

Simulation Update

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WP6 Meeting

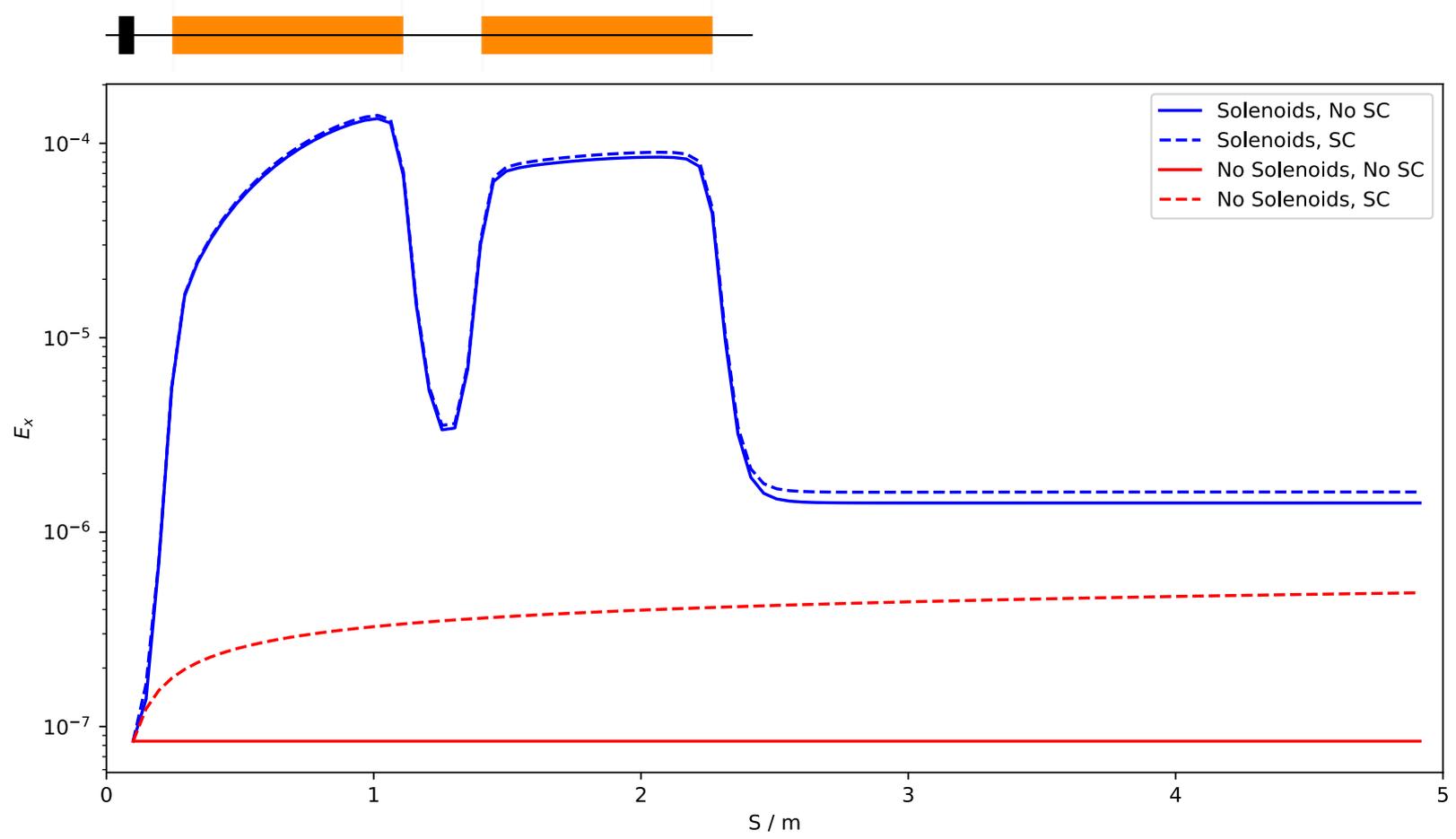
27th June 2023



ROYAL
HOLLOWAY
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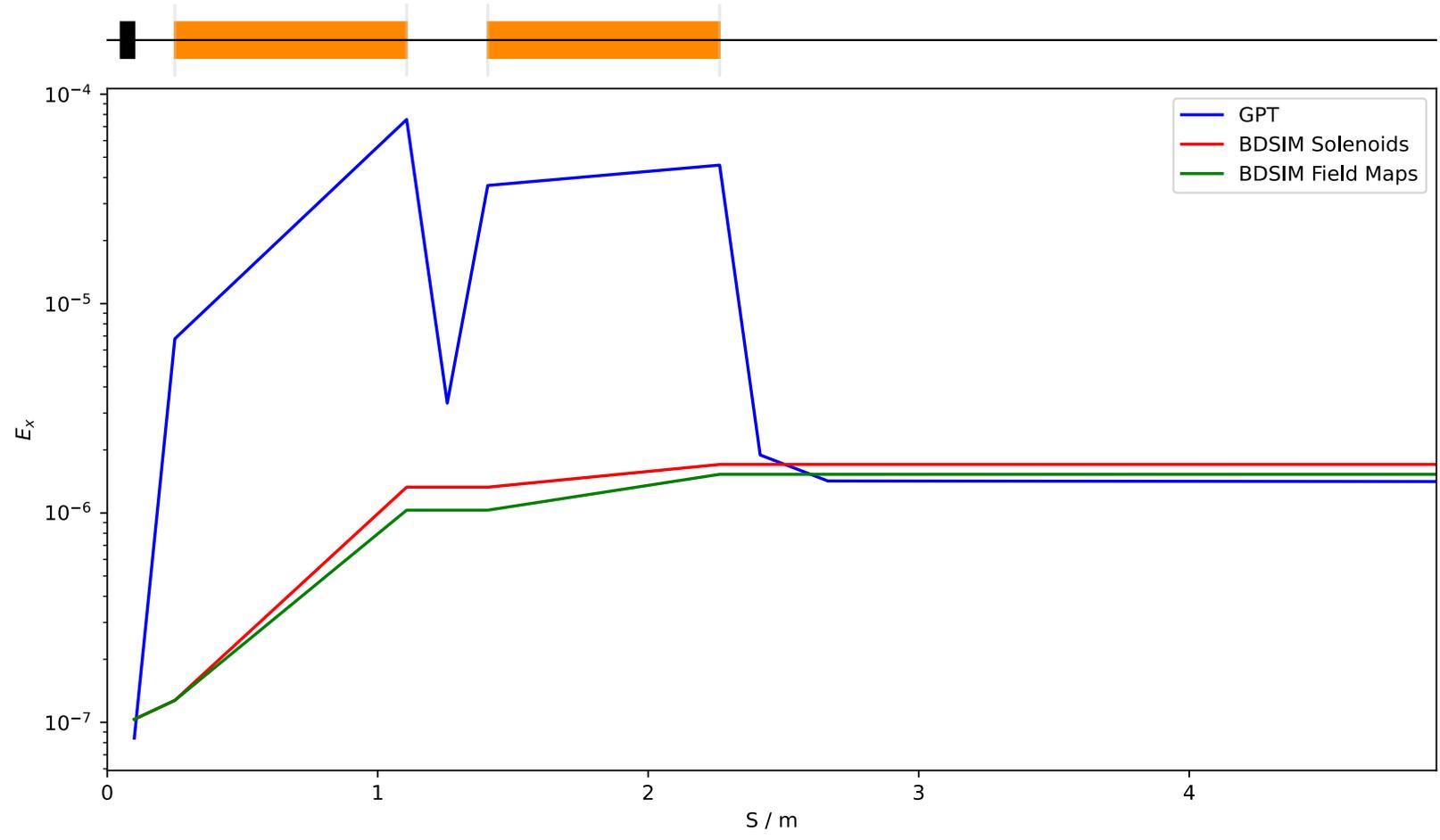


Capture Section Emittance



- Solenoids contribute biggest growth to the emittance (GPT)

Emittance: Solenoids Vs Field Map



- Similar behaviour for solenoids & Gabor lens field maps in BDSIM
- Imperfect models: hard-edged Gabor lens field maps & BDSIM solenoids .

	Mean RMS Emittance	Beta	Alpha	1 σ radius beam size (cm)
Nozzle End	8.100×10^{-8}	20.244	-204.991	0.128
Capture section	1.640×10^{-6}	102.931	0.317	1.289
Energy selection section (CAV02 mid point)	1.438×10^{-6}	5.423	-10.511	0.277
Matching section (start of vertical arc)	3.730×10^{-6}	15.216	-0.130	0.747

- Injection line condition, $\beta = 50\text{m}$:
 - $\sigma_x = \mathbf{1.365\text{ cm}}$
- Acceptable by the FFA?

