HGHG calculation for FLASH2

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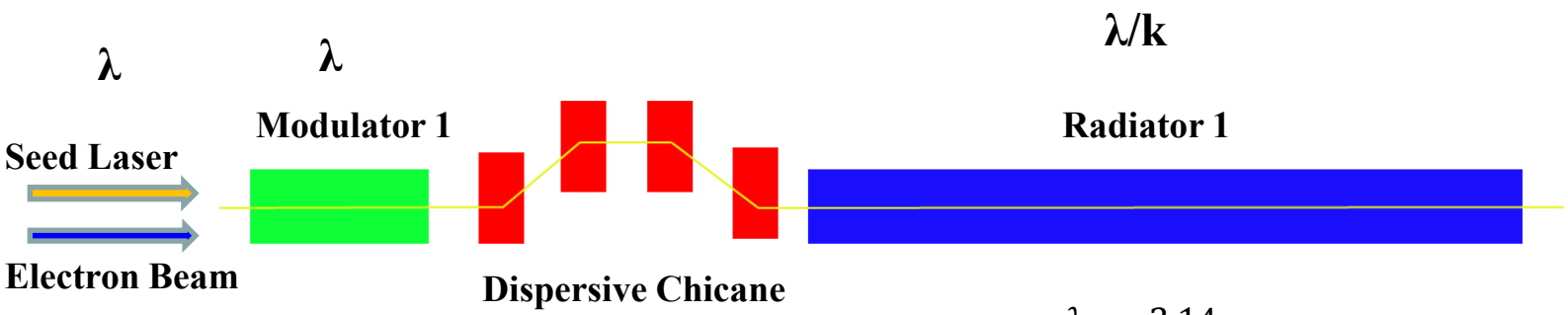
S2E Meeting

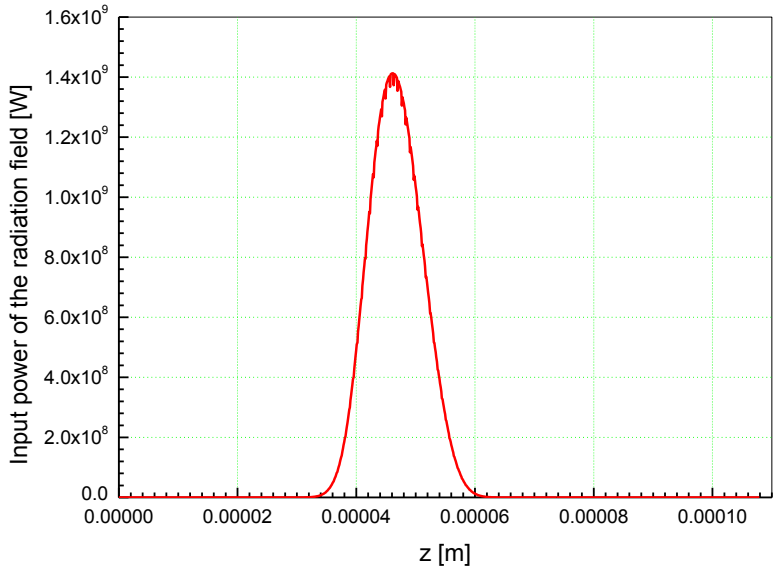
DESY

17.03.2014

Radiation calculation for FLASH2 HGHG



Seed Laser

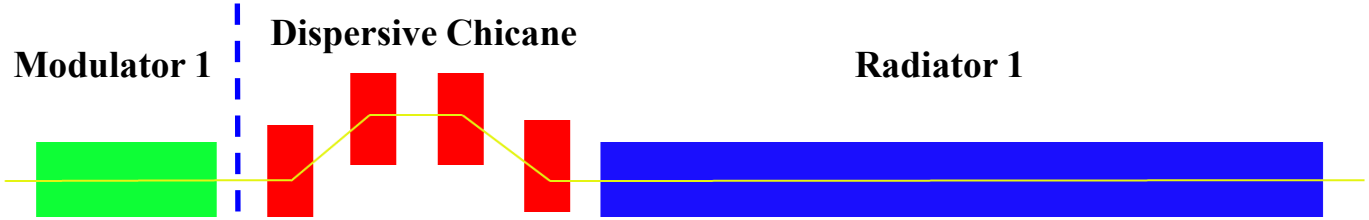


Chicane defined in Genesis input file

trama= 1
itram11= -0.9924
itram12= -0.0037
itram13= 0.000000D+00
:
:
:
itram66= 1.000000D+00

Radiation calculation for FLASH2 HGHG

Modulator and Chicane + Radiator are calculated separately with Genesis 1.3



Modulator run

1. Integrating through modulator with a seed.

2. Dumping particle distribution

```
$newrun
nbins = 32
nharm = 7
npart = 56448
Idmppar = 1
outputfile='modulator.out'
```

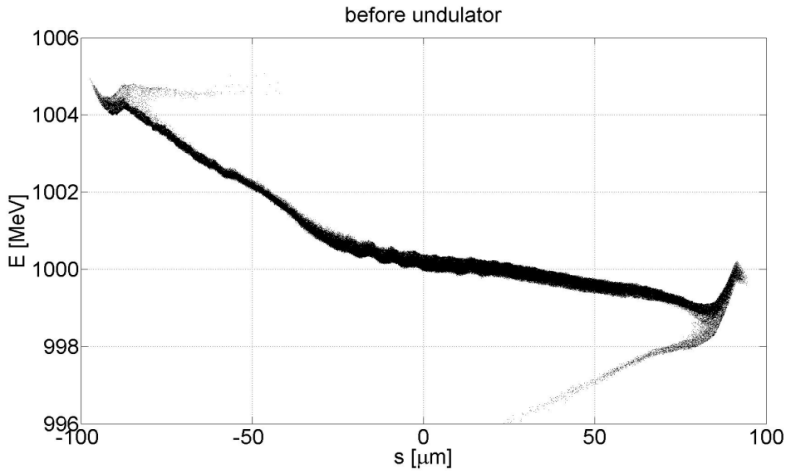
Chicane + Radiator run

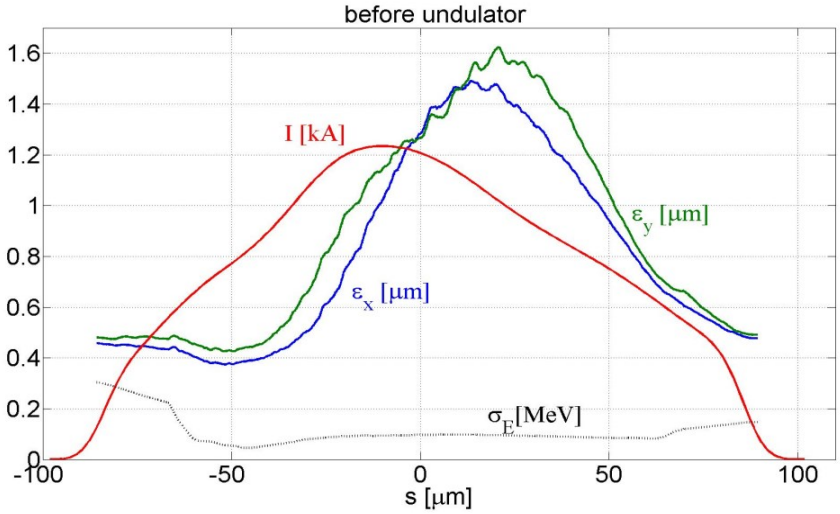
1. **Importing particle distribution.**
2. **Up converting the particle distribution to a higher harmonic.**
3. **Tracking through the dispersive chicane.**
4. **Integrating through the radiator.**

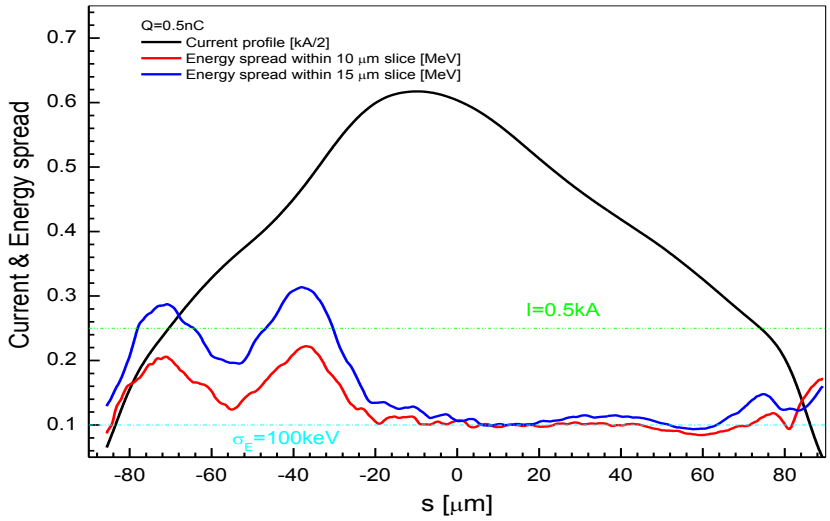
```
 $newrun
partfile='modulator.out.dpa,
convharm=  7
```

Radiation calculation for FLASH2 HGHG (Q=0.5nC)

Beam properties at the entrance of undulator for 0.5nC







5% bad particles are removed

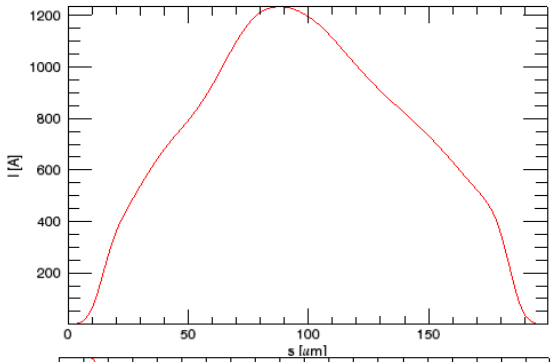
Energy spread within 15μm and 10μm slice length

