Work Progress in March 2013

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MPY, DESY

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The plan for last month

1. The start to end simulation for FLASHII (0.1nC) with Astra, CSRTrack and Genesis (100%)

2.

- The beam dynamics simulation for FLASHII extraction arc will be done with Elegant after getting the particle distribution file at the end of ACC7 from Astra. During the calculation, the chromatic aberrations impact in the vertical plane should be included.
- Doing beam dynamics simulation for the last straight section (before undulator) with Astra.
- The radiation calculation with Genesis (100%)

3. Making a comparison between 1 and 2 (50%)

4. Doing the start to end simulation for FLASHII with other bunch charge (0.25nC, 0.5nC, 1.0nC) if necessary (20%)

5. Begin to do the input files conversion from Elegant to Astra and CSRTrack for SASEII. (10%)

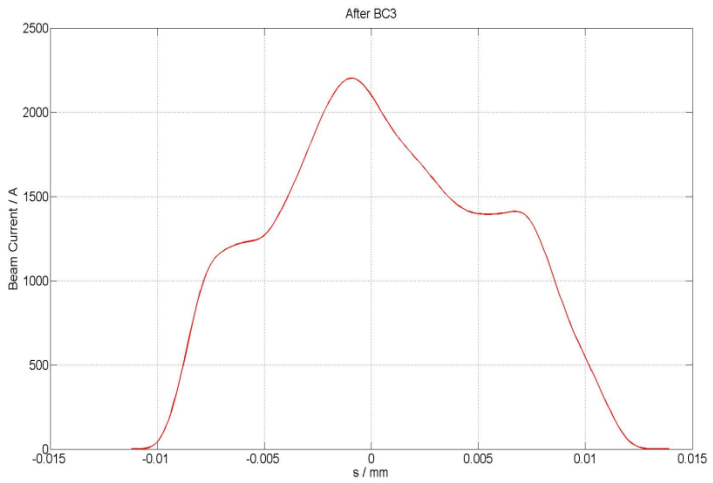
Achieved progress

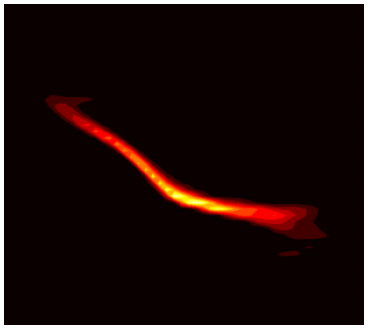
1. Start to end simulation for FLASHII with low bunch charge (0.1nC) (astra+csrtrack+genesis) **(95%)**

***RF parameters in February**

Element	Phase shift	V_{max}
RF Gun	2.00°	
ACC1	-11.838°	**168.586MV**
ACC39	132.935°	**28.651MV**
ACC2/3	25.00°	331.565MV
ACC4/5	0°	275.0MV
ACC6/7	0.0°	275.0MV

Exceed the limitation of the maximum energy gain for the accelerating modules





After BC3

Start to end simulation for FLASHII with 0.1nC

Restrictions:

- I_{peak}~2.5kA Compression ratio in the bunch compressors
- E=1.0GeV Beam energy at the end of the Linac
- E1=145MeV Beam energy after ACC39
- E2=450MeV Beam energy after ACC3
- Maximum energy gain for each accelerating module

ACC1	**165 MeV**
ACC39	**22 MeV**
ACC2/3	**345 MeV**
ACC4/5	**320 MeV**
ACC6/7	**430 MeV**

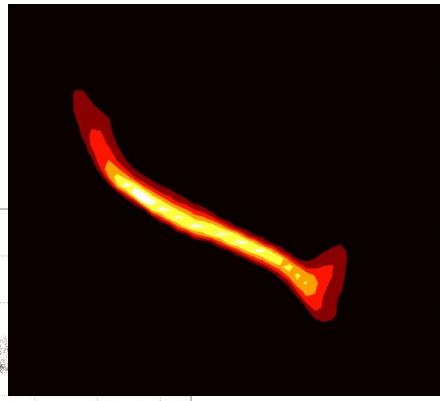
Start to end simulation for FLASHII with 0.1nC

