Beam trajectory modeling update

Achievements

- Measurement of the solenoid current – beam position dependency.

- Script for saving trajectory and magnets currents.

- Script for restoring magnets currents.

- Initial X, X` Y, Y` of the center of the beam after the gun(BPM-based).

- Measurements of the steerers strengths.

- The simulation can be checked offline (using already gathered data)

Difficulties

- Time of experiments ~2 shifts (smeared over 2 weeks).

- Forgot to switch off the booster before LOW.ST4 and LOW.ST5 measurements (strengths and couplings do not agree with prev. results).

- Previous and current results sometimes very different (difference of 90%).

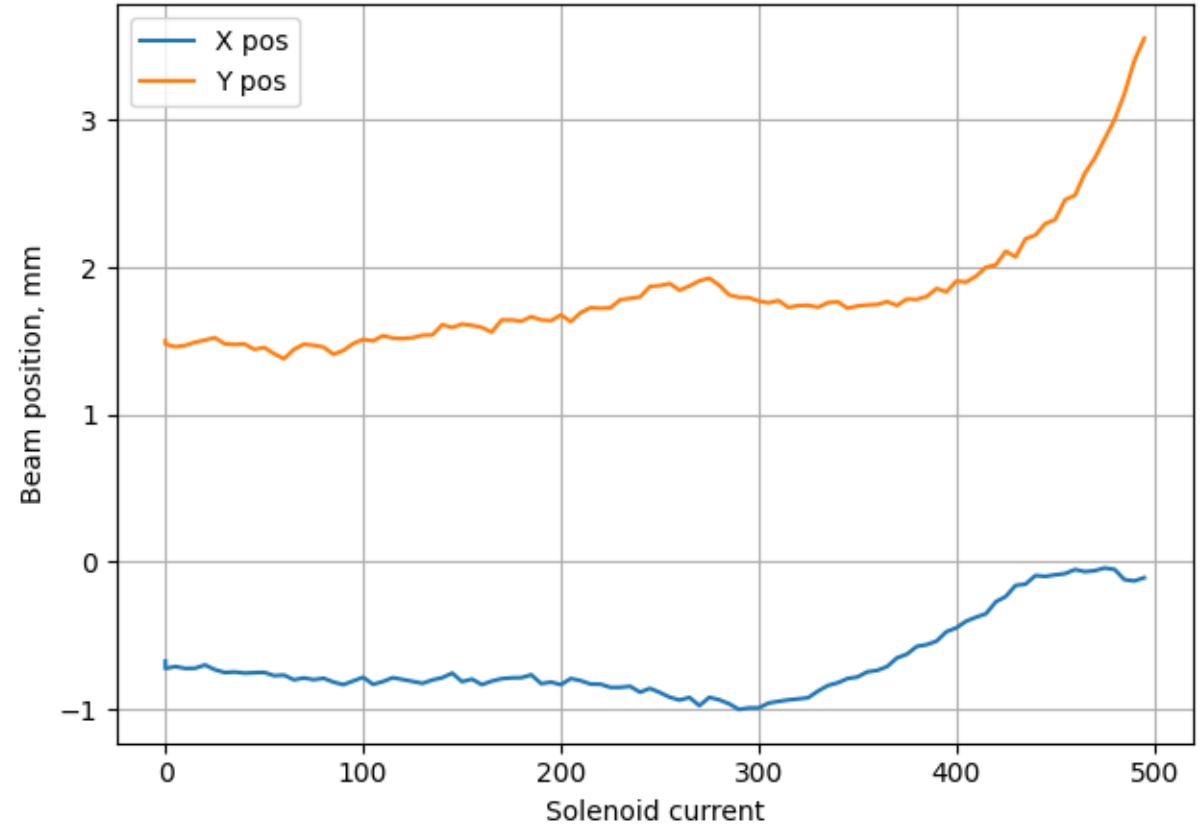- Not yet clear how to implement the influence of the remnant magnetic field.

