



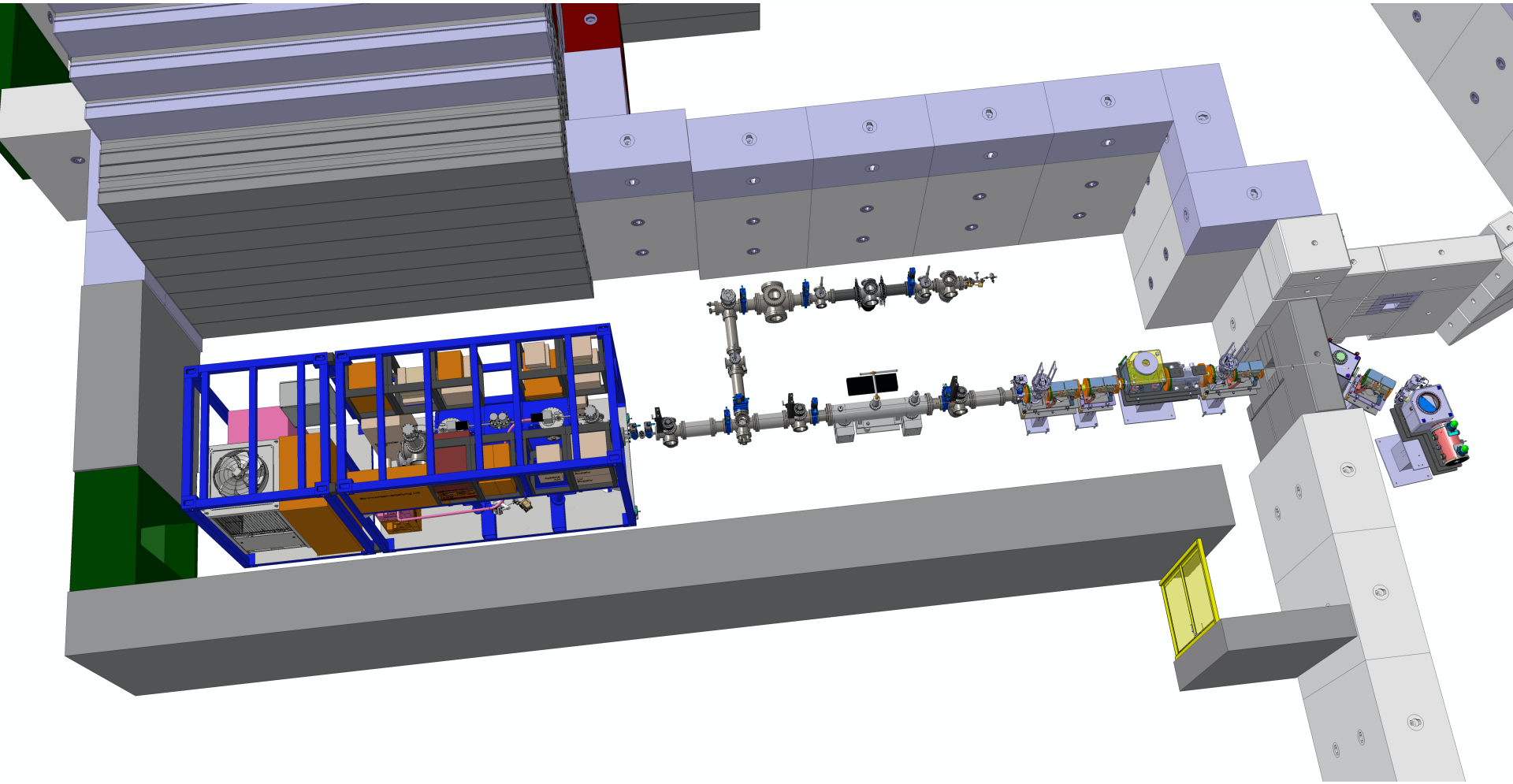
ELENA LNE51 modifications for PUMA

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Summary of checks

- Baseline layout and optics from AEGIS ECR proposal:
 - EDMS #1891119 (obsolete)
 - http://acc-models.web.cern.ch/acc-models/tls/2021/elena_extraction/lne51/line/
- New layout proposal has been implemented in MADX
 - Integration verified by Damien
 - Option to switch to another line (LNE52) retained
 - Number of transfer line elements remains the same
 - Naming may need updating in second iteration
- Original optics requirements can be met with quite some flexibility within voltage limits (± 6 kV)
 - Strength of last 4 matching quadrupoles varied only