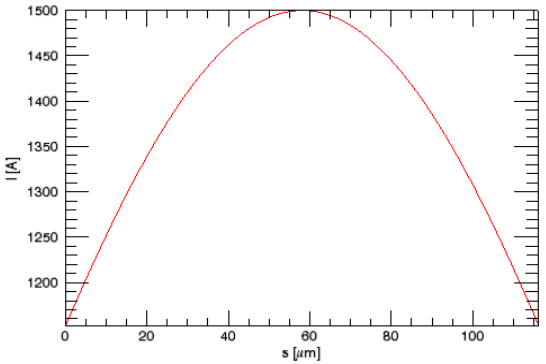
Radiation calculation for FLASH2 HGHG (Q=0.5nC)

CASE 1: With particle distribution file genereted from ASTRA simulation

CASE 2: Using beam parameters definition in Genesis main input file

Current profile

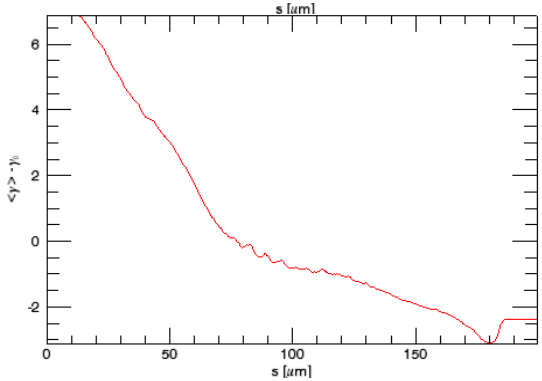


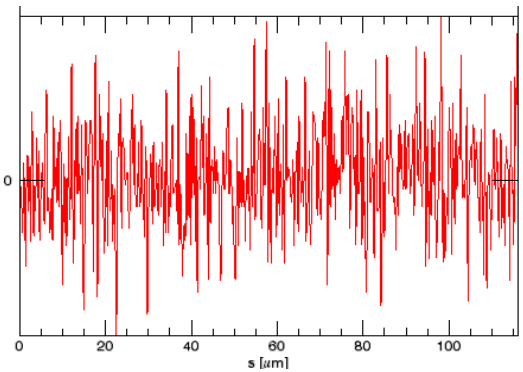


Gaussian distribution

$\sigma_s = 80$ μm

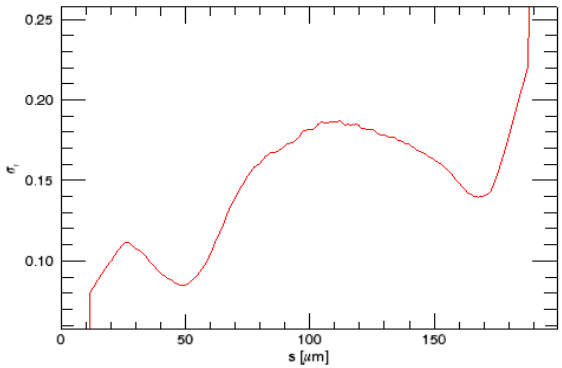
Initial energy distribution

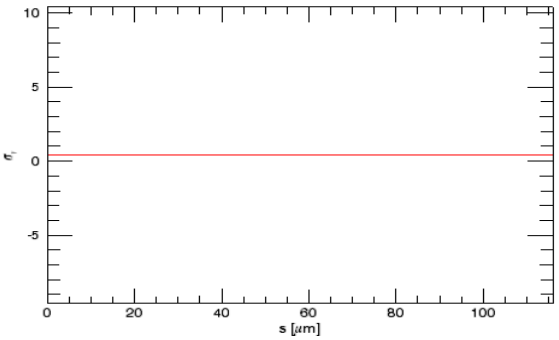




no energy chirp

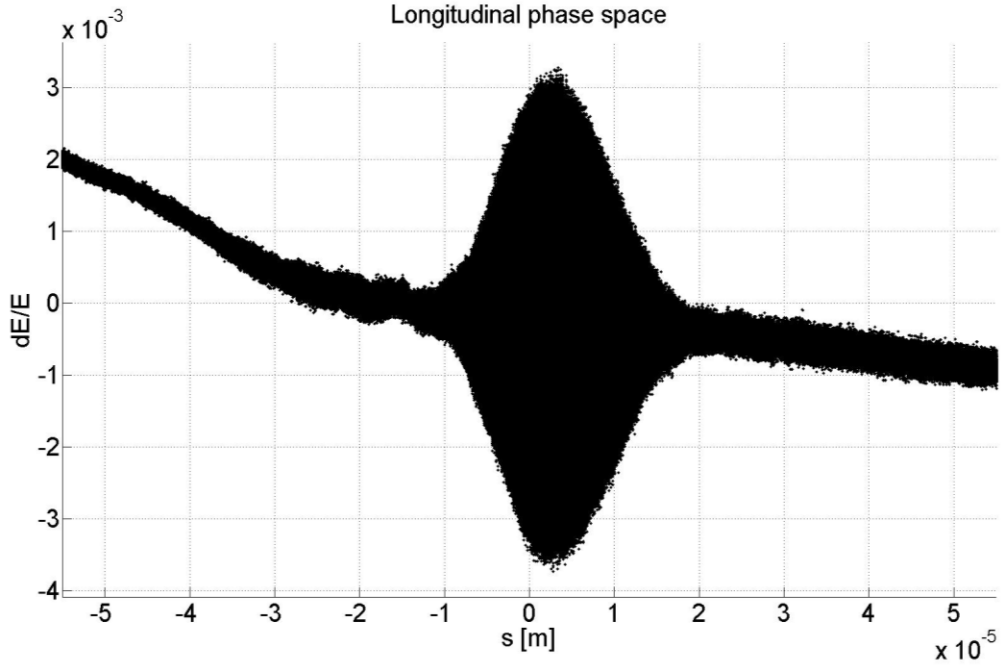
Initial slice energy spread

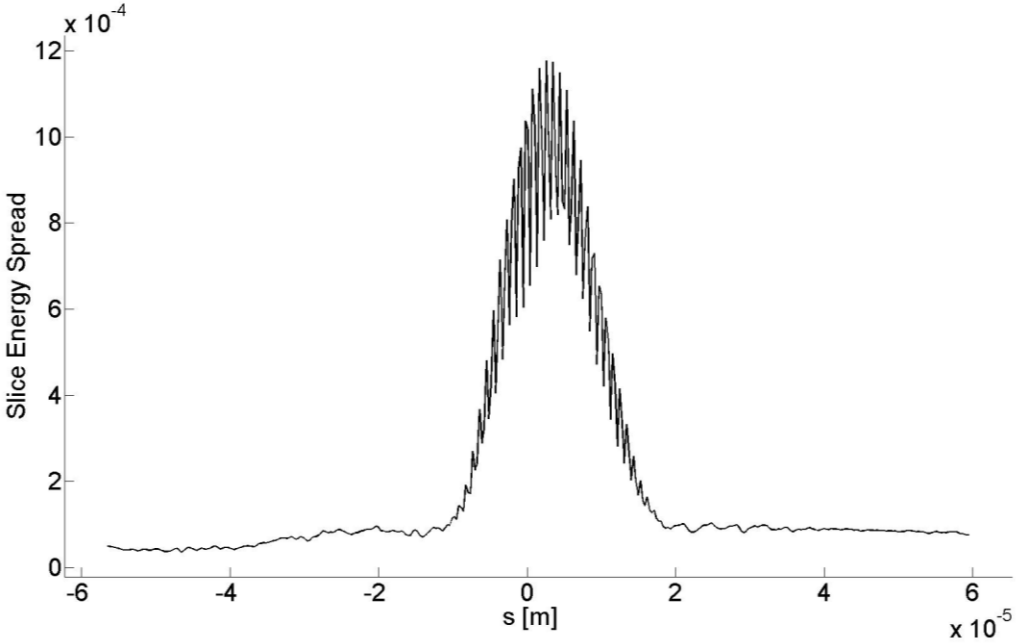




$\sigma_\gamma = 0.4$

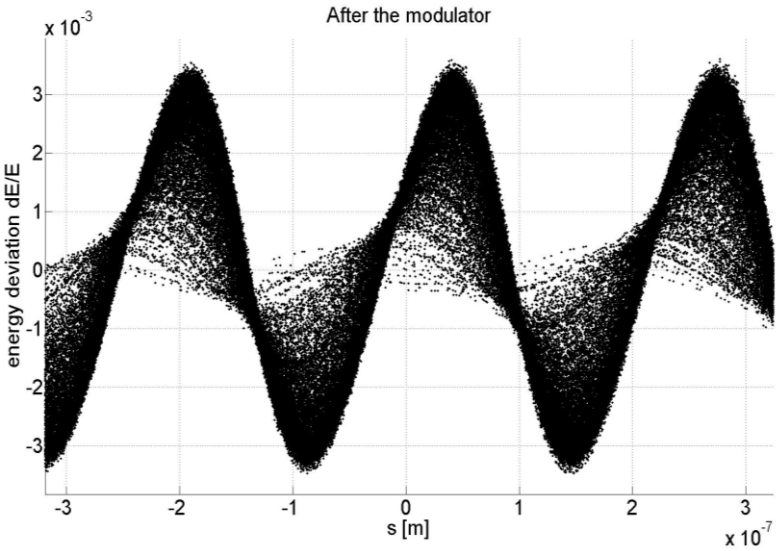
After the modulator (CASE 1)

