ELENA source line tracking studies

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Short summary of results so far

Quad scans have been done on 4 quads + kick response on 2 correctors

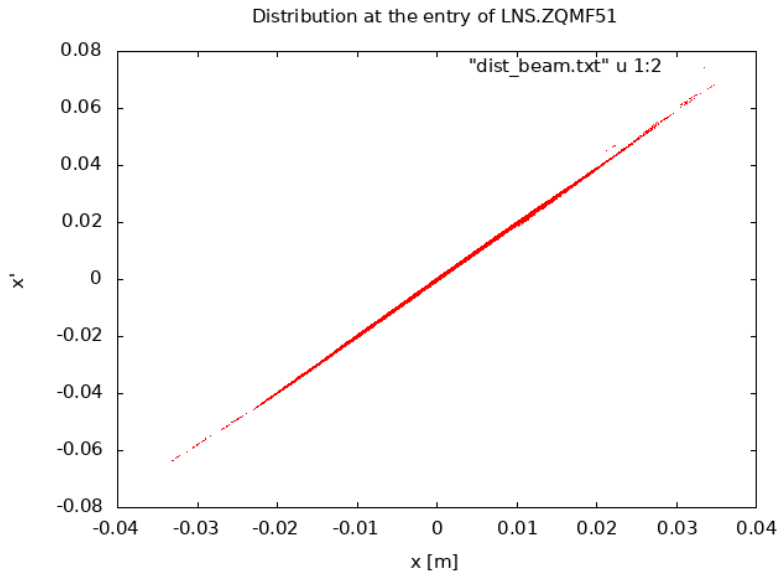
Linear model is built as a Jupyter notebook. Initial conditions and optics for the line calculated on linear model.

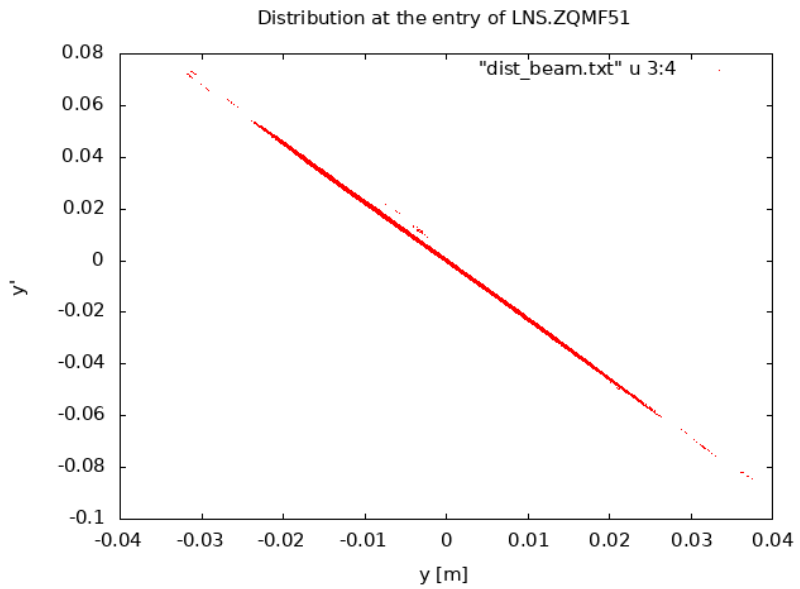
Distribution before the first quad QFNE51 has been reconstructed based on the first quad scan (preliminary ?)

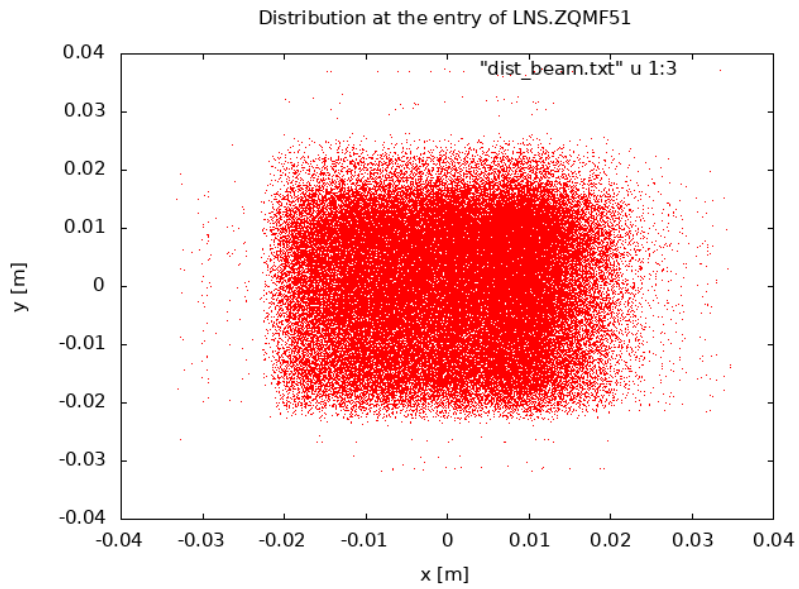
Realistic model of the line has been built and tracking studies made with phase space grids and circles. Important non-linearities are observed in the results.

