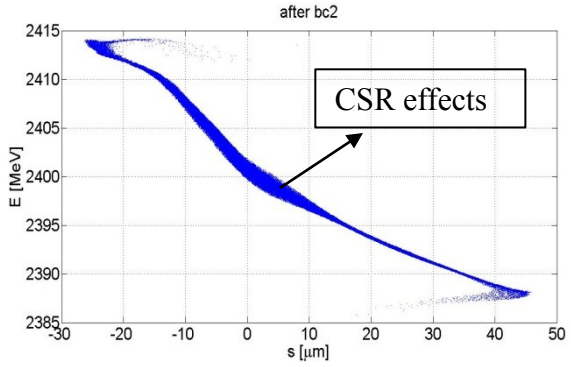
Longitudinal phase space for Q=0.5nC with collective effects

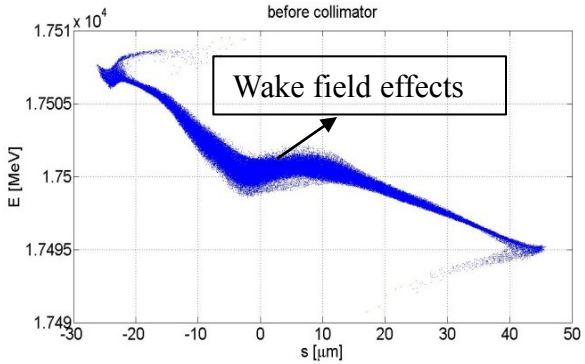


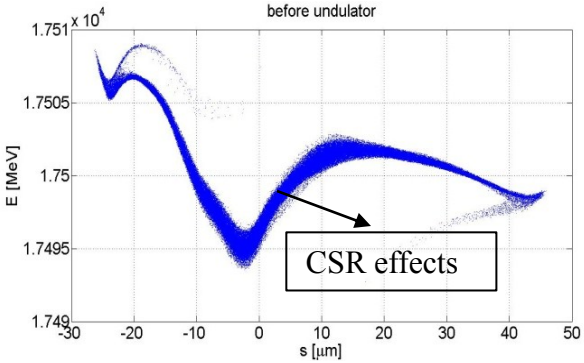


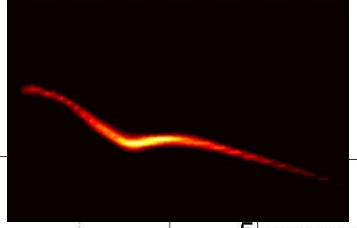


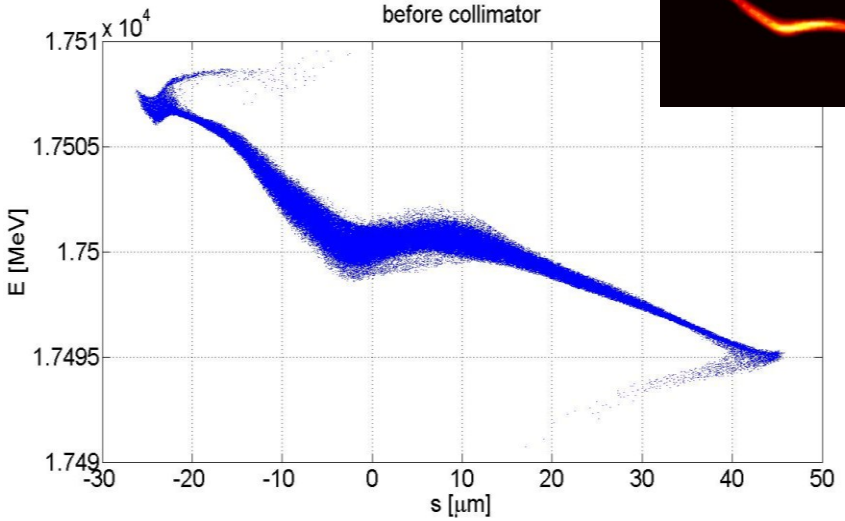


