Stanford Linear Accelerator Center

Stanford Synchrotron Radiation Laboratory

LCLS Physics Requirements Document # 1.3-007	Linac	Revision 0

LTU Beamline Requirements

Paul Emma (Author)	Signature	Date 5/6/04
Eric Bong (System Manager)	Signature	Date 5/5/04
Paul Emma (System Physicist)	Signature	Date 5/6/04
John Galayda (Project Director)	Signature	Date 12 MAY 2004

Brief Summary: This specification summarizes physics requirements for the first Linac-To-Undulator (LTU) beamline.

Keywords: Linac, Transport

Key WBS#'s: 1.3

LTU Beamline Requirements

The Linac-To-Undulator (LTU) is composed of four horizontal dipole magnets, two vertical dipole magnets, and many quadrupole magnets, as shown in Figure 1 below. The purpose of this beamline is to transport a 1-nC, 20-μm long (rms) electron bunch, at a repetition rate of 120 Hz, at 14 GeV to the LCLS FEL undulator.

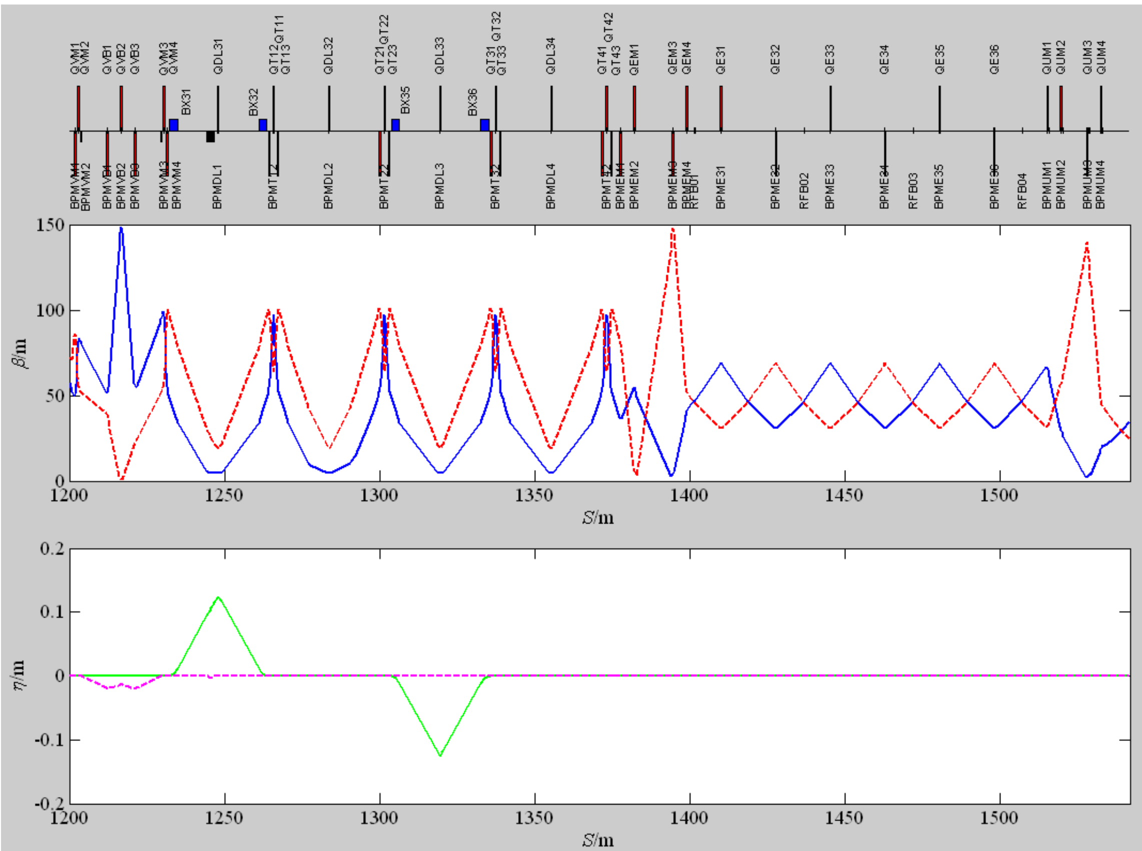

Figure 1: LTU schematic layout with optical functions and nearby device names. The blue rectangles in the map at top are the LTU dipole magnets.

The LTU beamline must also include:

- Beam diagnostics to measure:
  - o the bunch length
  - o transverse emittances
  - o energy spread
  - o trajectory
  - o time-sliced emittance
  - o time-sliced energy spread
- Horizontal bends to allow:
  - o collimation of off-energy particles
  - o relative energy measurement with BPMs to drive energy feedback

- Collimation to protect the undulator
- Vertical bends to level the undulator (SLAC linac is pitched down by 5 mrad)

The time-sliced diagnostics are accomplished with a RF deflector in the linac and OTR monitors in the LTU.

In addition, the transverse slice-emittance of the electron bunch must be well preserved to a level of <4% growth in both planes, especially with respect to the coherent synchrotron radiation (CSR) produced in the bends.

Table 1 lists some of the main parameters of LTU.

Table 1: LTU parameters (1 nC, 120 Hz).

Parameter Description	**Symbol**	**Value**	**Unit**
Electron energy range	E	4.5 to 14	GeV
Bunch length (rms)	σ_z	22	μm
Active length of system	L	342	m
Relative energy spread of e^- bunch (rms)	σ_E/E	0.01	%
Bend angle of each of 4 horizontal dipoles	$\|\theta_B\|$	0.5	deg
Bend angle of each of 2 vertical dipoles	$\|\theta_y\|$	2.3	mrad