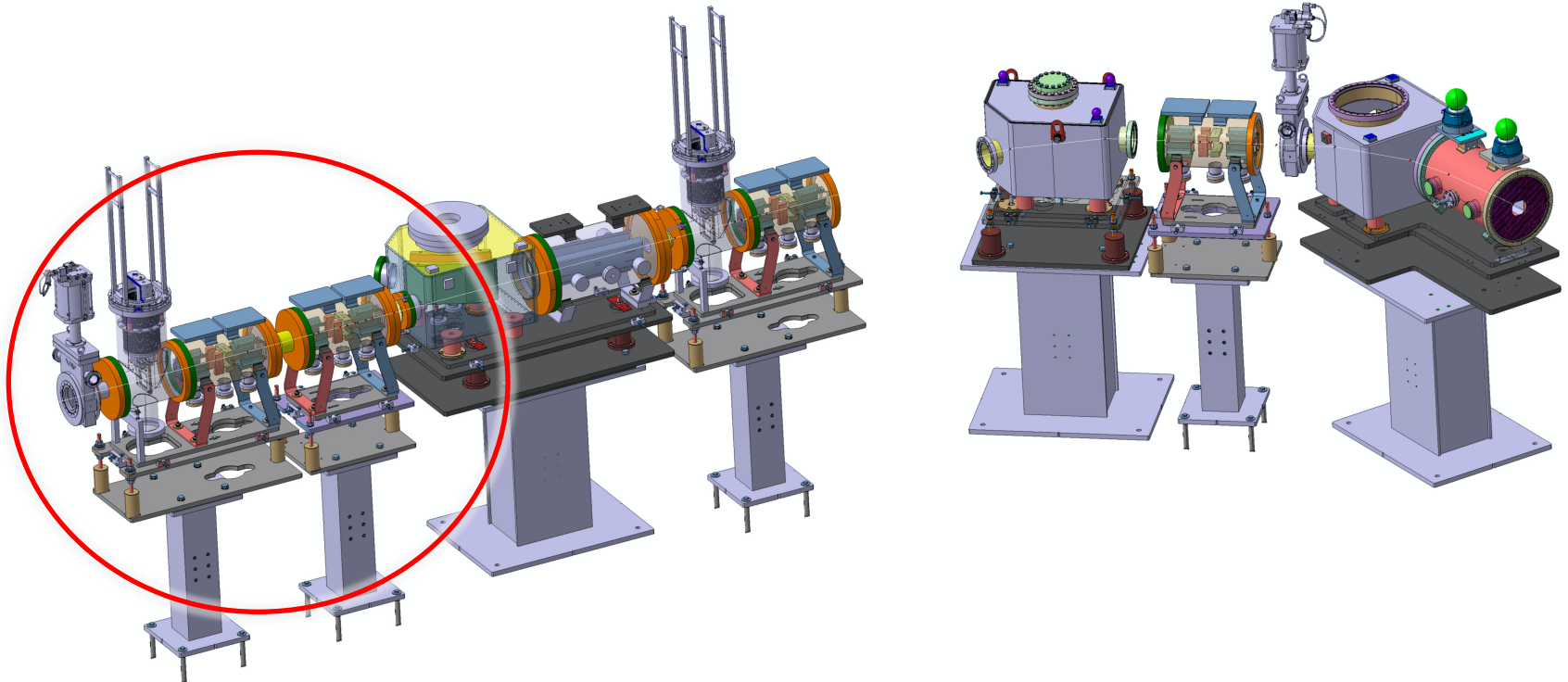
New layout implemented in MADX (1)