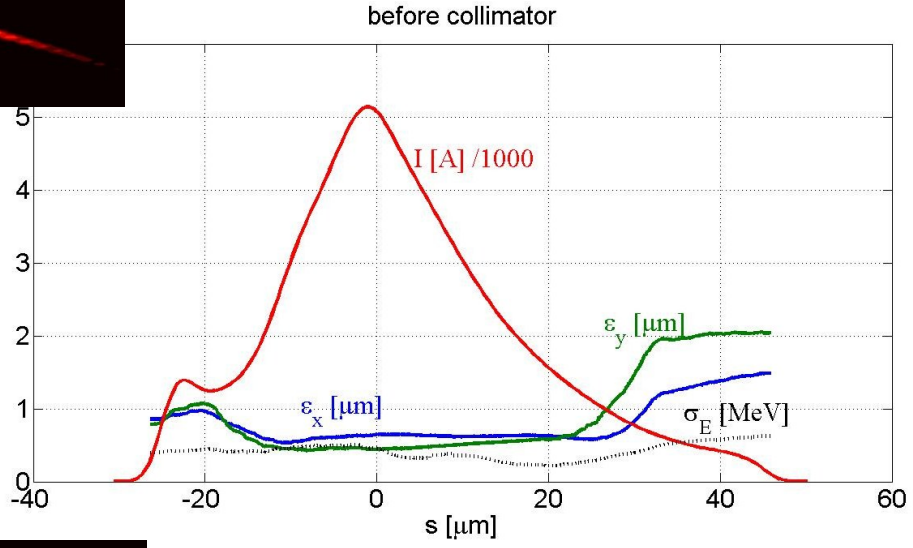


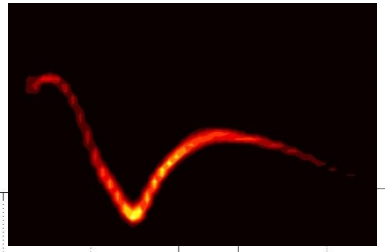




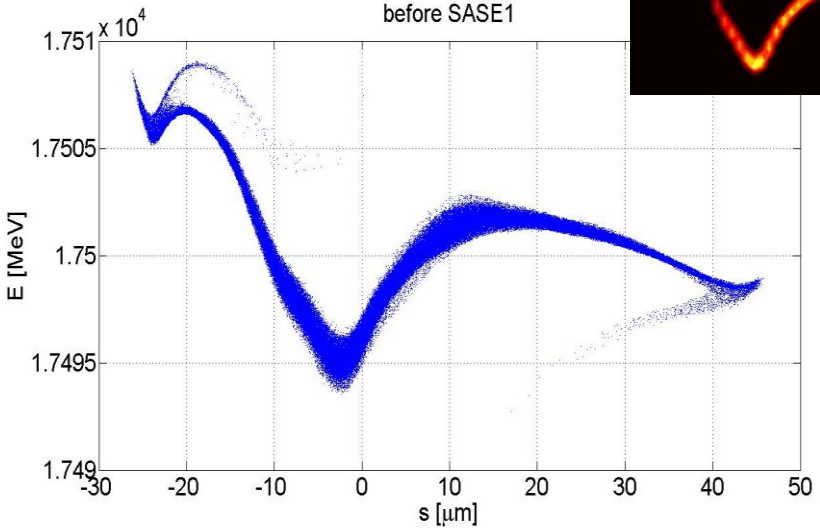


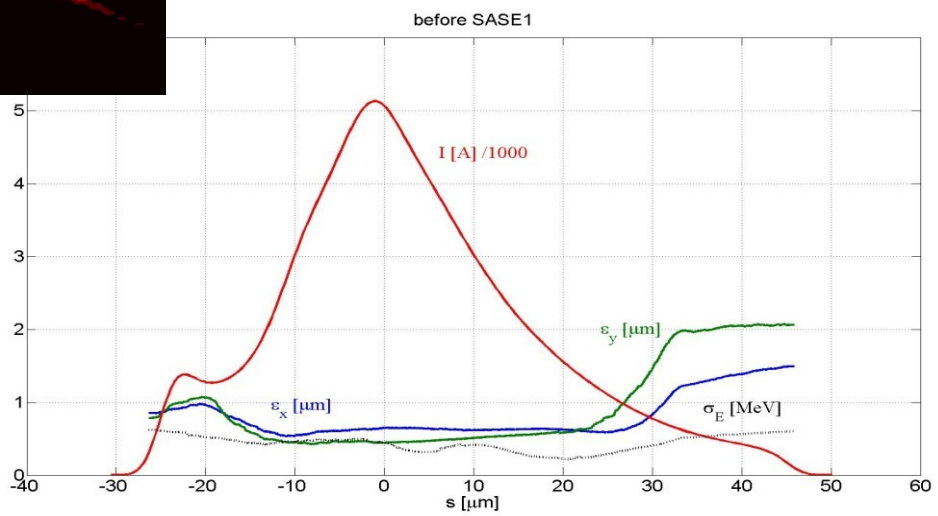






$\varepsilon_x^{proj} = 0.84\mu m, \varepsilon_y^{proj} = 1.94\mu m$



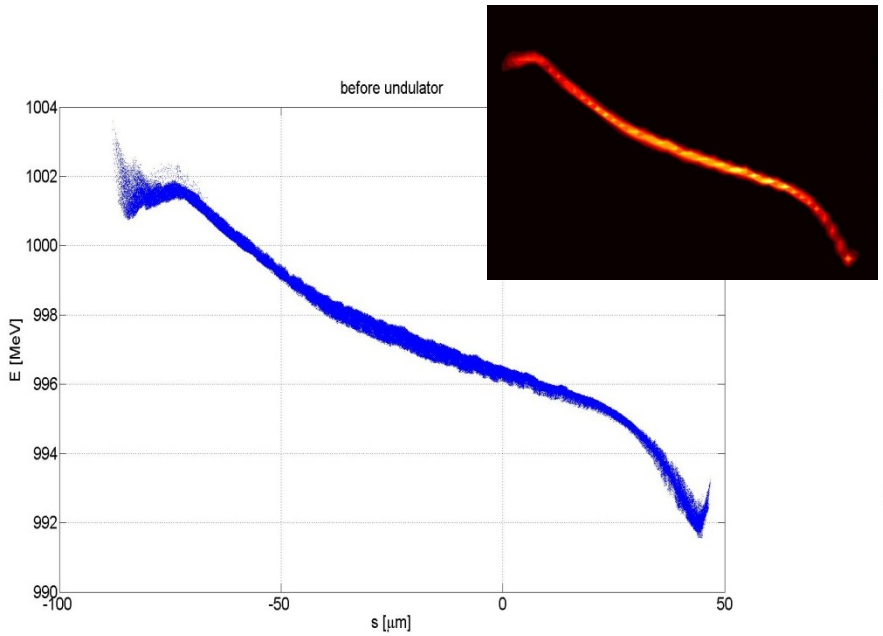