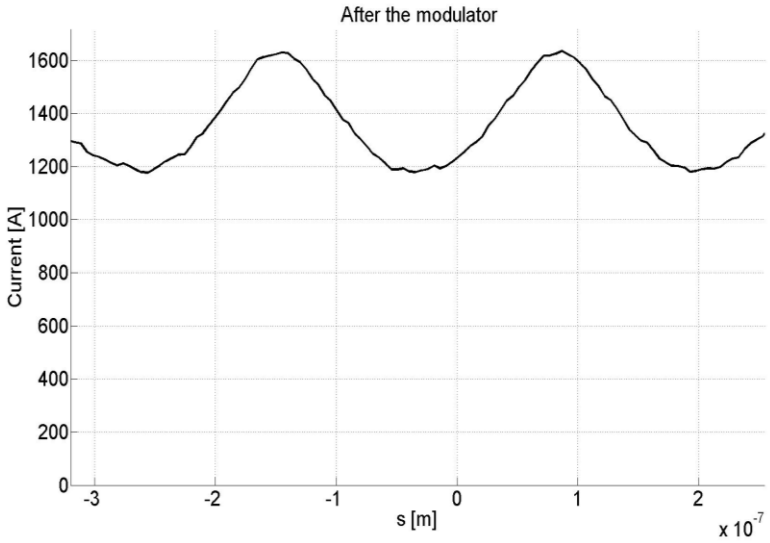




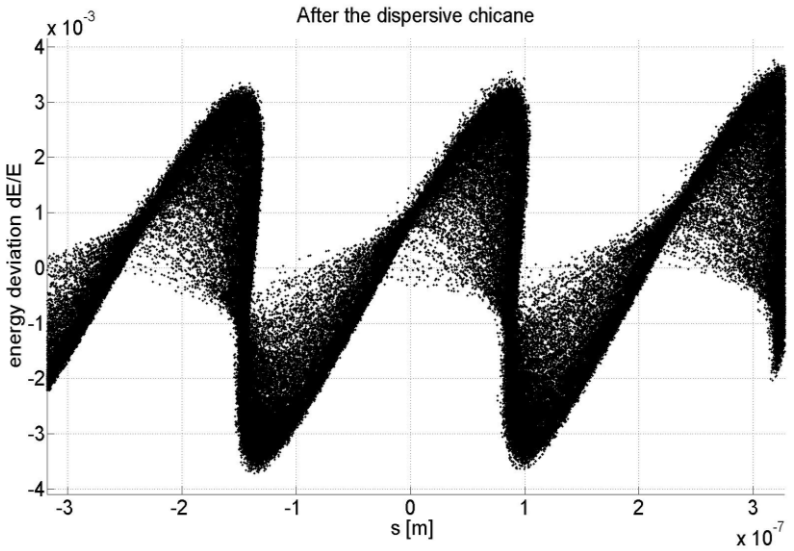
Energy modulation and microbunching (CASE 1)

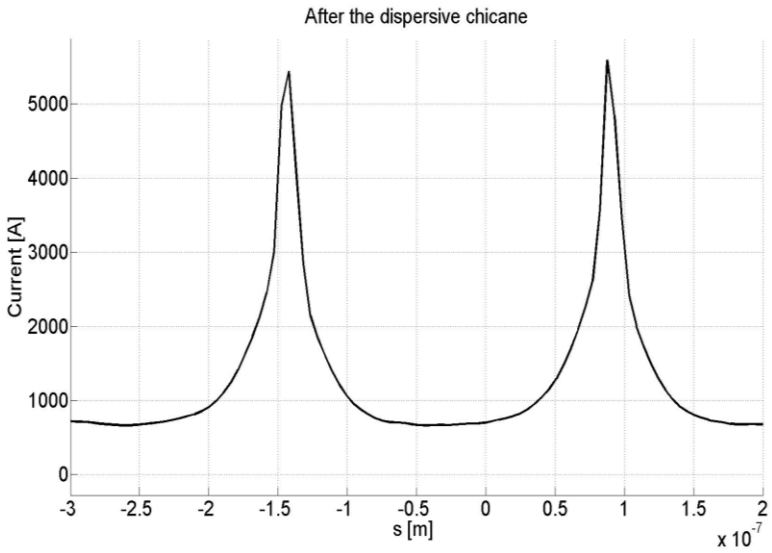
After the Modulator





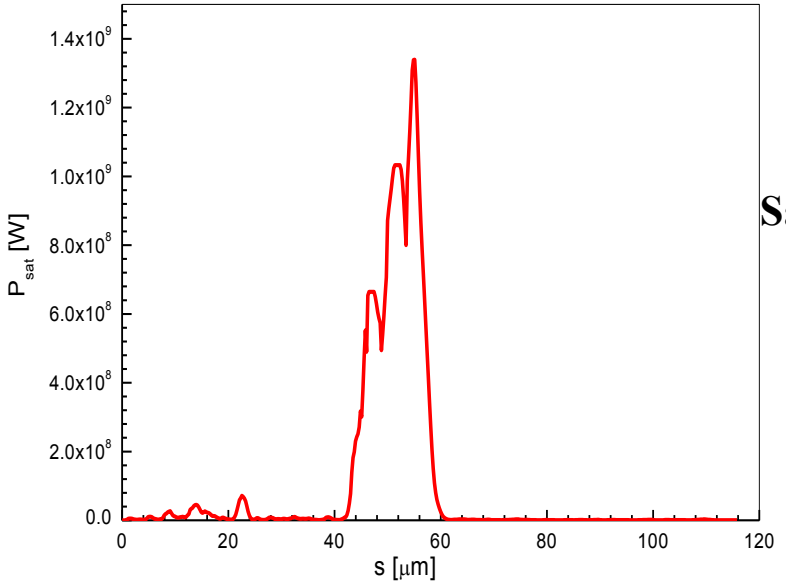
After the Chicane



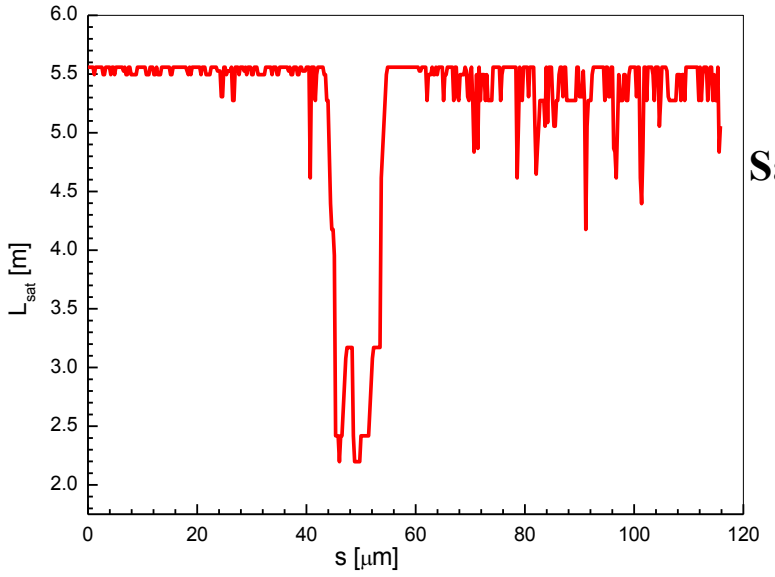


Radiation calculation for FLASH2 HGHG (Q=0.5nC)