Beam trajectory modeling update

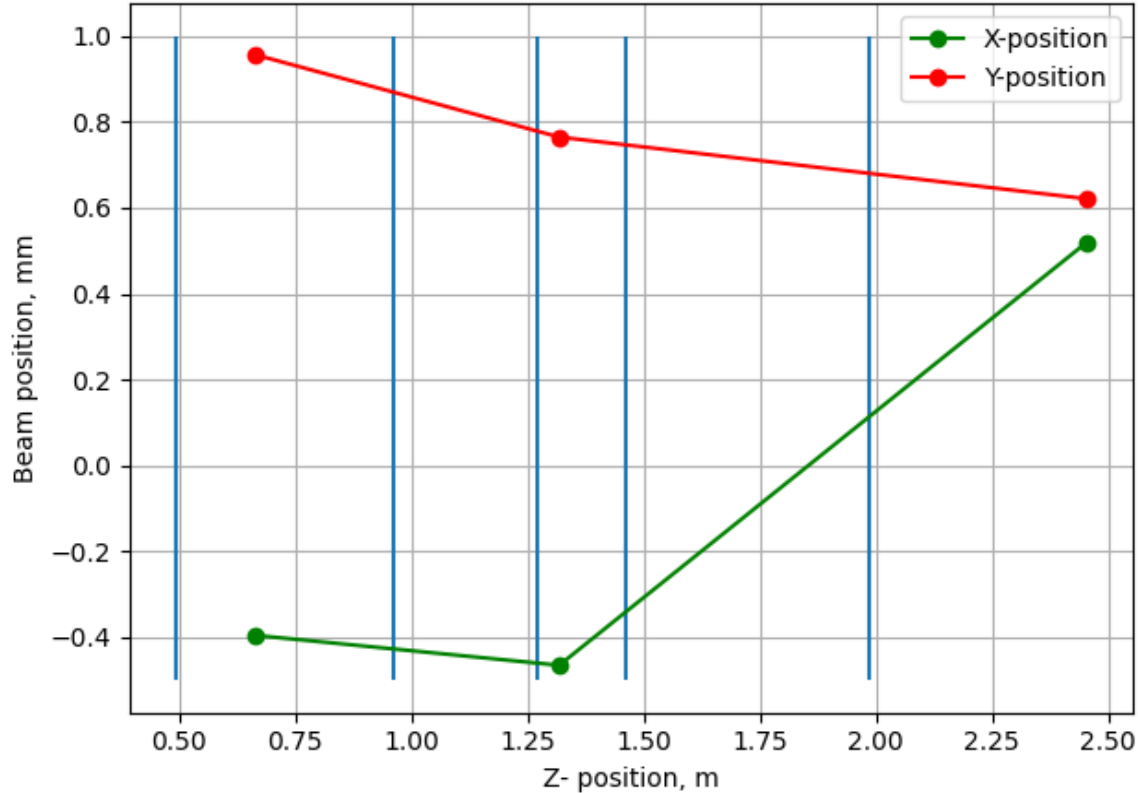## Solenoid current – beam position dependency