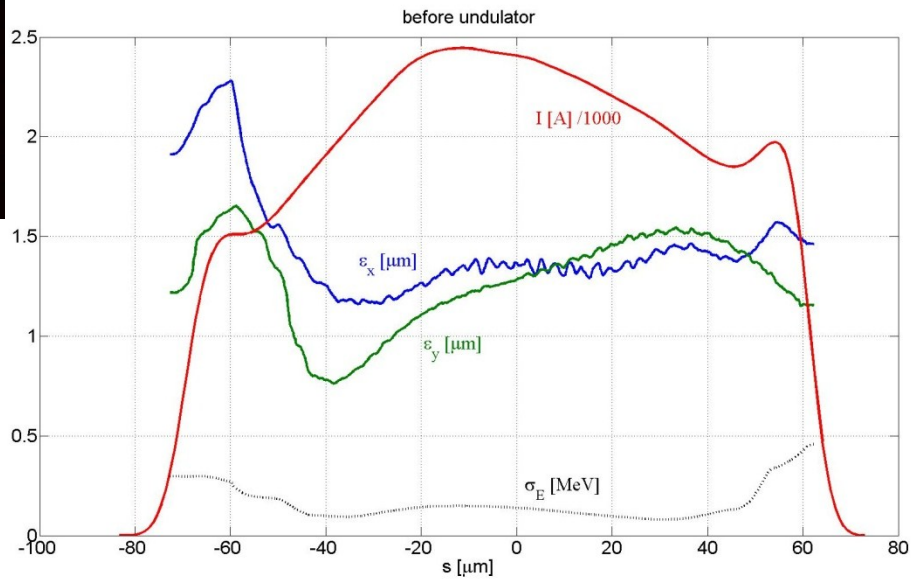
bunch head

$\varepsilon_x^{proj} = 0.84\mu m, \varepsilon_y^{proj} = 1.95\mu m$

2. S2e simulation for FLASHII with 1.0nC **(70%)**

(1) Beam dynamics simulation **(100%)**
(2) Radiation calculation **(going forward)**

