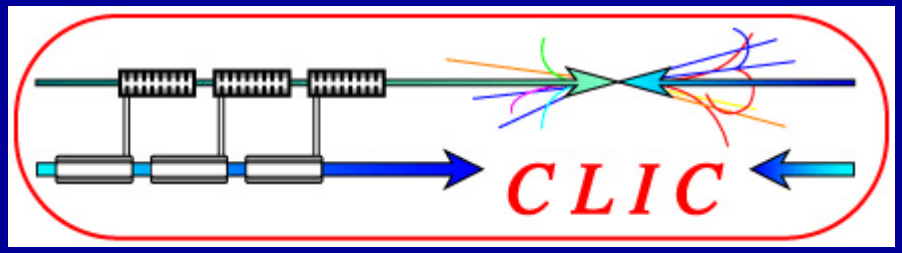

Requirements for Main Linac Magnets

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Background

Main linac focused and guided by quadrupoles

- to suppress wakefield effects,
  - high fill factor (short magnets): 0.35, 0.85, 1.35 and 1.85 m
  - high field (strong magnets): >200 T/m
- preserve beam quality
  - small dynamic & static imperfections
  - precision magnetic center: <10 μm
  - minimum bore radius (beam pipe) : 4 mm

Beam Orbit Correction

Quadrupoles also used as beam orbit correctors (feedback mode)

- shift quadrupole centre
  - mechanically or magnetically
  - steps of 5 nm, total range +/- 10 μm
  - stepping time < 5ms
- larger corrections with mechanical movers
- possibility to use separate orbit correctors
- possibility to use laminated magnets or solid iron core?

Beam Based Alignment

Dispersion free steering method

- no requirements on quadrupoles

Ballistic alignment method requires

- some quadrupoles switched off
  - remnant field <2 μT (0.1% of nominal)

Kick minimisation method requires

- max. shift magnetic centre <10 nm for a field change of 10%

impossible??

Beam Orbit Stability

- vertical quadrupole centre movements < 1nm
- relative field stability < 0.5×10^{-4} (quad and corrector)
- timescale determined by response beam orbit feedback
- transverse field jitter contributions
  - mechanical jitter quadrupole
  - quad strength variations, combined with beam offset in quad
  - corrector strength variations

Summary Magnet Specifications

Parameter	value
Field gradient	$\geq 200\,\mathrm{T/m}$
Minimum inner radius of beam pipe	$\geq$ **4** mm
Precision of magnetic centre	$10\,\mu\mathrm{m}$
Alignment beam pipe to magnetic centre	$20\,\mu\mathrm{m}$
Precision of field gradient	0.1%
Horizontal stability of field centre	2 nm
Vertical stability of field centre	1 nm
Stability of field gradient	0.5×10^{-4}
Corrector resolution	5 nm
Corrector speed	$\leq 5\,\mathrm{ms}$
Corrector range	$\pm 10\,\mu\mathrm{m}$
Corrector field stability	0.5×10^{-4}
Residual field gradient	$0.2\,\mathrm{T/m}$
Residual field at centre	$2\,\mu\mathrm{T}$