Radiator, CASE 1

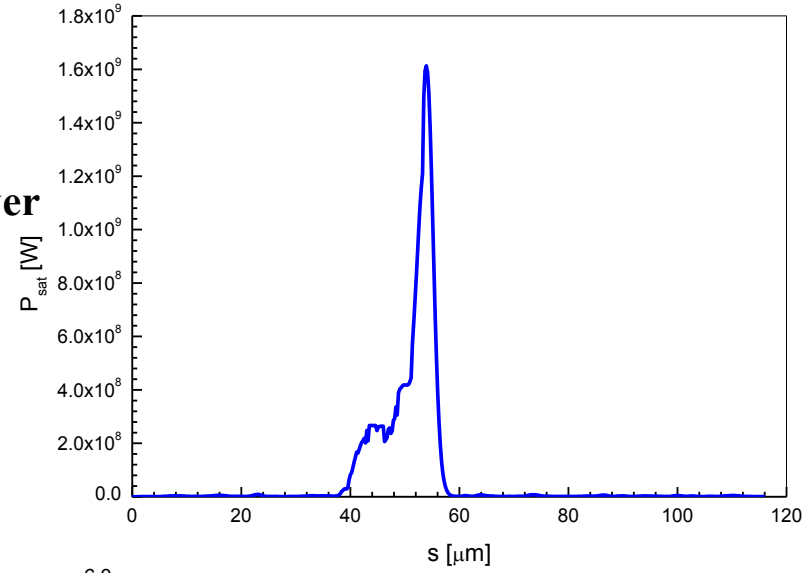


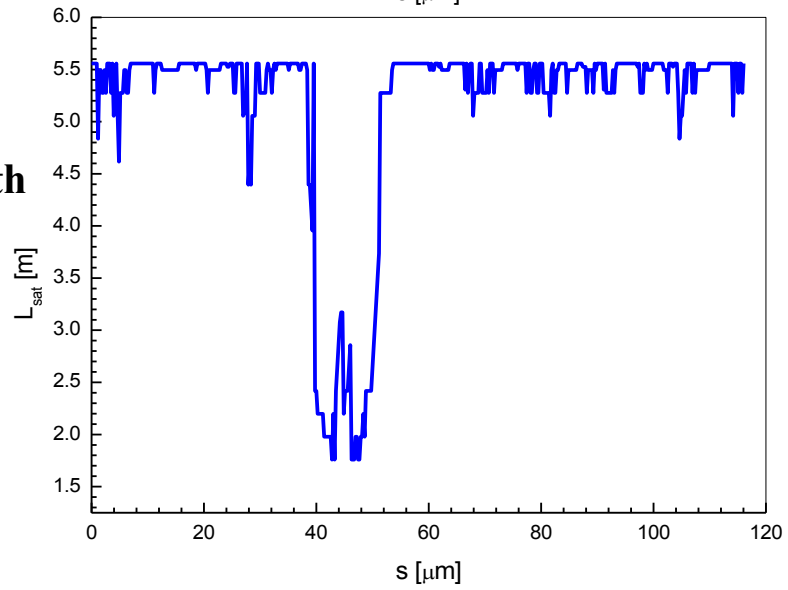
Saturation power



Saturation length

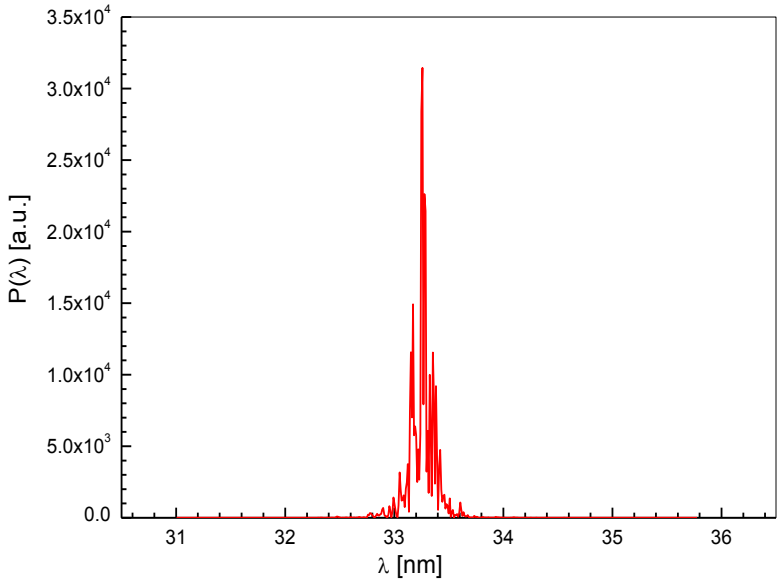
Radiator, CASE 2





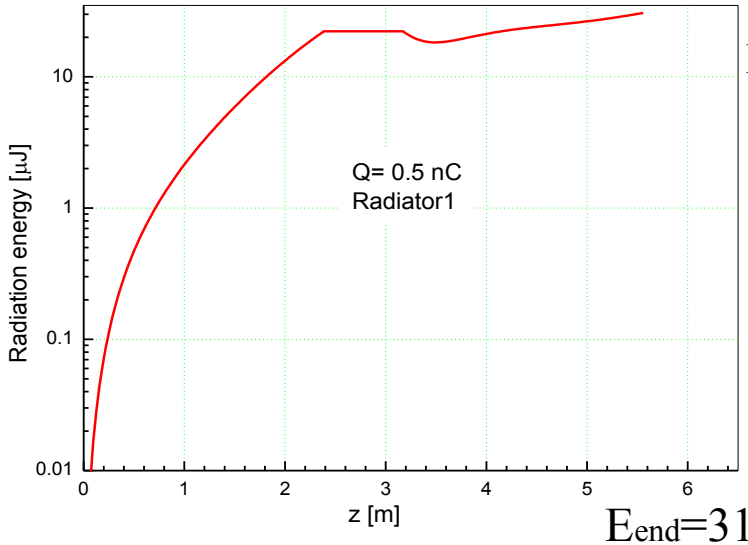
Radiation calculation for FLASH2 HGHG (Q=0.5nC)