Reconstructed distribution by tomography

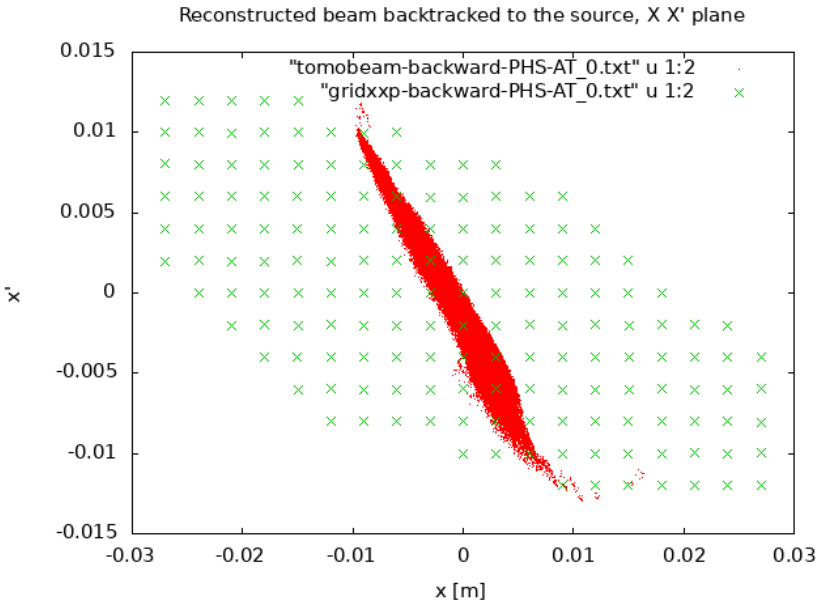
Vittorio provided me 100000 phase space coordinates at the entry of QFNE51

