ELBD Tunes

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Tune to collimator Notes

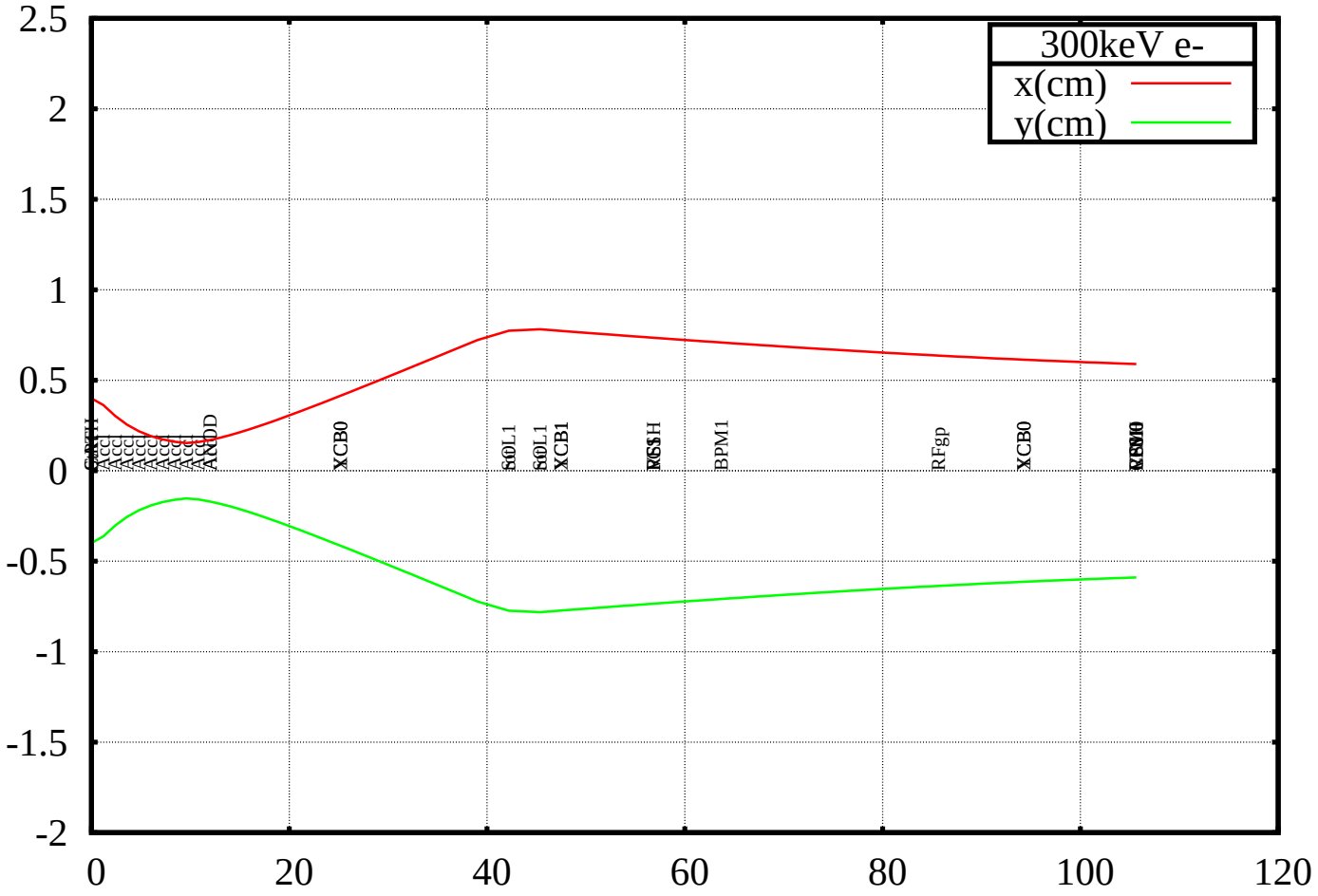
Note: all beam parameters are "2σ"

EGUN:SOL current is 2.70 Amps for image on collimator plate, with 16pC per bunch, but it is only 2.63A for zero current.

The zero current tune has 5.4mm by 6.8mrad, at a waist. ($\epsilon = 34.5\,\mu$m.) Choosing a 'beamlet' gives the full 6.8mrad.

