

# Modelling the ALICE Electron Beam Properties Through the EMMA Injection Line Tomography Section

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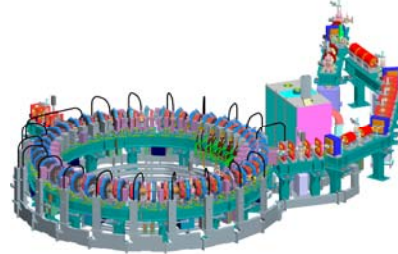


## EMMA:

- Electron Machine with Many Applications;
- Non-scaling electron FFAG being built at Daresbury Laboratory;
- NS-FFAGs related to EMMA have an unprecedented potential for:
  - Medical accelerators for carbon and proton hadron therapy;
  - ADSR (Accelerator Driven Sub-critical Reactor).

## MAD8 modelling (no space charge)

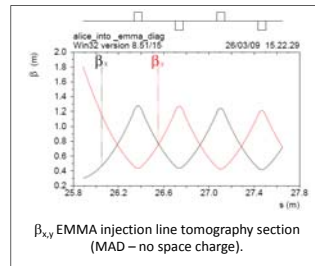
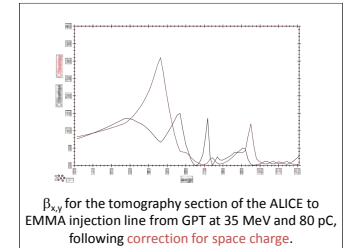
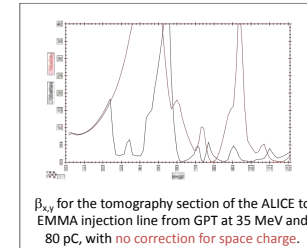
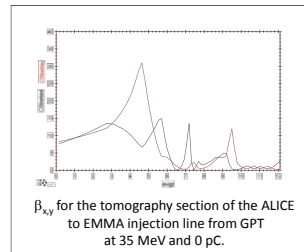
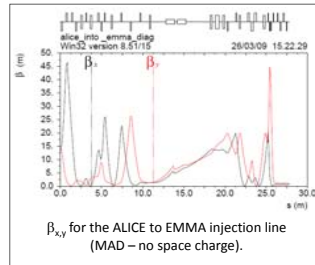
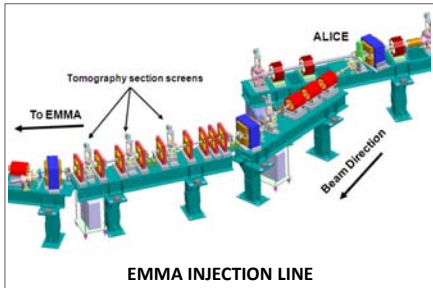
- Initial modelling of the ALICE to EMMA injection line with MAD8;
- Standard ALICE tuning:
  - 8.35 MeV injector beam;
  - 35 MeV after second superconducting module;
- Matched into the existing tomography section design for EMMA.



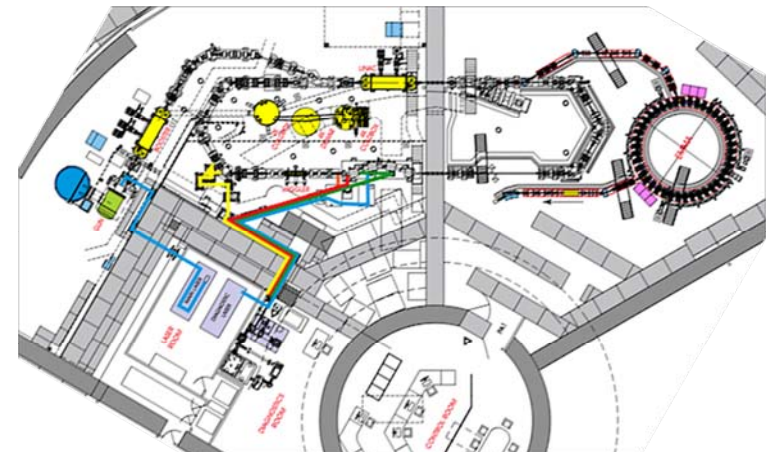
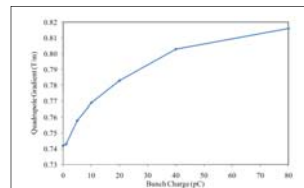
## GPT modelling (with space charge)

- 35 MeV beam from the exit of the second superconducting module;
  - Using the Twiss parameters derived from the MAD modelling;
  - Initially repeated with zero bunch charge;
- Repeat the matching while progressively increasing the bunch charge from zero up to 80 pC;
- Use the quadrupole settings obtained at the previous (lower) bunch charge as a starting point.

The degree of agreement between 0 and 80 pC is very good; this suggests that the combination of 80 pC and 35 MeV is not too difficult for this technique.



Note that zero metres on GPT plots corresponds to  $s = 15.7$  m on the MAD results.



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## EMMA injection line

- Upgraded to operate at the nominal ALICE operating energy of 35 MeV (c.f 20 MeV max. for EMMA) by:
  - Uprating of the magnet power supplies;
  - Addition of OTR screens in parallel with the original YAG screens;
  - Magnets did not need changing;
- EMMA tomography section can now used to measure the properties of the ALICE full-energy beam.



## COLLABORATION