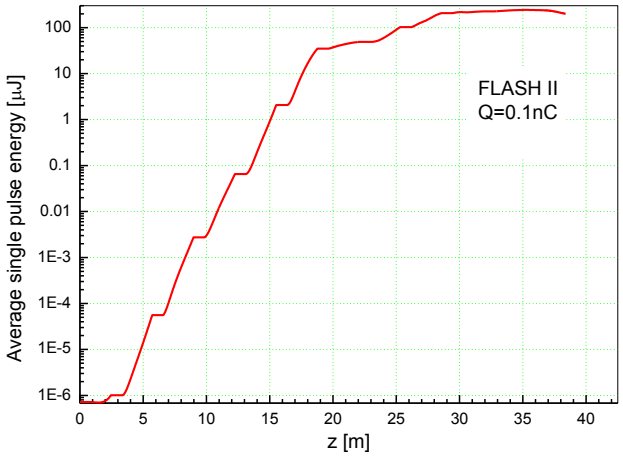


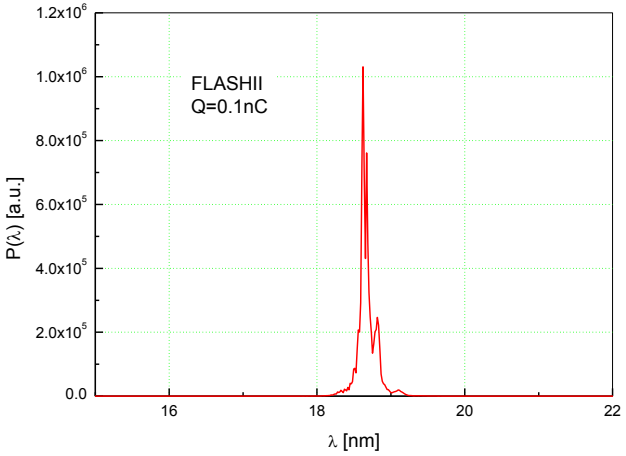


$\varepsilon_x^{proj} = 2.35\mu m, \varepsilon_y^{proj} = 1.82\mu m$

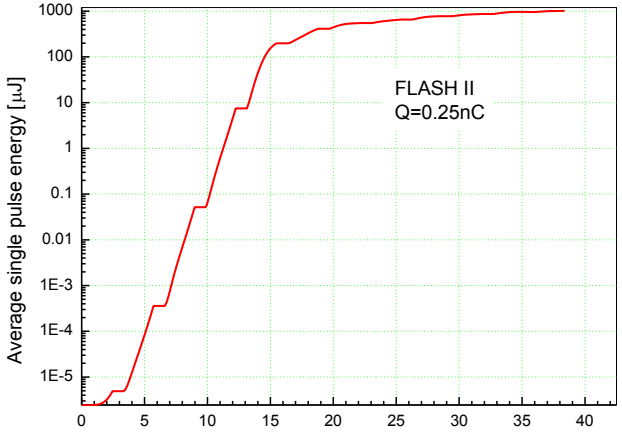
3. Radiation calculation for FLASHII (0.1nC case and 0.25nC case) **(40%)** **(with more random seeds)**

