

Progress Update

William Shields
(william.shields@rhul.ac.uk)

WP6 Meeting

10th March 2023

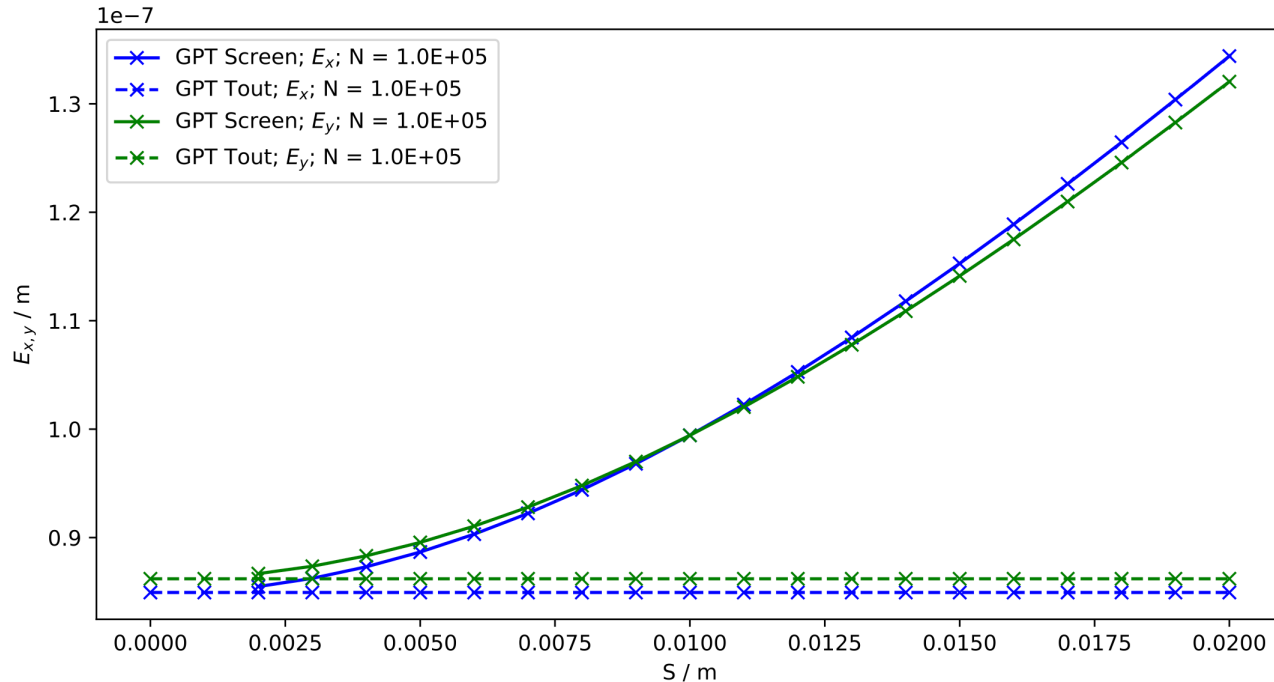


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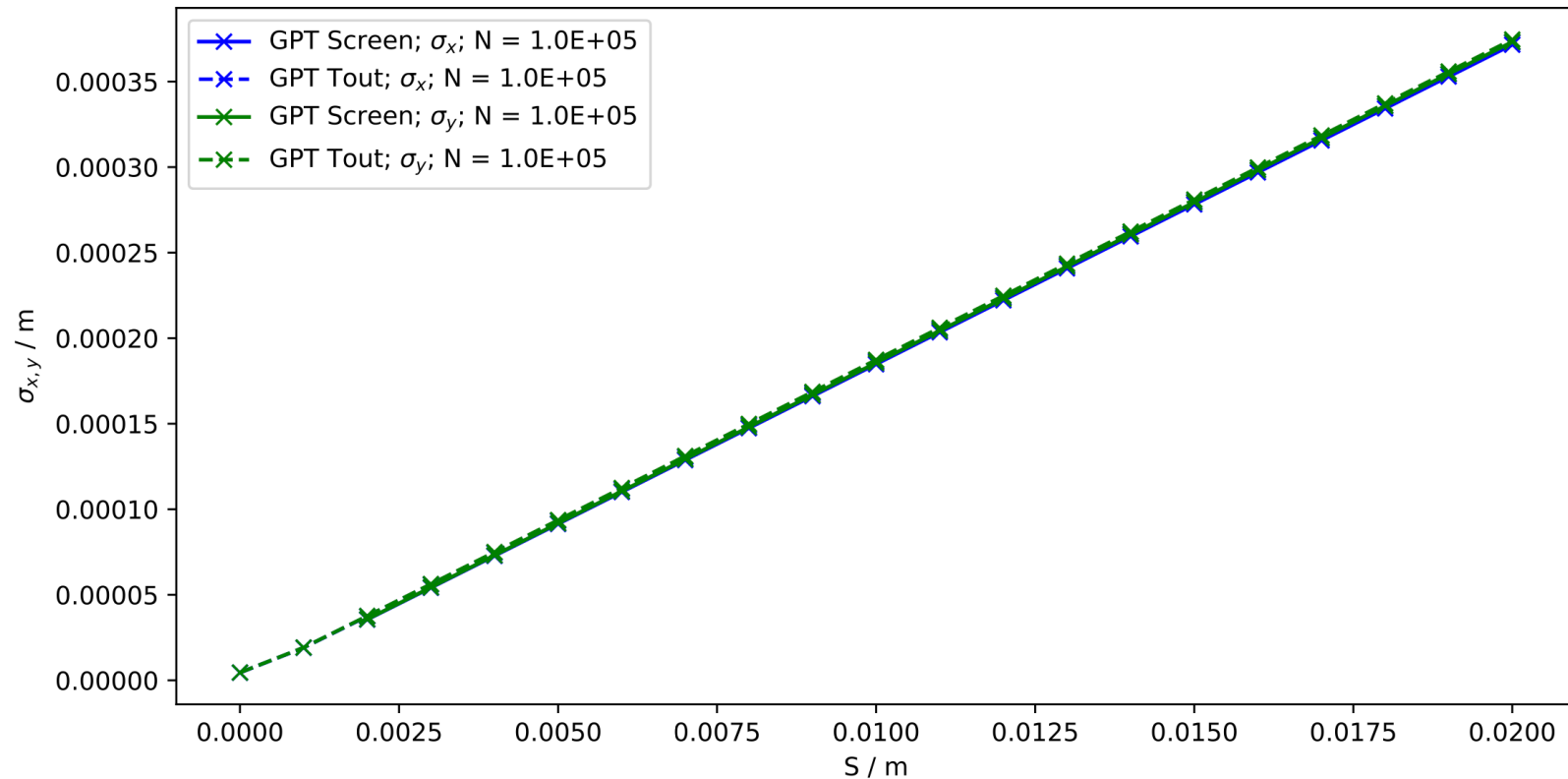


- No progress on optimisation
- Continued assembling & tabulating data for report
- Report write-up in progress
- Investigating emittance issue