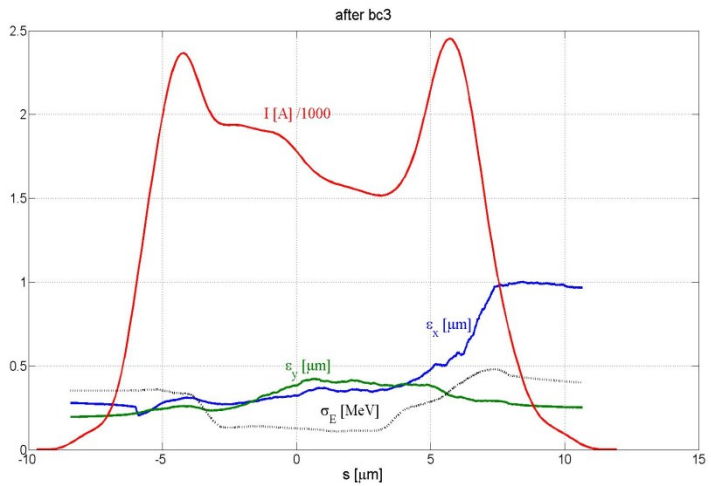
RF parameters optimization

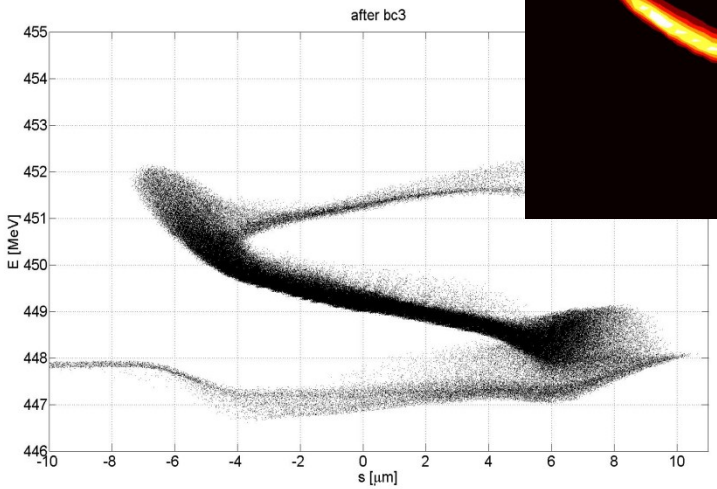
Element	Phase shift	V_{max}
RF Gun	2.00°	
ACC1	-1.57498°	159.759MV
ACC39	151.031°	**21.9628MV**
ACC2/3	25.00°	337.082MV
ACC4/5	0°	320.0MV
ACC6/7	0.0°	230.0MV

$$\begin{pmatrix} V_1 \\ \varphi_1 \\ V_{39} \\ \varphi_3 \end{pmatrix} = M \begin{pmatrix} V(0) \\ V'(0) \\ V''(0) \\ V'''(0) \end{pmatrix}$$