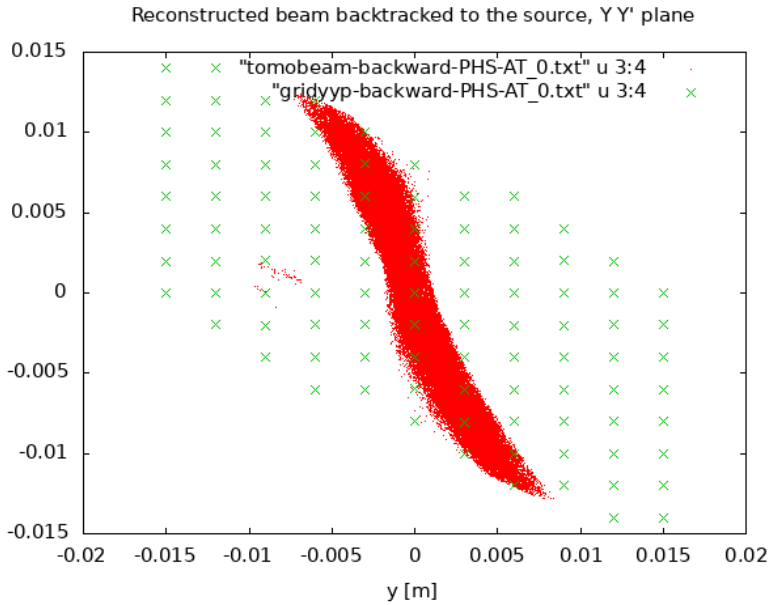


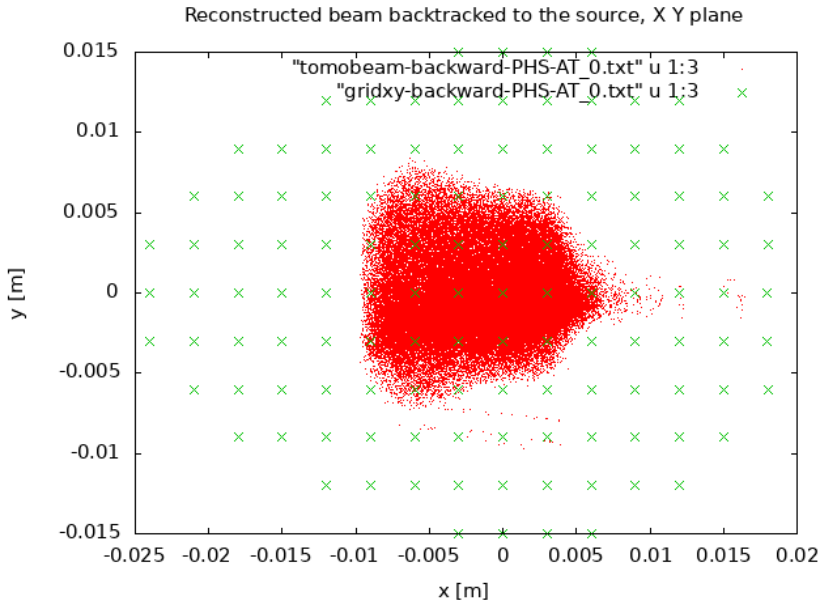




Tracking backward to the source







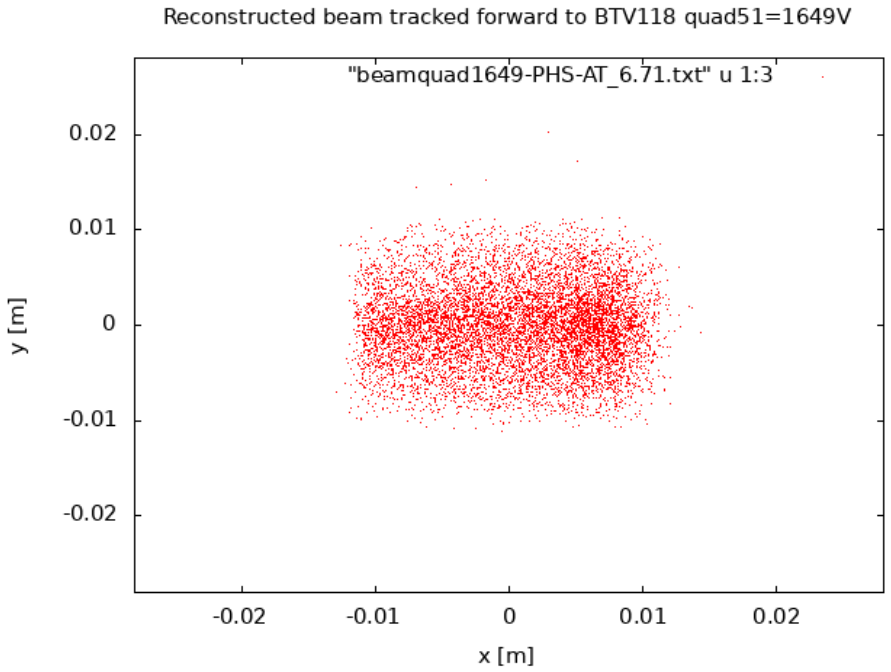
Displayed together with the surviving part of the grid beam tacked back to the source

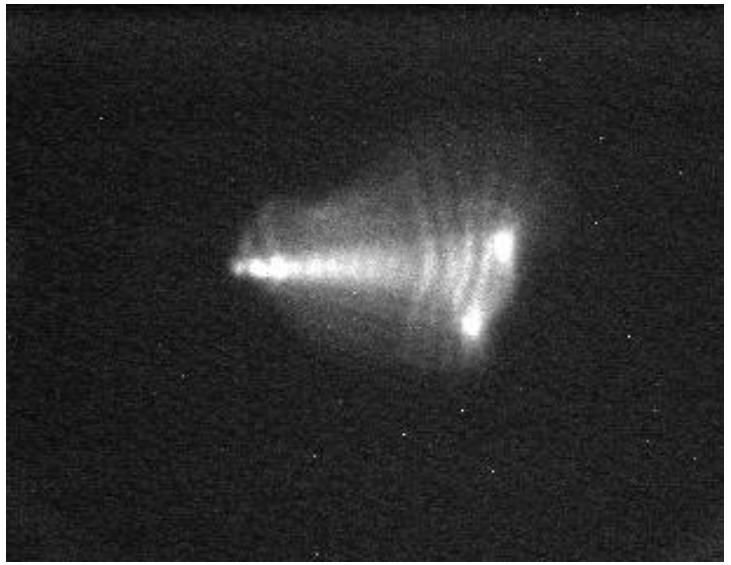
The files are available in the cernbox shared directory:
/afs/cern.ch/user/l/lbojtar/eos/quadscan_LNS/re-scan/simpa/lns_line/wdir/
Backtracked distribution: tomobeam-backward-PHS-AT_0.txt

Plots can be found with gnuplot scripts in:
/afs/cern.ch/user/l/lbojtar/eos/quadscan_LNS/re-scan/simpa/lns_line/plot/

Some basic checks I.