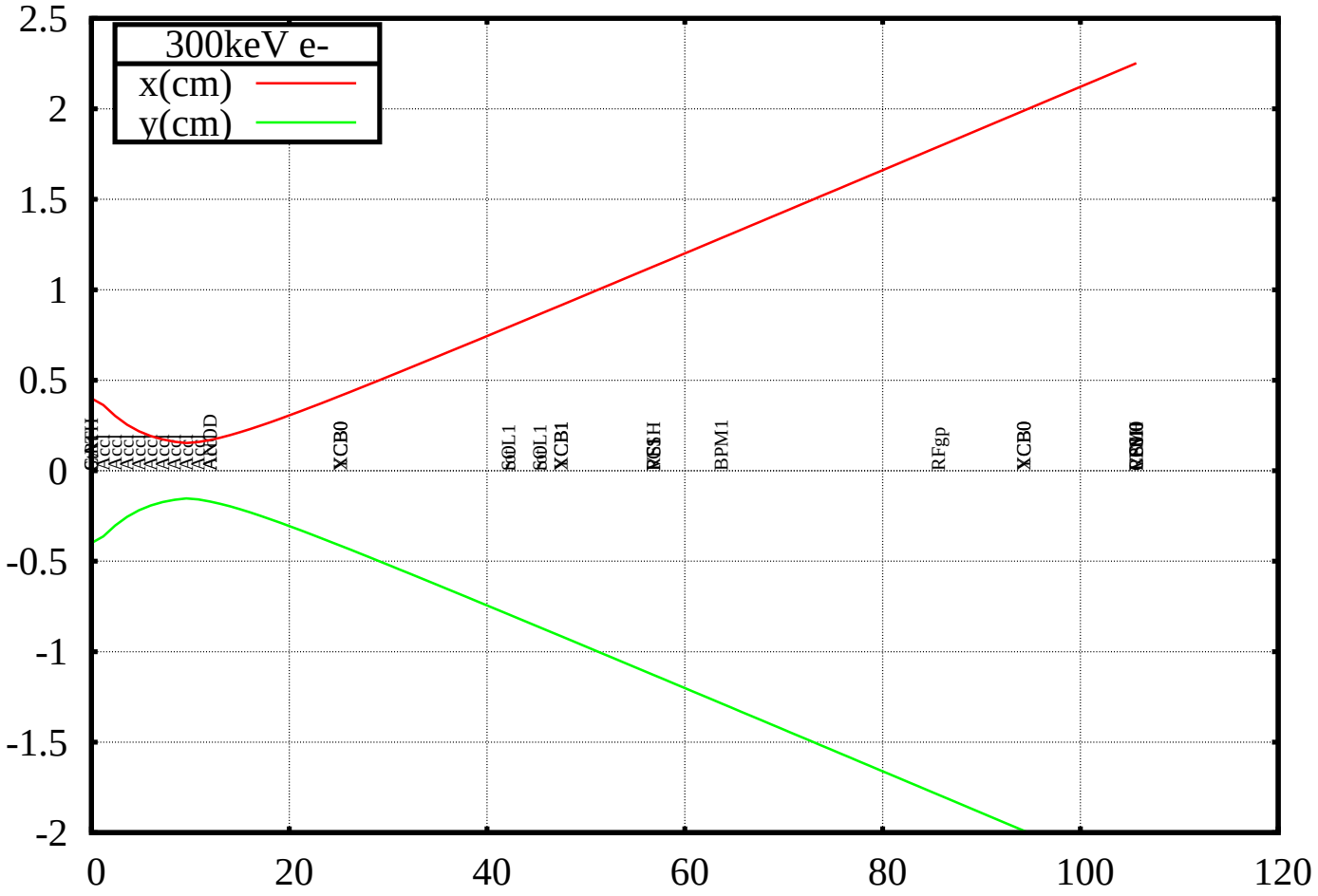
If we set the SOL to zero, to collimate angles better, beam is (for 0 pC) 22.5mm by 23mrad very far from a waist. If here we choose a tiny collimator hole, the divergence is 34.5um/22.5mm=1.5mrad.

Tune to Collimator (grid image)



(c) R. Baartman 09/10/14

Tune to Collimator (defocus)