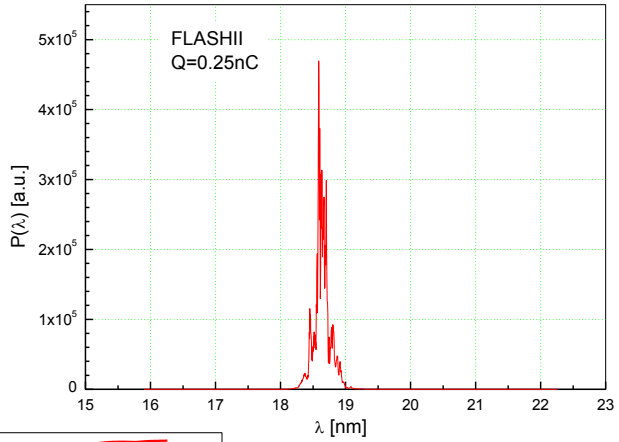
Q=0.1nC
6 random seeds



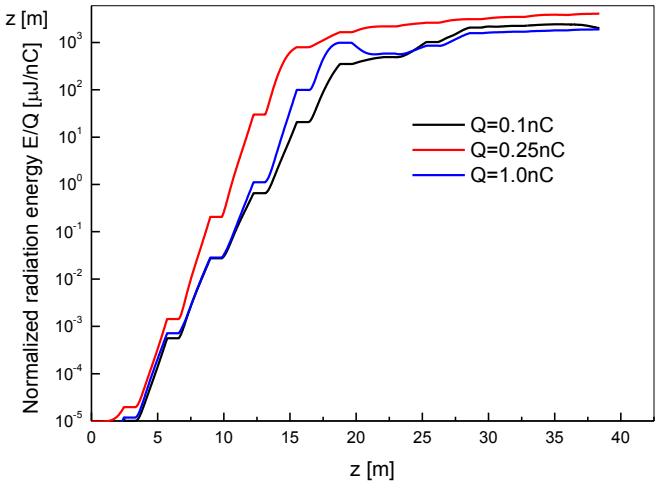


Q=0.25nC
7 random seeds





Q=1.0nC
1 random seeds



4. Small slice energy spread for FLASHII HGHG option

(100%)

Requirements:

1) the global slice length: ~15 um slice = 50 fs

* Within this slice, the energy spread should be smaller than 100 keV

2) min current along the global slice: Should exceed at least 0.5 kA

3) how large can be the variation of the current along the global slice:

most important to assure min. 0.5 kA.

4) maximal local slice emittance along the global slice?: 1.5 um

5) maximal local (uncorrelated) energy spread: ~100 keV

Energy in BC2 [MeV]	Energy in BC3 [MeV]	Deflecting radius in BC2 [degree]	Deflecting radius in BC3 [degree]
145	450	18	4.5