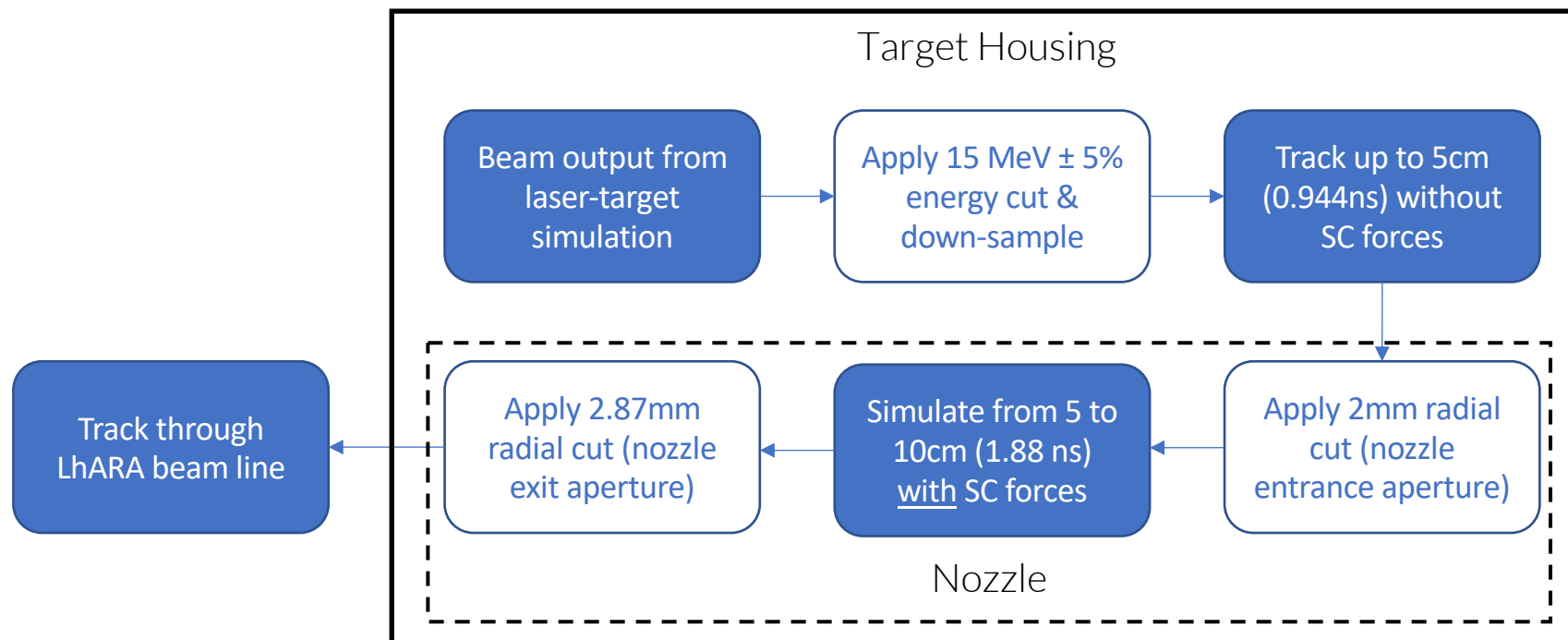
- Observing emittance growth without space charge:



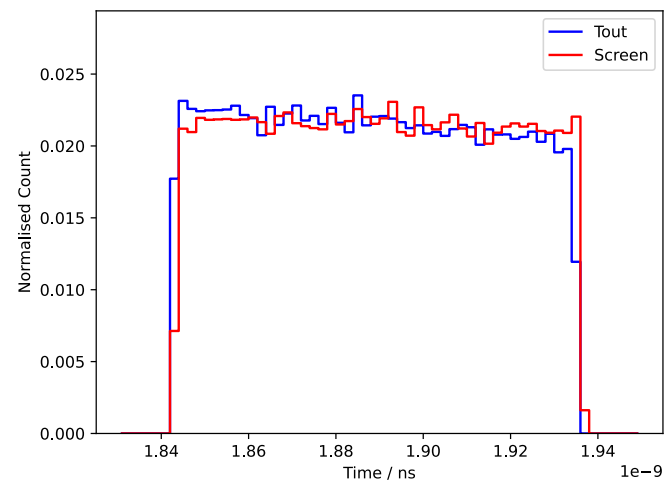
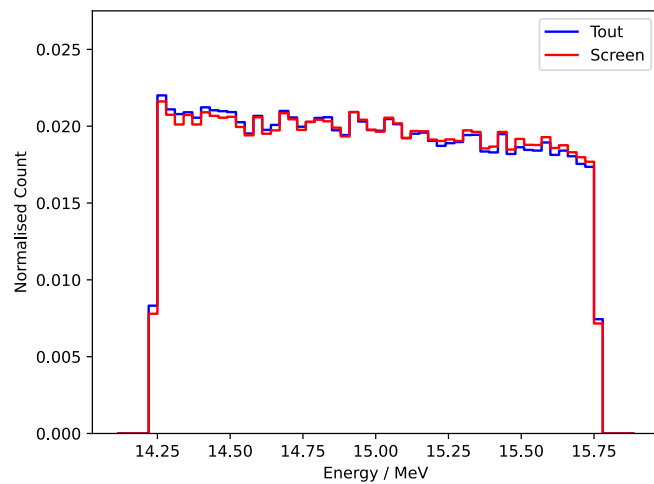
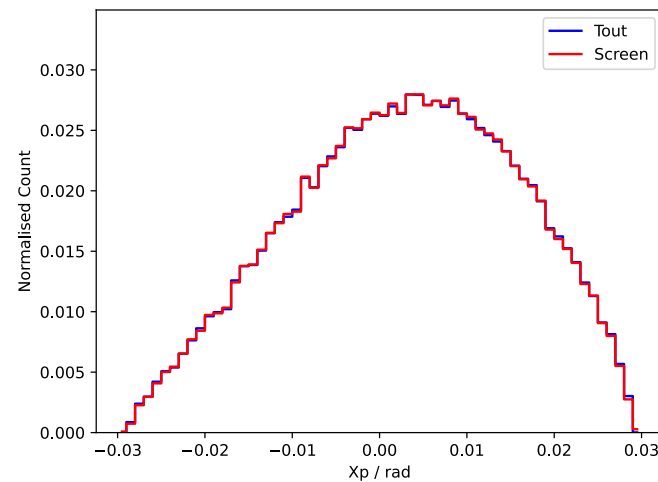
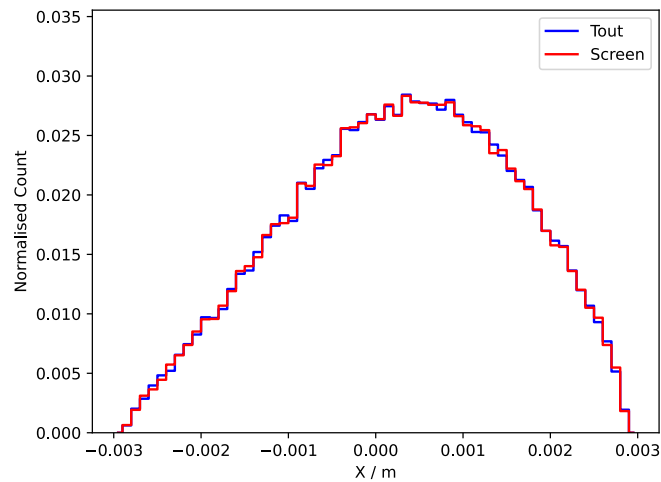
- Cause: GPT screens. No emittance growth observed when sampling in time.
 - Unknown reason why.
- Impact: minor
- Time snapshots will capture beams within magnetic fields
 - Accept that GPT won't be identical to BDSIM & MADX.