New layout implemented in MADX (2)

Quick checks made on flexibility of optics by varying matching quad strength only:

- ZQMF.5130, ZQMD.5131, ZQMD.5138, ZQMF.5139



Handover parameters

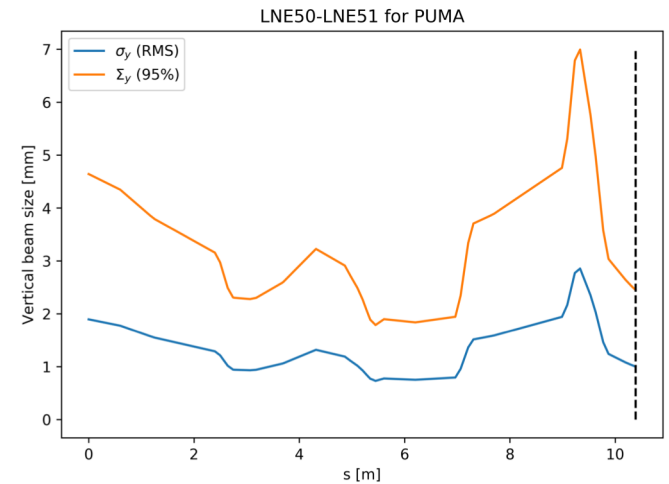
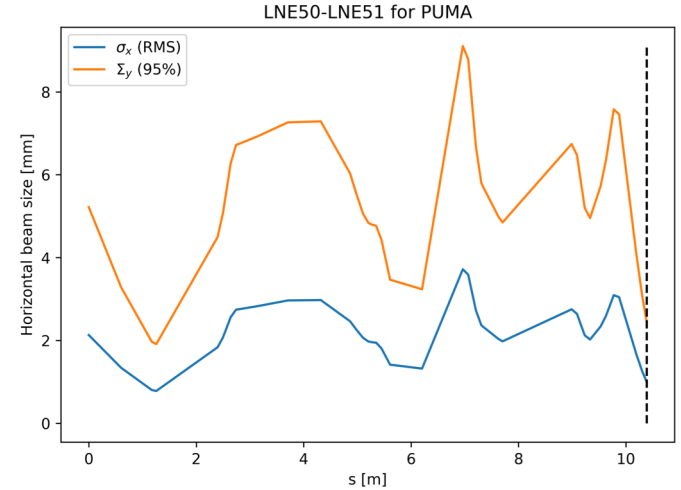
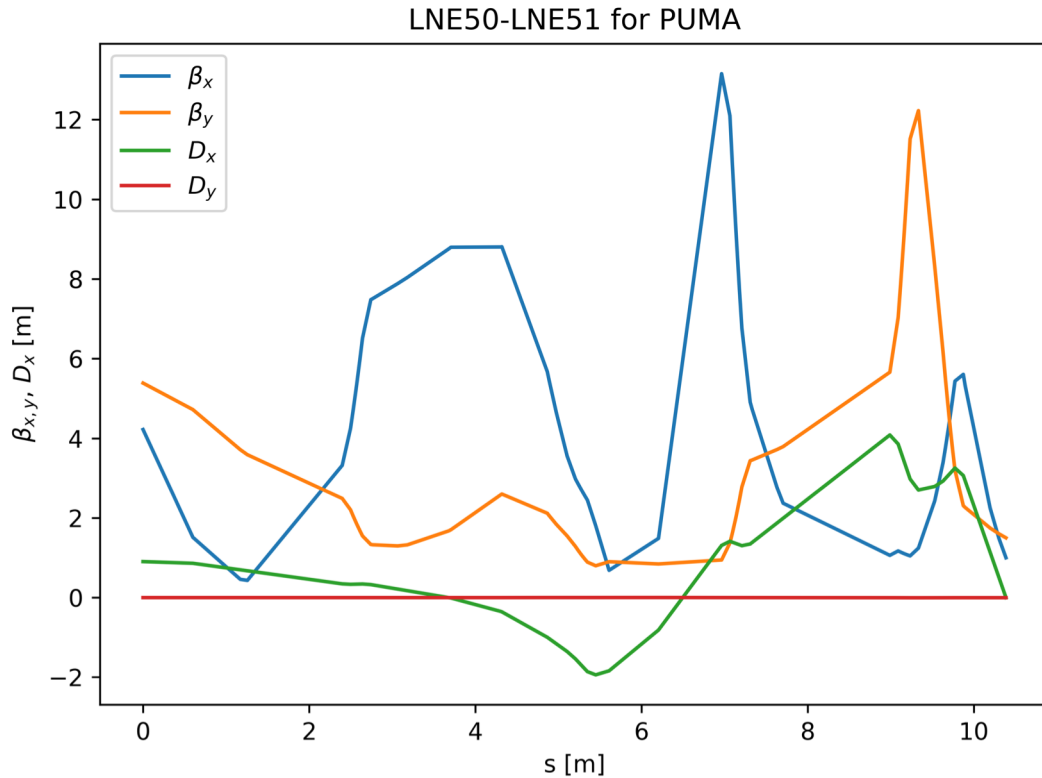
- ELENA experiment handover beam parameters:
 - Hard-focus to a small beam size
 - Typically, RMS beam size $\sim 1 - 2$ mm in both H and V
 - Dispersion made as small as possible
 - Twiss tables of beam parameters found attached
 - Comments:
 - Not ideal if matching to a downstream optical system
 - Once we agree on layout/parameters I will update the optics repository
 - Dispersion given by MADX needs multiplying by the relativistic velocity = 0.146

