Influence of longitudinal beam density modulation on bunch properties for 10 pC charge

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PITZ Physics Seminar

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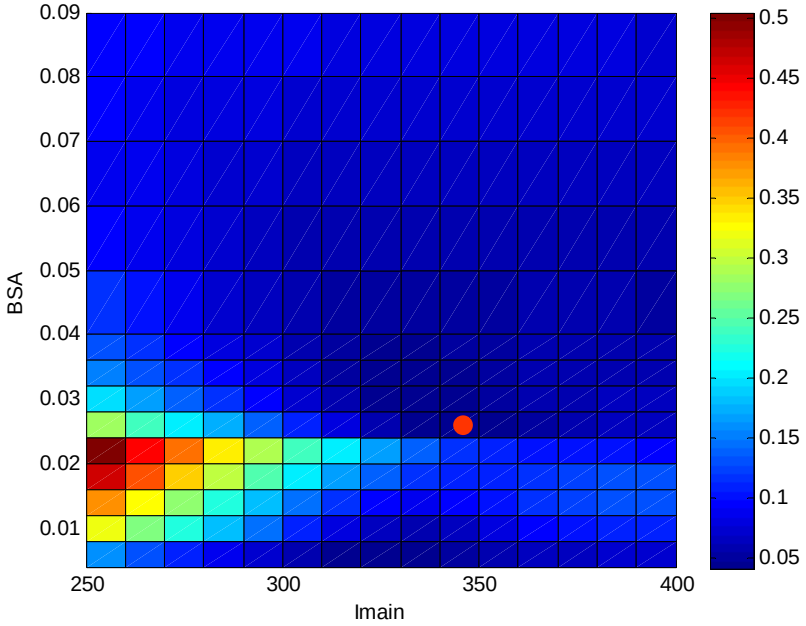
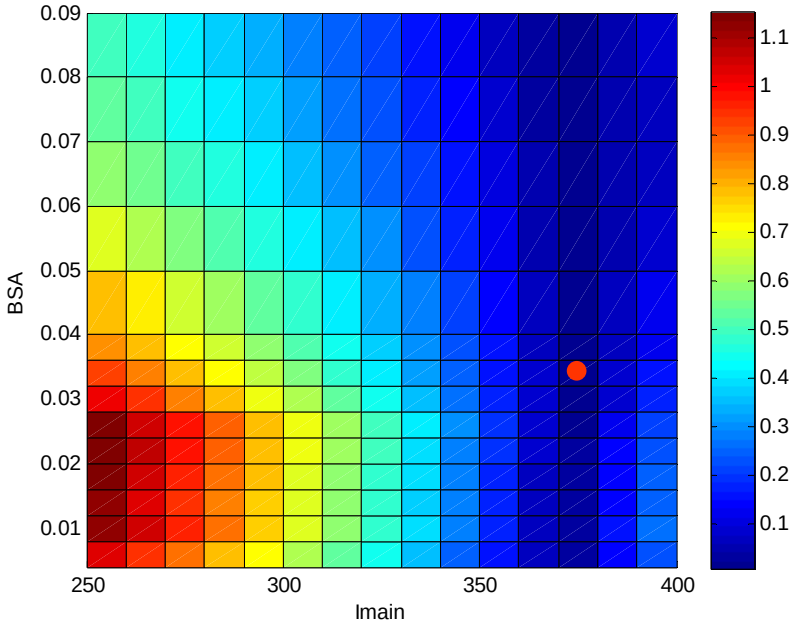
Q = 10 pC, E = 25 MV/m, gun phase = -0.5

Xemit, mm*mrad



min:
Xemit = 0.0423
BSA = 0.024
Imain = 340
Xrms = 0.3

Xrms, mm



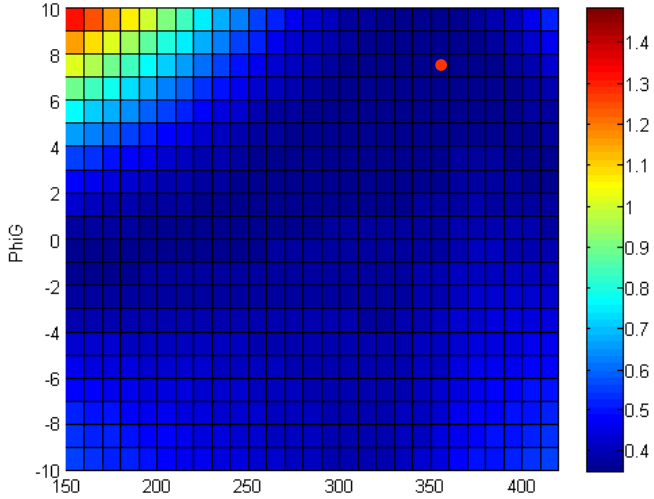
min:
Xrms = 0.069,
BSA = 0.032
Imain = 370
Xemit = 0.0596

