Optics of MICE Step IV

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22 December 2011

MICE Note 88

- Dated 7-Nov-2004:
  - contains all optic solutions for MICE Steps IV, V and VI for vintage superconducting coil layout from 2004
    - p = 140, 170, 200, 240 MeV/c
    - β = 7, 15, 25, 42 cm
  - obtained by Palmer matching software with Bravar improvements
  - same solutions incorporated in present version of TRD, paragraph 4.1, excluding semi-flip mode
- Coil design has evolved multiple times since 2004

A few remarks

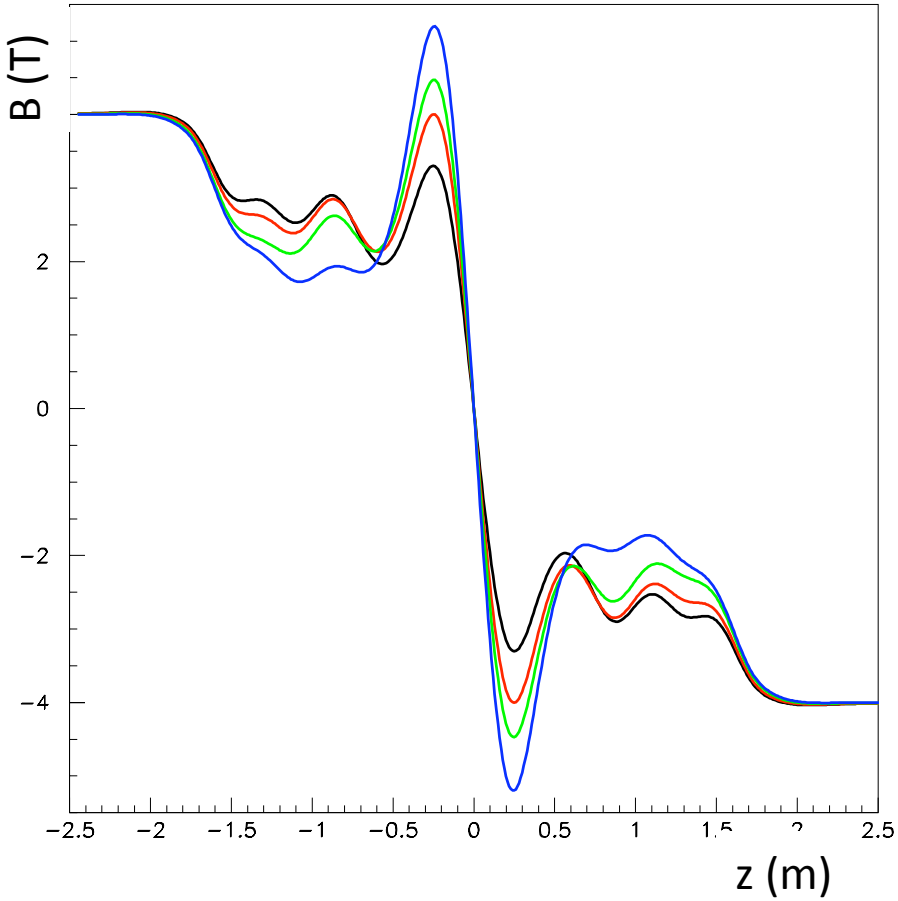
- All optic solutions in Note 88 are fully compatible with superconducting coil limitations
- Optic solutions are periodic:
  - solution for Step IV can be extended to Steps V and VI
- Optic solutions are scalable:
  - e.g. solution for p = 200 MeV/c and β = 7 cm can be obtained from solution for 140 MeV/c & 7 cm by scaling all currents by a factor of 200/140
  - however, no guarantee coil limitations can support this
  - p = 240 MeV/c is different: FC & CC currents scalable, but spectrometer stays at B = 4 T. Hence, MCs have to be re-matched