$$V(0) = V_1 \mathrm{Cos}(\varphi_1) + V_{39} \mathrm{Cos}(\varphi_3)$$

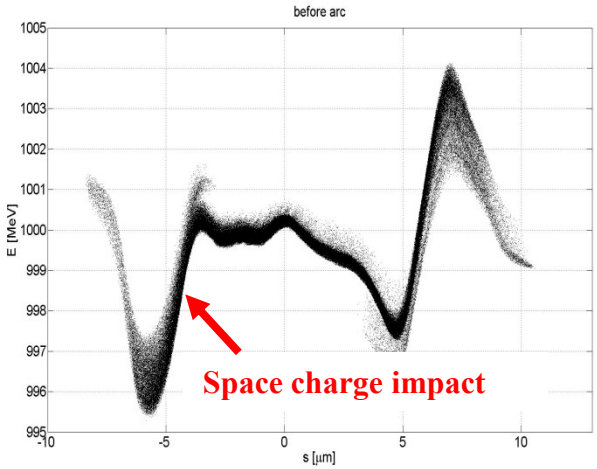


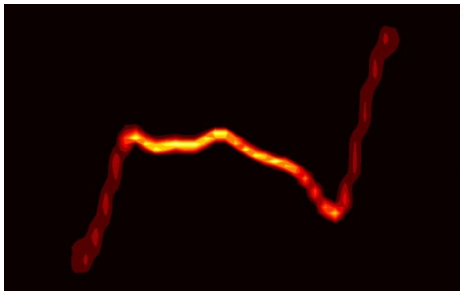




After BC3

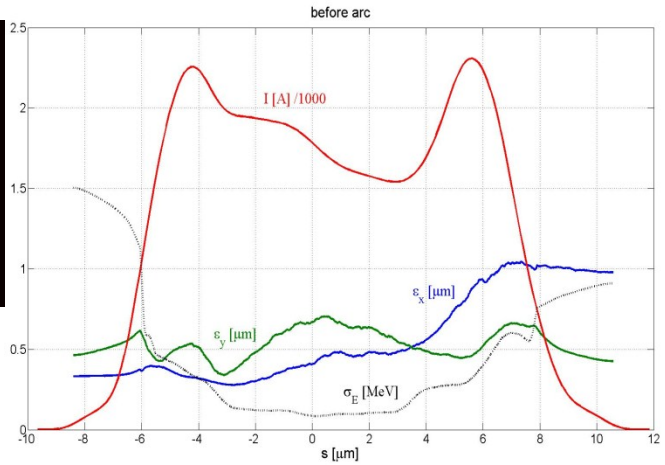
Start to end simulation for FLASHII with 0.1nC