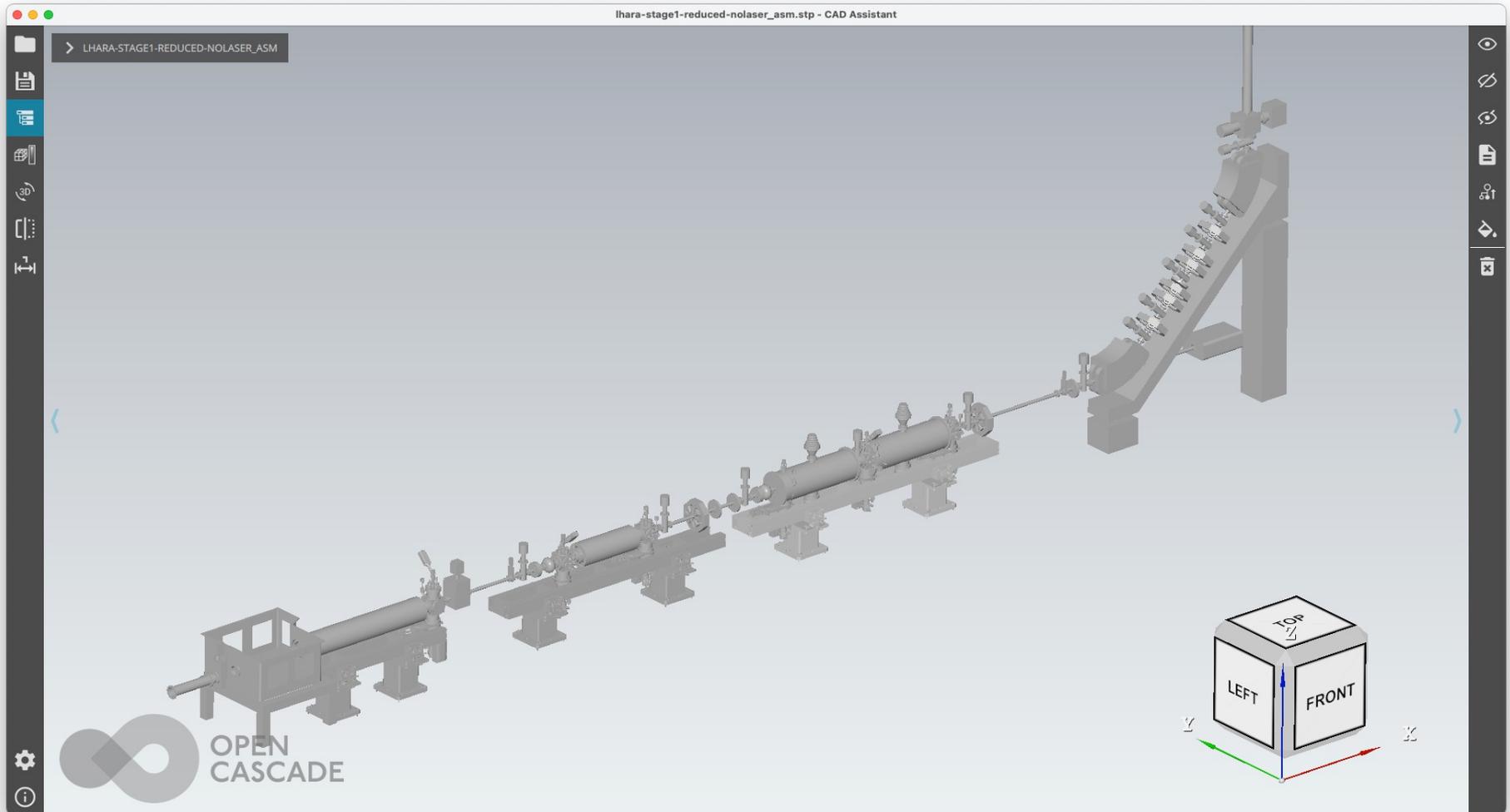
- Emittance growth due to energy spread in a laser-driven proton beamline
 - <https://doi.org/10.1016/j.rinp.2021.104779>
- Possibly simulate co-propagation of proton and electron beams with space charge:

The main simulation is a simple drift from the laser–target interaction point to the entrance of the focusing quadrupole triplet. We included an electron bunch alongside the proton bunches, with full space-charge interactions including all bunches together. The interesting features of the simulation are the unusual energy spectrum and the ability to vary a number of different beam parameters in a batch run.