Q = 10 pC, E = 25 MV/m

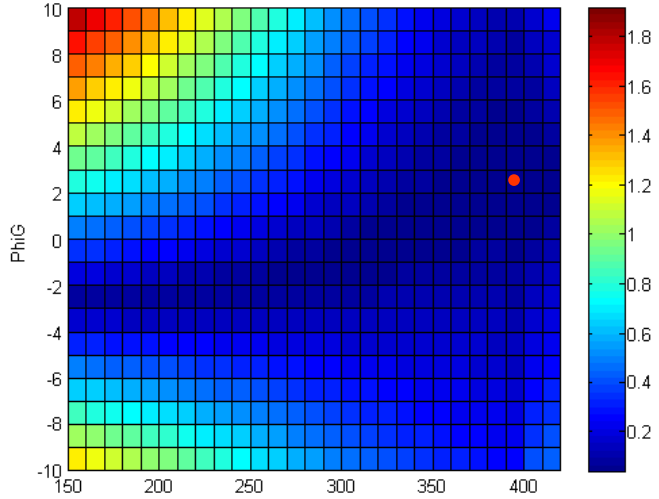
Xemit, mm*mrad

BSA = 0.4 mm

min:
Xemit = 0.3493,
PhiG = 7
Imain = 350
Xrms = 0.2303



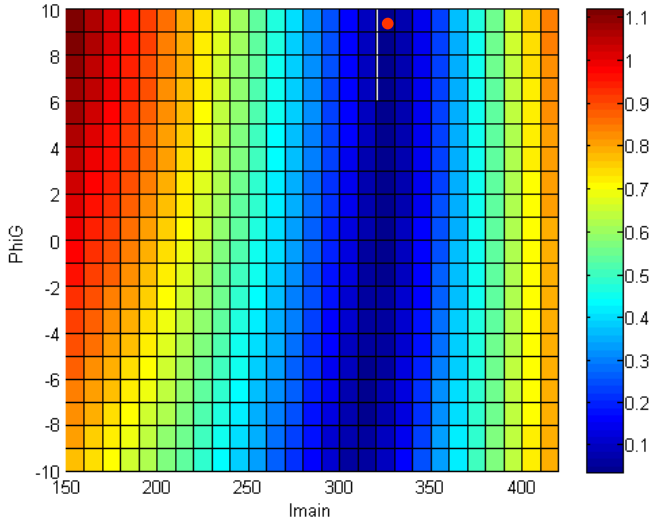
BSA = 0.03 mm

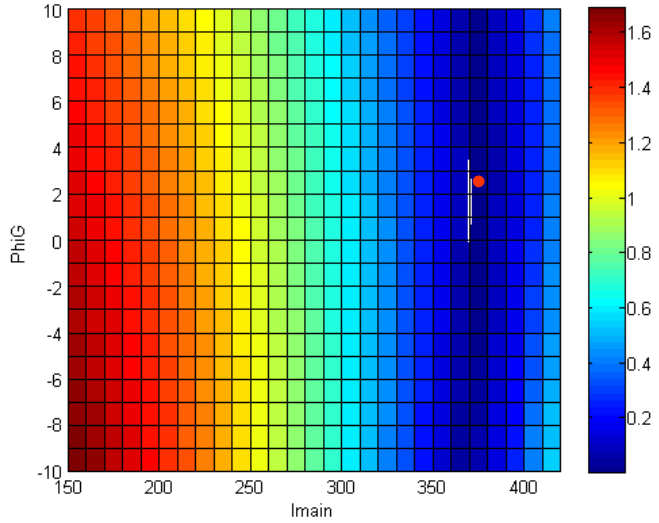


min:
Xemit = 0.0397,
PhiG = 2
Imain = 390
Xrms = 0.1545

Xrms, mm

min:
Xrms = 0.0367,
PhiG = 10
Imain = 320
Xemit = 0.37

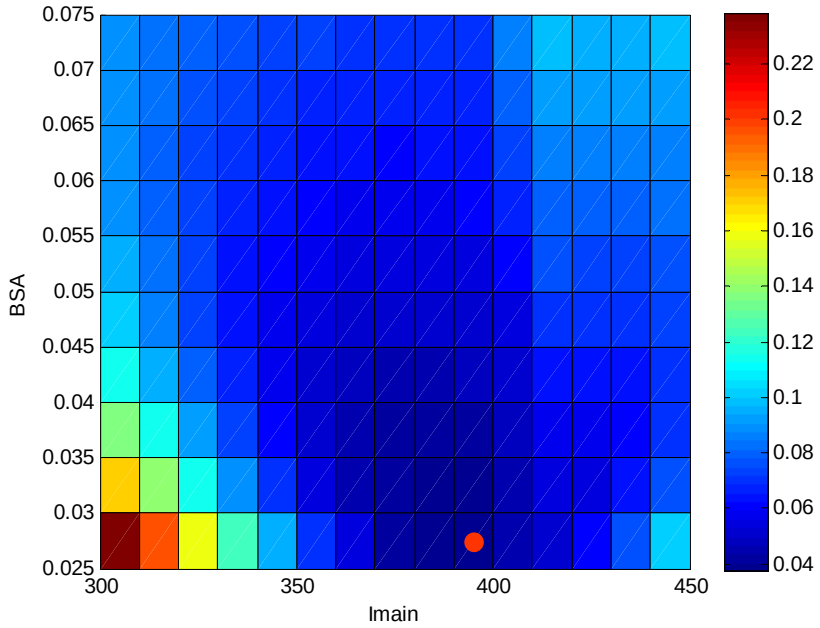




min:
Xrms = 0.0044,
PhiG = 2
Imain = 370
Xemit = 0.041

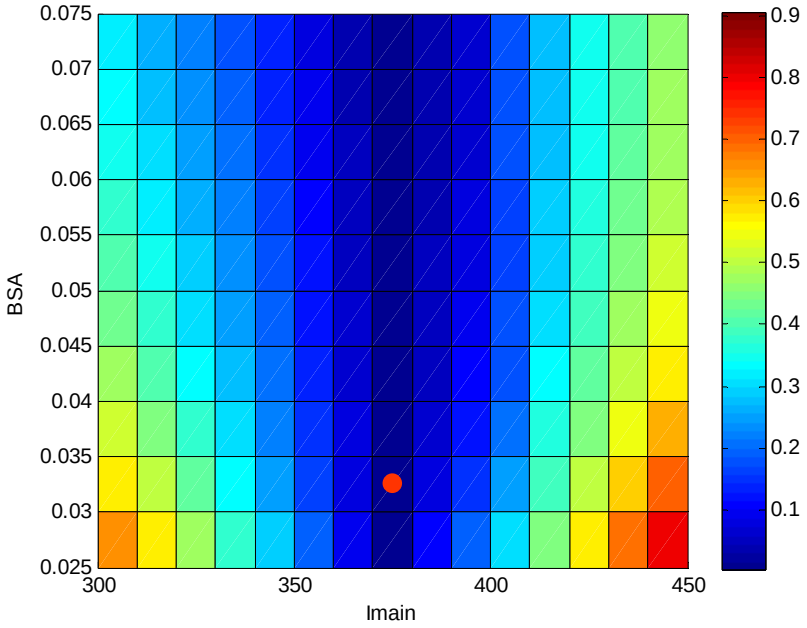
Q = 10 pC, E = 25 MV/m, gun phase = 2.0

Xemit, mm*mrad



min:
Xemit = 0.0378,
BSA = 0.025
Imain = 390
Xrms = 0.1908

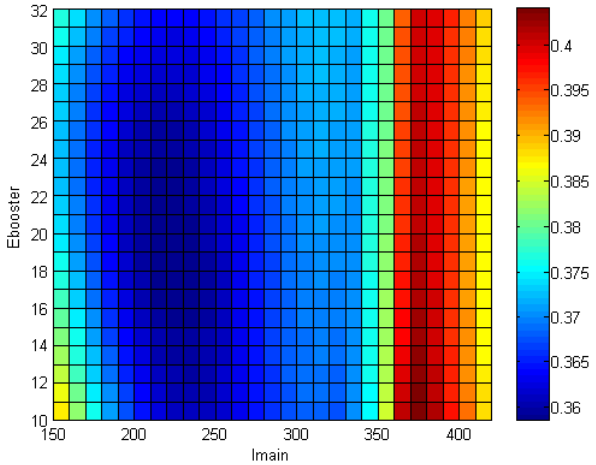
Xrms, mm



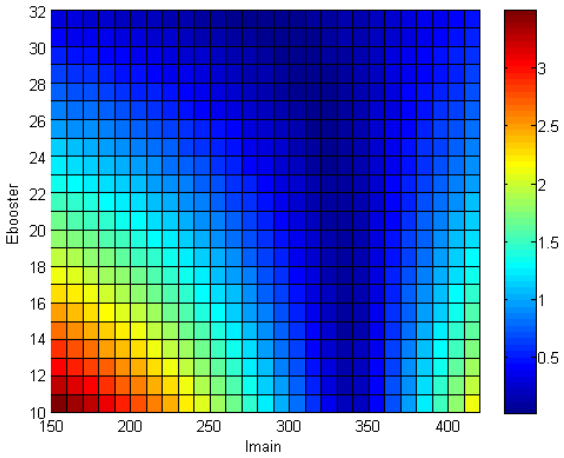
min:
Xrms = 0.0044,
BSA = 0.03
Imain = 370
Xemit = 0.041

Gun phase = -0.5

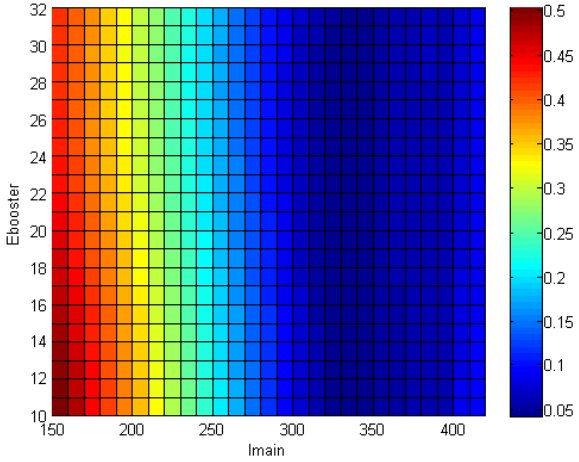
BSA = 0.4 mm



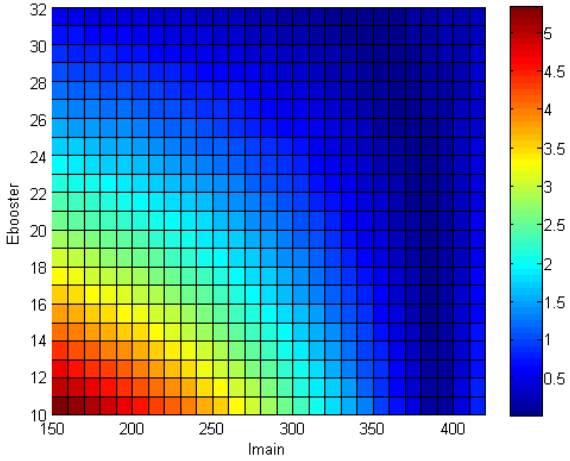
Xemit = 0.3763, Xrms = 0.0178
E = 32 MeV/m, Imain = 260
(Xemit initial = 0.34)