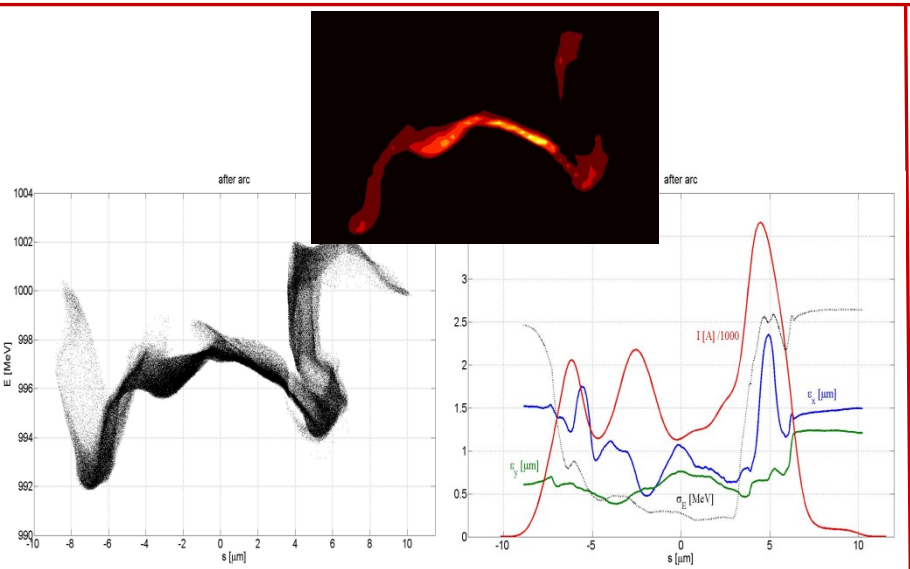




$\varepsilon_x{}^{proj}$=0.848μm , $\varepsilon_y{}^{proj}$=0.731μm

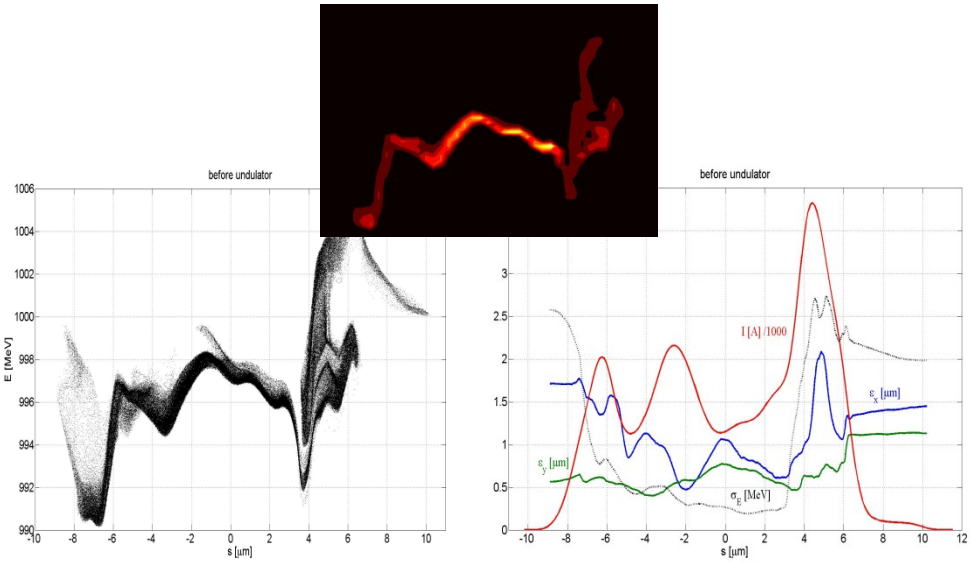
Before extraction arc





$\varepsilon_x{}^{proj}$=1.35μm , $\varepsilon_y{}^{proj}$=0.734μm

After extraction arc



$\varepsilon_x{}^{proj}$=1.35μm , $\varepsilon_y{}^{proj}$=0.74μm

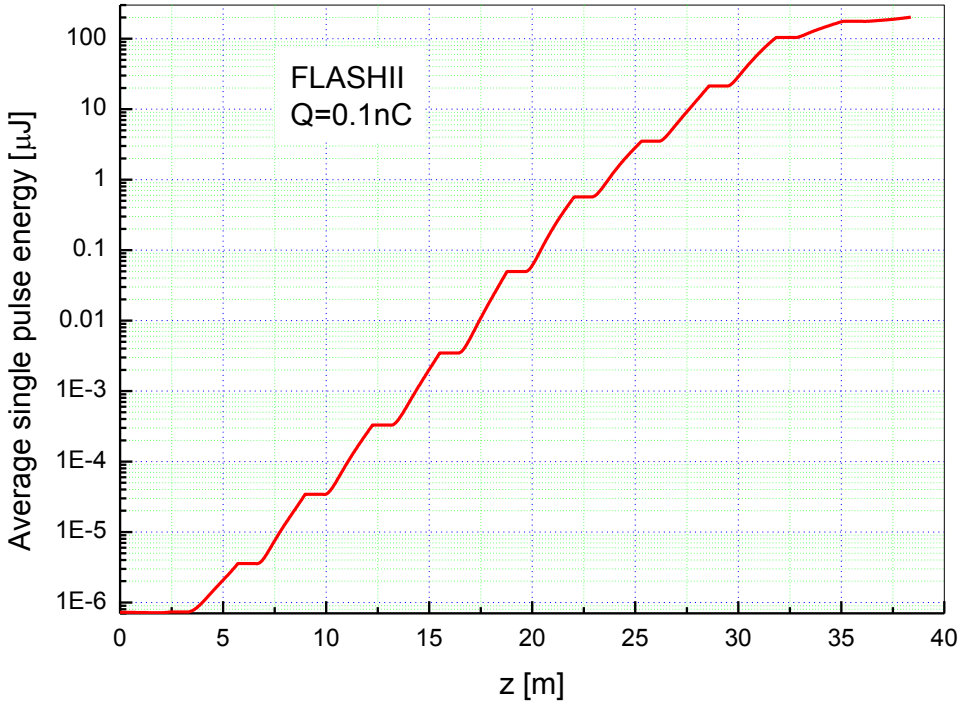
Before undulator

Start to end simulation for FLASHII with 0.1nC

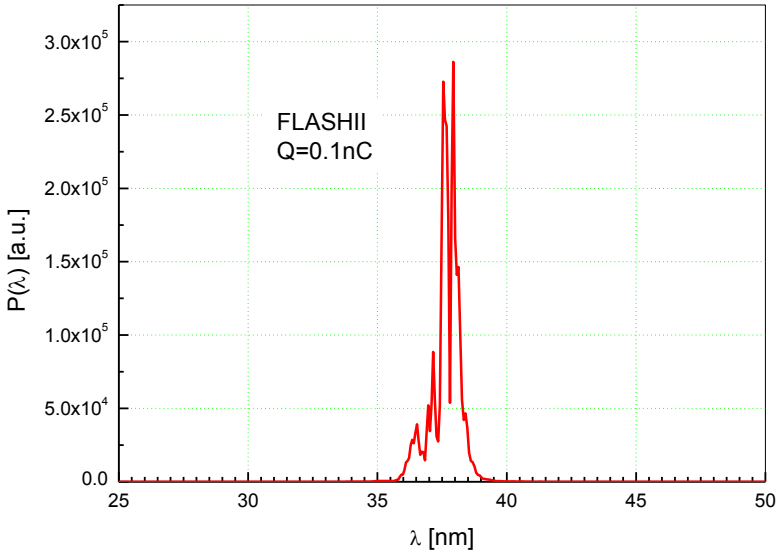
SASE FEL simulation* Going forward … …

Slice parameters are extracted from s2e simulations for SASE simulation

$$\gamma \quad \Delta\gamma \quad \varepsilon_x \quad \varepsilon_y \quad \beta_x \quad \beta_y \quad \langle x \rangle \quad \langle y \rangle \quad \langle x' \rangle \quad \langle y' \rangle \quad \alpha_x \quad \alpha_y \quad I$$



