Capture Section Optimization

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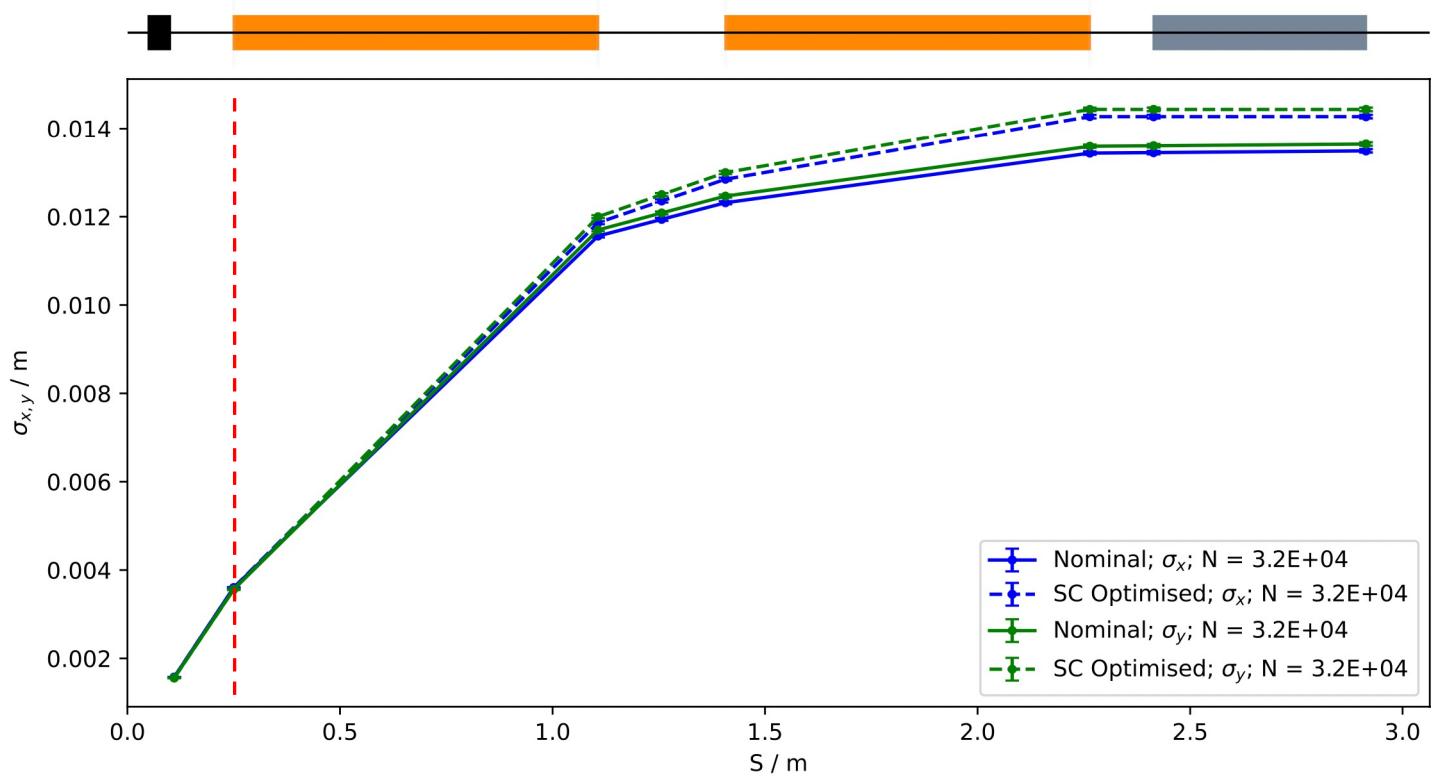
ROYAL HOLLOWAY UNIVERSITY OF LONDON