Radiator, CASE 1



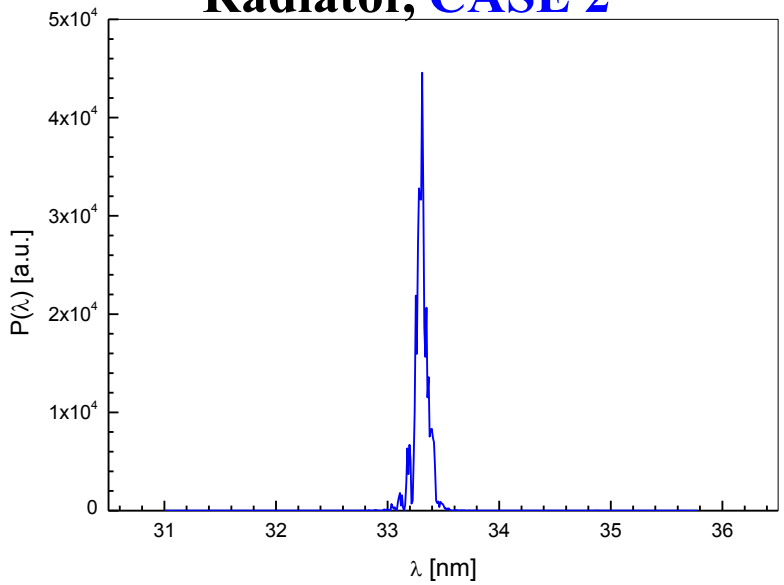
Spectrum

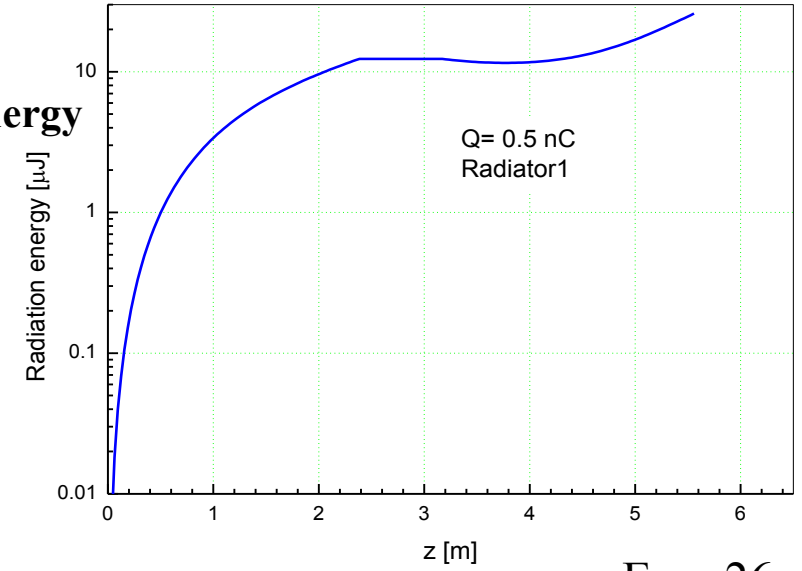
Radiation energy



E_{end}=31μJ

Radiator, CASE 2



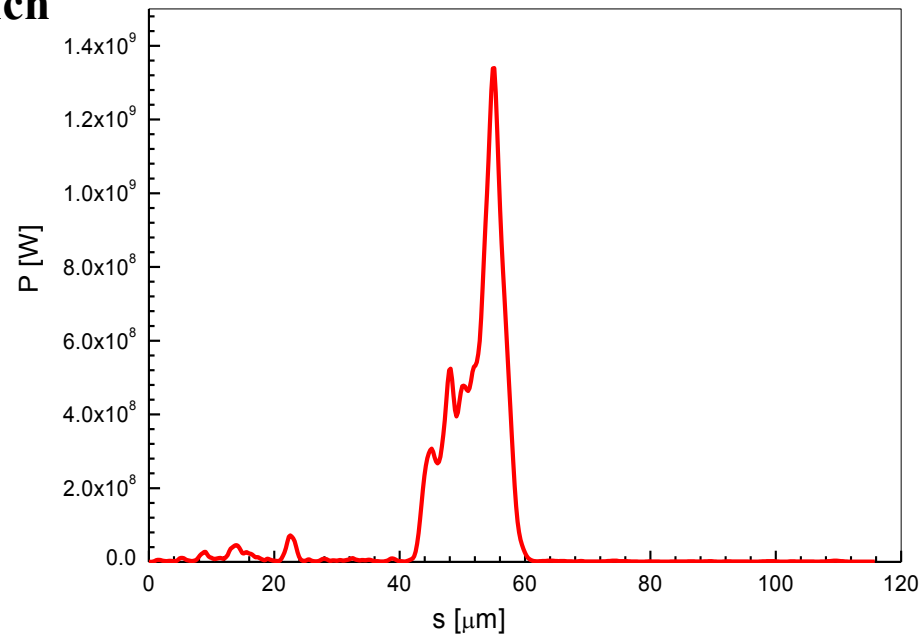


E_{end}=26μJ

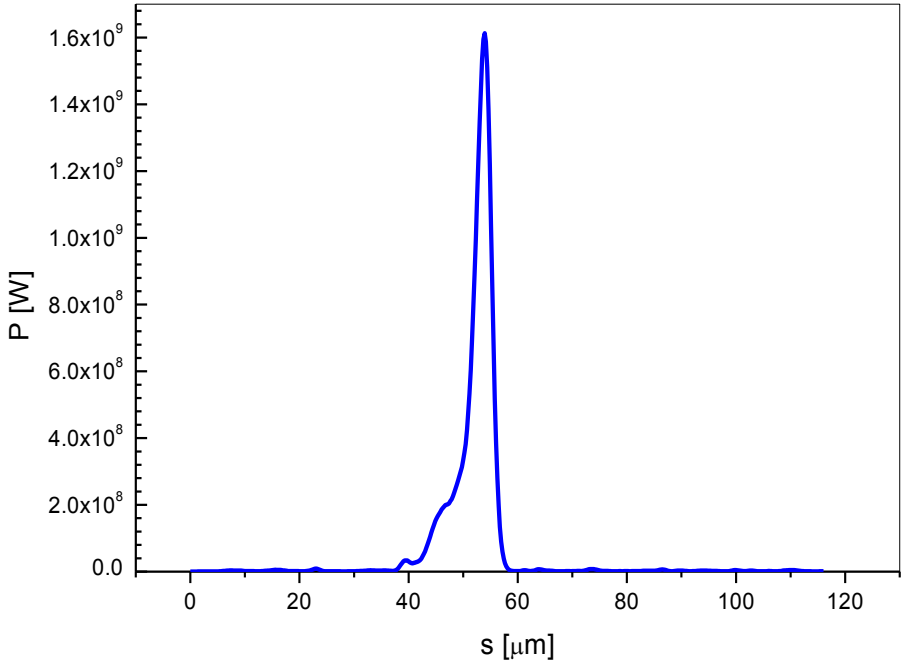
Power distribution along the bunch

At the exit of radiator

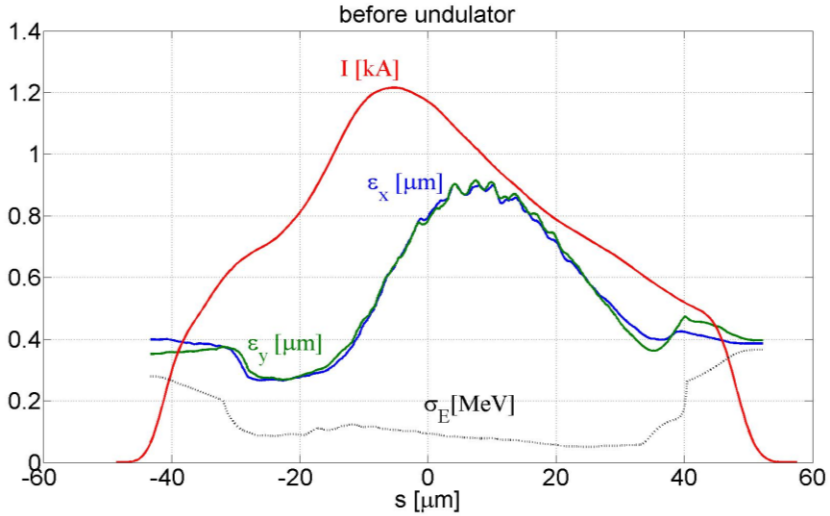
CASE 1

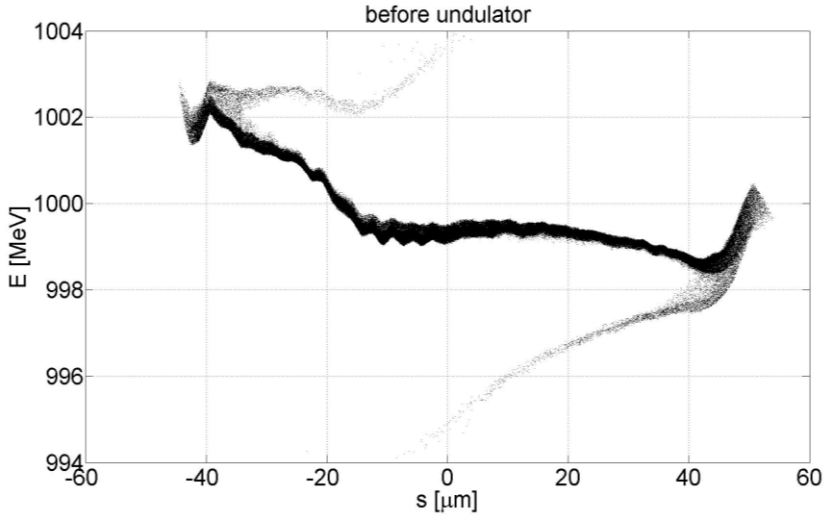


CASE 2



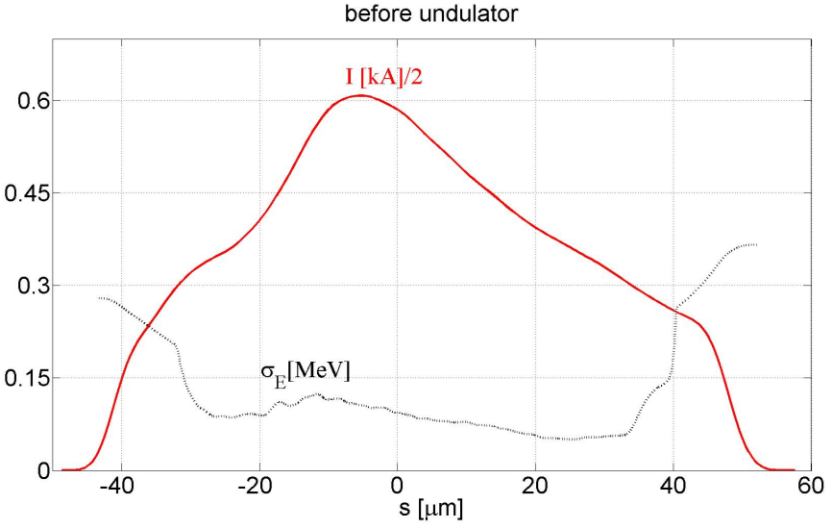
Radiation calculation for FLASH2 HGHG (Q=0.25nC)



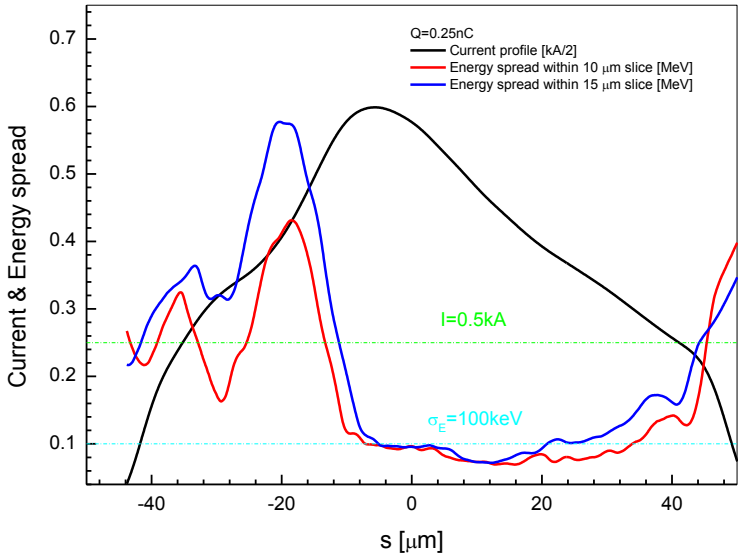


$\varepsilon_x{}^{proj} = 0.63\mu m \cdot rad, \varepsilon_y{}^{proj} = 0.62\mu m \cdot rad$

5% bad particles are removed



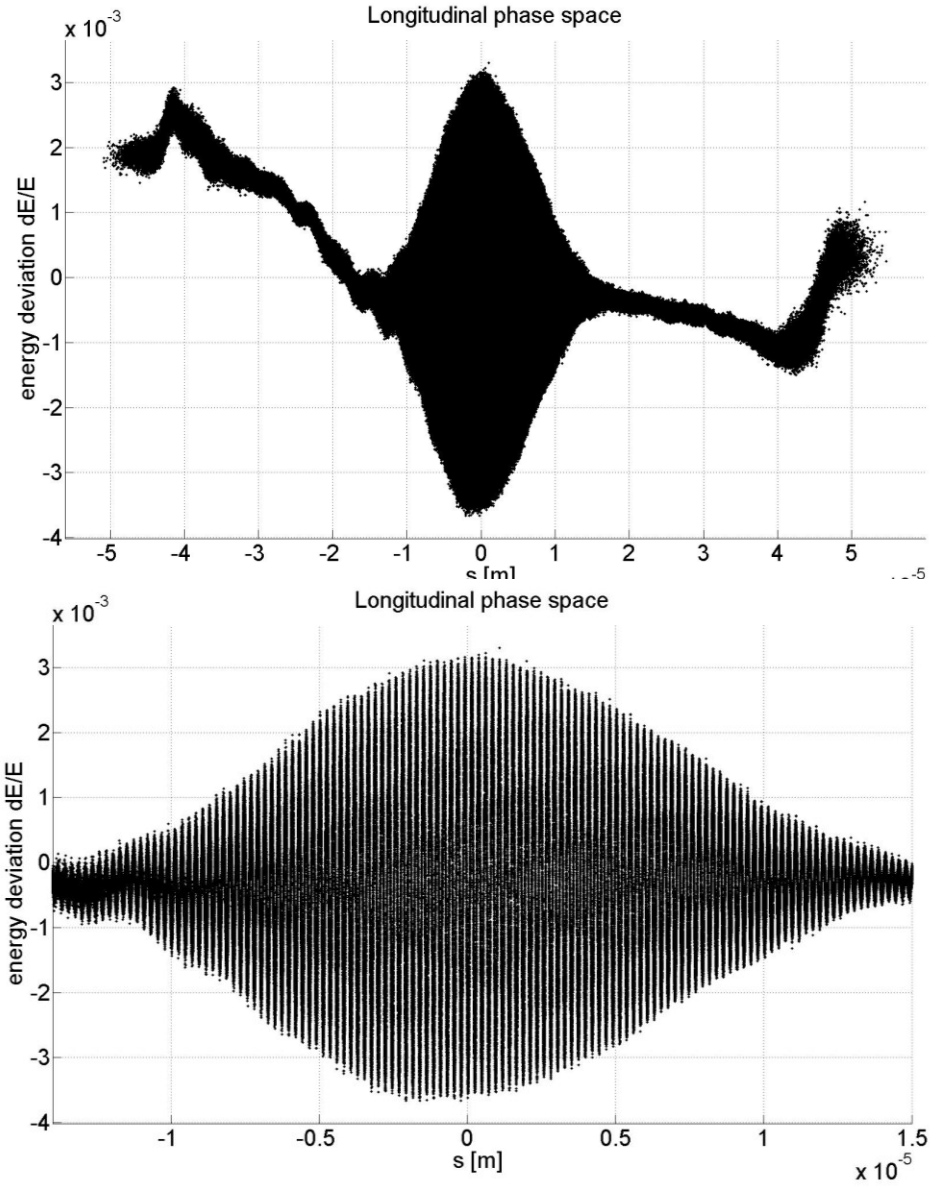
Slice energy spread distribution (uncorrelated)



Energy spread within 15μm and 10μm slice length

Radiation calculation for FLASH2 HGHG (Q=0.25nC)