Q=0.1nC
E = 202μJ

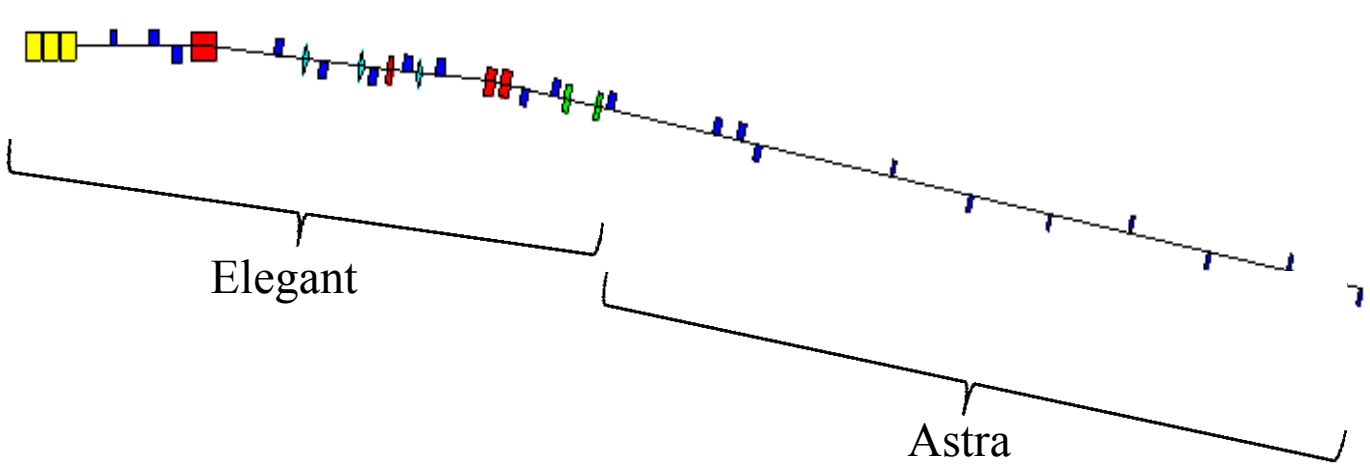


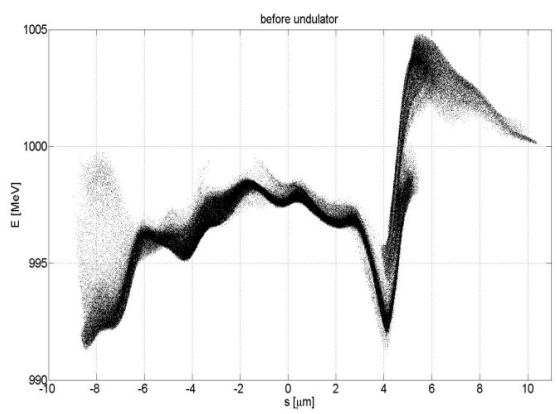
3 random seeds for shot noise

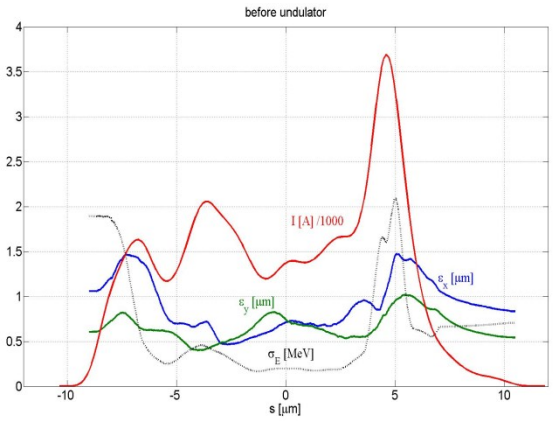
* The magnet description file for the undulator system comes from Matthias