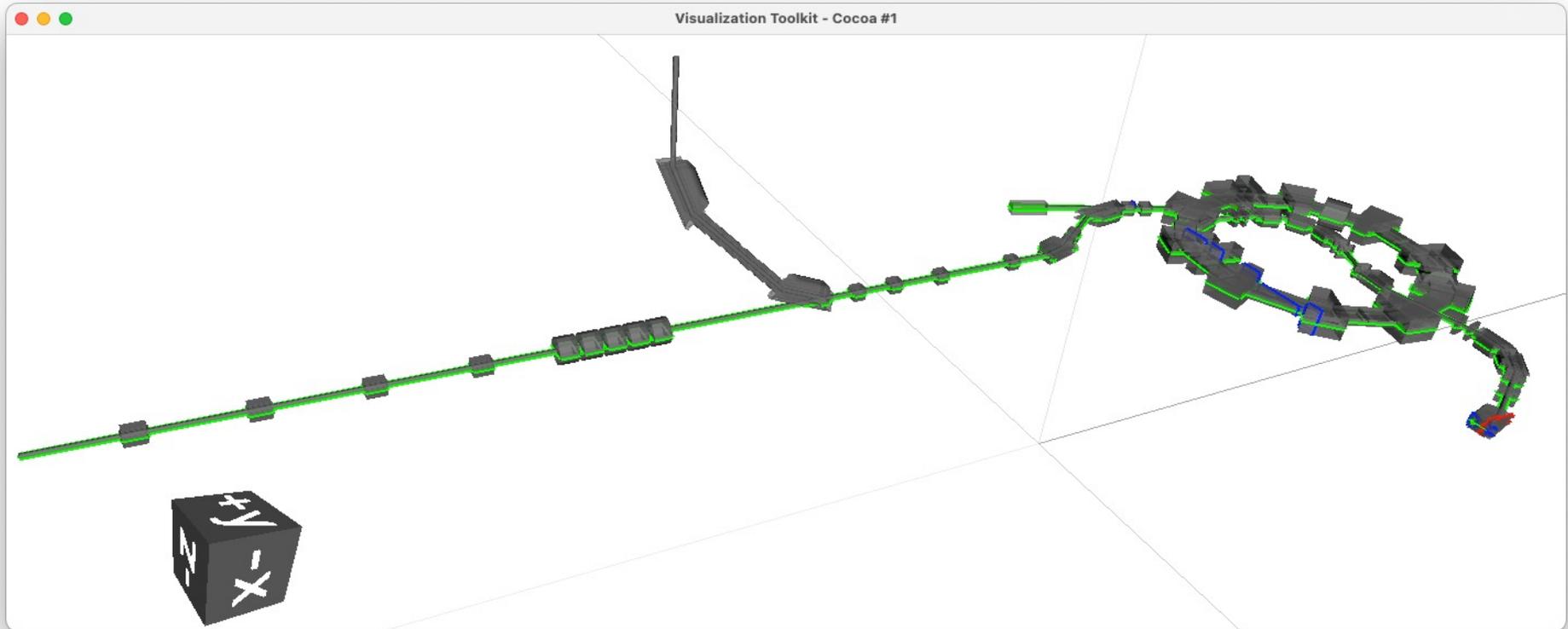
- IMPACT-T: (LBNL)
 - <https://github.com/impact-lbl/IMPACT-T>
 - Fortran:
 - Non-trivial input files
 - Parsing output for LhARA...?
 - Compiled on Mac, examples ran.

- WK1: Software installation, model intro, BDSIM end station dose
- WKS 2 – 6: Studies:
 - **End station dose**
 - Comparison to baseline design.
 - Stage 1 ion simulations? Missing beam data...
 - **Octupole strengths**
 - Beam uniformity, field strength feasibility
 - **Collimator settings**
 - Optimise transmission
 - Energy selection
 - **Injection line modelling with SCAPA beam**
 - Transport performance, collimation requirements.
 - Loss maps
 - Optimise aperture radius
 - Field maps in GPT
 - Comparative study, BDSIM & GPT, monitor emittance changes
 - Implement/update alternate models