After the modulator



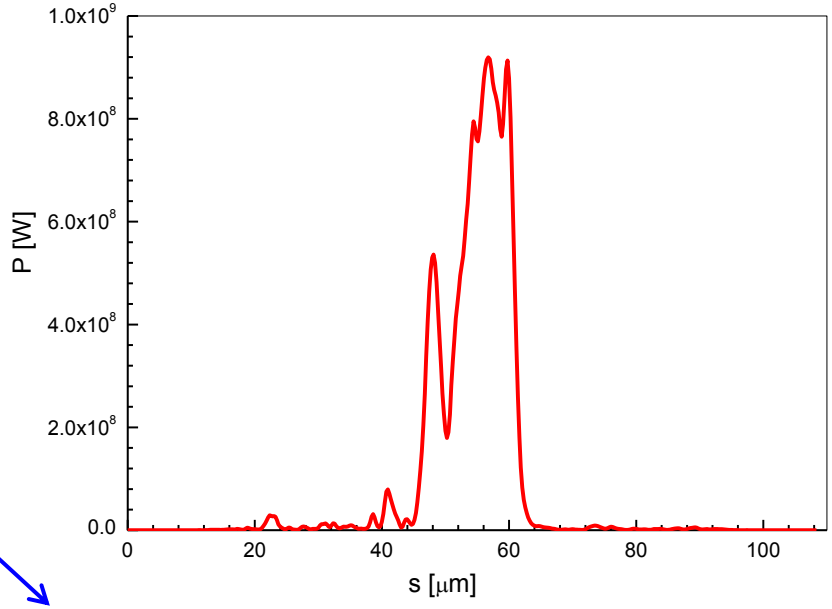
Radiation calculation for FLASH2 HGHG (Q=0.25nC)

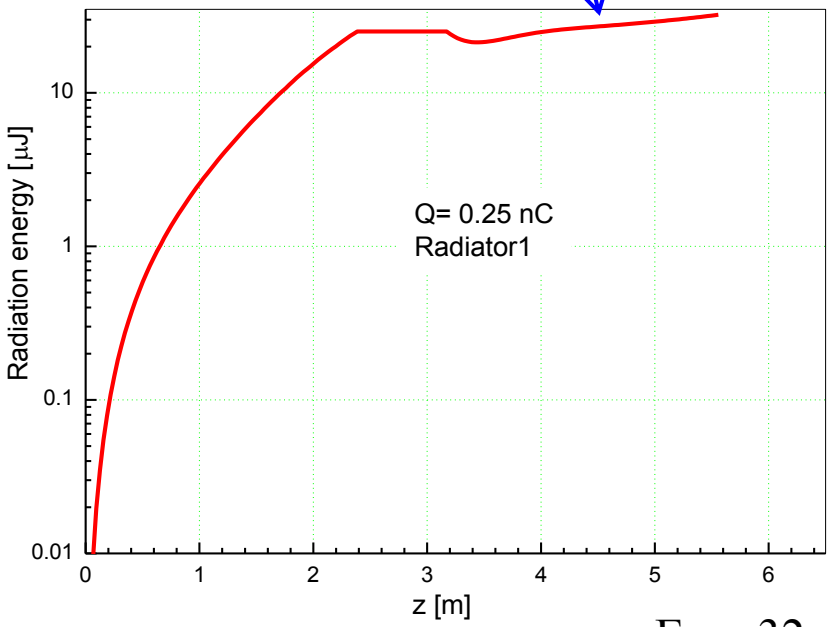
Radiator calculation

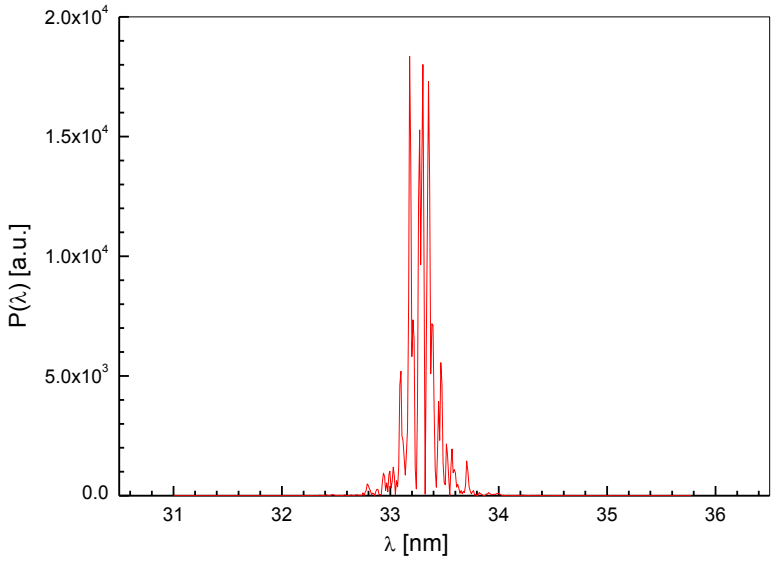
Power distribution along the bunch

Spectrum

Radiation energy along the Radiator

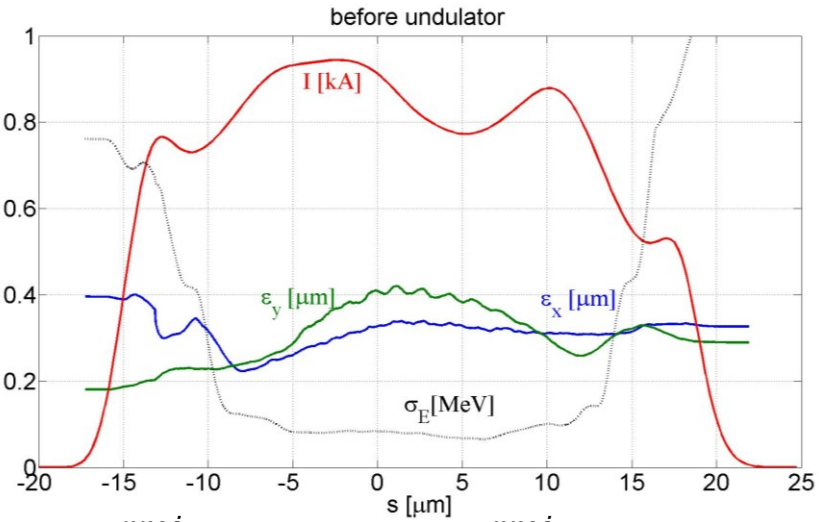






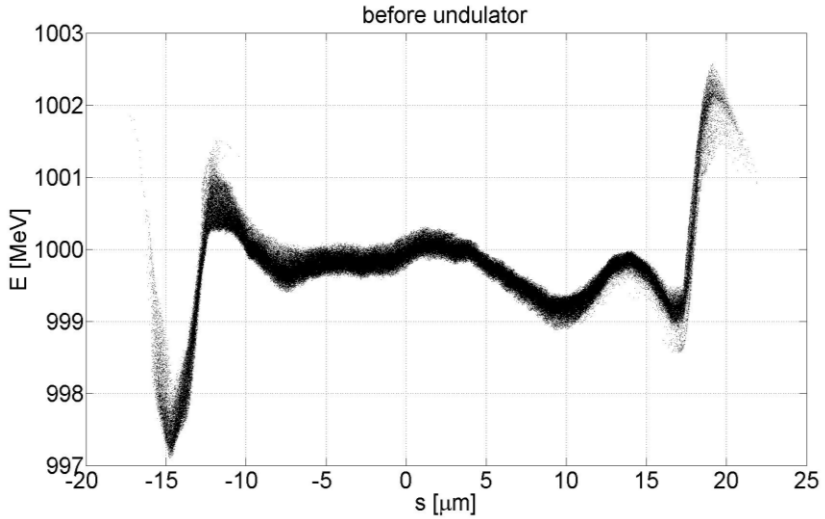
$E_{end}=32\mu J$

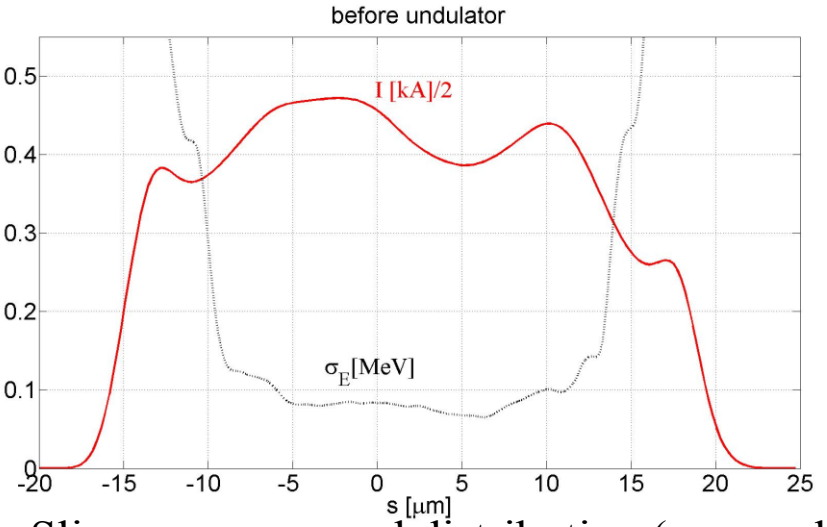
Radiation calculation for FLASH2 HGHG (Q=0.10nC)



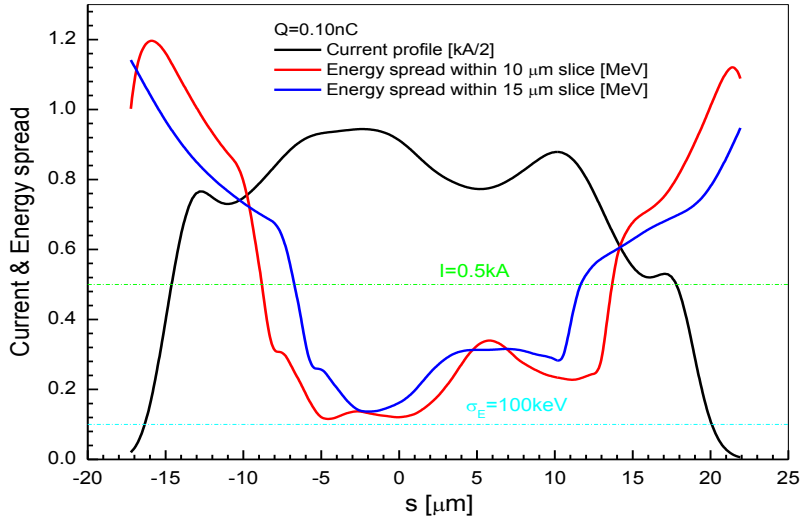
$\varepsilon_x{}^{proj} = 0.40\mu m \cdot rad, \varepsilon_y{}^{proj} = 0.39\mu m \cdot rad$