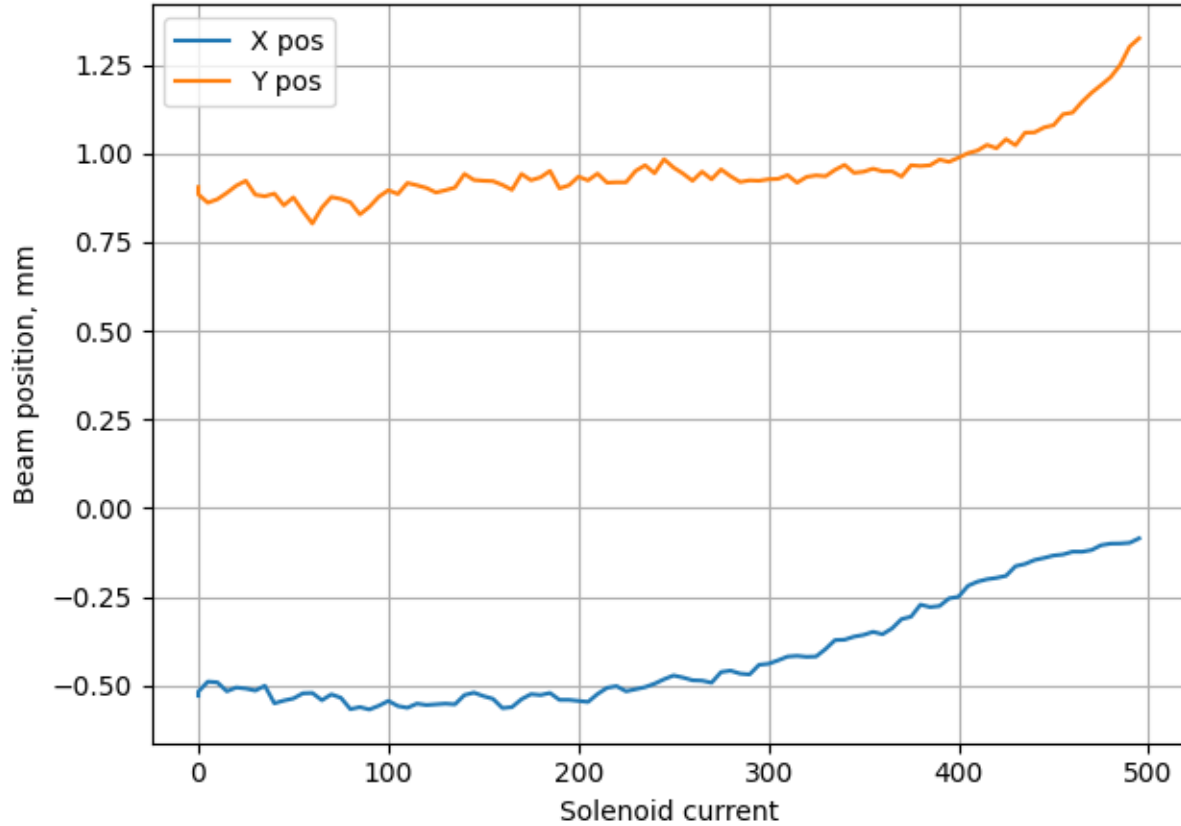
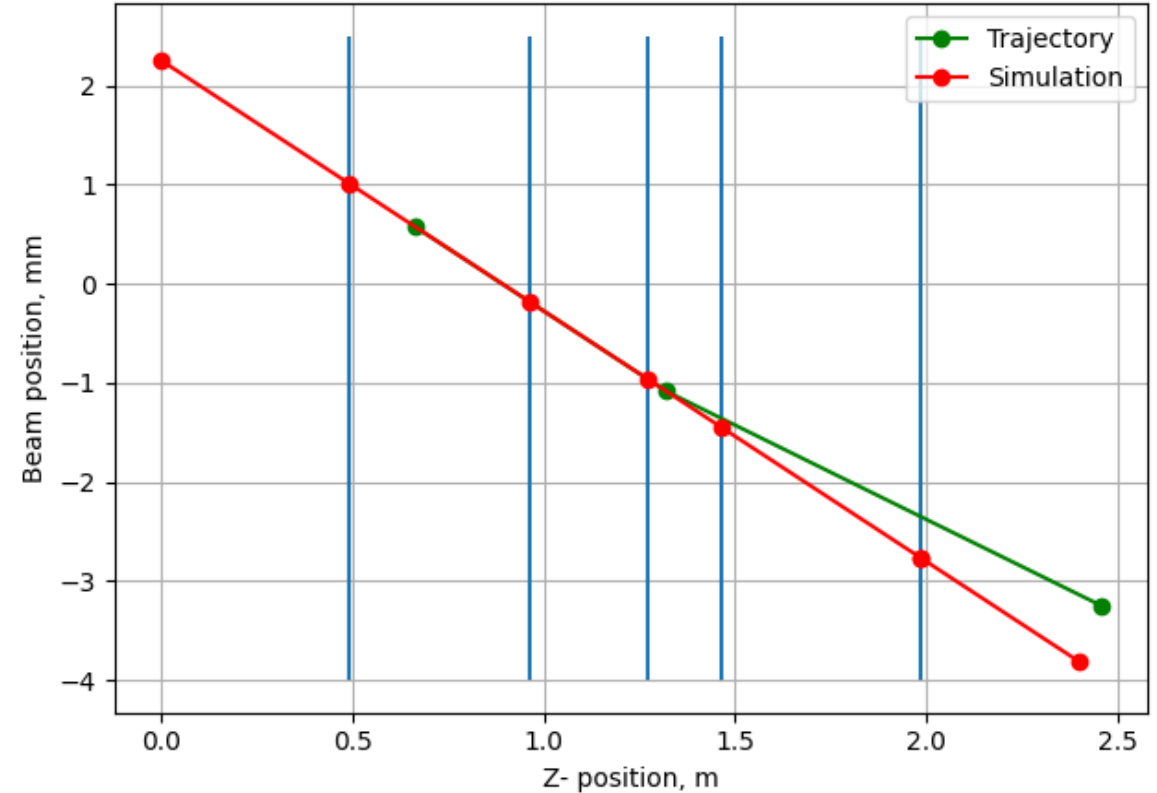LOW.ST1 IX = 1.9997
LOW.ST1 IY = 1.6998
LOW.ST2 IX = 1.1009