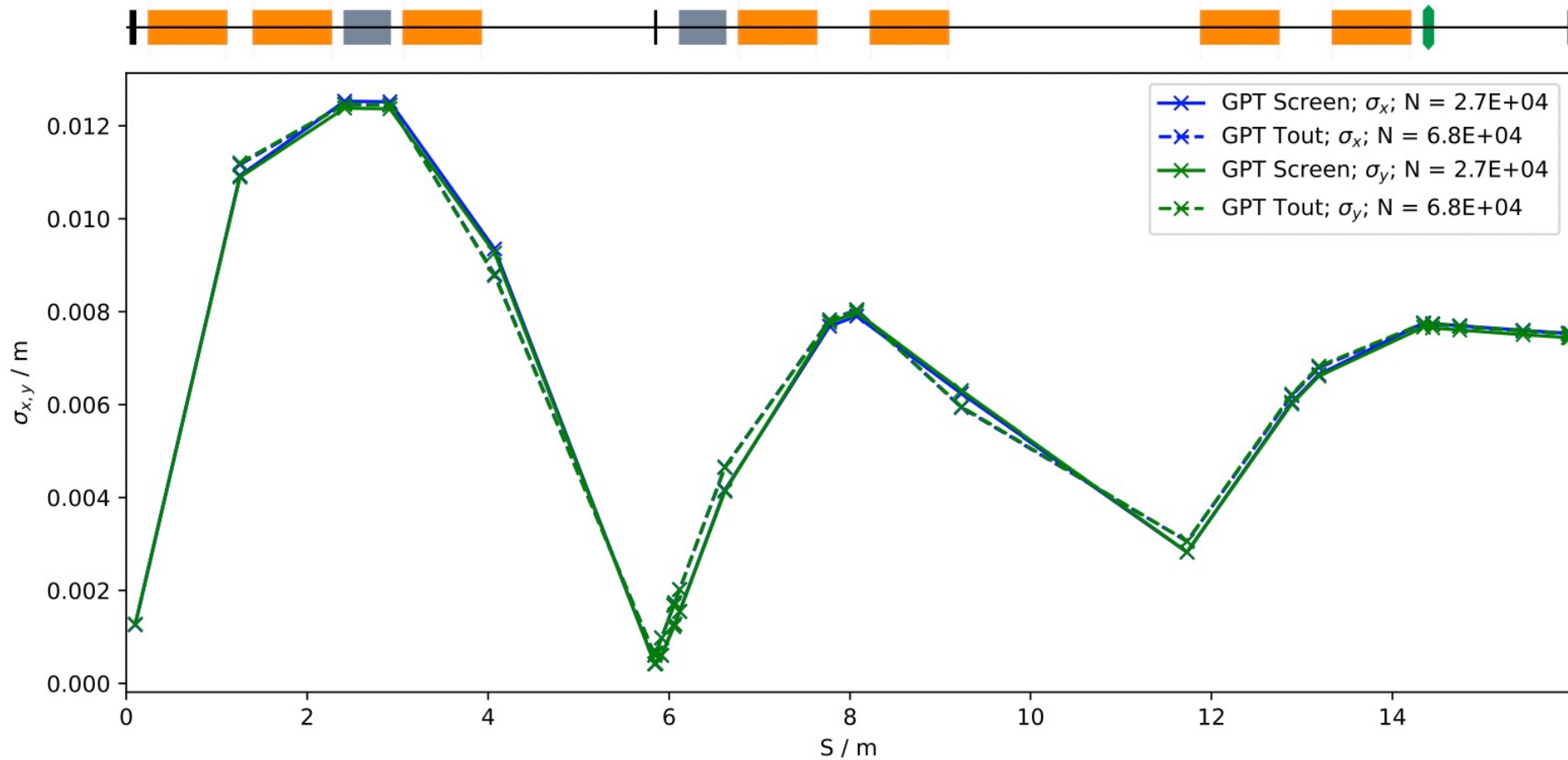
- Minimal impact on tracking
 - Beam size & momentum match well
- Conclusion: Don't use screens!