2. Beam dynamics simulation for the extraction arc with Elegant (0.1nC) (elegant+astra+genesis) **(95%)**

Astra output

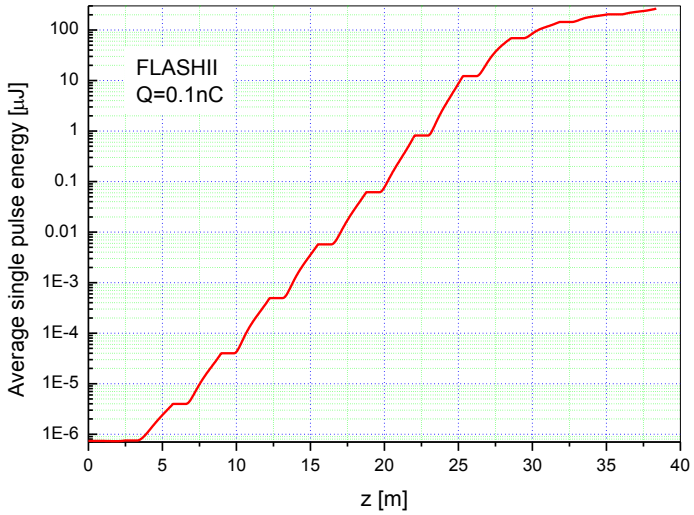






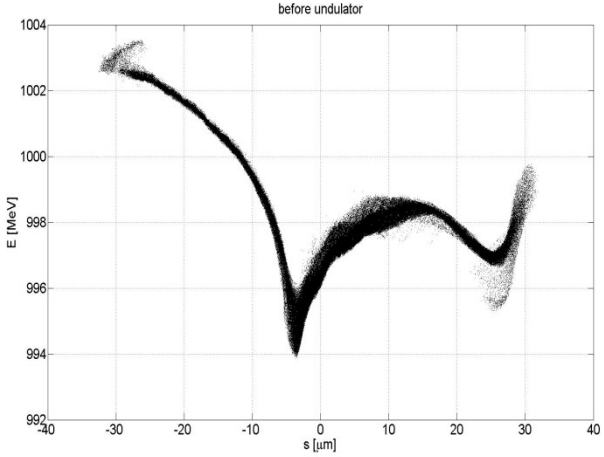
$\varepsilon_x{}^{proj}$=1.78μm , $\varepsilon_y{}^{proj}$=1.02μm