Beam trajectory modeling update

Initial X, X` Y, Y` of the center of the beam after the gun

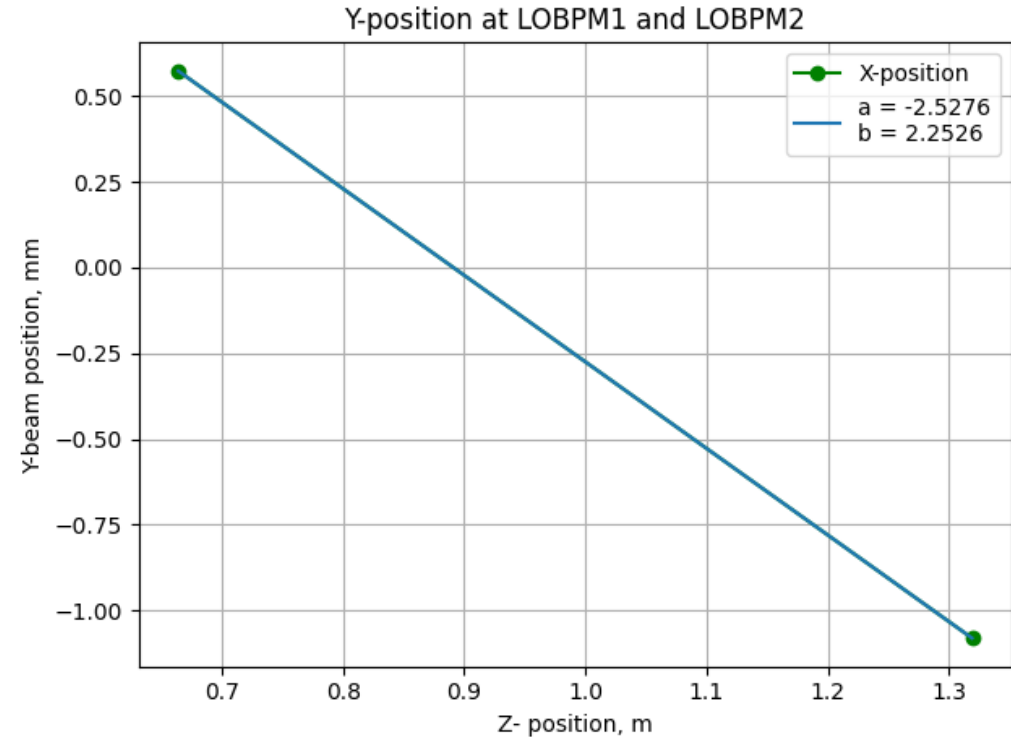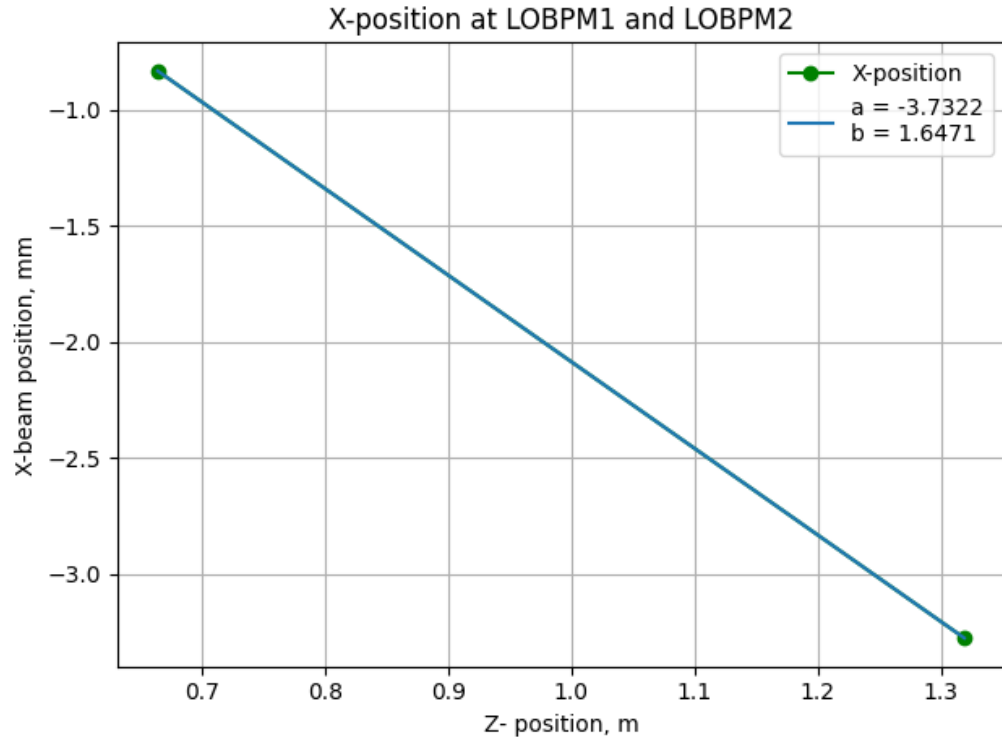

LOW.ST1 IX = 1.9997
LOW.ST1 IY = 1.6998
LOW.ST2 IX = 1.1009

LOW.ST1 IX = -0.0006
LOW.ST1 IY = 0
LOW.ST2 IX = 0.0006

X = 1.647 mm
X` = -1.3 rad
Y = 2.253 mm
Y` = -1.194 rad

Beam trajectory modeling update

Initial X, X` Y, Y` of the center of the beam after the gun

$Y = aX + b$ $X = b$ (fit) $Y = b$(fit) $X = 1.647$ mm

   $X` = \arctan(a)$      $Y` = \arctan(a)$ $X` = -1.3$ mrad