9.5% bad particles are removed





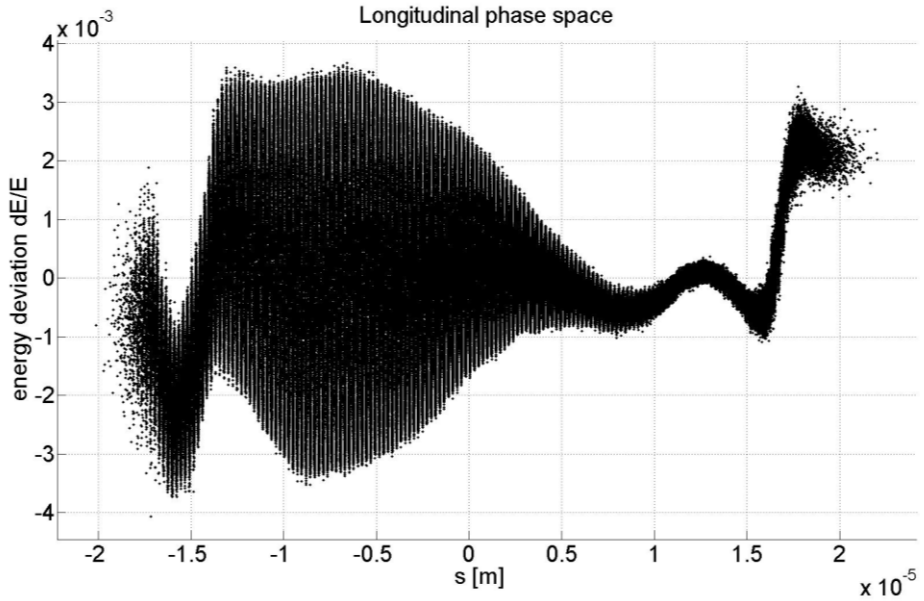
Slice energy spread distribution (uncorrelated)

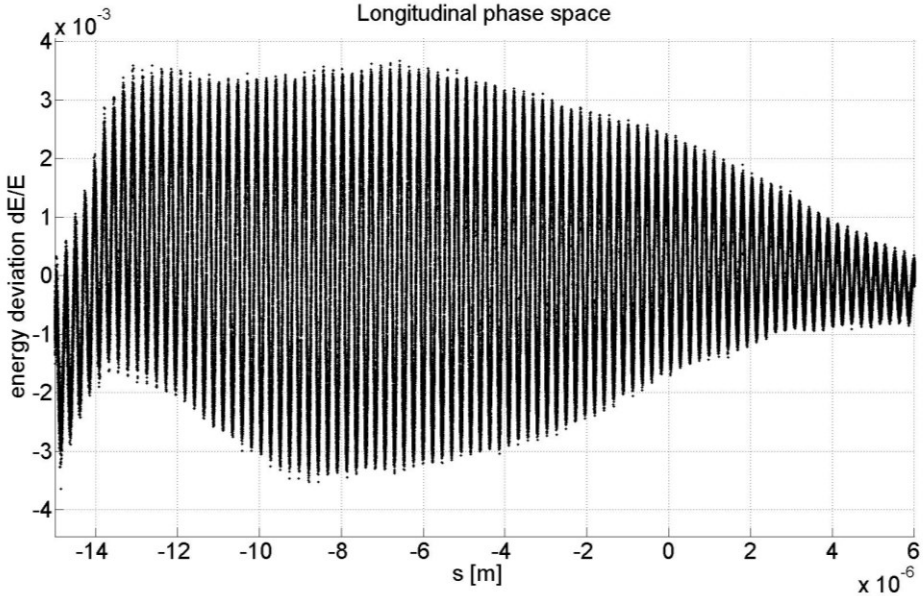


Energy spread within 15μm and 10μm slice length

Radiation calculation for FLASH2 HGHG (Q=0.10nC)

After the modulator





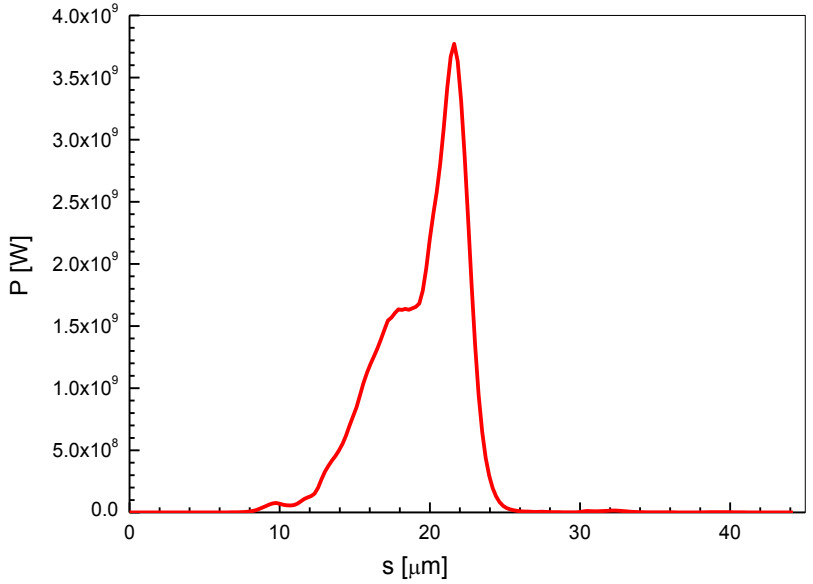
Radiation calculation for FLASH2 HGHG (Q=0.10nC)