B-field in Step IV

- flip mode
- <p> = 200 MeV/c

- β = 42 cm
- β = 25 cm
- β = 15 cm
- β = 7 cm

- Note: solutions for β = 15 & 7 cm actually not supported at 200 MeV/c

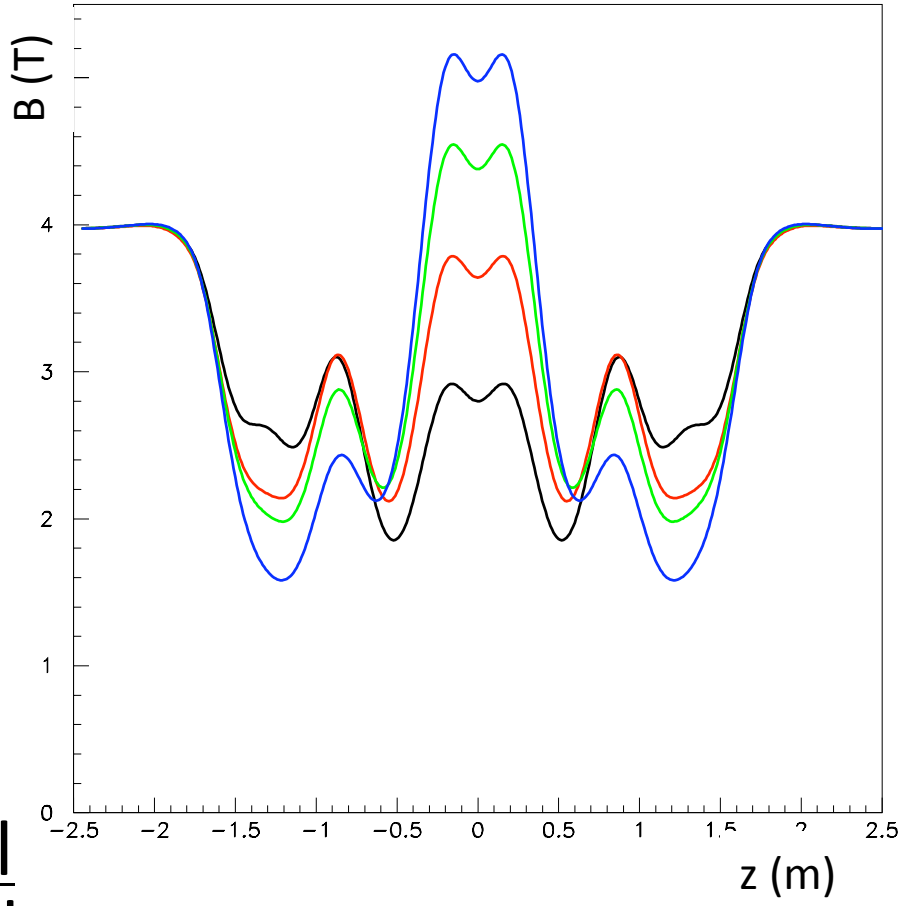


B-field in Step IV

- non-flip mode
- <p> = 200 MeV/c

- β = 42 cm
- β = 25 cm
- β = 15 cm
- β = 7 cm

- Note: solutions for all values of β supported at 200 MeV/c.