BSA = 0.03 mm

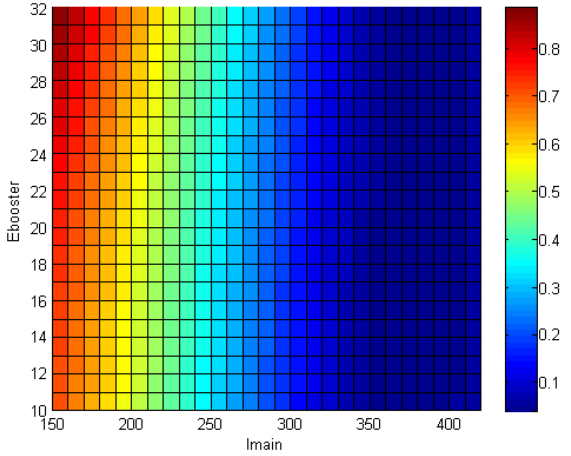


Xemit = 0.0478, Xrms = 0.0231
E = 32 MeV/m, Imain = 330

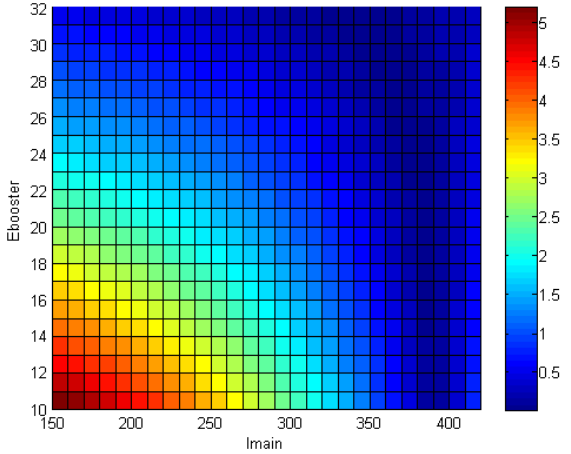


Gun phase = 2.0

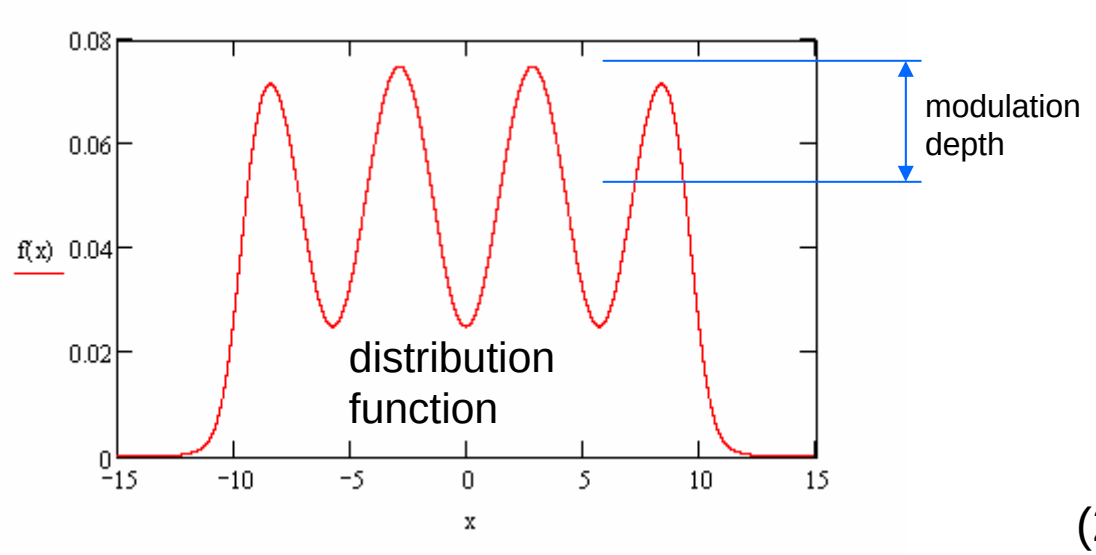
BSA = 0.03 mm



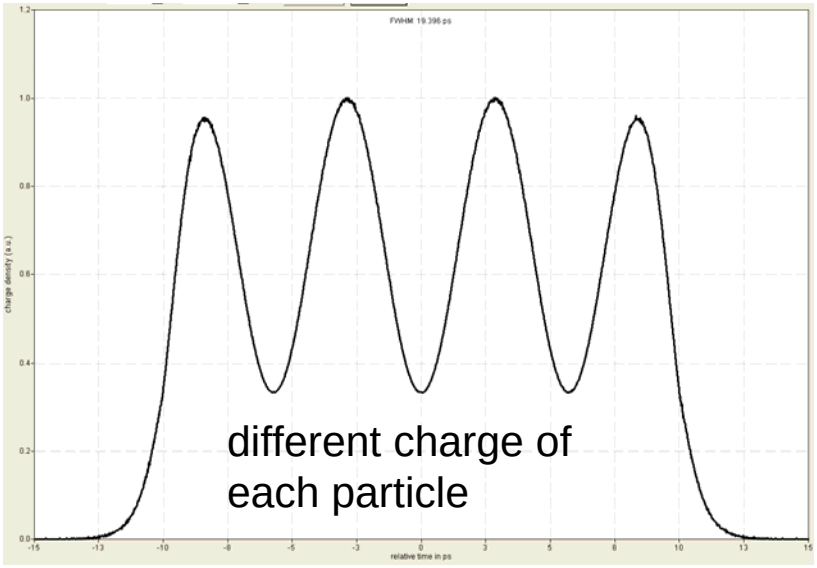
Xemit = 0.0392, Xrms = 0.1687
E = 32 MeV/m, Imain = 397
(Xemit initial = 0.025)



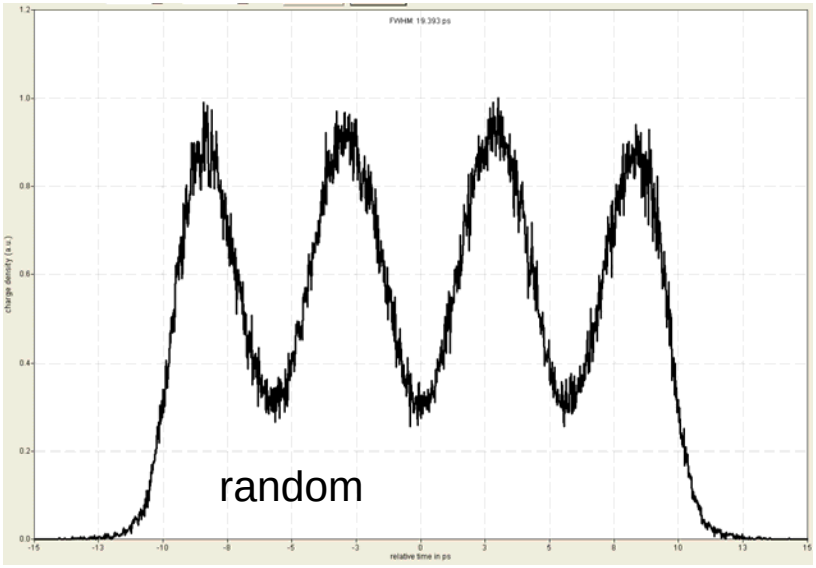
Plateau longitudinal distribution, L=20ps, rt=2ps, N=4, depth=0.5.



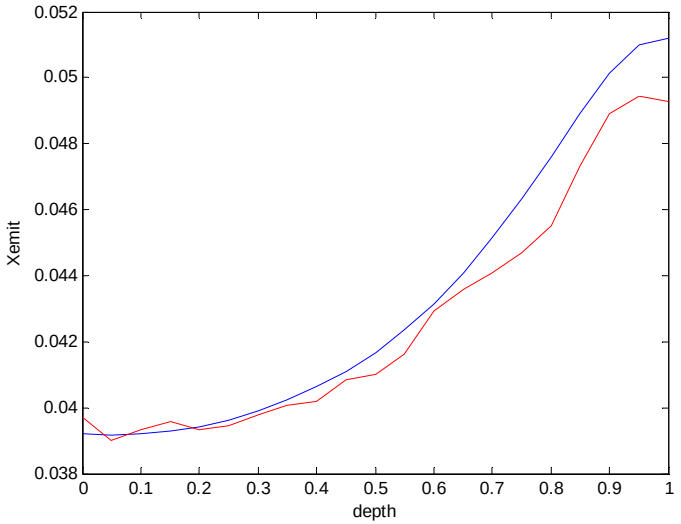
(1)

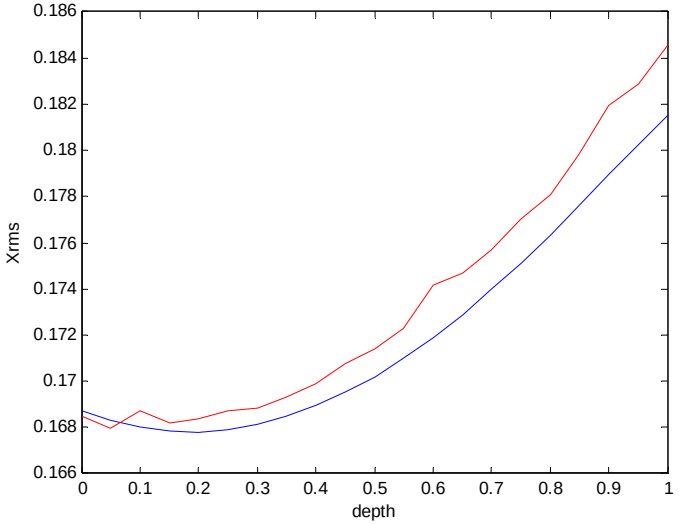


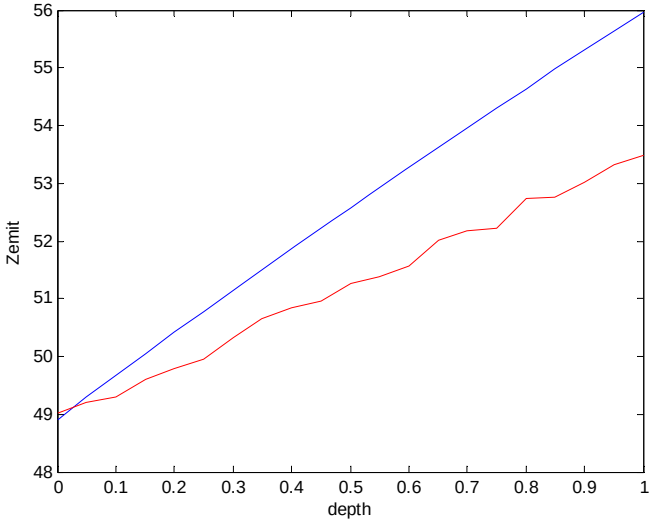
(2)