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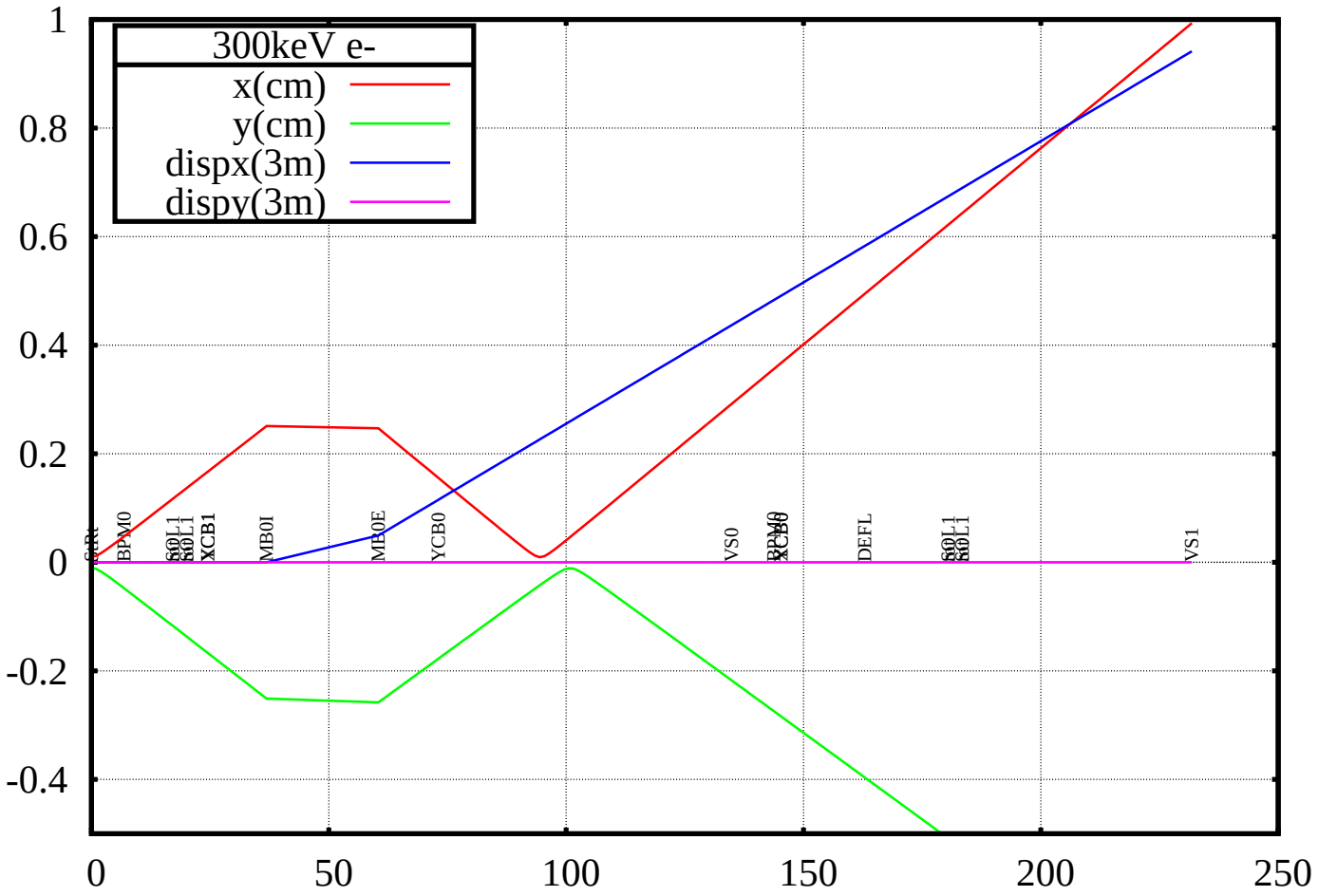
ELBD tuning notes

If choosing a beamlet, the resolution at VS0 is very very poor: **200**. ELBT:SOL1 does not help. But the resolution at 40cm upstream of VS0 is **3600**!

A decision was made to put in this extra 400mm, back in Feb.2014. Why? Major loss of functionality.

The resolution at VS1 with all solenoids off is **110**. It means that what we are interpreting as energy spread is actually egun divergence mixed with energy spread, in about equal measure.