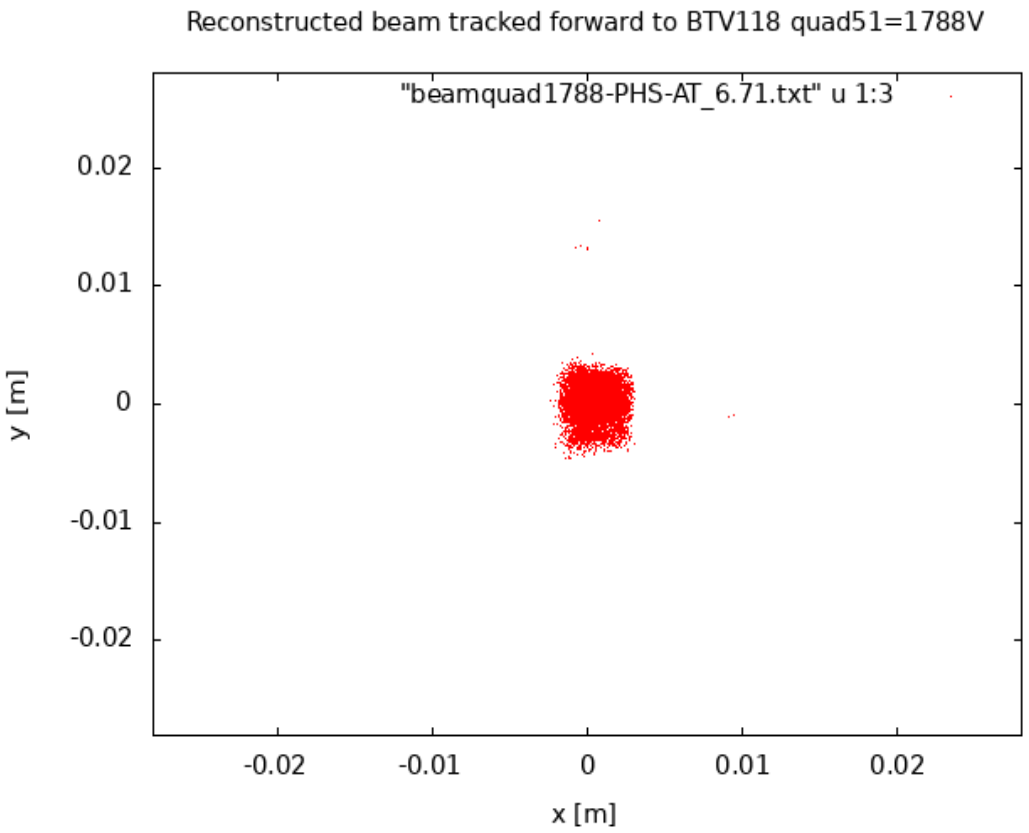
Tracking forward again the distribution from the source to BTV118 with QFNE51 = 1649 V and compare the XY plane with the measurements