BDSIM

LhARA Laser-hybrid Accelerator for Radiobiological Applications

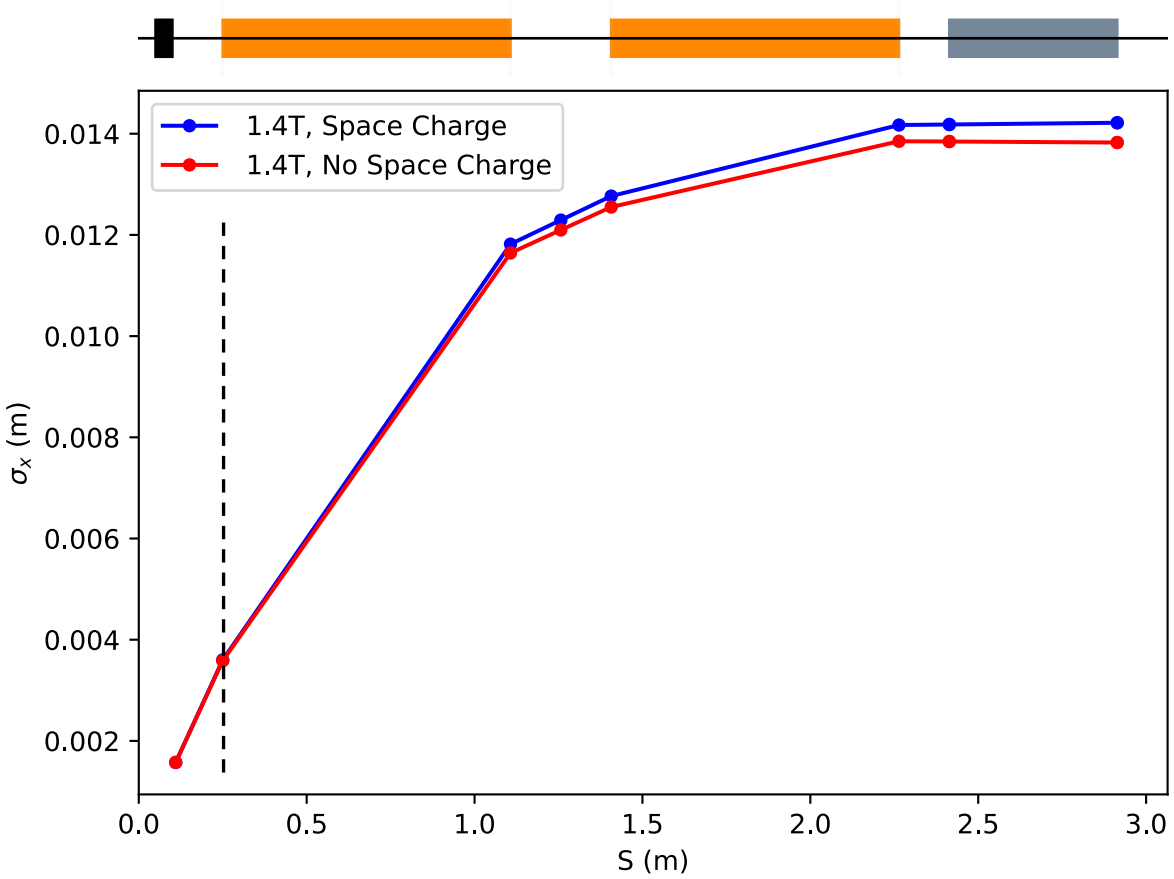
JAI John Adams Institute for Accelerator Science

Solenoid Strength Optimisation



- MADX optimisation after GPT space charge simulation (target housing exit to solenoid 1):
  - Cannot produce nominal parallel beam with solenoids < 1.4 T
  - Smallest achieved parallel madx beam after capture section (1.4T constraint):
    - β_X : 1550 m, α_X = 1.6e-4
    - LHA_TR_MAG_SOL_01: **1.392 T** (initial: 1.4387 T)
    - LHA_TR_MAG_SOL_02: **0.579 T** (initial: 0.5271 T)