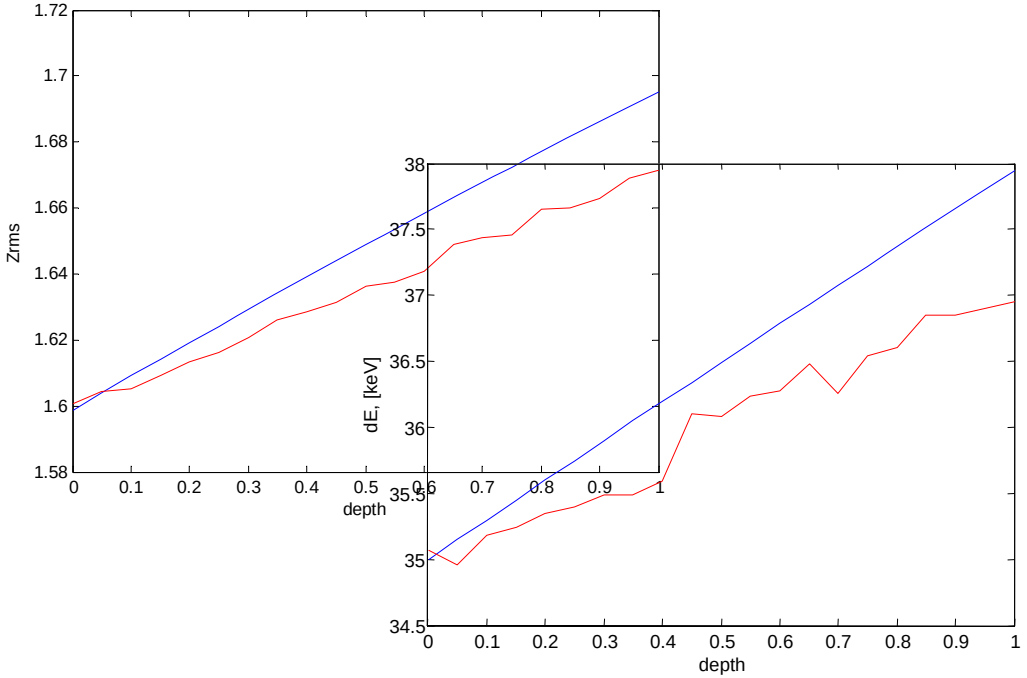


Qch = 10pC, Xrms = 0.03, I = 397, Phase = 2, E = 32 MeV/m

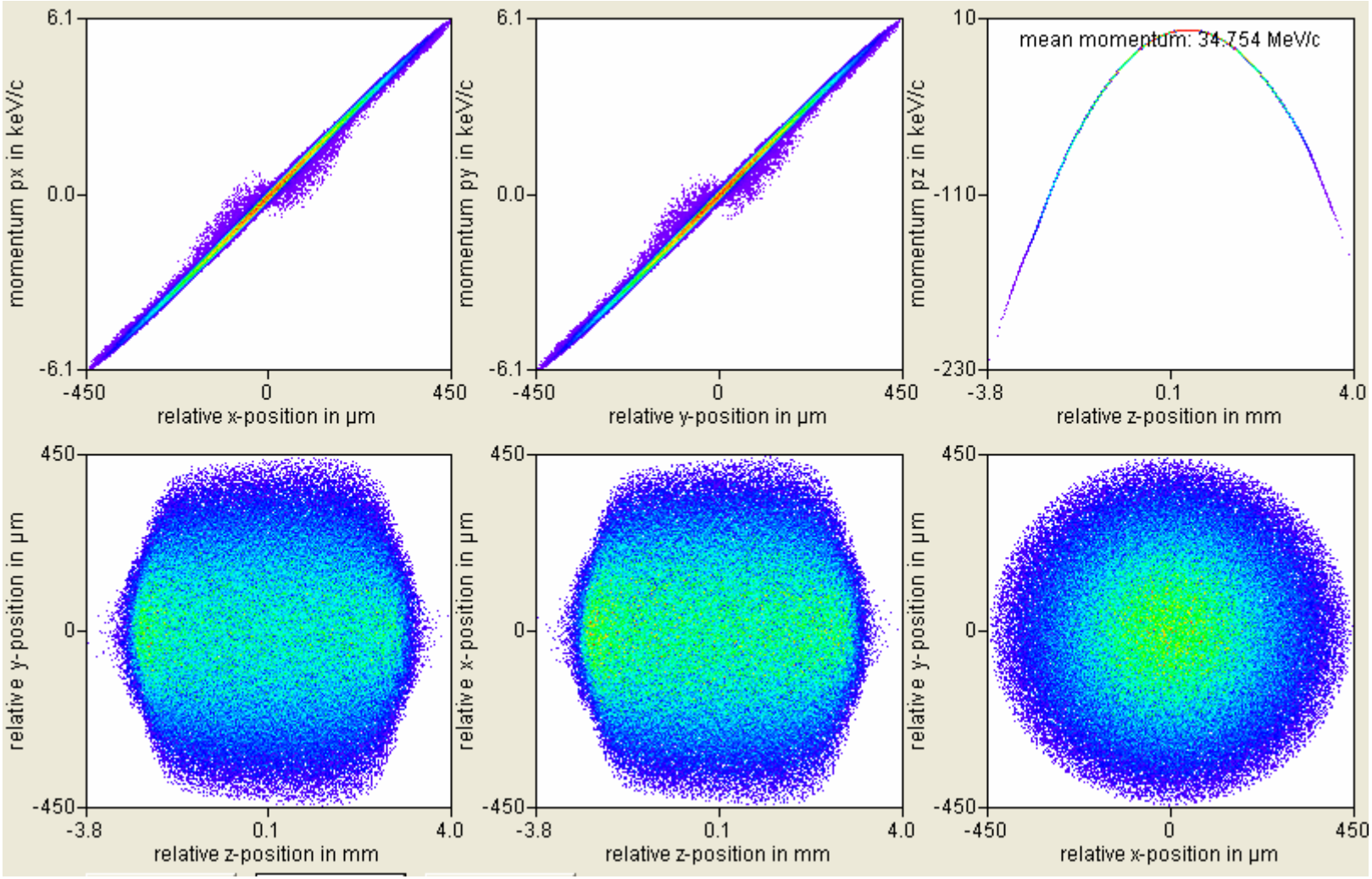






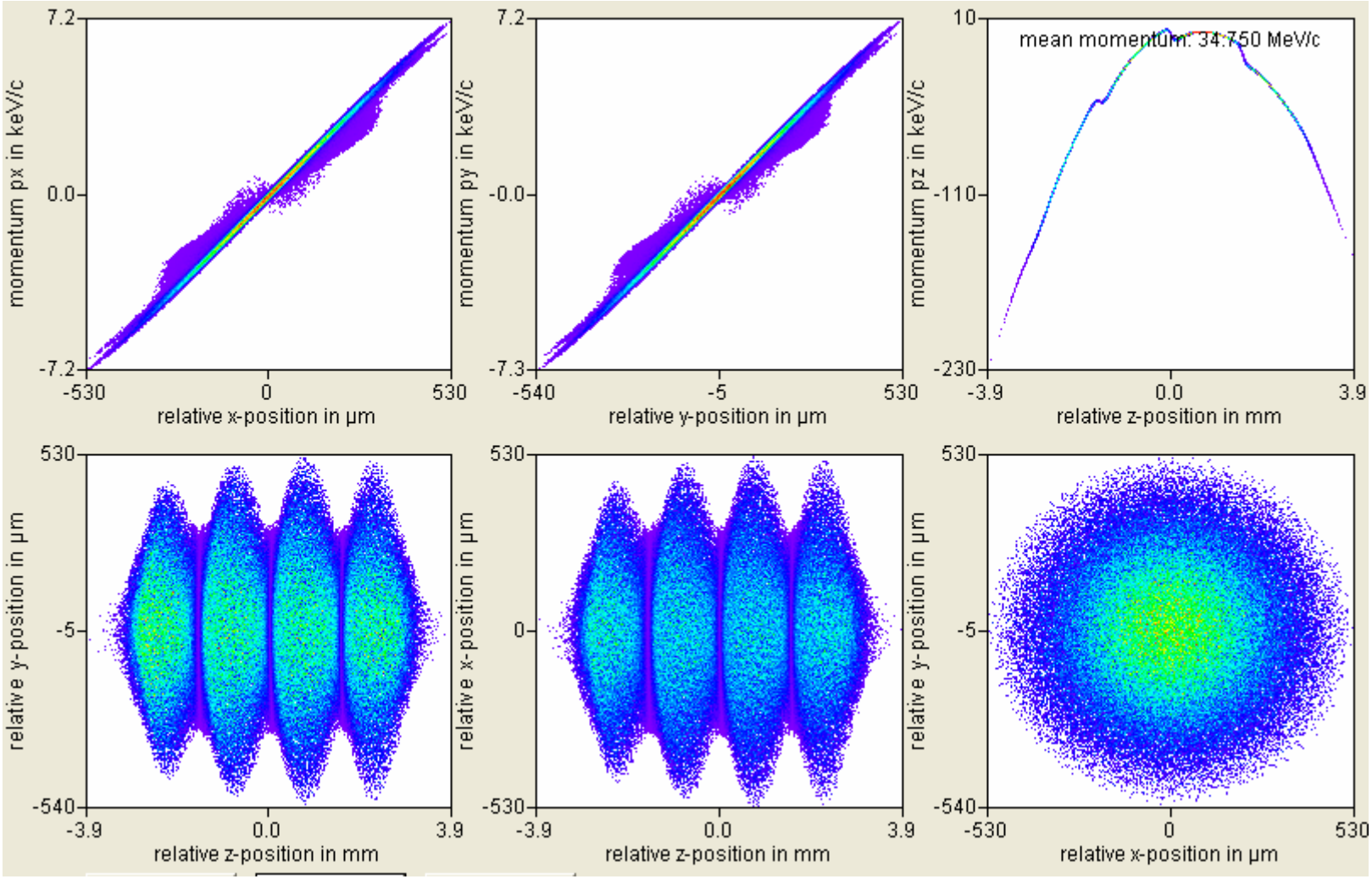


Phase space summary (no modulation)