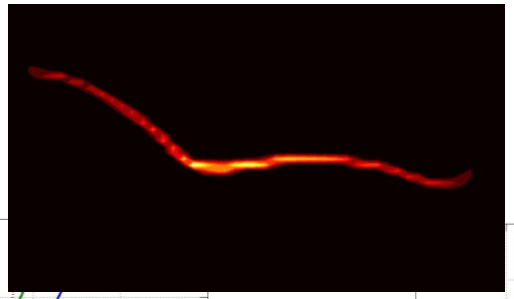
0.25nC case

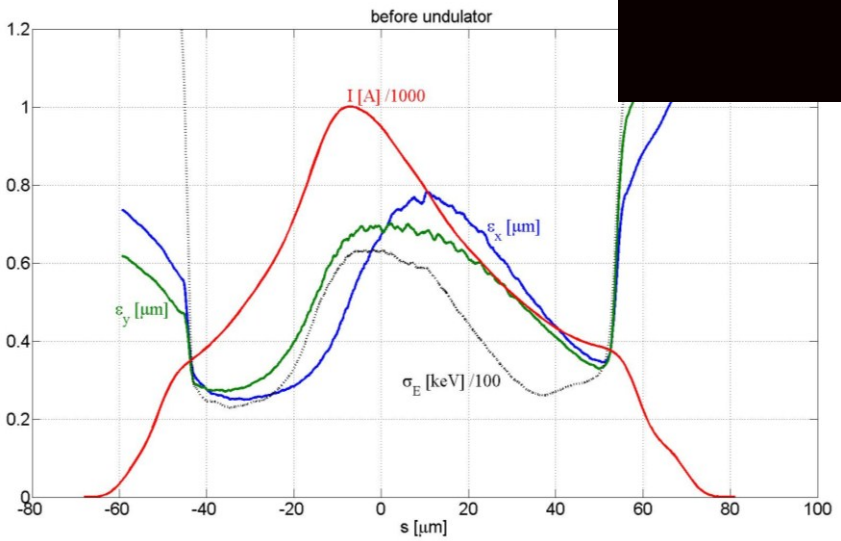
Element	Phase shift	V_{max}
RF Gun	2.00°	
ACC1	-2.6868°	159.662MV
ACC39	149.745°	21.998MV
ACC2/3	**6.5°**	302.645MV
ACC4/5	**-10.0°**	320.0MV
ACC6/7	**-10.0°**	238.485MV

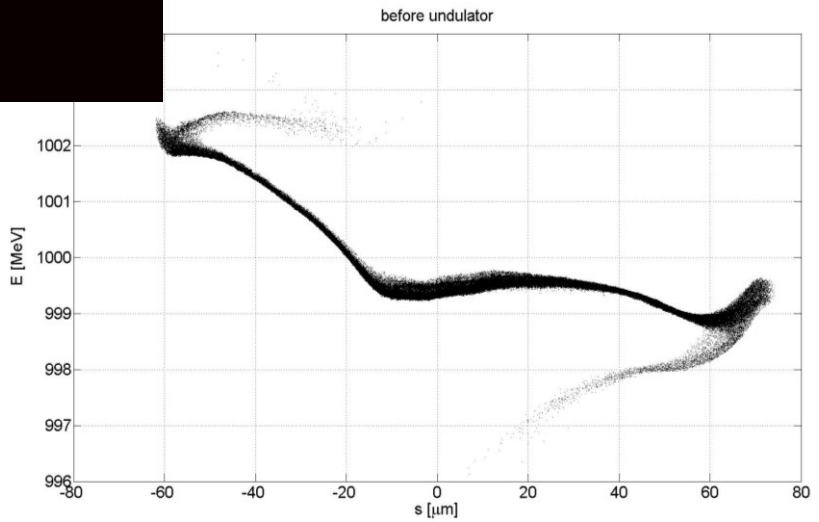
0.40nC case

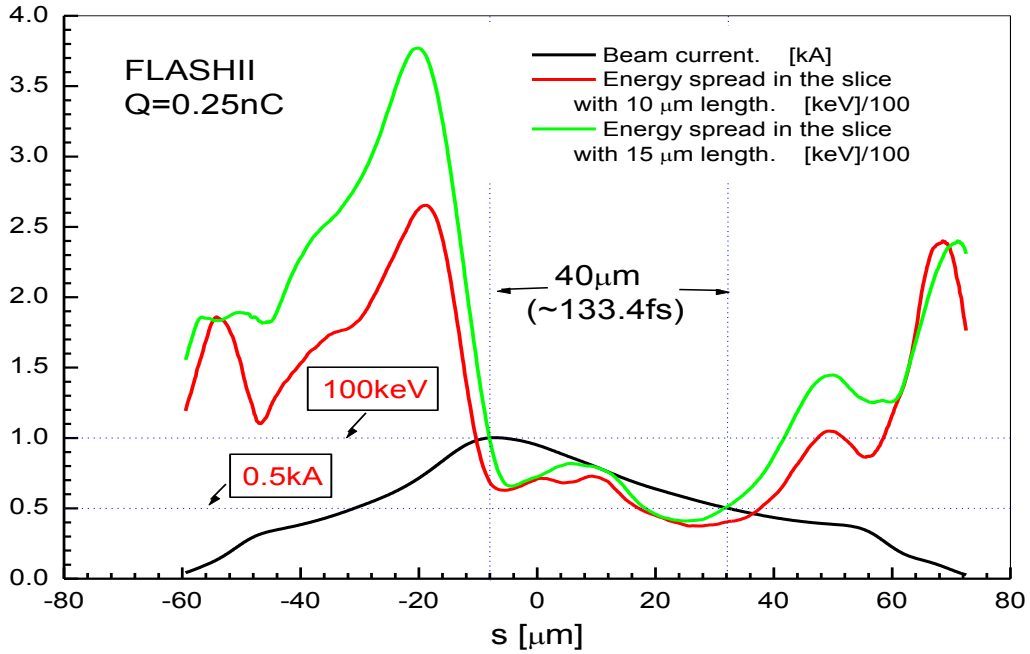
Element	Phase shift	V_{max}
RF Gun	2.00°	
ACC1	0.18657°	159.883MV
ACC39	157.588°	20.983MV
ACC2/3	**18.7°**	321.998MV
ACC4/5	**-25.0°**	320.0MV
ACC6/7	**-25.0°**	286.858MV