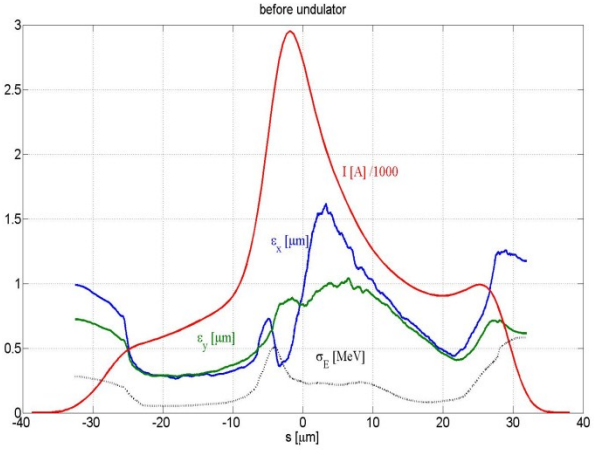
Before undulator system

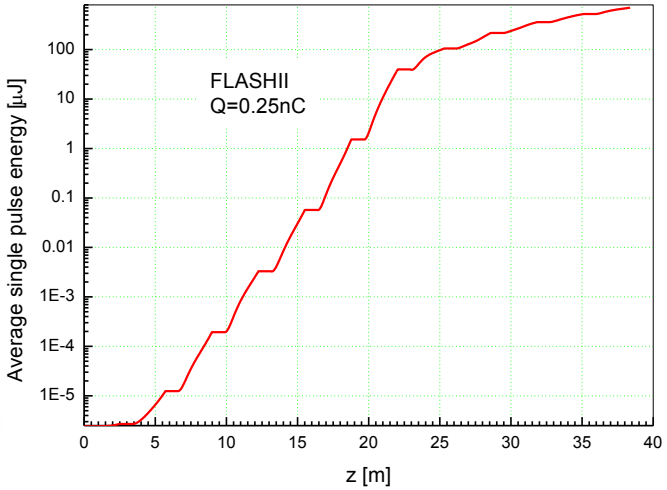


E = 264μJ

3. Start to end simulation for FLASHII with 0.25nC **(95%)**

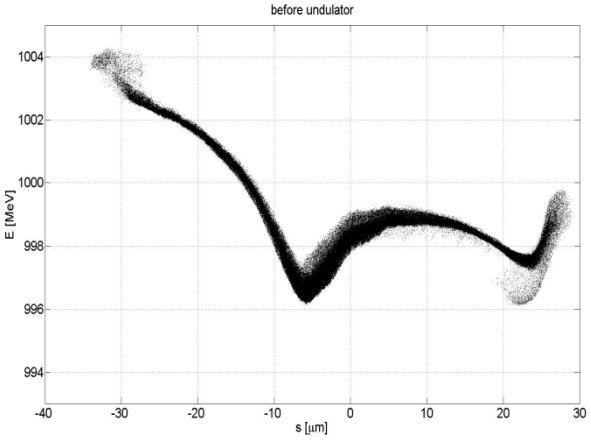


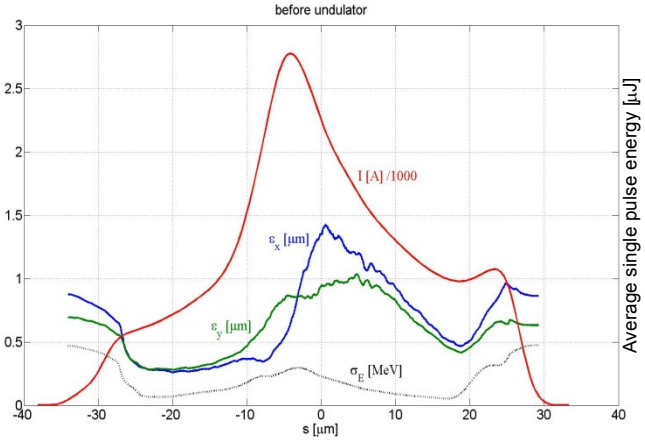


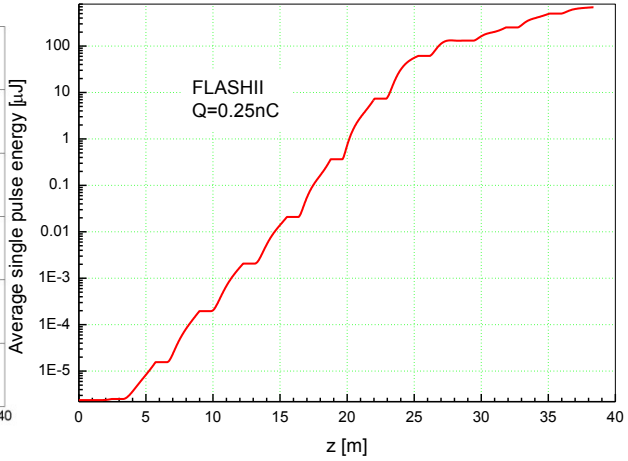


Astra + Csrtrack + Genesis

E = 700 μJ







E = 690 μJ

Astra + Csrtrack + Elegant (Extraction arc)+ Genesis

Other work progress

- Seeking beam bunch with special properties for FLASHII HGHG option
- Input files conversion from Elegant to Astra for EXFEL SASEII **(100%)**

Questions about EXFEL simulation

(1) Model of the RF gun for EXFEL?
Same as the one for FLASH?
Voltage and phase shift of the gun?

(2) Restrictions of the maximum energy gain for the accelerating modules?
Especially L1(ACC2), L2(ACC3+…+ACC5) and L3(ACC6+…+ACC26).

(3) Restrictions of the beam energy after ACC39, L1 and L2?
Should be the beam energy fixed at some critical positions?

(4) Limitations of the exciting current for BC0, BC1 and BC2.
Or the maximum degrees in the bending magnets.

The plan for this month

1. Continue doing the radiation calculation for FLASHII (0.1nC case and 0.25nC case) (100%)

2. Start to end simulation for FLASHII with 1.0nC and 0.5nC (50%)

3. Start to end simulation for SASEII with 0.5nC (30%)

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