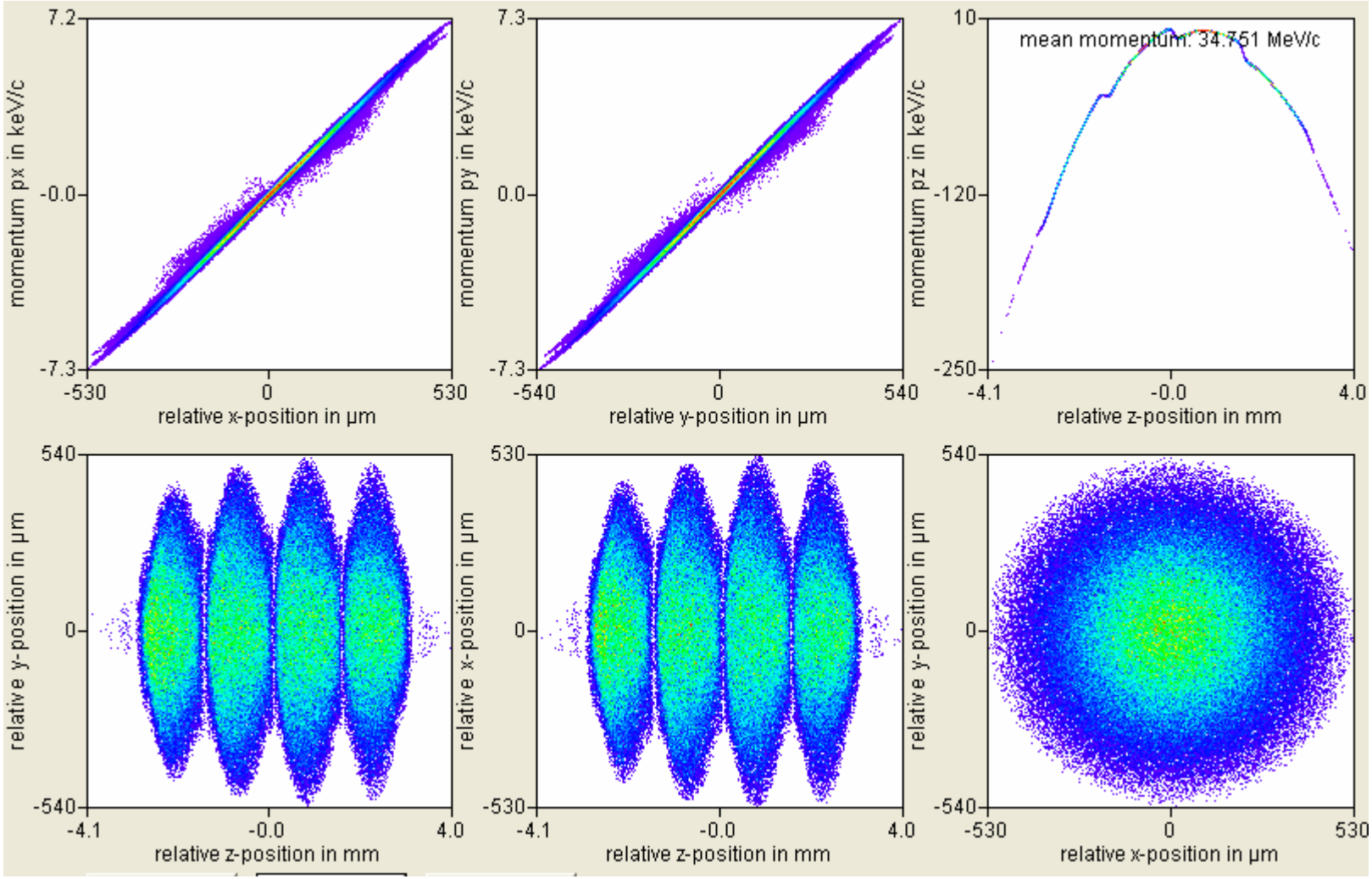
depth = 0.0

Phase space summary (case 1)



depth = 1.0

Phase space summary (case 2)



depth = 1.0

Conclusion for the 1st part

1. For a small modulation amplitude of longitudinal charge density in bunch there are no big changes in bunch parameters.

   For 10% modulation:

   dXemit = 0%

   dXrms = 0%

   dZemit = 1.5%

   dZrms = 0%

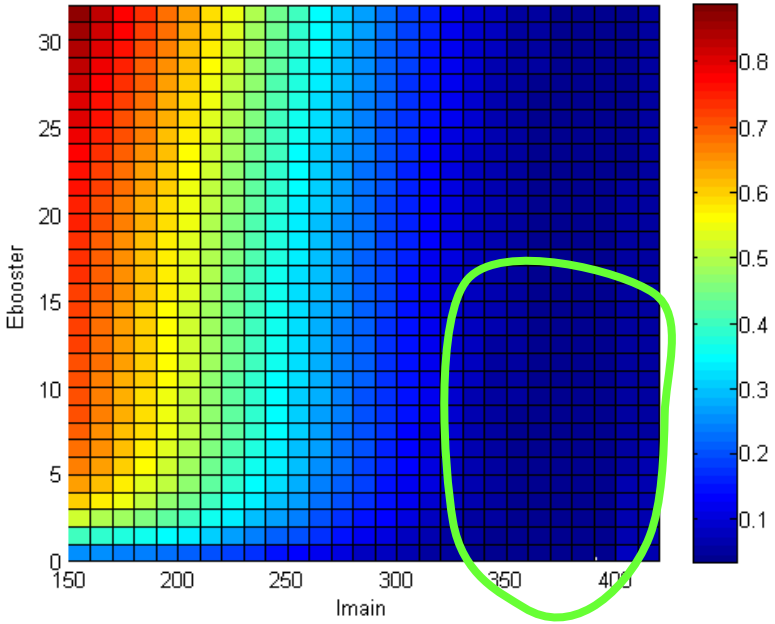
   dErms = 1%

2. Two different ways to create initial distribution give similar results.

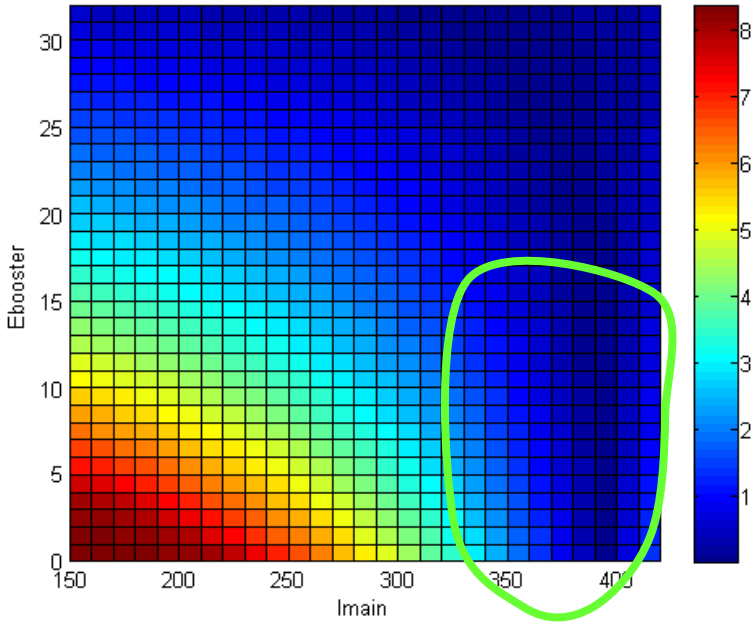
Simulation with low booster gradient.