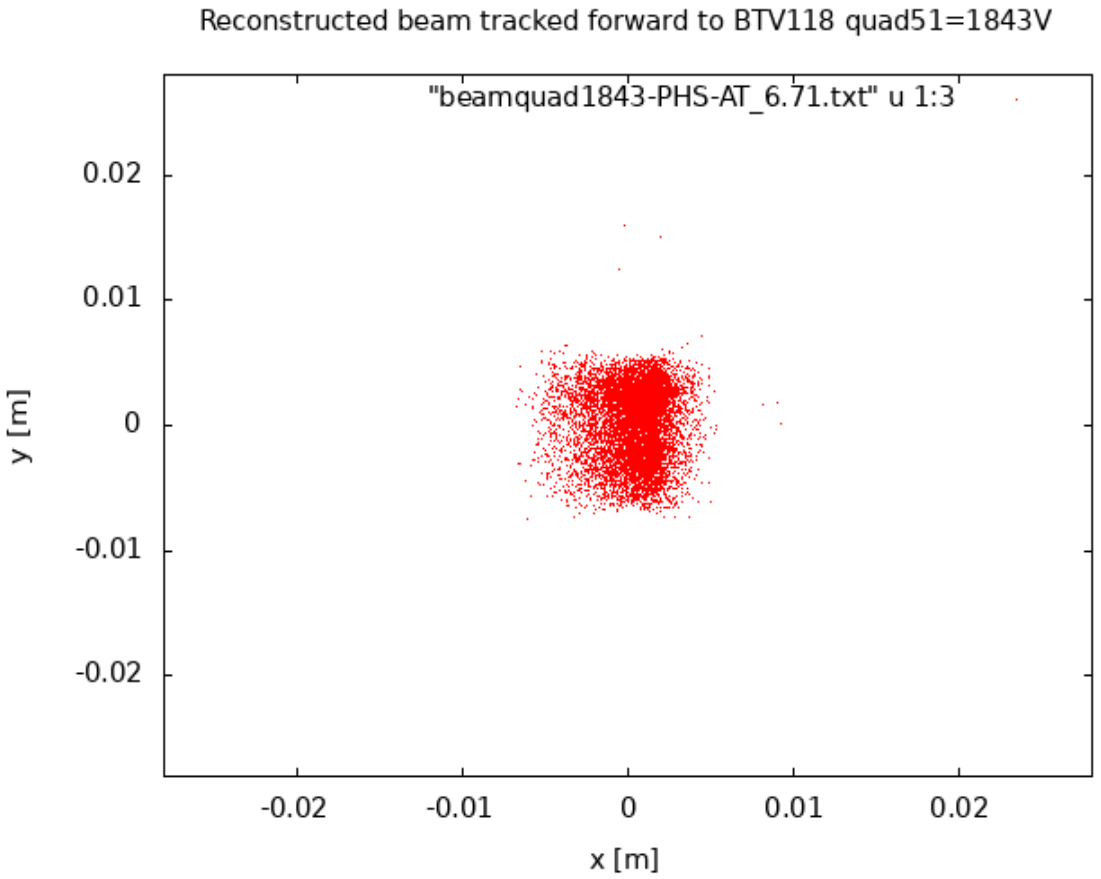
Some basic checks II.

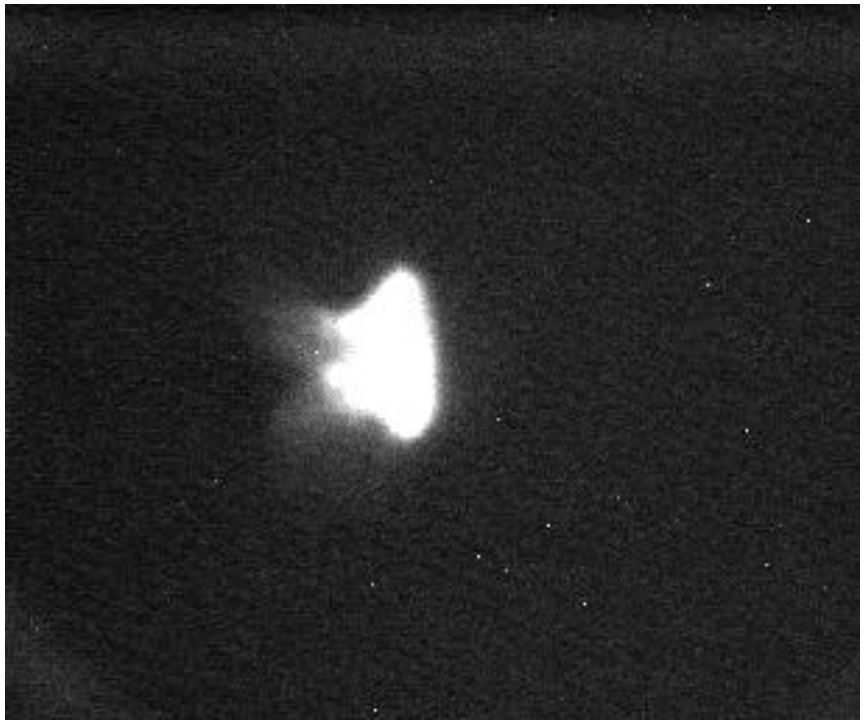
Tracking forward again the distribution from the source to BTV118 with QFNE51 = 1788 V and compare the XY plane with the measurements



Some basic checks III.