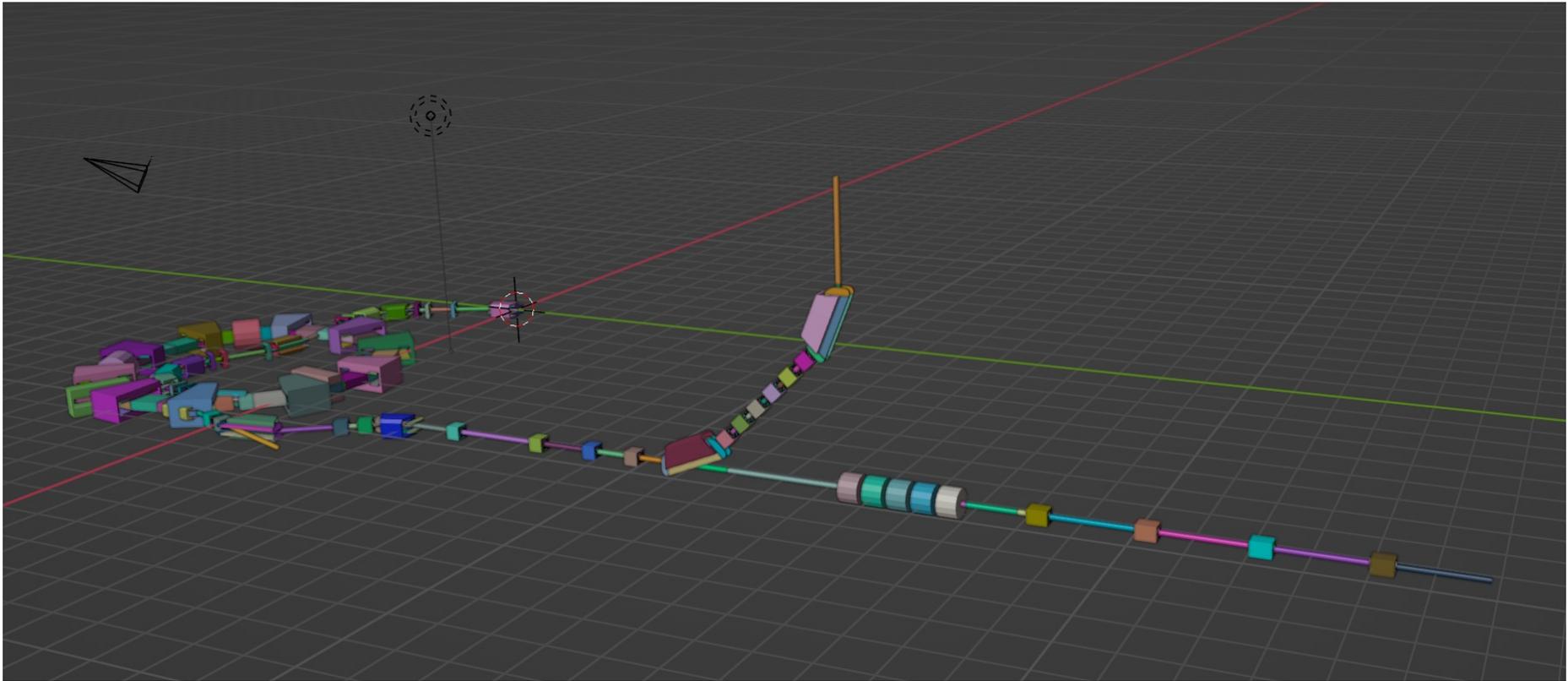
- Wk3 – Continued importing geometry into Blender (3D renderer) for outreach
 - NOT final material – examples, workflow, object library
 - Interrupting next week for vacation & personal activities, returns in August
- Identify AR / VR workflow
 - Input from Stewart Boogert needed on BDSIM models & particle tracks – can include.
- Geometry conversion issues:
 - Limited Blender import file types (stl, glb, ...)
 - Limited PTC Creo export file types (stl, step,)
 - Some STL won't export from Creo
 - Cherry-pick the CAD model, convert troublesome parts/assemblies to Step & convert in pyg4ometry
 - E.g. Laser
 - Hybrid geometry workflow
 - Guide being written
- LONG render times – Mac Studio ordered on RHUL outreach budget



- Some overlapping geometries removed (e.g. target chambers)



- Export BDSIM model, convert to stl with pyg4ometry.
 - Some meshing errors (quads in high energy vertical arc)



- Imported Blender geometry trivial.



- Combination of:
 - PTC exports
 - Pyg4ometry conversion
 - License-free objects & textures.
- Ongoing:
 - Further geometry
 - Improved textures
 - Lighting
 - Camera motion

- Done:
 - Write talk for IOP PAB
 - Investigate emittance growth from solenoids/lenses vs space charge.
 - Check field map – no fringes
- Ongoing:
 - Data regeneration – data loss
 - Re-run optimisation routines
- Todo:
 - Comparison to baseline design
 - Test IMPACT-T & model LhARA beam.
 - Update models of alternative baseline design (v5.5)
 - Develop OPAL model of FFA – need JP input.