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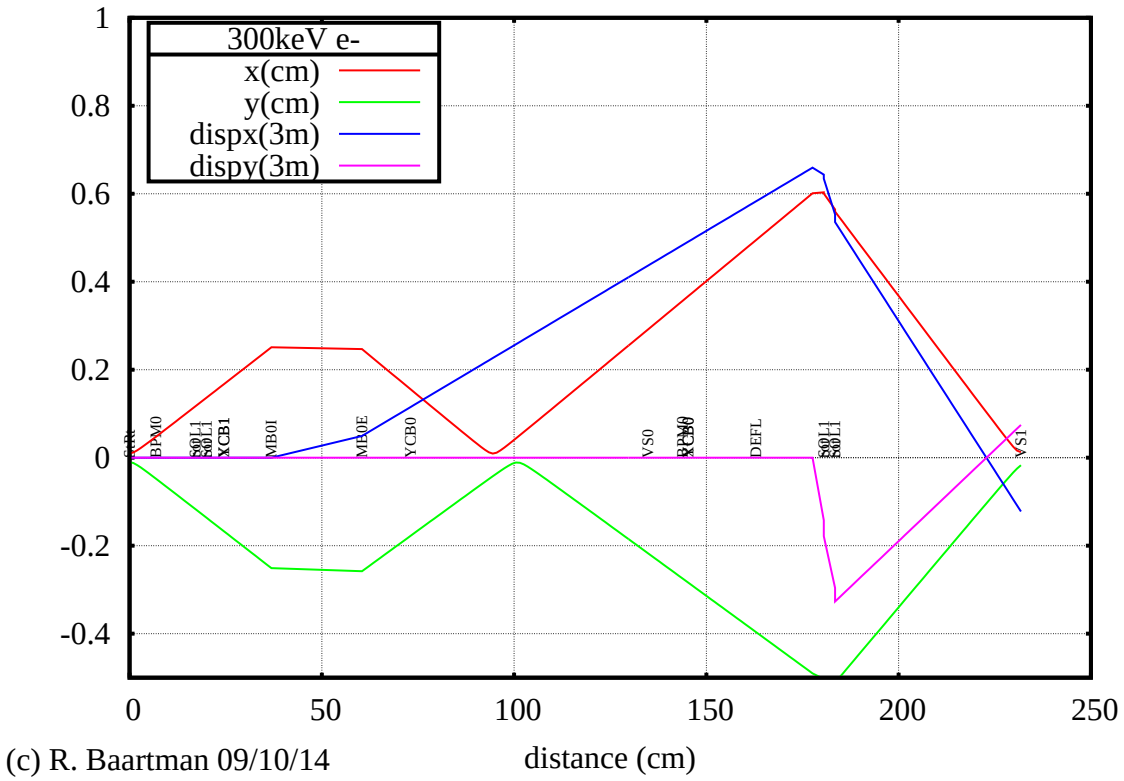
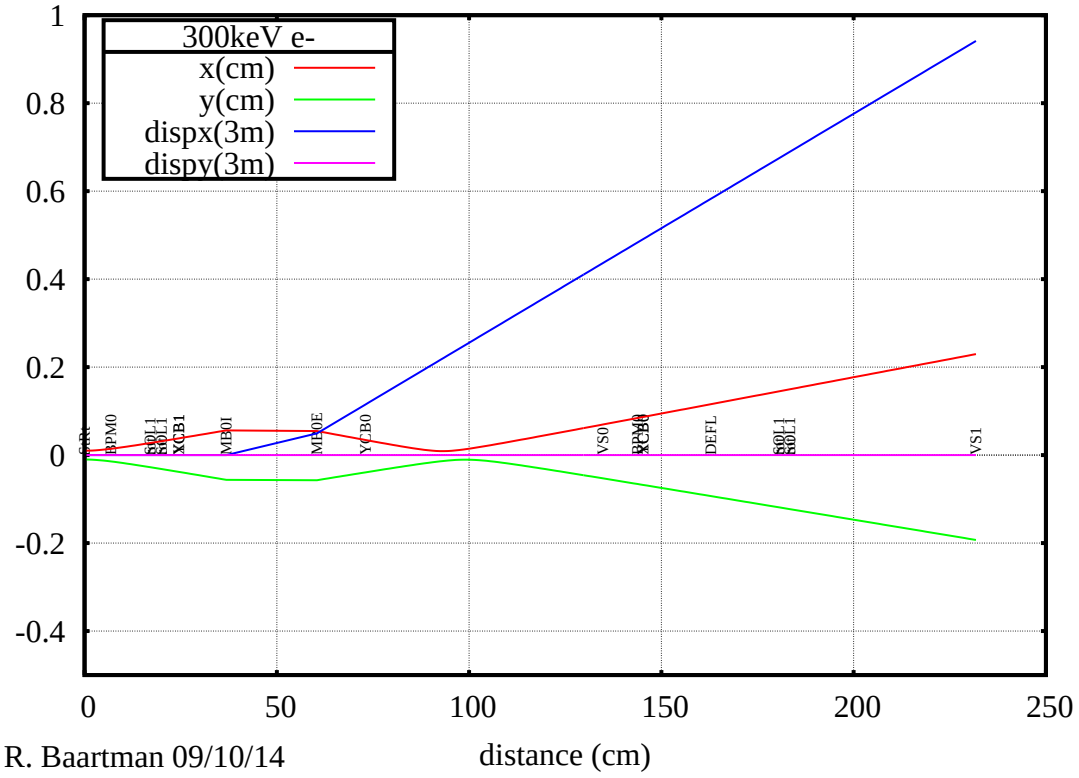
Focus with ELBD Solenoid

If we power the ELBD solenoid, need 2.68A, resolution rises to **1500**. Quite a bit better! But the energy spread is tilted and this could confuse the RF deflector results.