0.25nC case:

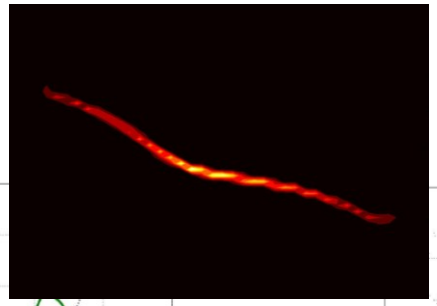


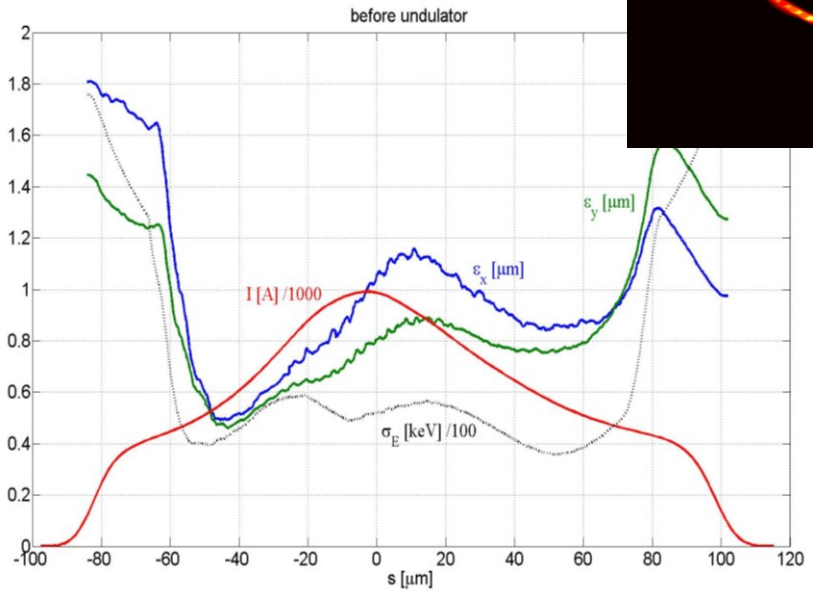

before undulator
I [A] /1000
ε_x [μm]
ε_y [μm]
σ_E [keV] /100
s [μm]