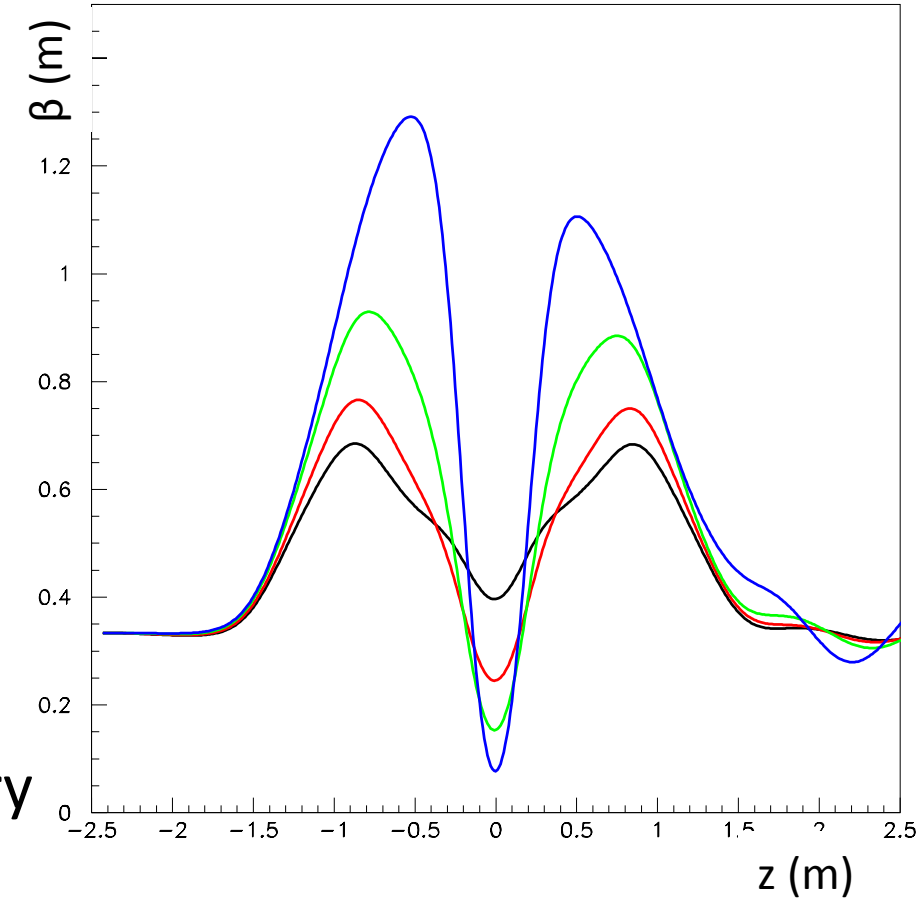


Beta function in Step IV

- flip mode
- <p> = 200 MeV/c

- β = 42 cm
- β = 25 cm
- β = 15 cm
- β = 7 cm

- β = 7 cm sort of satisfactory
  - large values in drift space
  - potential scraping