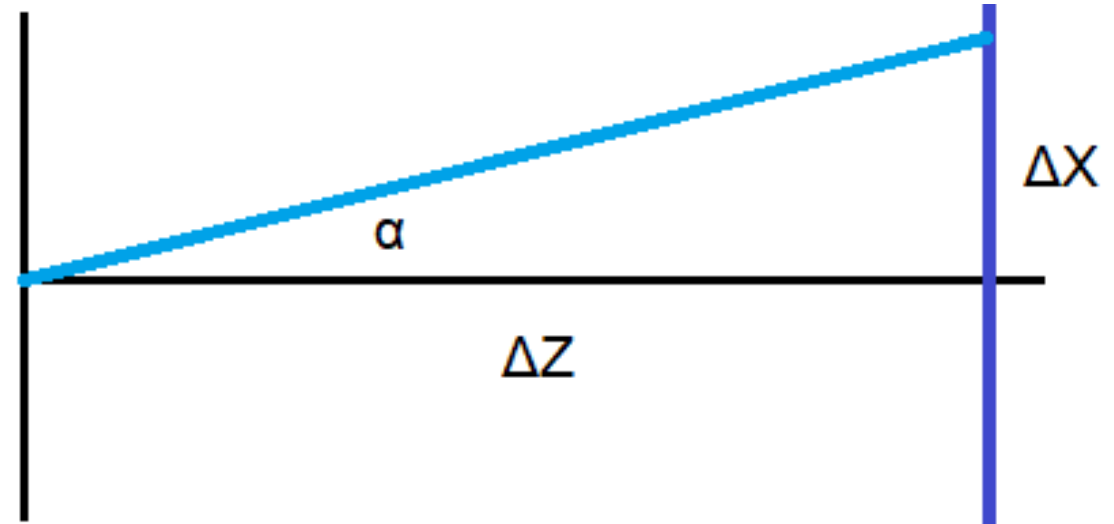 $Y = 2.253$ mm

                                                    $Y` = -1.194$ mrad

Beam trajectory modeling update

Steerers strengths (example for LOW.ST1 X-direction)
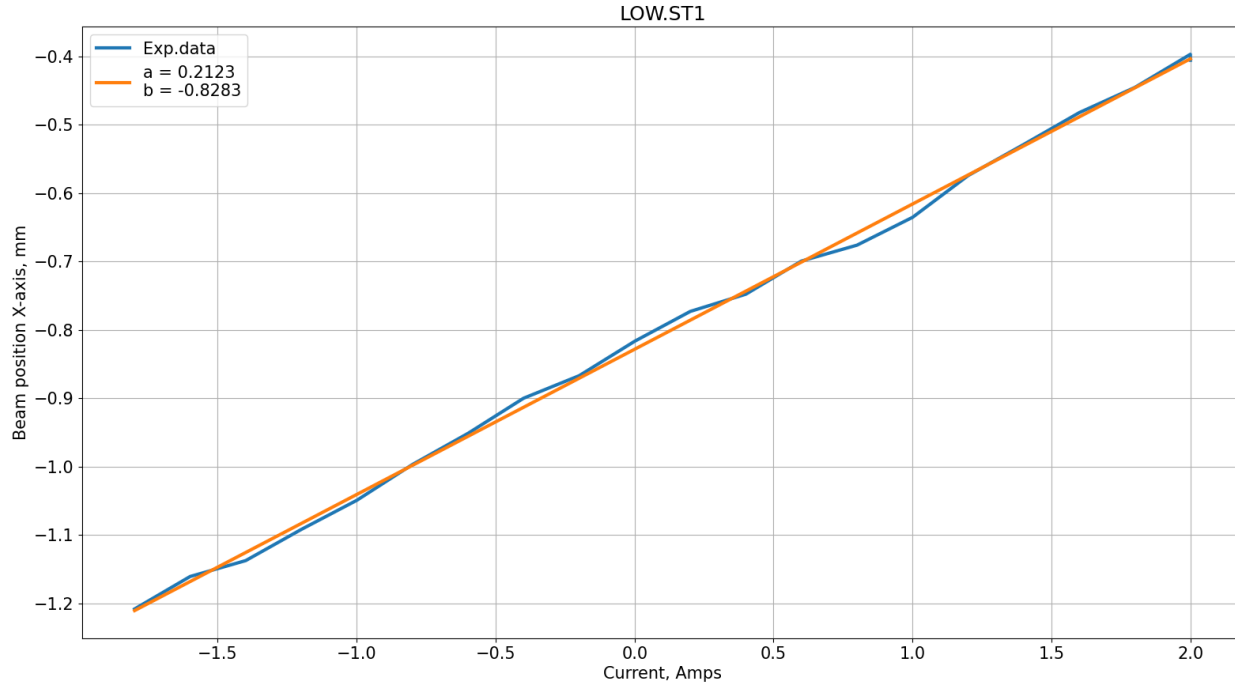
$\Delta X = 0.802$ $\tan(\alpha) = (\Delta X*0.001)/\Delta Z = 0.0047 => \alpha = 0.0047(rad)$ $p = 6.3168(LEDA)$

$\Delta Z = 0.172$

$\Delta I = 3.8$ $mrad/A = \alpha / \Delta I * 1000$ (1000 to go from rad to mrad) $S = mrad/(A*p) = 7.7511(7.7180)$

Beam trajectory modeling update

Steerers strengths

24.04.2023	X Strength	Y Strength	Kxy	Kyx
LOW.ST1	7.7511	7.9552	0.2282	0.2384
LOW.ST2	11.6088	0.0000	0.6377	0.0000
LOW.ST3	18.6380	22.0742	2.0721	2.0118
LOW.ST4	19.0968	18.4619	-0.1291	0.7179
LOW-HORI.S	2.4211	0.0000	0.3649	0.0000
LOW-VERT.S	0.0000	2.2583	0.0000	0.3921

01.2023	X Strength	Y Strength	Kxy	Kyx
LOW.ST1	7.7180	8.7155	-0.4528	0.3347
LOW.ST2	11.0364	0.0000	-0.7425	0.0000
LOW.ST3	19.7472	21.3395	1.8727	-2.0123
LOW.ST4	18.1826	20.1317	-0.2057	0.0617
LOW-HORI.S	2.6900	0.0000	0.0329	0.0000
LOW-VERT.S	0.0000	2.7197	0.0000	0.0203