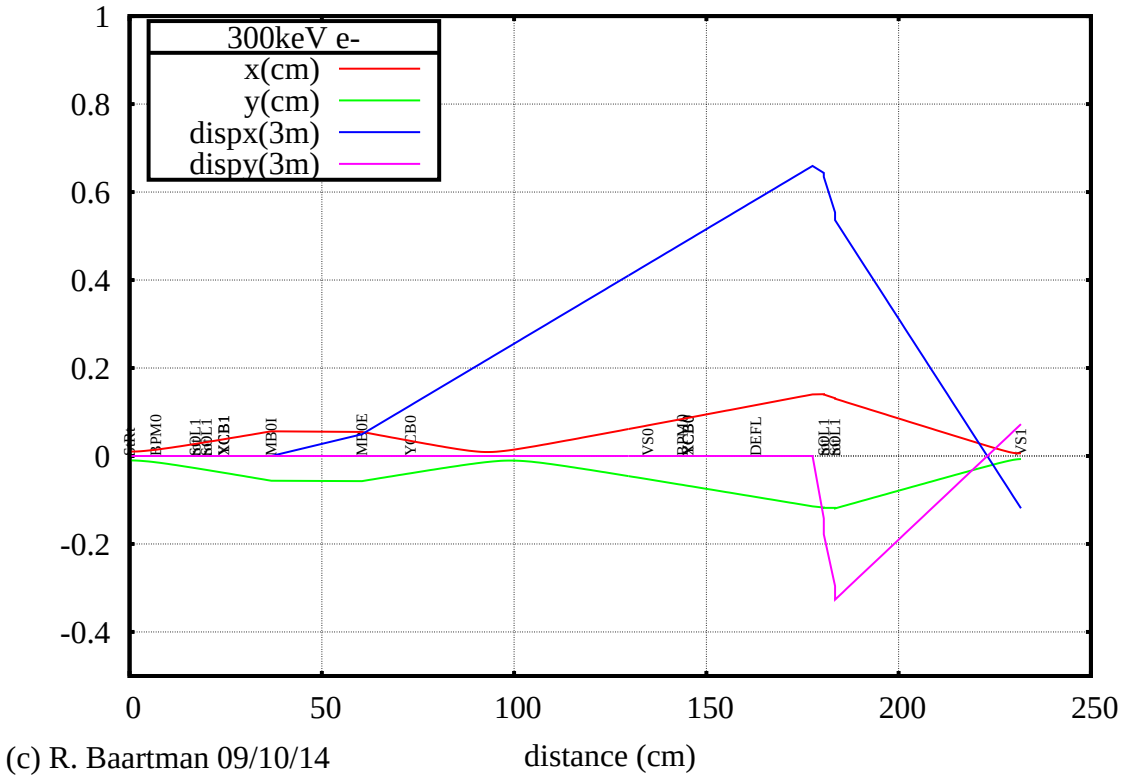
EGUN:SOL off, ELBD Solenoid off

If we don't use a beamlet, but leave egun solenoid off, then initial divergence is 1.5 mrad instead of 6.8mrad. Then solenoids-off gives resolution **621** at VS1.