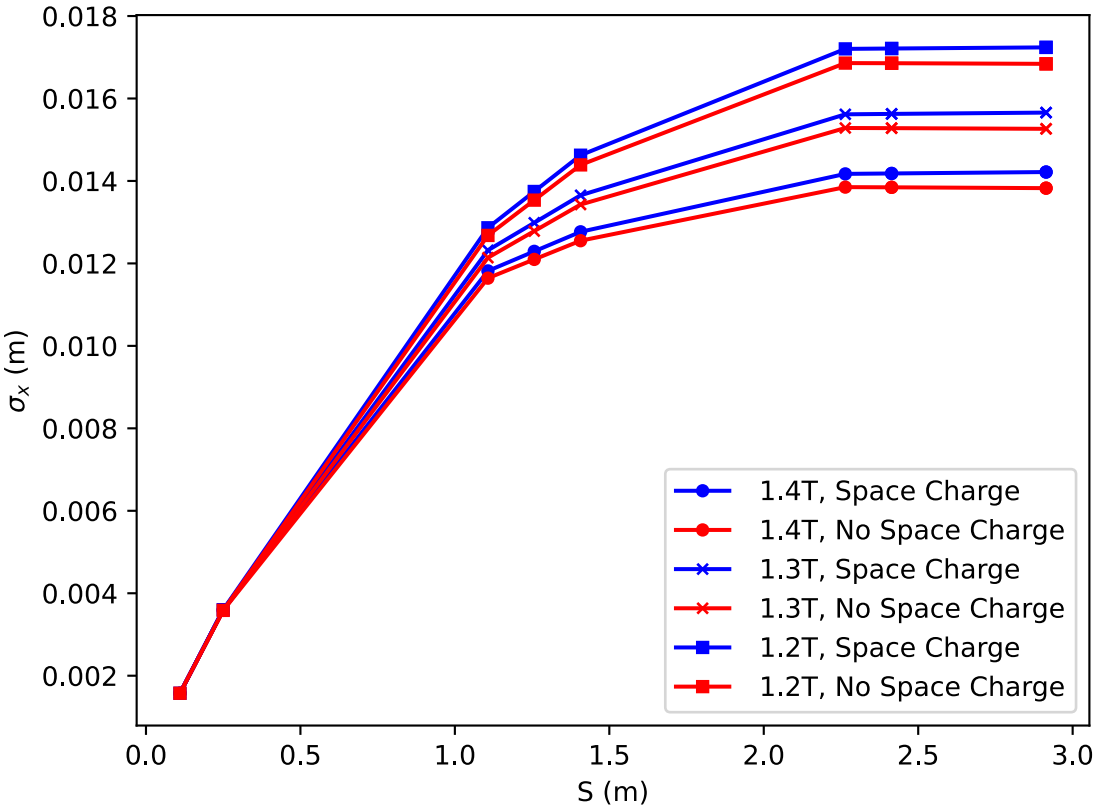
Solenoid Strength Optimisation



- Space charge forces still impact performance despite MADX optimisation efforts
  - Neither beams completely parallel
    - ~ 0.2% beam size growth over 0.5m cavity length
    - Sensitive to initial beam parameters
- <u>GPT optimisation is needed.</u>

Lower Field Constraints

- 1.3T:
  - Smallest parallel β_x ~ 1880 m
  - LHA_TR_MAG_SOL_01: **1.300 T**
  - LHA_TR_MAG_SOL_02: **0.659 T**
  - Beam size: ~15.6 mm
- 1.2T:
  - Smallest parallel β_x ~ 2270 m
  - Beam size: ~17.2 mm
  - LHA_TR_MAG_SOL_01: **1.193 T**
  - LHA_TR_MAG_SOL_02: **0.725 T**



- Less divergent for larger beam – space charge effects.

Summary

- Done:
  - Madx optimization method of capture section for parallel beam
    - Space charge still impacts tracking performance

- Ongoing:
  - Continued capture section optimization
  - Recheck GPT optimisation scripts & send
  - Update models with JP modifications

- Todo:
  - Develop OPAL model of FFA – need JP input.