Tracking forward again the distribution from the source to BTV118 with QFNE51 = 1843 V and compare the XY plane with the measurements





Calculating the beam matrix of the distribution at the source

$$\Sigma = \begin{pmatrix} \langle x^2 \rangle & \langle x p_x \rangle & \langle xy \rangle & \langle x p_y \rangle & \langle xz \rangle & \langle x\delta \rangle \\ \langle p_x x \rangle & \langle p_x^2 \rangle & \langle p_x y \rangle & \langle p_x p_y \rangle & \langle p_x z \rangle & \langle p_x \delta \rangle \\ \langle yx \rangle & \langle y p_x \rangle & \langle y^2 \rangle & \langle y p_y \rangle & \langle yz \rangle & \langle y\delta \rangle \\ \langle p_y x \rangle & \langle p_y p_x \rangle & \langle p_y y \rangle & \langle p_y^2 \rangle & \langle p_y z \rangle & \langle p_y \delta \rangle \\ \langle zx \rangle & \langle z p_x \rangle & \langle zy \rangle & \langle z p_y \rangle & \langle z^2 \rangle & \langle z\delta \rangle \\ \langle x\delta \rangle & \langle p_x \delta \rangle & \langle y\delta \rangle & \langle p_y \delta \rangle & \langle z\delta \rangle & \langle \delta^2 \rangle \end{pmatrix}$$

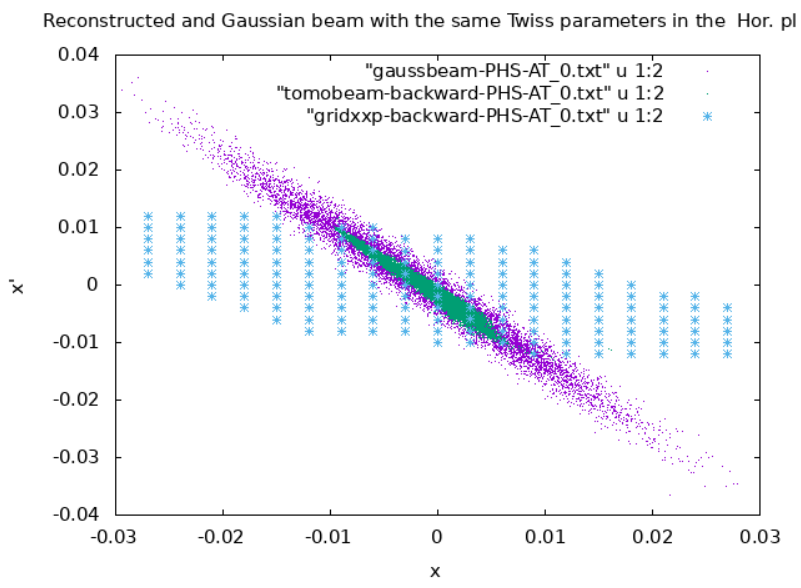
$$\Sigma = \begin{pmatrix} \langle x^2 \rangle & \langle x p_x \rangle \\ \langle p_x x \rangle & \langle p_x^2 \rangle \end{pmatrix} = \begin{pmatrix} \beta_x & -\alpha_x \\ -\alpha_x & \gamma_x \end{pmatrix} \varepsilon_x$$

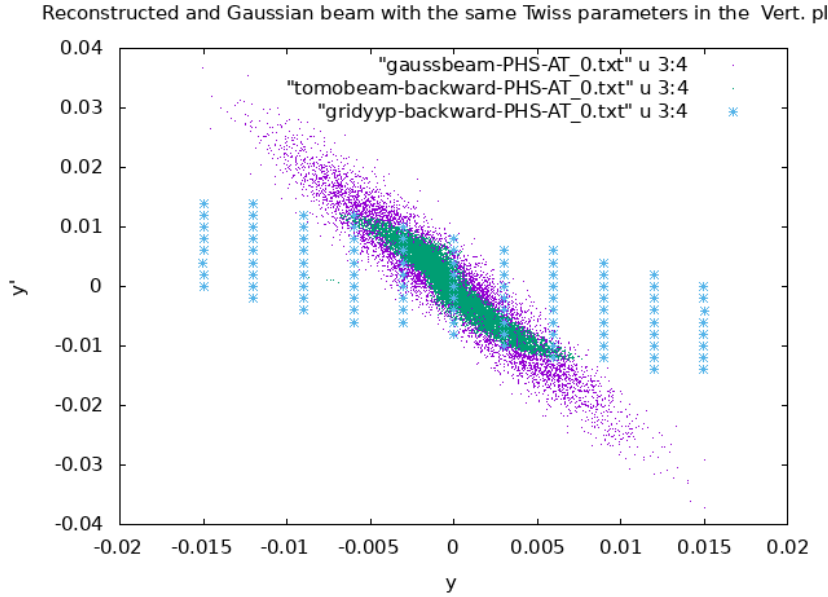
Twiss parameters calculated from beam covariance matrix:

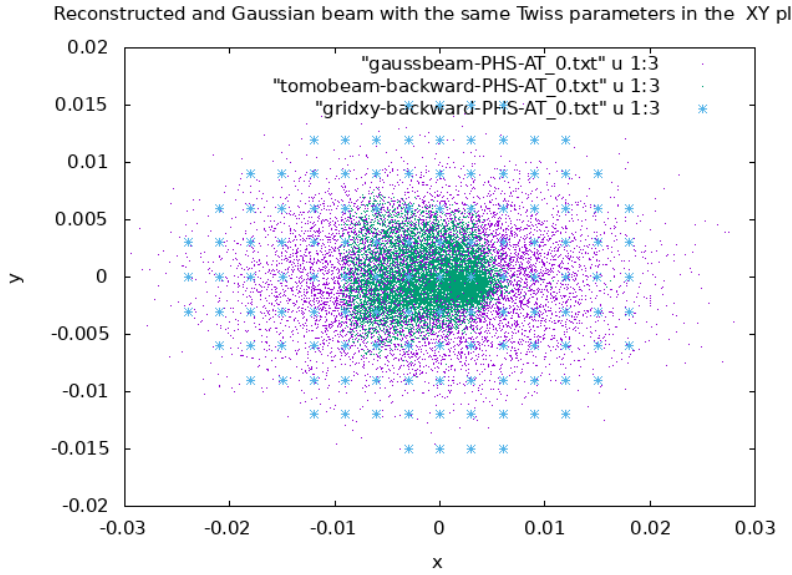
Hor. Em= 3.1220883263449287E-6[mm mrad]
Hor. beta= 4.2918161326419
Hor. alpha= 5.1877335545141605
Hor. position= -9.994461624473249E-4
Hor. angle= -4.8839656354866 29E-4

Vert. Em= 4.173600538319882E-6[mm mrad]
Vert. beta= 1.325107464032276
Vert. alpha= 2.972367515263827
Vert. position= -1.4690053536284175E-4
vert. angle= 2.8280410038968 26E-4

Comparing the backtracked distribution with the Gaussian beam with the Twiss parameters calculated