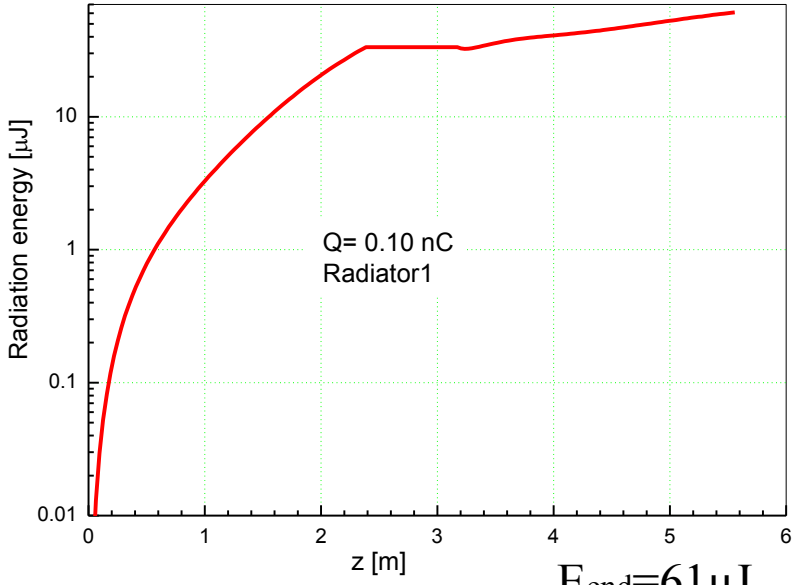
Radiator calculation

Power distribution along the bunch

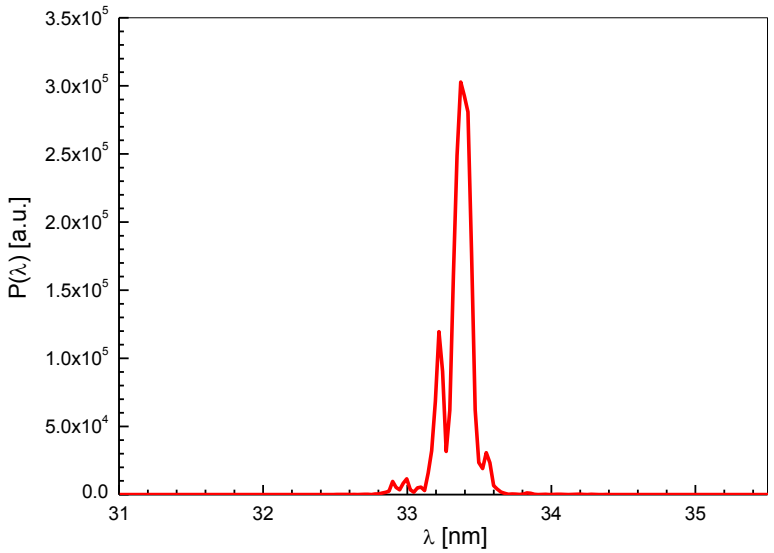
Spectrum

Radiation energy along the Radiator

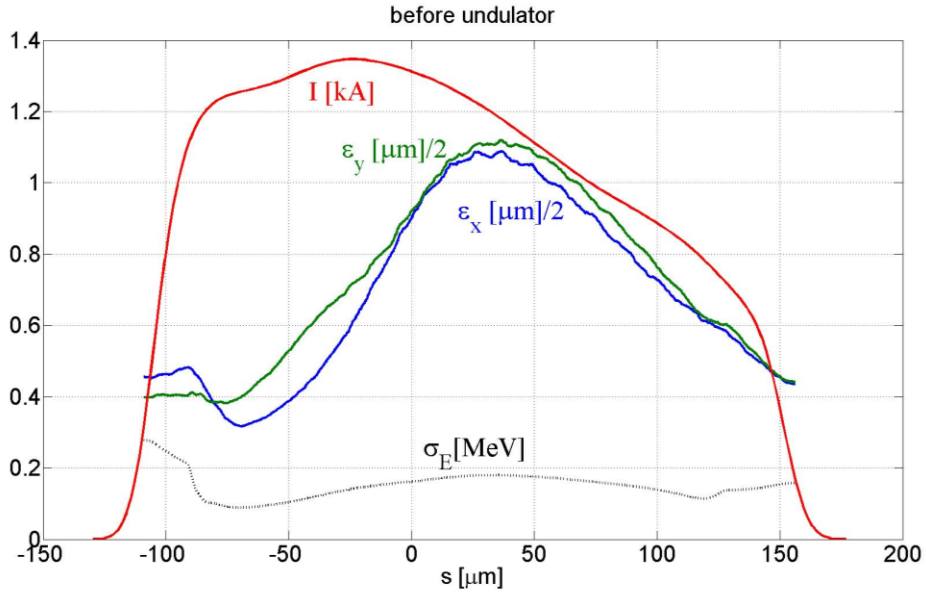




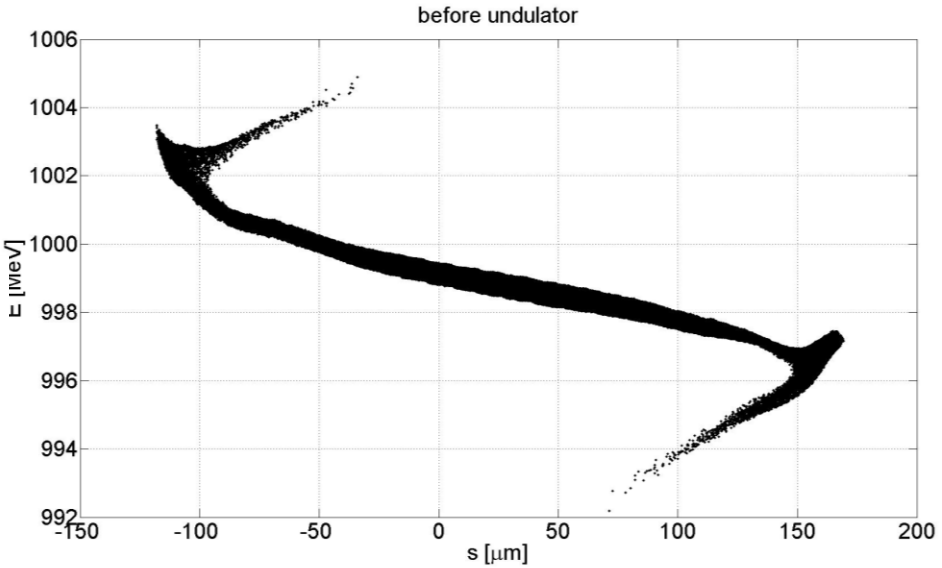
E_{end}=61 μJ

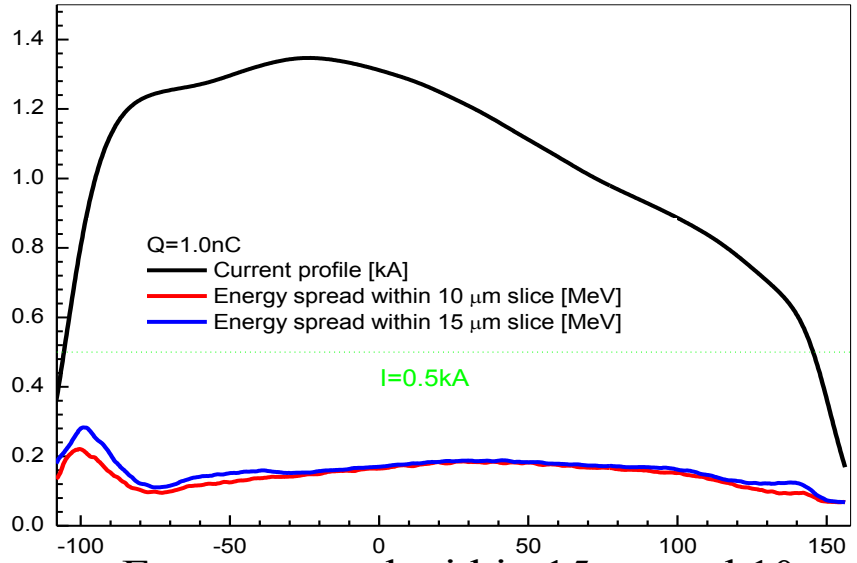


Radiation calculation for FLASH2 HGHG (Q=1.0nC)



$$\varepsilon_x{}^{proj} = 2.26\mu m \cdot rad, \varepsilon_y{}^{proj} = 2.24\mu m \cdot rad$$





Energy spread within 15μm and 10μm slice length

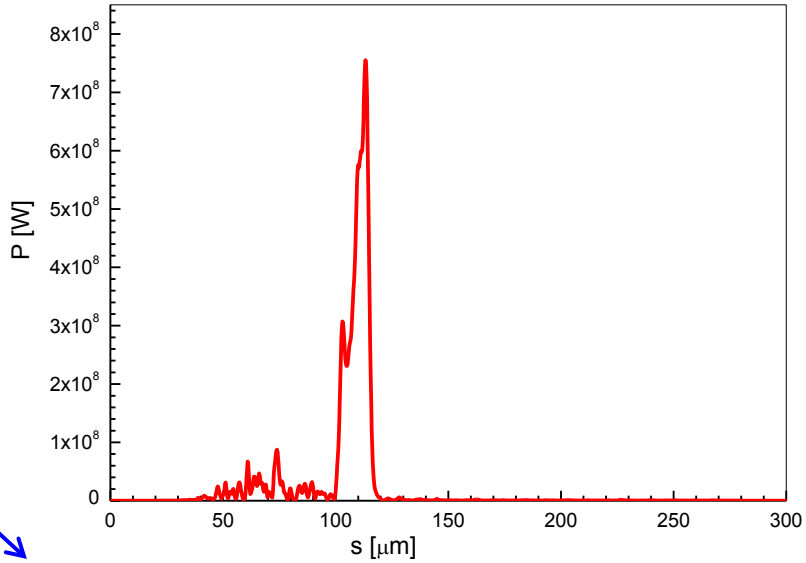
Radiation calculation for FLASH2 HGHG (Q=1.0nC)

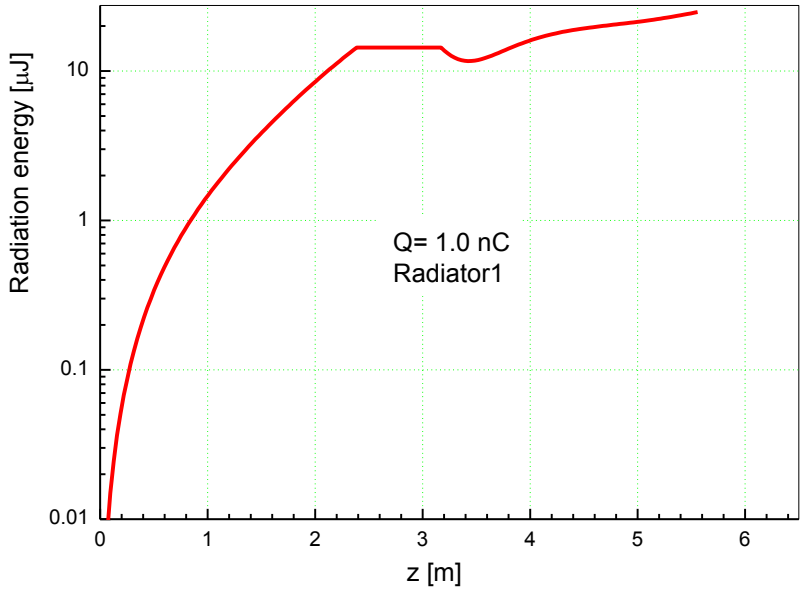
Radiator calculation

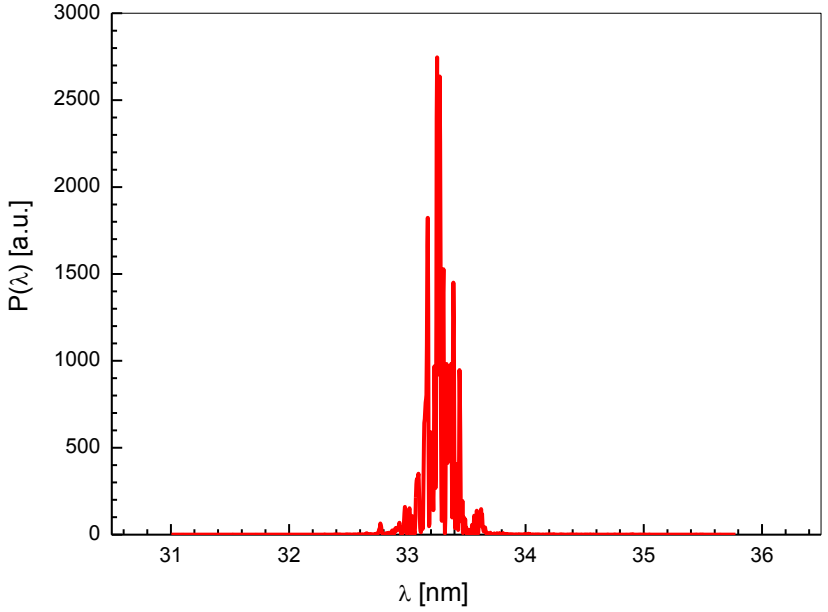
Power distribution along the bunch

Spectrum

Radiation energy along the Radiator







E_{end}=25μJ

The plan

1. Modifying the internal report of beam dynamics simulation for FLASH2.

2. New beam dynamics simulations for FLASH2 for low bunch charge cases.

3. Preparing for cascaded HGHG calculation (Modulator1 + Dispersive chicane + Radiator1 + Fresh bunch chicane + Modulator2 + Dispersive chicane + Radiator 2)