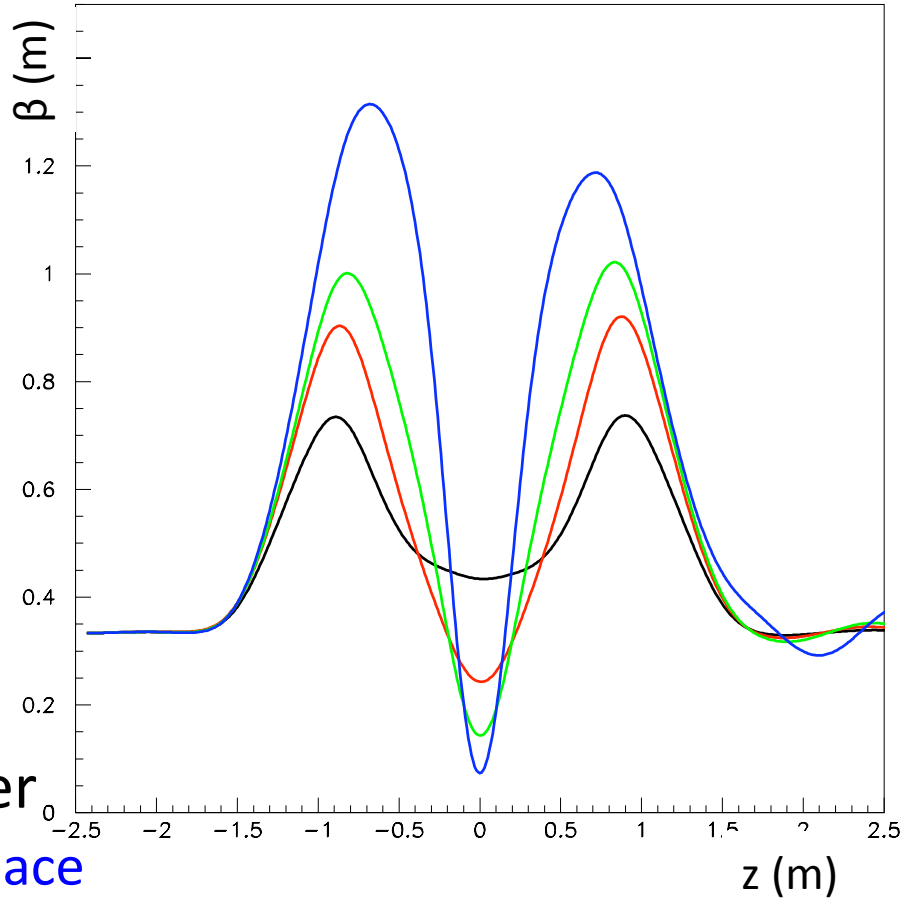


Beta function in Step IV

- non-flip mode
- <p> = 200 MeV/c

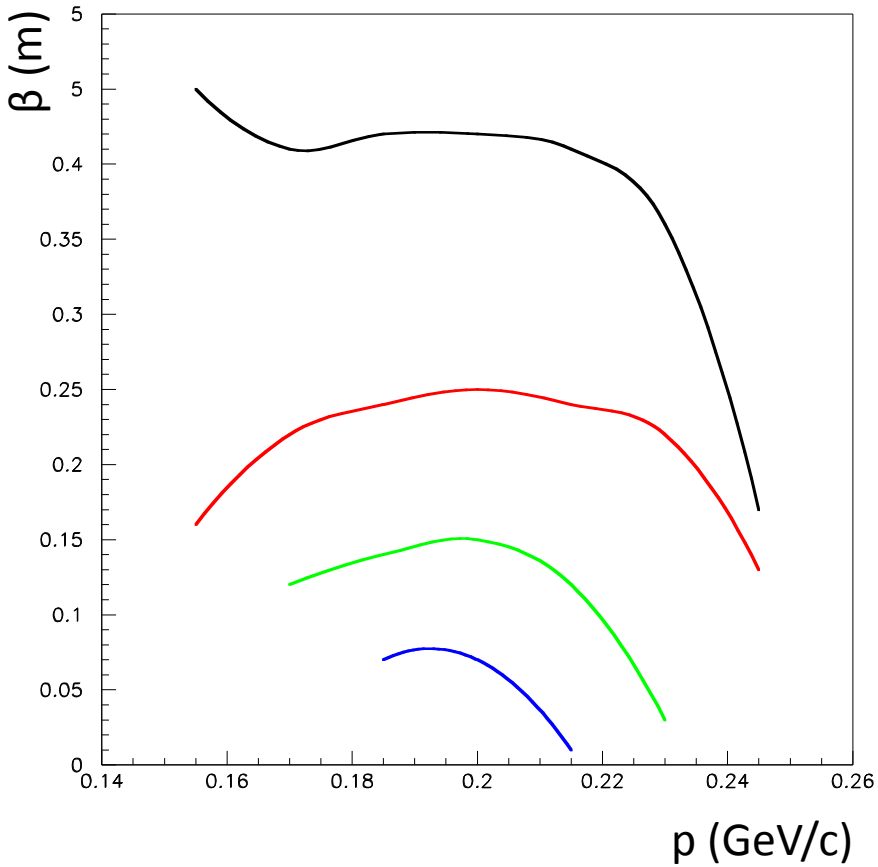
- β = 42 cm
- β = 25 cm
- β = 15 cm
- β = 7 cm

- β = 7 cm looks much better
  - still large values in drift space
  - potential scraping



Momentum acceptance

- <p> = 200 MeV/c
- the smaller β, the narrower the momentum acceptance
- β = 42 cm
- β = 25 cm
- β = 15 cm
- β = 7 cm



What needs to be done

- Track down documentation with parameters of coils presently under construction
- Re-match the entire Step IV:
  - use actual coil design dimensions
  - match for p = 140, 170, 200, 240 MeV/c
  - multiple values of β = 7, 15, 25, 42 cm
- Confirm that present Step IV layout can support each solution:
  - check peak currents, peak B-fields, forces between coils…
  - e.g. if p = 200 MeV/c, β=7 cm exceeds tolerances, can always run at p = 140 MeV/c, β = 7 cm
  - multiple values of β = 7, 15, 25, 42 cm
- Perform Monte Carlo simulations to confirm cooling performance