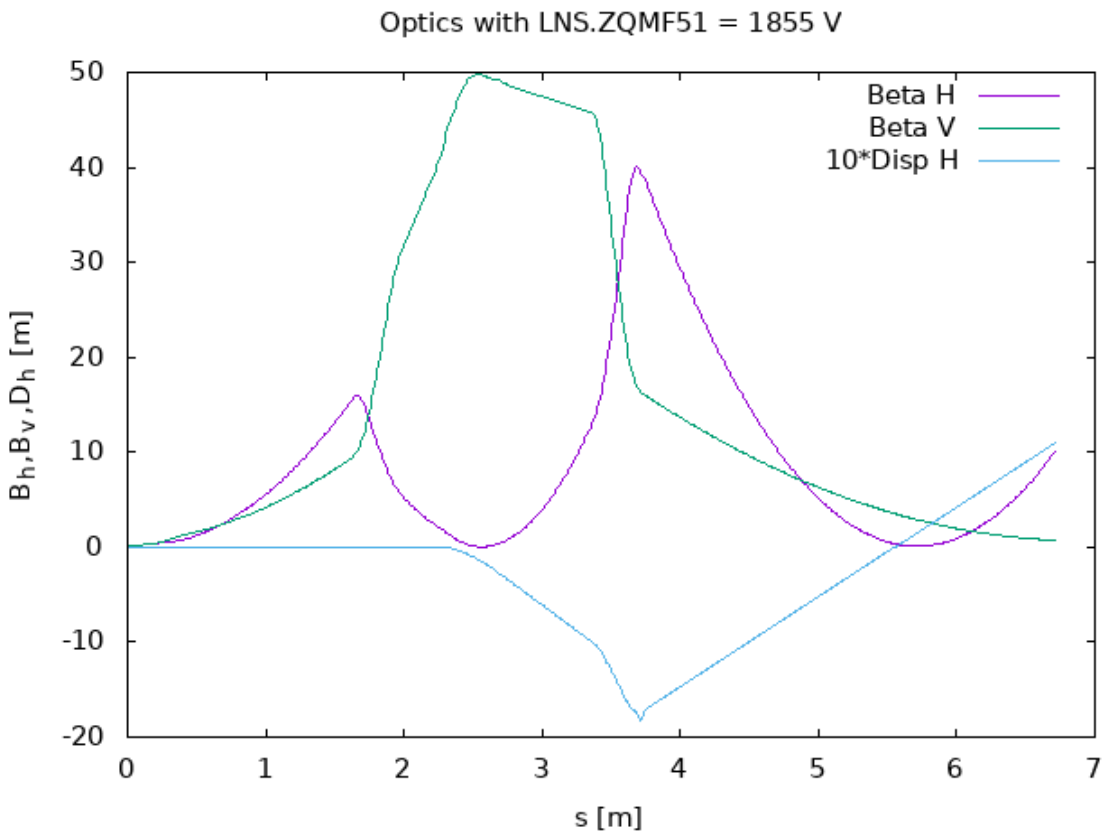


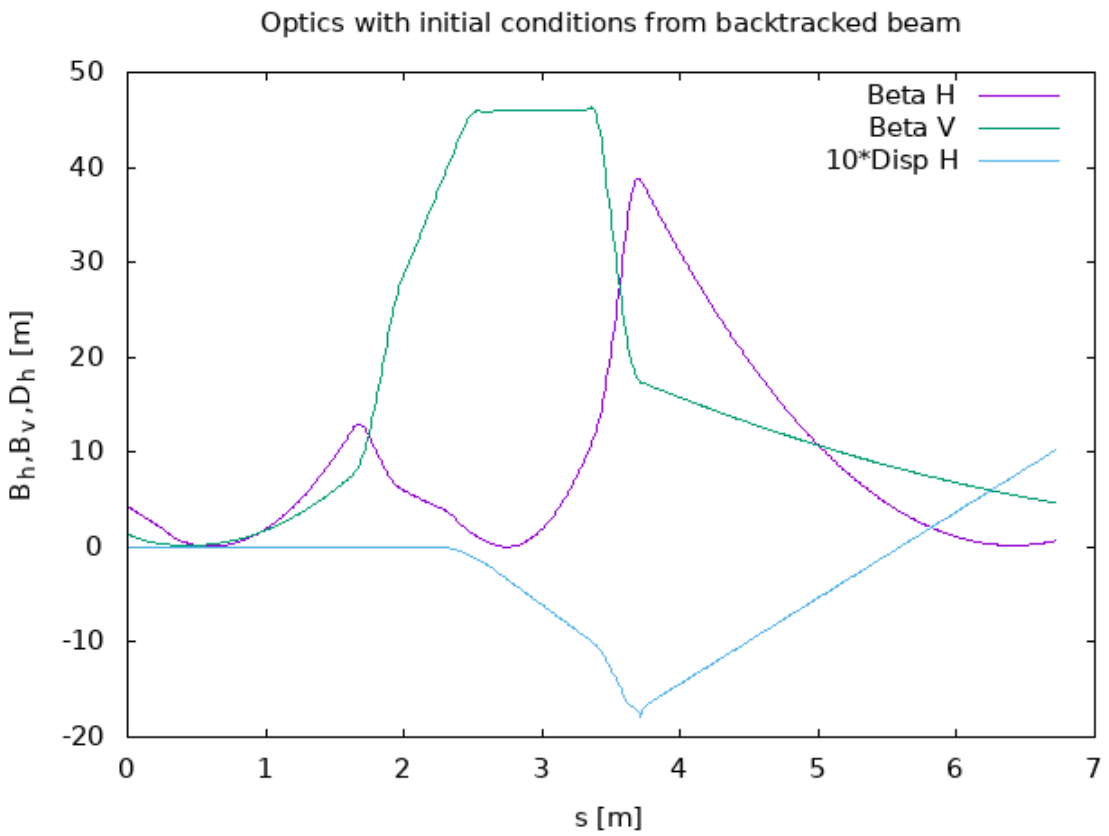




The Gaussian beam is cut by the angle limitation of the currently used optics. This suggest we might improve the acceptance of the line and inject more… To be investigated.

Optics with different initial conditions





Beta hor =0.2
Beta vert = 0.2
All other are zero

Trying your ideas or settings with SIMPA

You can play with the tracking code yourself under linux:

Make o copy of the directory /afs/cern.ch/user/l/lbojtar/eos/quadscan_LNS/re-scan/simpa somewhere to not overwrite the files

cd ~/your_direcrory/simpa/lns_line/wdir

Start SIMPA from there : ../../code/simpa-acc/bin/simpa-acc

Execute the tracking of the distribution: call -f "../track_distr.simpa“

This does everything from the beginning (creation of elements, field maps, tracking, optics, etc..): call -f "../LNS_ALL.simpa“

There is some very preliminary doc here: https://simpa-project.web.cern.ch/