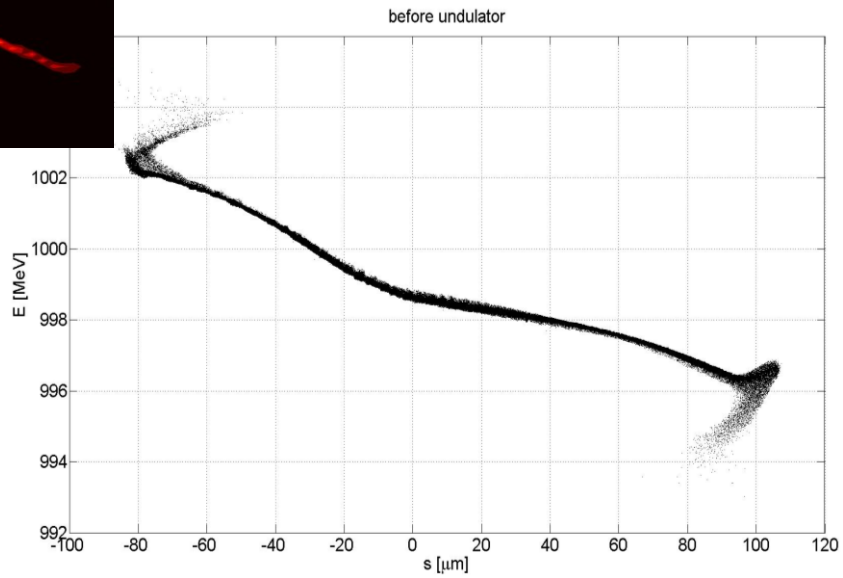

before undulator
E [MeV]
s [μm]

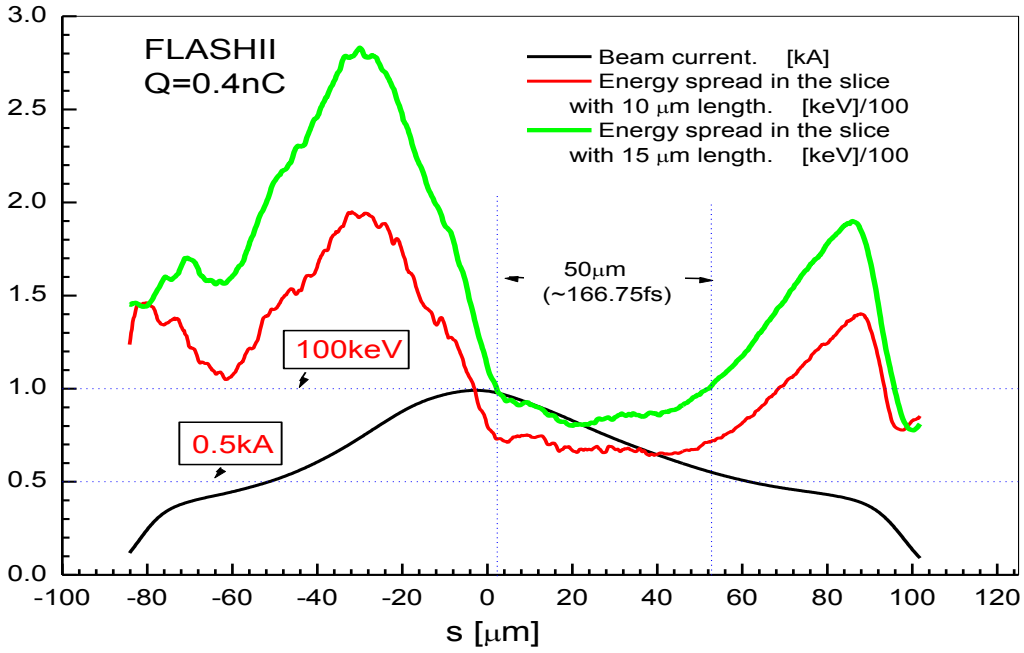

FLASHII
Q=0.25nC
Beam current. [kA]
Energy spread in the slice with 10 μm length. [keV]/100
Energy spread in the slice with 15 μm length. [keV]/100
40μm
(~133.4fs)
100keV
0.5kA
s [μm]

0.40nC case:




before undulator
I [A] /1000
ε_x [μm]
ε_y [μm]
σ_E [keV] /100
s [μm]


before undulator
E [MeV]
s [μm]


FLASHII
Q=0.4nC
Beam current. [kA]
Energy spread in the slice with 10 μm length. [keV]/100
Energy spread in the slice with 15 μm length. [keV]/100
50μm
(~166.75fs)
100keV
0.5kA
s [μm]

The plan for this month

1. Continue doing the radiation calculation for FLASHII (0.1nC ,0.25nC, 1.0nC case) (50%)

2. Simulation for EXFEL SASE3 with 0.5nC (70%)

3. S2e simulation for FLASHII with 0.5nC (50%)

4. Continue writing the internal report for the completed work (75%)