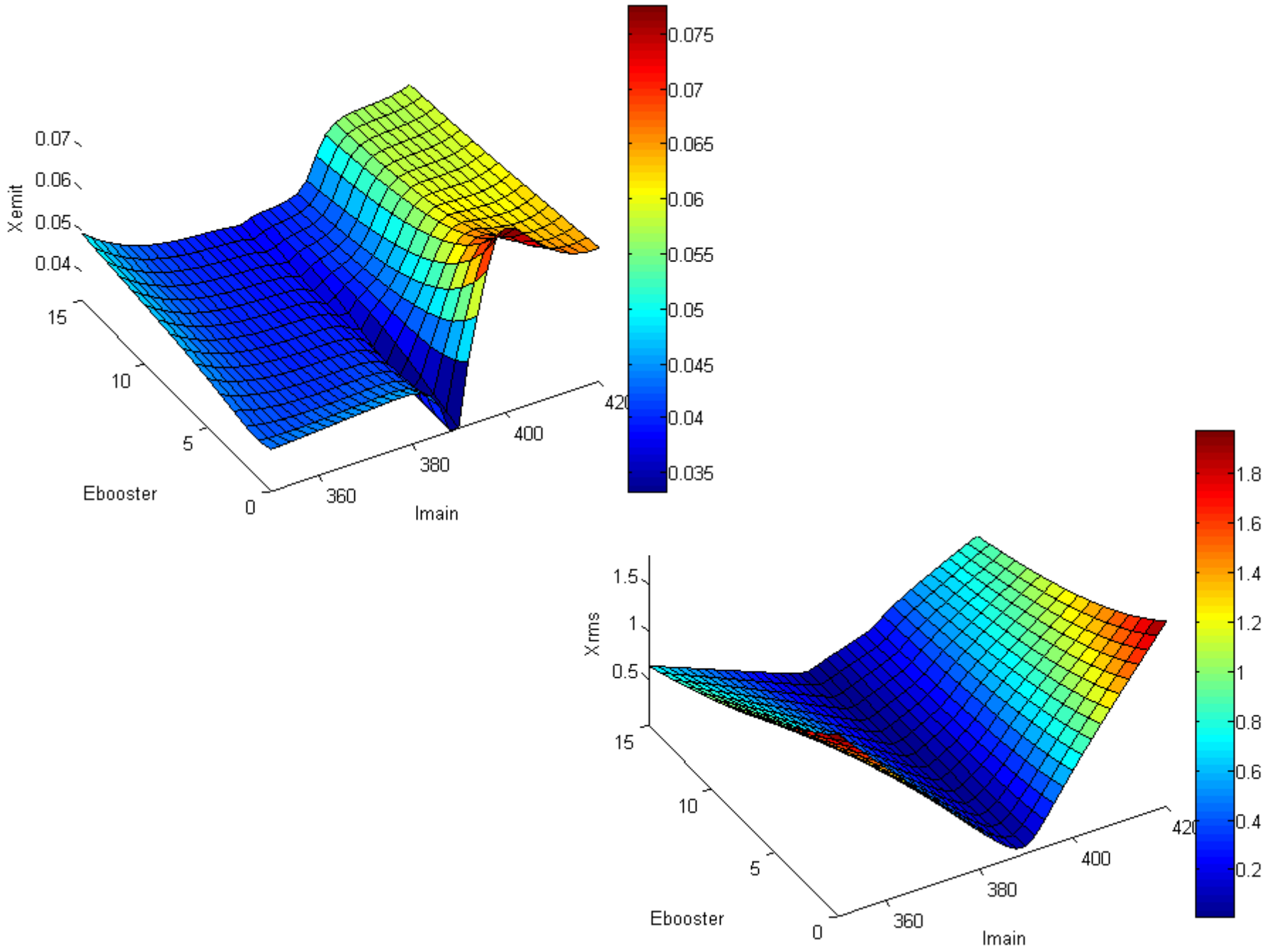
Q = 10 pC, BSA = 0.03, gun phase = 2.0

Xemit, mm*mrad

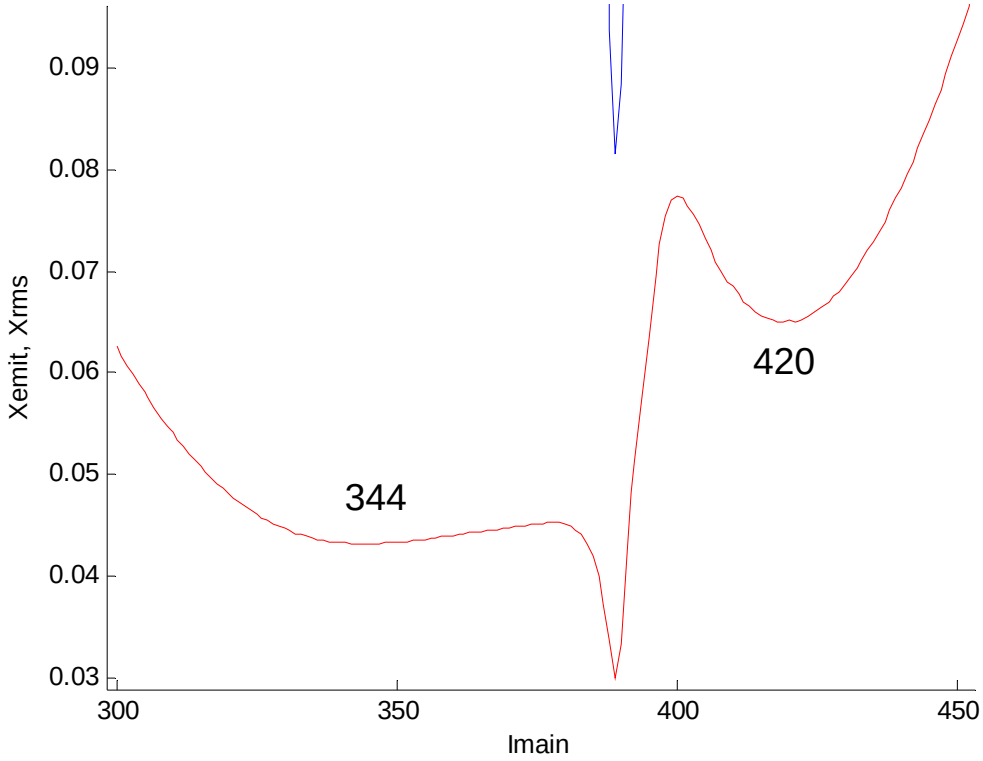


Xrms, mm



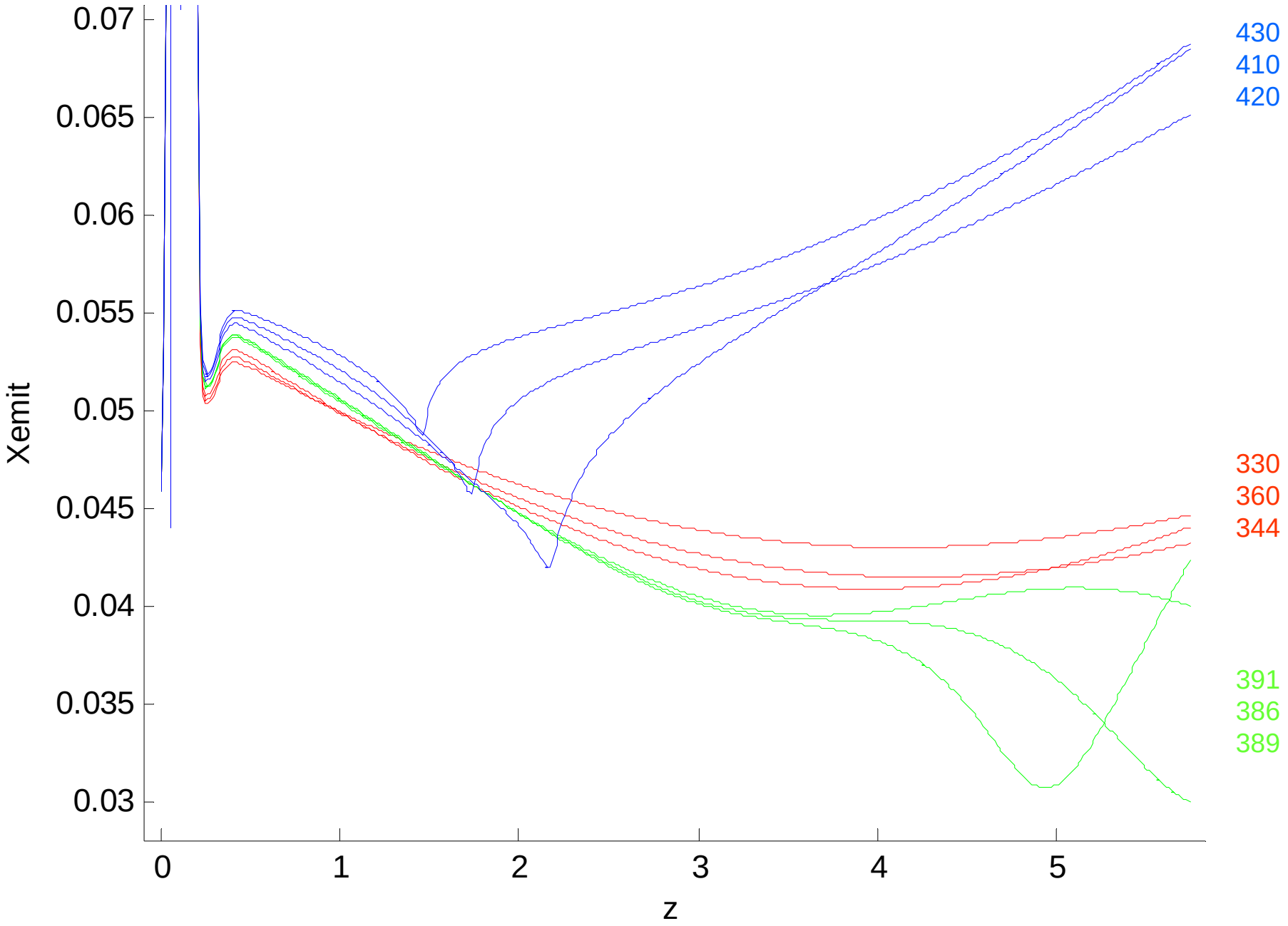

Xemit
0.07
0.06
0.05
0.04
15
10
5
0
Ebooster
360
380
400
Imain
0.075
0.07
0.065
0.06
0.055
0.05
0.045
0.04
0.035
Xrms
1.5
1
0.5
1.8
1.6
1.4
1.2
0.8
0.6
0.4
0.2