Diff	X Strength	Y Strength	Kxy	Kyx
LOW.ST1	-0.0043	0.0956	-2.9843	0.4039
LOW.ST2	-0.0493	0.0000	-2.1643	0.0000
LOW.ST3	0.0595	-0.0333	-0.0962	-2.0002
LOW.ST4	-0.0479	0.0904	0.5934	-0.9140
LOW-HORI.S	0.1111	0.0000	-0.9098	0.0000
LOW-VERT.S	0.0000	0.2043	0.0000	-0.9483
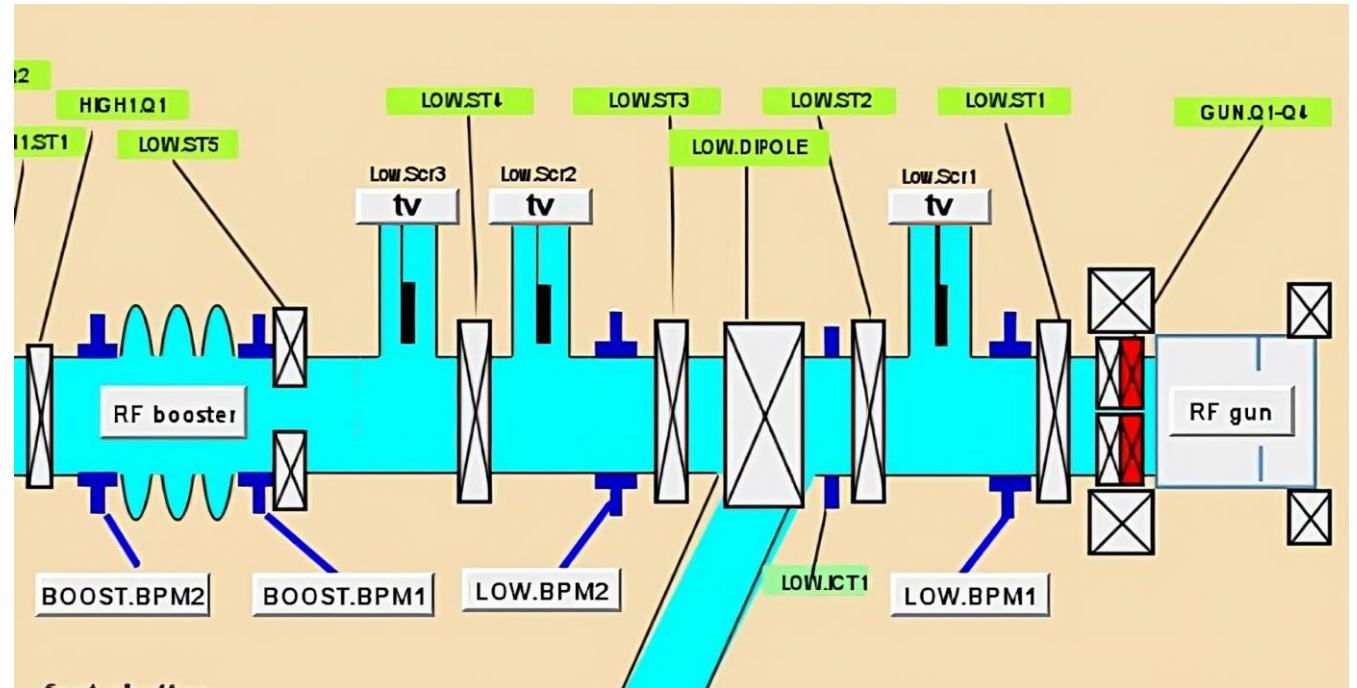
Beam trajectory modeling update

Outlook

- Implement steerers strengths in simulation script

- Check the simulation using gathered data

- Calculate the influence of the remnant fields

- Automatize checking of the initial beam parameters (X, X` Y, Y`)

- Create GUI for the scripts which save/restore magnets settings

- Next step is to gather data before/after booster and further in HIGH section

- Implement the influence of the quadrupoles on the beam trajectory