- Beam from laser-target simulation output tracked again (no screens)
- Initially down-sampled to 100k
- Second down-sampling after nozzle exit to 10k
 - Computational efficiency
- Regenerate some stage 1 tracking data -> weekend.



- Only time distribution showing notable differences
- $15 \text{ MeV} \pm 5\%$ (similar agreement for $15 \text{ MeV} \pm 2\%$)



- Good optics agreement without space charge
 - 3cm beam configuration settings (2 sigma diameter)

- Beam parameters at exit of target housing:

Beam Energy (MeV)	E_x (m rad)	E_y (m rad)	β_x (m)	β_y (m)	α_x	α_y
$15 \pm 2\%$	8.13e-8	7.82e-8	19.84	20.59	-201.03	-208.70
$15 \pm 5\%$	6.87e-8	6.72e-7	23.40	24.10	-236.43	-243.58

- Comparison to other beams :

- Factor ~ 1.75 difference between SCAPA screen & tout beams

	Smilei Sampled Beam	SCAPA Beam (Screen)	Scapa Beam (Tout)	Pre-CDR Beam
Mean RMS emittance [m]	1.43×10^{-8}	1.26×10^{-7}	7.98×10^{-8}	3.26×10^{-7}
Mean beta [m]	141.34	12.82	21.62	4.89
Mean alpha	-1418.43	-129.79	-222.23	-50.22

- Comparable nozzle transmission:

Beam Energy (MeV)	Initial Proton Distribution	Protons at nozzle entrance (with 2.00 mm cut)	Protons at nozzle exit (with 2.87 mm cut)	Nozzle Transmission (%)	Nozzle Transmission - Screen Data (%)
15 ± 2%	100000	88709	68044	76.70	76.80
15 ± 5%	100000	88704	69162	77.97	76.78

- Baseline update recommendations
 - Collimator for stage 2 operation, removal of 1st octupole
- Beam discussion
 - Motivation for pursuing performance with SCAPA beam
- Baseline design performance with SCAPA beam
 - Highlight doubts over flexibility to deliver different spot sizes
 - Low beta requirement for FFA injection line
- 7 Gabor lens configuration
 - Nominal performance
 - Space charge impact
 - Optimisation
 - Done (locally)
 - Ongoing
 - To do

- Done:
 - Identified cause of observed emittance growth issue – peculiar GPT behaviour
 - Re-simulated beam transport in the target housing
- Ongoing:
 - Write-up for 6 month report
 - Re-running of stage 1 beam transport simulations
 - Re-run optimisation routines with updated beam
 - Update models of alternative baseline design (v5.5)
- Todo:
 - Re-run collimation settings study
 - Determine nominal octupole settings
 - Quads only model (v6.0)
 - Develop OPAL model of FFA – need JP input.