Ring to Main Linac Transport

Discussion on Status and CDR Preparation

- Status
- Plans for the CDR

Introduction

Property	Symbol	Value	Unit	Tolerance
Particle energy	E_0	2.86	GeV	10^{-5}
Bunch charge	Q_0	0.65	nC	1%
RMS bunch length	σ_s	1600	µm	1%
RMS energy spread	σ_E / E_0	0.13	%	1%
uncorr. energy spread	σ_E / E_0	0.13	%	1%
Energy chirp	u	0	1/m	
Normalized emittance	$\varepsilon_{n,x}$	500	nm rad	1%
	$\varepsilon_{n,y}$	5	nm rad	1%
Polarization	P	?	%	
Phase offset 2GHz	$\Delta\phi$	0	deg	0.1 deg

= allowed deviation within one filling time of 60 ns

@ exit of damping rings

Do we know static and dynamic tolerances on all of these values (bunch to bunch, pulse to pulse)?

Property	Symbol	Value	Unit	Tolerance
Particle energy	E_0	9	GeV	0.2%
Bunch charge	Q_0	> 0.6	nC	0.1%
RMS bunch length	σ_s	44	µm	0.5%
RMS energy spread	σ_E / E_0	< 1.7	%	
uncorr. energy spread	σ_E / E_0	< 1.7	%	
Energy chirp	u	0	1/m	
Normalized emittance	$\varepsilon_{n,x}$	< 600	nm rad	1%
	$\varepsilon_{n,y}$	< 10	nm rad	1%
Polarization	P	?	%	
Phase offset 12 GHz	$\Delta\phi$	0	deg	0.1 deg

@ entrance of main linac

Sub-Systems

Transfer Lines, Loops and Arcs: connection of damping rings and main linac, including the vertical transfer to tunnel level

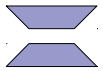
Booster Linac: acceleration to main linac injection energy

Bunch Compressor RF and Chicanes: two staged longitudinal compression

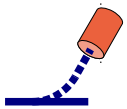
Spin Rotator: rotation from vertical spin orientation to longitudinal orientation

Diagnostics: characterization of beams especially at damping ring exit and main linac entrance

Feedback and Feed-Forward Systems: correction of slow and fast dynamic errors



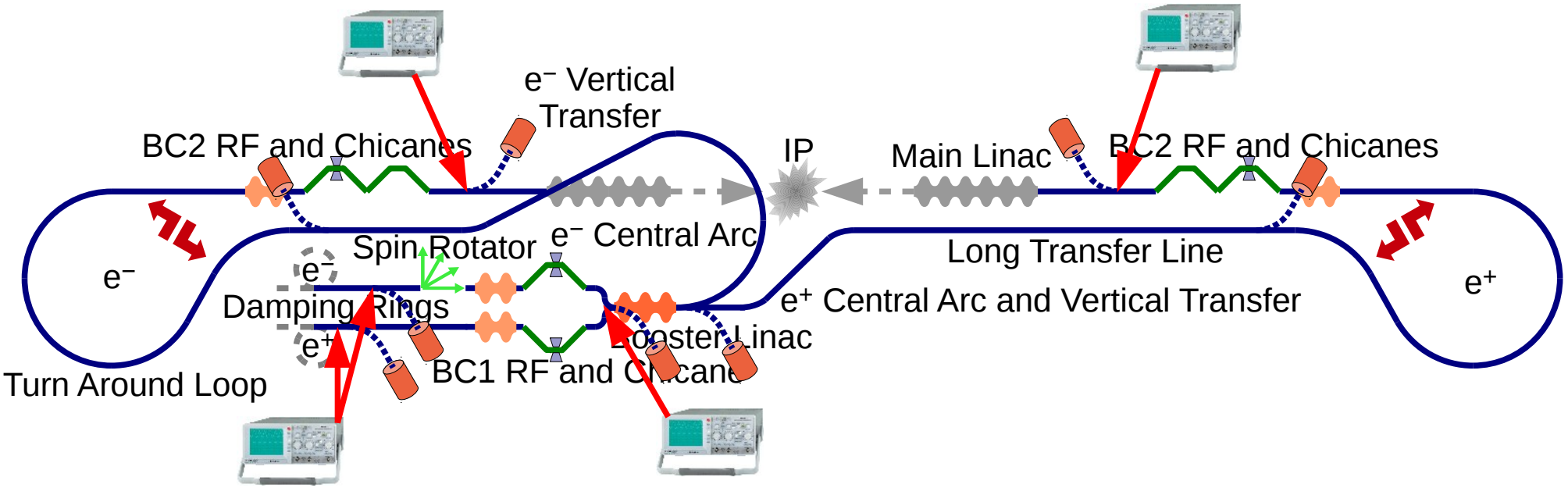
Collimators, Spoilers: scraping of tails, machine protection



Commissioning Dumps: for setting up parts of the machine, also used as spectrometers

General Layout

an almost complete but messy version...



Status

- Lattices have been created for the codes Elegant and Placet.
  A simplified MAD-X lattice can be converted from Placet (useful only for Twiss and survey).
- The lattices follow the general layout but deviate in some cases.
  For example merging and splitting of the two beam lines around the booster linac is missing. Diagnostics beam lines are for the moment replaced by place holders, dumps and collimators are not included. The path length difference between electron beam lines and positron beam lines is not tuned to the correct value.
  (The spin rotator still needs to be included.)
- The general layout itself deviates from the civil engineering layout.
  Arcs and loops have a different radius, some smaller arcs, which are included in the CE layout to match the CERN site, are missing.
- Despite these differences and despite the fact that there is some room for improvements or clean-up, the lattices are considered (almost) complete and sufficient for beam dynamics studies.
- The performance of the perfect lattices, i.e. no misalignment, no magnet errors but with synchrotron radiation and single bunch wakes, is considered to be good.

Status

- Error tolerance of the turn around loop has been improved and should now be sufficient, but this remains to be proven.
- A study on the emittance measurement stations is on-going.
- The vacuum requirements in the long transfer line due to fast beam ion instability and the impact of resistive wall wake fields in this beam line seem to be well enough studied.
- We should now be in a position to concentrate on studies of static and dynamic imperfection.
- There is one important open point: booster linac frequency. The longer we keep discussing, the more unlikely a switch to 4 GHz gets. So, if anyone is seriously considering this, he should tell us now.

Plans for the CDR

- Integrated studies of the full RTML will be continued including effects like ISR, CSR and (long range) cavity wake fields, first without imperfections, later may be with imperfections. Spin rotator lattices will be included soon.
- Additionally, the RTML will be integrated with the main linac and the BDS for more complete start-to-end simulations.
- Tolerance studies, i.e. misalignment, magnet strength jitter and magnetic stray fields, will be performed at least for

  Booster Linac, Vertical Transfer, Long Transfer Line, Turn Around Loop

  These beam lines are expected to require the tightest tolerances in the RTML.

  Correction schemes like 1-to-1 steering, dispersion free steering and wake free steering will be applied.
- The evaluation of tolerances on beam phase and energy will be enhanced. Requirements on other beam parameters, e.g. position, length, energy spread, will be evaluated.
- Feedback and feed-forward system will be specified. But time might not allow us to study their performance in simulations.
- Study on emittance measurement will be continued. But time might not allow us to optimize it and include it in the integrated studies.
- A few studies will be performed using CLIC@500 GeV parameters to validate that the lattices are suitable or easily adjustable.
- Depending on the results of the studies and the remaining time we might either improve lattice performance or we just describe possible enhancements.