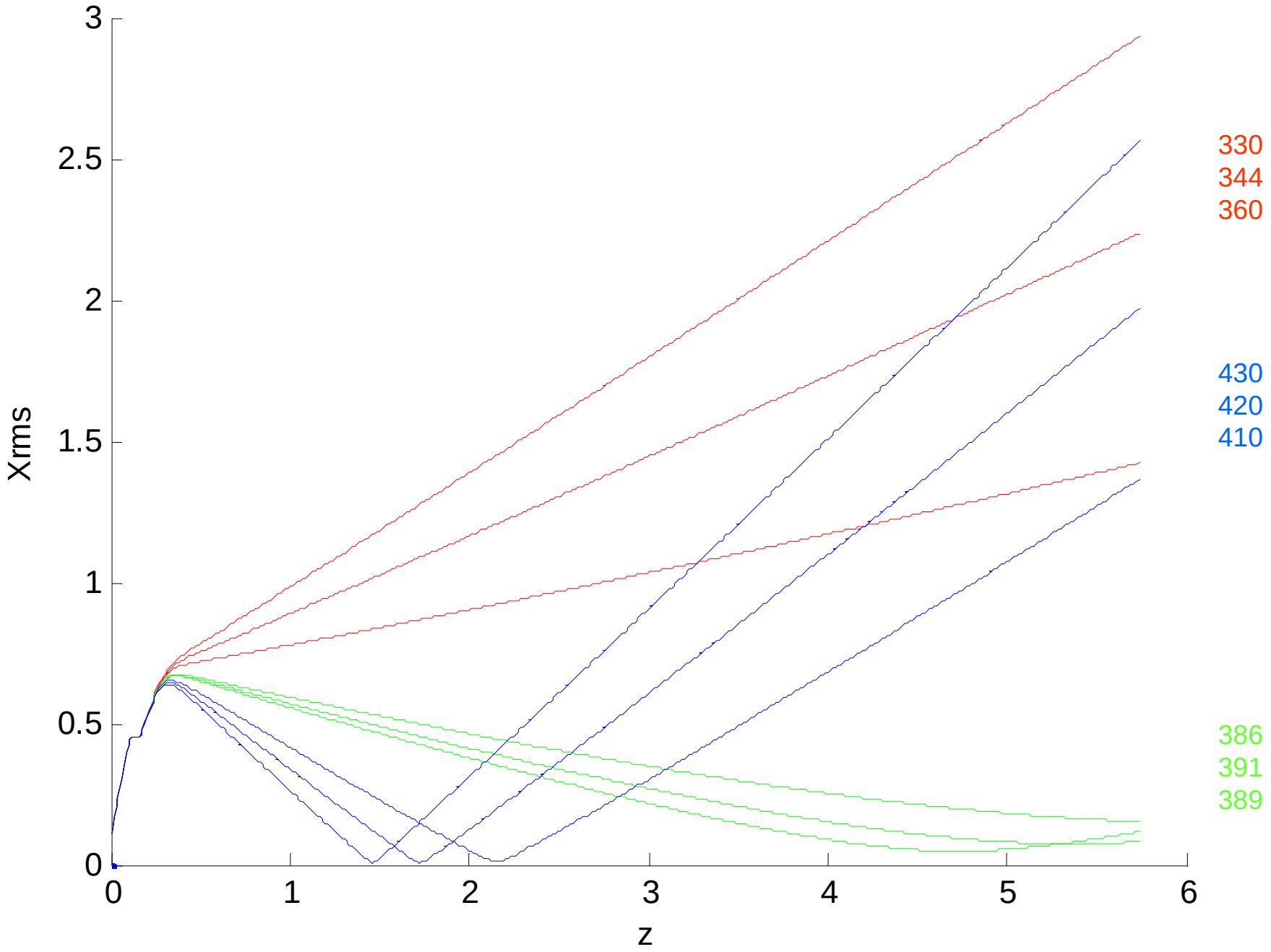
No booster

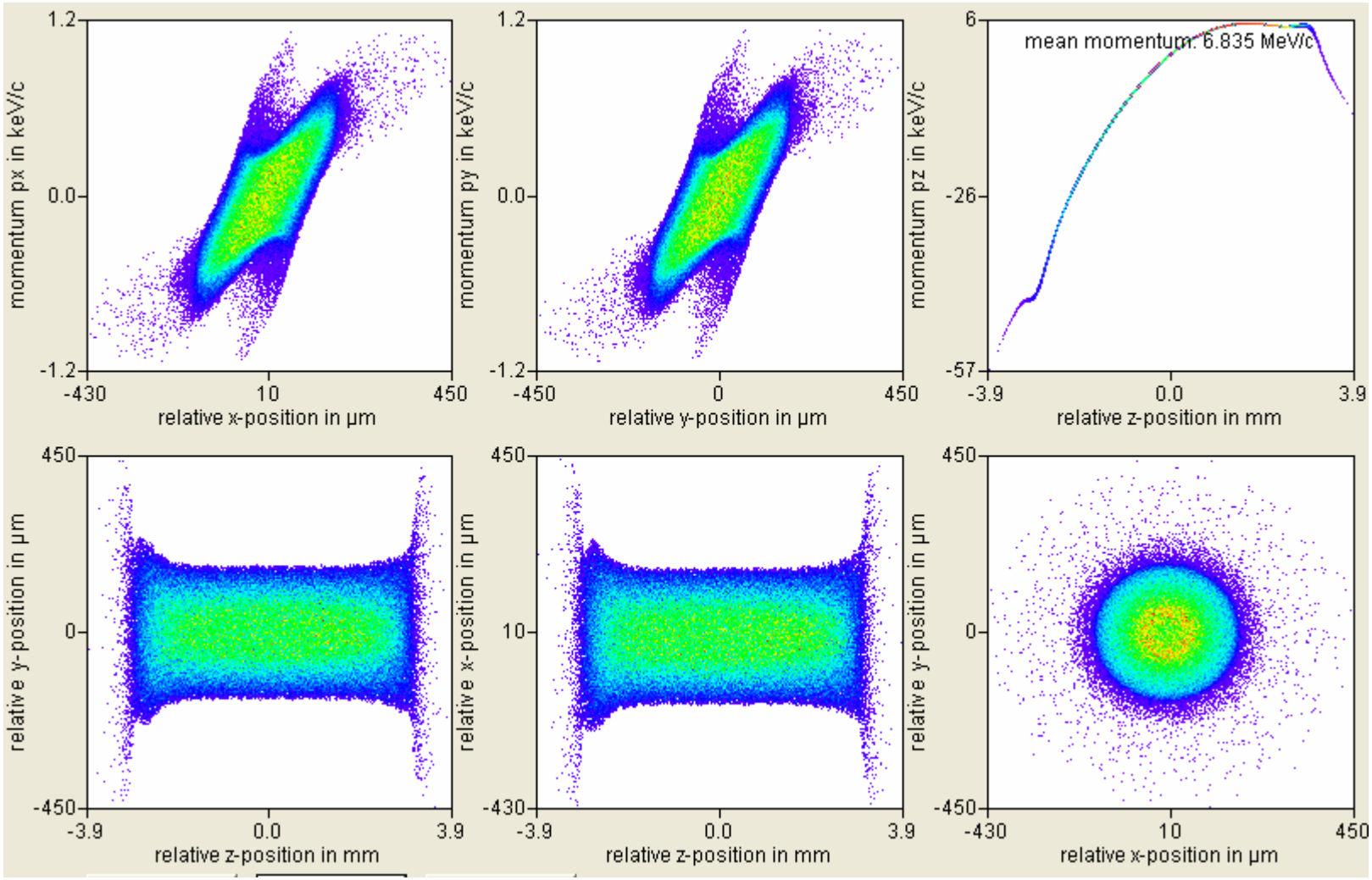


min:
Imain = 389
Xrms = 0.08
Xemit = 0.03

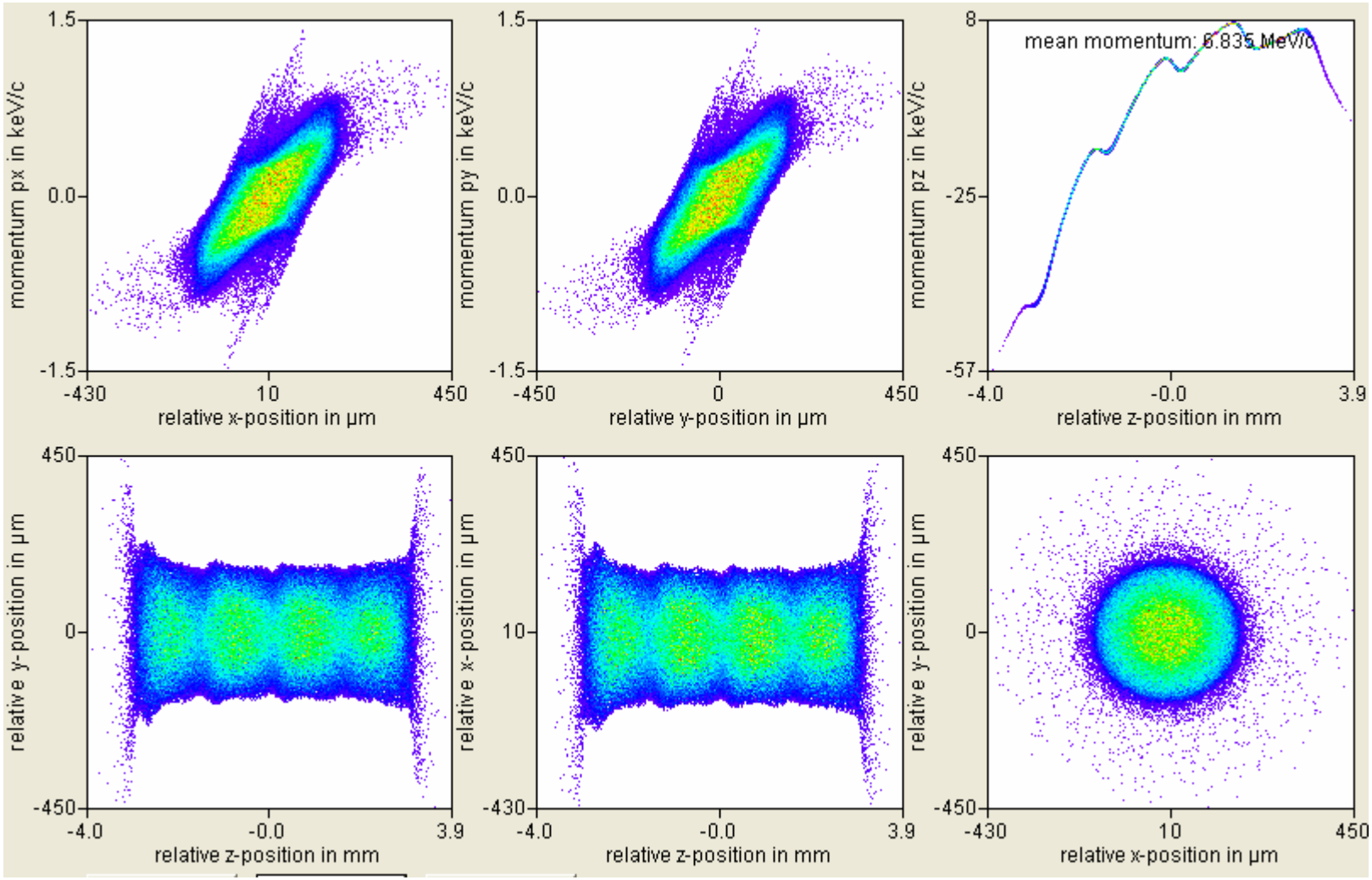
Xemit initial = 0.025


0.07
0.065
0.06
0.055
0.05
0.045
0.04
0.035
0.03
Xemit
0
1
2
3
4
5
z
430
410
420
330
360
344
391
386
389