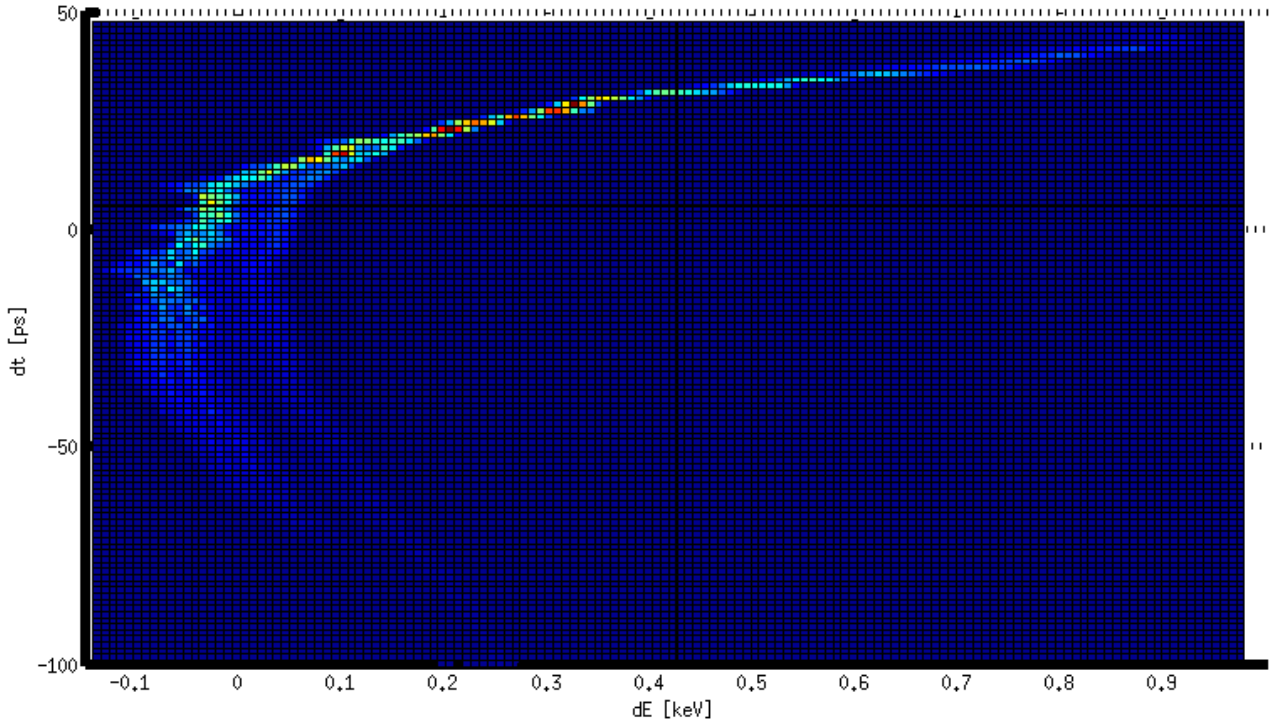


EGUN:SOL off, ELBD Solenoid on

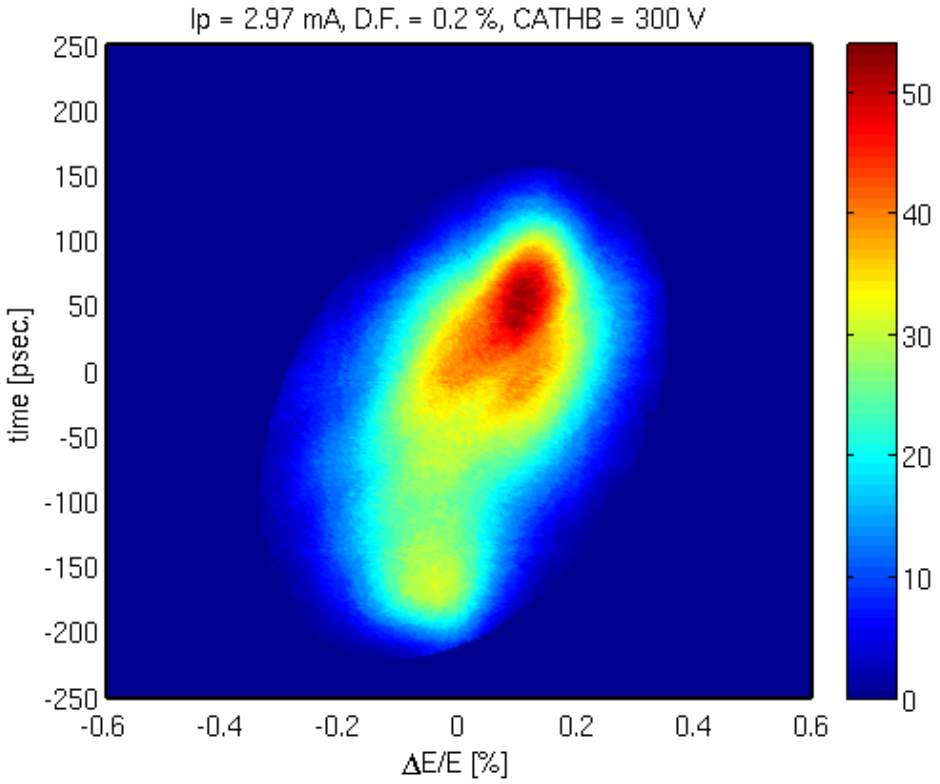
ELBD solenoid on at 2.67A gives resolution **2890**. OK!



Expected?



Observed


Ip = 2.97 mA, D.F. = 0.2 %, CATHB = 300 V
time [psec.]
250
200
150
100
50
0
-50
-100
-150
-200
-250
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
ΔE/E [%]
50
40
30
20
10
0

Sept. 11 Results

Much of the above was confirmed in the beam shift of Sept. 11. Detailed analysis still to come, but we saw the following:

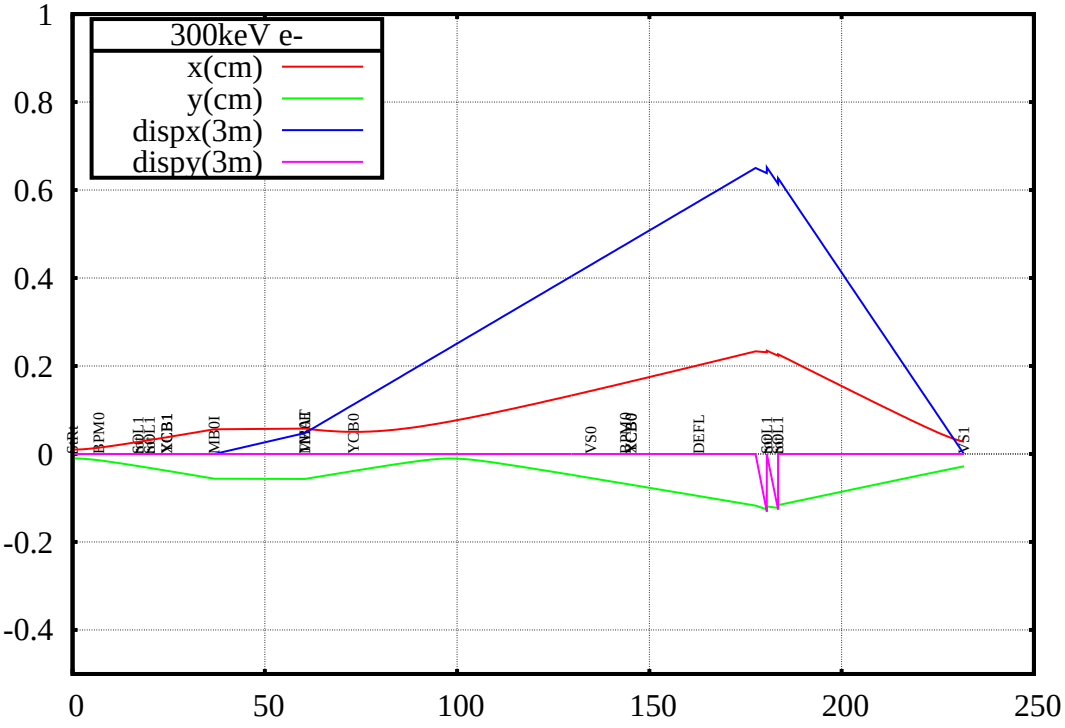
- With ELBD solenoid off, collimator in at position 3, beam at VS1 is indeed much smaller when the egun solenoid is off than when it is at the setting (2.6A) for imaging on the collimator. This already improves energy reolution a lot. We needed to raise duty factor to 1% with EGUN:SOL1 off.

- Then, with ELBD:SOL1 powered up, we could get an extremely small spot at VS1, and with it a little higher, it resolved into a thin line.

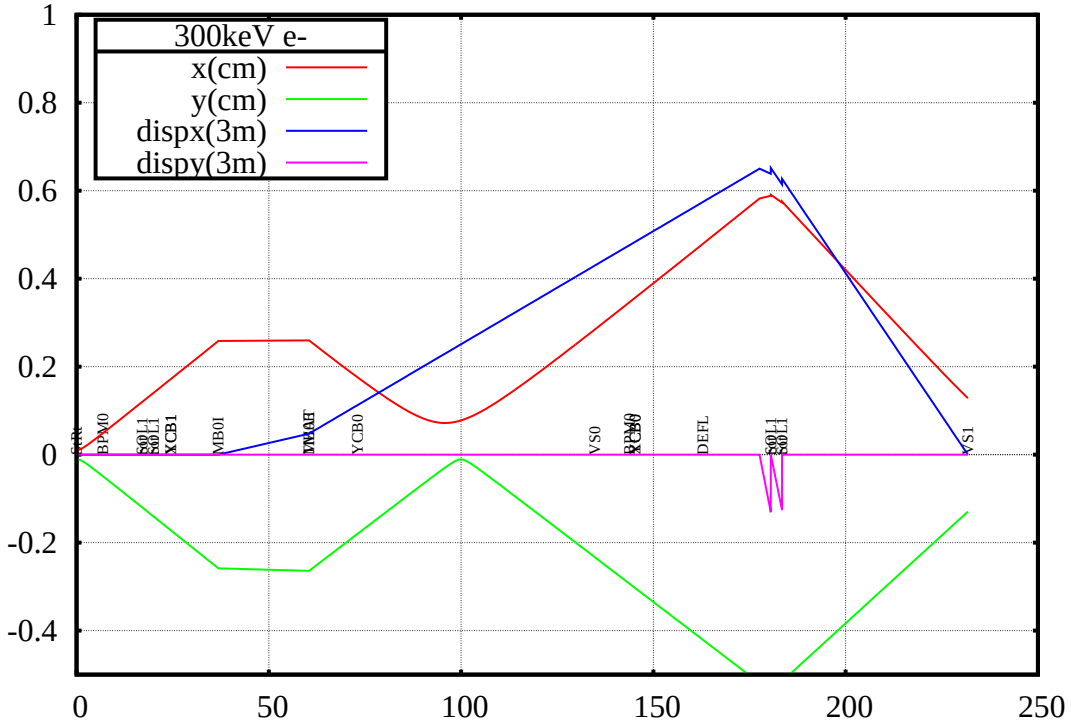
- This line is tilted, but it is clear that the long direction is the energy and the short direction is time when the RF deflector is powered. There is no ambiguity: since the energy and the RF deflector give orthogonal effects, they still do so even after rotation by the solenoid.