Optics: 1 mm focus

Re-matched for $\sigma = 1$ mm and $D = 0$ m
in both planes

$$\begin{aligned} \varepsilon_{H,RMS} &= 6 \mu\text{m} \\ \varepsilon_{V,RMS} &= 4 \mu\text{m} \end{aligned} \quad \left. \frac{\Delta p}{p} \right|_{RMS} = \frac{2.5}{4} \times 10^{-3}$$

$$\sigma = \sqrt{\beta \varepsilon_{RMS} + \left(D \frac{\Delta p}{p} \right)_{RMS}^2}$$



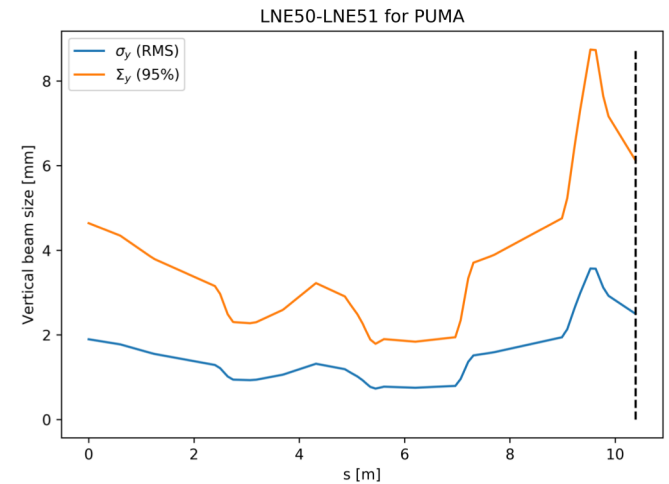
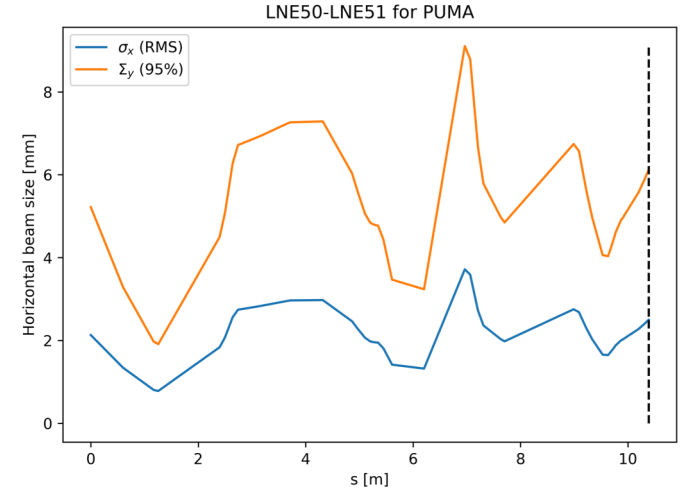
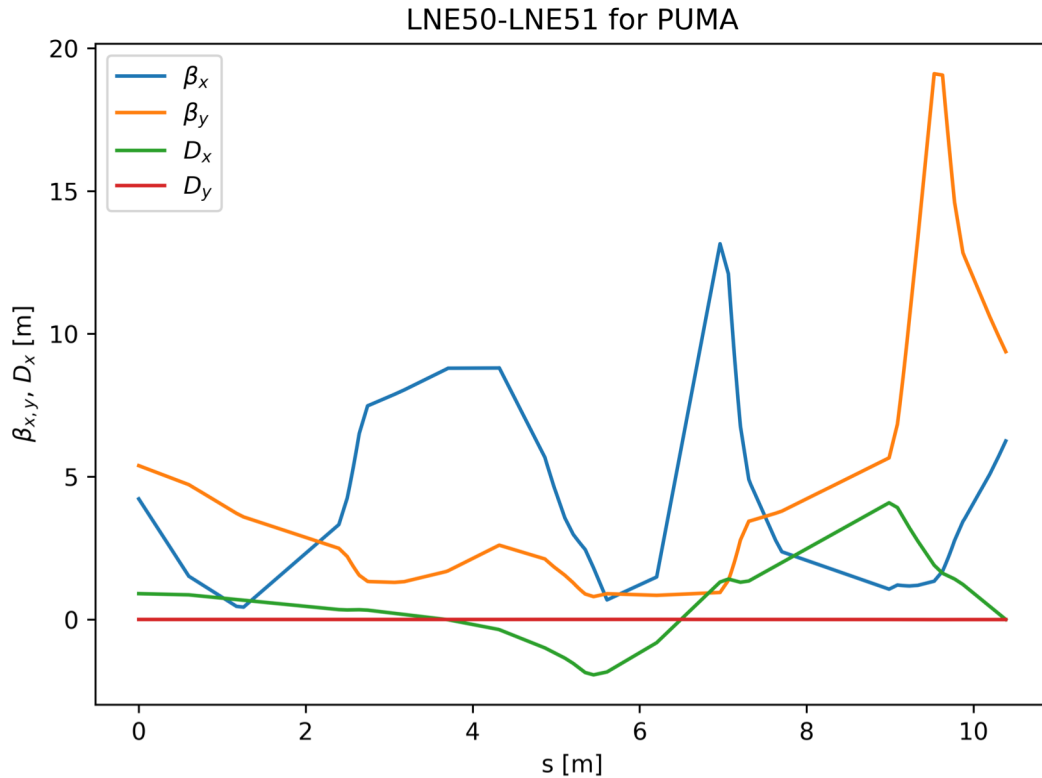
Optics: 2.5 mm focus

$$\sigma = \sqrt{\beta \varepsilon_{RMS} + \left(D \frac{\Delta p}{p} \Big|_{RMS} \right)^2}$$

Re-matched for $\sigma = 2.5$ mm and $D = 0$ m
in both planes

$$\varepsilon_{H,RMS} = 6 \mu\text{m} \quad \frac{\Delta p}{p} \Big|_{RMS} = \frac{2.5}{4} \times 10^{-3}$$

$$\varepsilon_{V,RMS} = 4 \mu\text{m}$$



Conclusion

- New LNE51 layout for PUMA can provide the beam parameters requested by typical ELENA experiments
- A range of beam parameters can be provided within the voltage limits of the HW
- In a next step, optics parameters could be matched to parameters requested by PUMA:
 - We can match not just to beam size but to specific Twiss parameters for PUMA's optical system...
 - e.g. no particular need to force dispersion to zero