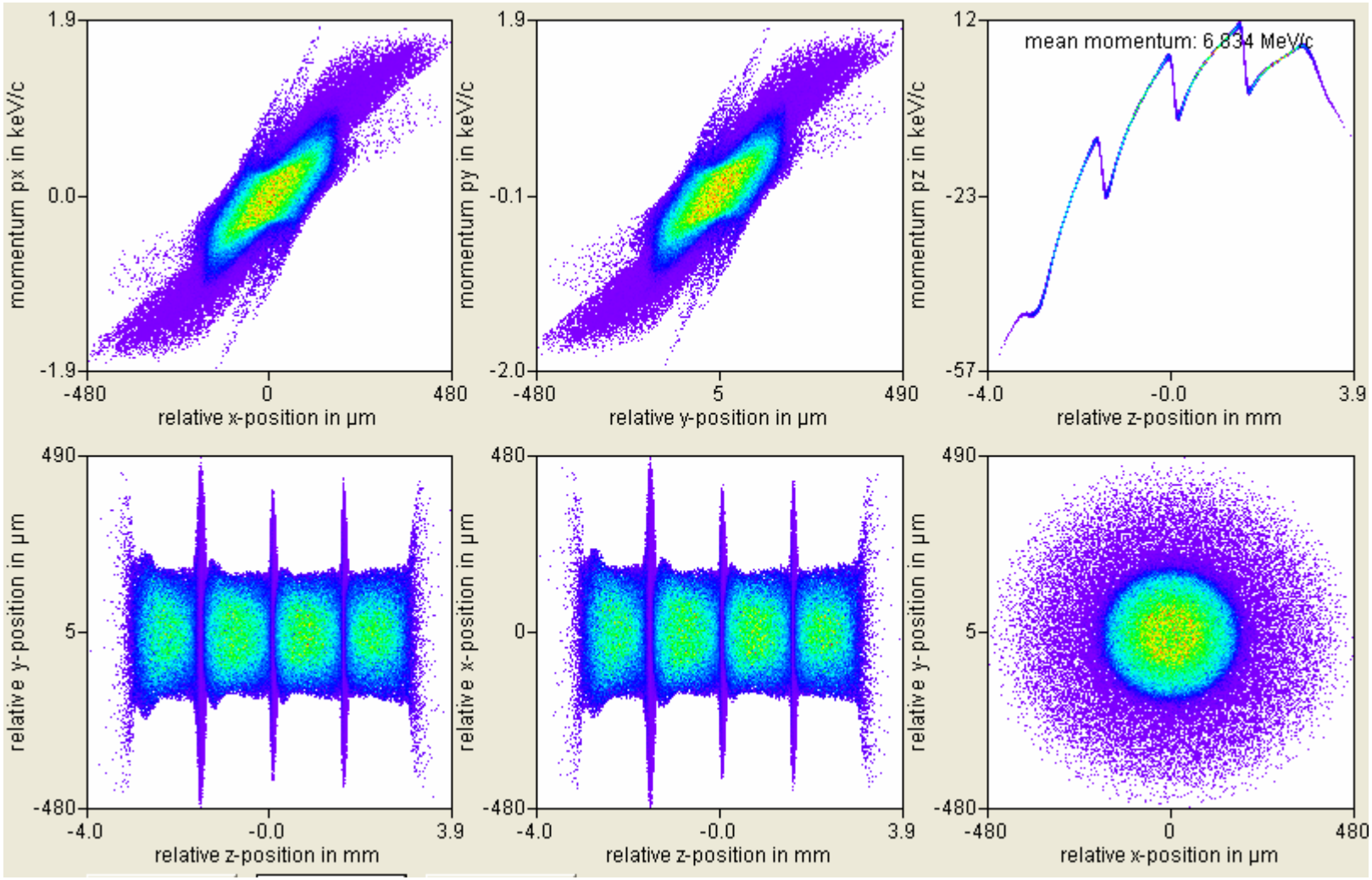

Xrms
z
0
0.5
1
1.5
2
2.5
3
0
1
2
3
4
5
6
330
344
360
430
420
410
386
391
389



Ebooster = 0, BSA = 0.03, PhiG = 2.0, Imain = 389, d = 0.0



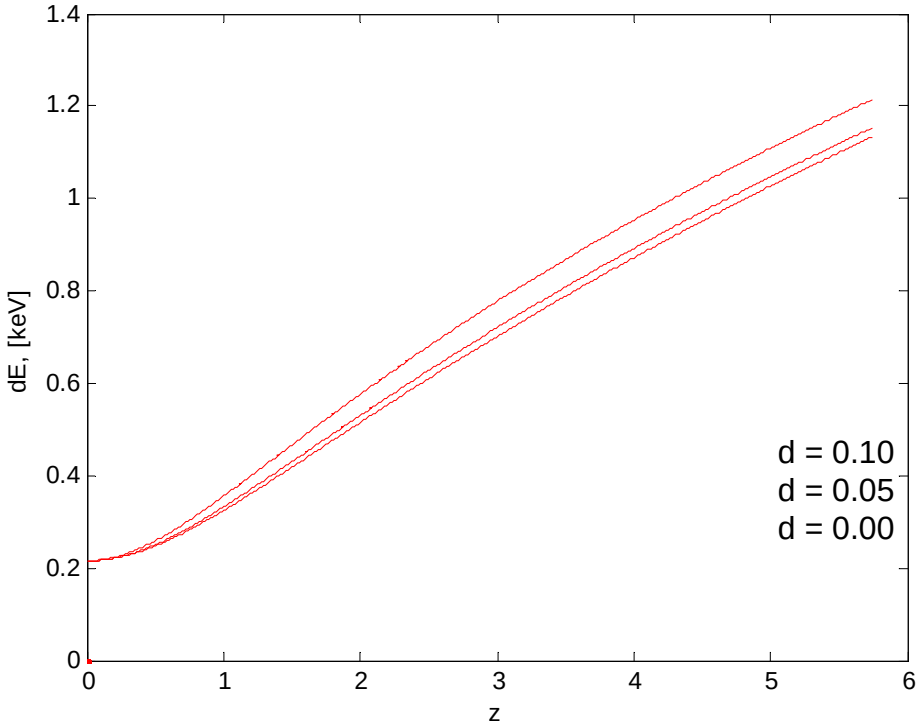
Ebooster = 0, BSA = 0.03, PhiG = 2.0, Imain = 389, d = 0.5

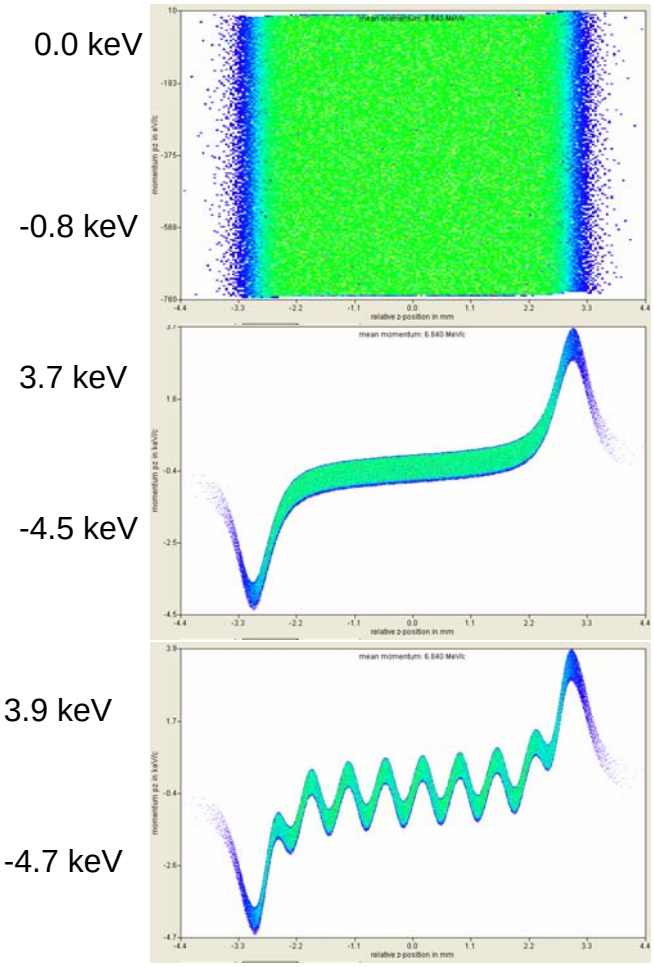


Ebooster = 0, BSA = 0.03, PhiG = 2.0, Imain = 389, d = 1.0

Thank you for your attention

For 10 pC





To compare “Computation of the longitudinal space charge effect in photoinjectors”, EPAC 2004.
(1 nC bunch charge)