The interpretation is as follows. All following calculations use Dobrin's new matrix, but the difference from previous calculations is slight. In each case, I rotate the beam back by the amount of the solenoid, which is $\sim 31^\circ$.

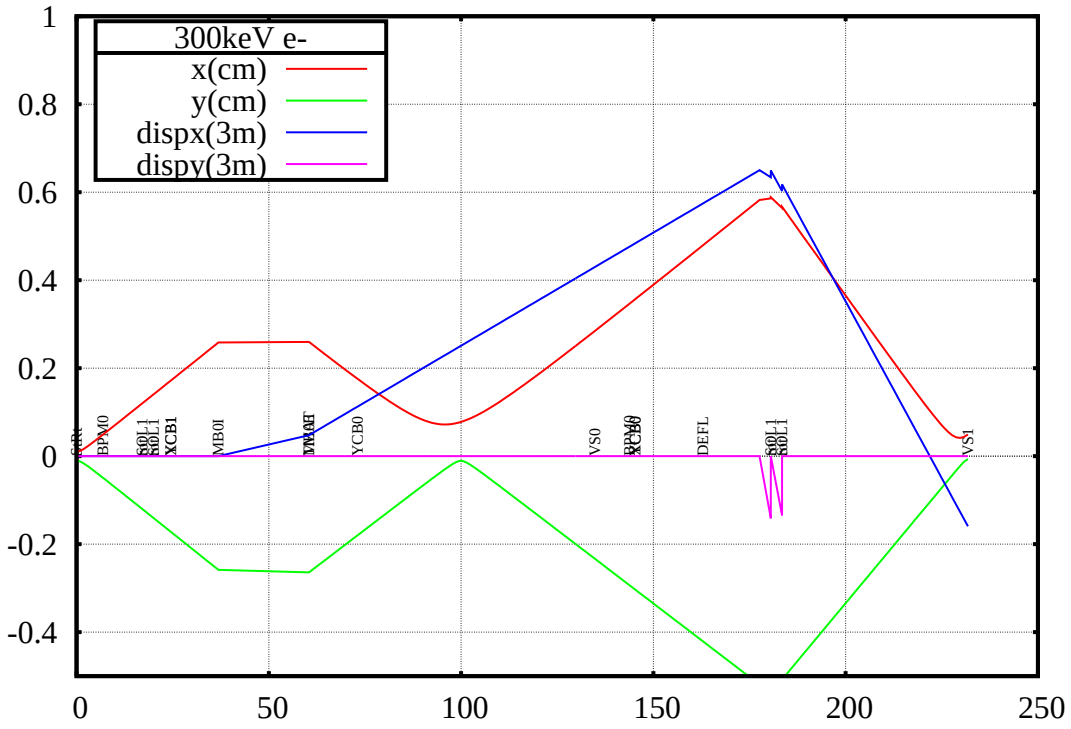
As the ELBD:SOL1 is run up, the spot size decreases, but there is a point at which the dispersion is exactly zero. Here is the calculation using dp/p spread of 0.1%. The beam is round and the dispersion is zero because it is focused out. The ELBD:SOL1 setting for this is 2.485 A.


300keV e-
x(cm)
y(cm)
dispx(3m)
dispy(3m)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
0
50
100
150
200
250
BPM0
MB01
YCB0
VS0
DEFL
VS1
(c) R. Baartman 09/12/14
distance (cm)

On hindsight, I now realize that we could have put the EGUN:SOL1 back to 2.6 A. The envelope would have looked like



Now I ask for a tune to minimize the beam size in the non-dispersed direction. The ELBD:SOL1 current is 2.70 A. Note well: The resolution goes from zero at 2.485 A to maximum (2300) at 2.70 A. This is a small change.



Two observations:

1. Setting up to measure energy and energy spread is a simple matter of raising ELBD:SOL1 to the point where one observes the thinnest possible line on VS1. At this setting, the resolution is the same as if we had the VS0 at the optimum point before the 400 mm drift was inserted. But the magnification is 0.65 rather than 1, so in fact the thickness of this line is 0.13 mm full width (2 pixels). And the line is tilted; not a big deal.

2. One need not defocus the beam on the collimator. In fact, the tighter the focus, the more beam passes through the collimator. At some point, the extreme divergence particles will be scraped on the beam pipe, and/or experience aberration. This will show up as a halo around the thin line.