

two magnets of the vertical dog-leg already in use will be replaced with a merger composed of two septum, fast kicker and specially designed quadrupole magnets to provide focusing of two positron beams in the area where they have small vertical separation.

In Section D the extraction system for the DR dump line is located. The design of these dump lines is now identical to the dump lines used after the first stage of the bunch compressor [2], since in the new design the Twiss functions of the beams are similar in both locations. The radius of curvature of sections E is constrained by the geometry of the spin rotator in the positron/electron injection beamlines (share the same tunnels) which are needed to change the direction of the spin from longitudinal to vertical before the beams enter their damping rings to avoid dilution of the polarization.

The Twiss functions of the ETRL and PRTL calculated using MAD-8 code are shown in Fig. 3. The boundaries of sections B, C, D and E are shown by blue colour.

The skew quadrupole correction, beam diagnostics and collimation sections that were originally placed along GETAWAY beamline in old (RDR) RTML design are now located at the beginning of the ELTL/PLTL lines.

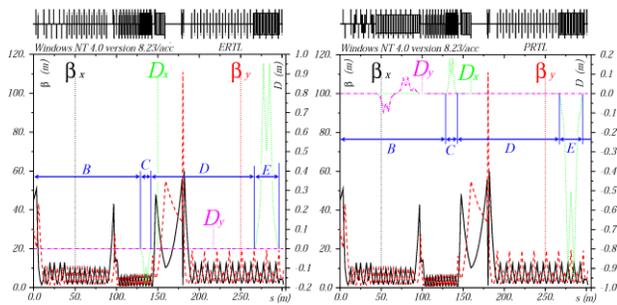


Figure 3: New optics of ERTL and PRTL beamlines.

NEW DESIGN OF RETURN LINES (ELTL/PLTL)

The ELTL and PLTL lines are follow to the earth curvature in the ML tunnel and have straight line geometry in other locations except of areas near connection of Main linac and BDS where the beam geometry is carefully adjusted using horizontal doglegs. In the first section of this line we have the skew quadrupole system for coupling correction, beam diagnostics section with few laser wire stations and magnet chicane for emittance measurements, and the collimation section needed to get rid of the beam halo. The lattices for these sections were borrowed from RDR design and re-matched in new line. Since the first part of the ELTL and PLTL share the BDS tunnel, a horizontal dog-leg needed to be inserted at the juncture between the BDS and Main Linac [3] to follow the geometry of the tunnel in this area. At that point on the electron side it is situated the positron source, and the electron beam performs a dog-leg after passing through the undulator, to avoid the positron target. The ELTL needed then to follow the same path in the opposite direction (see Fig. 4).

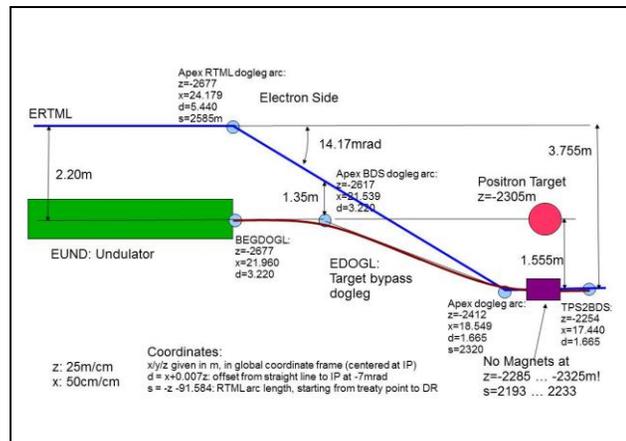


Figure 4: Layout of ELTL dog-leg.

It should be noted that because of the radiation produced at the positron target, the beamlines passing next to it need to be magnet-free to come through the radiation shielding wall. The result of the optical study for this section is reported in Fig. 5.

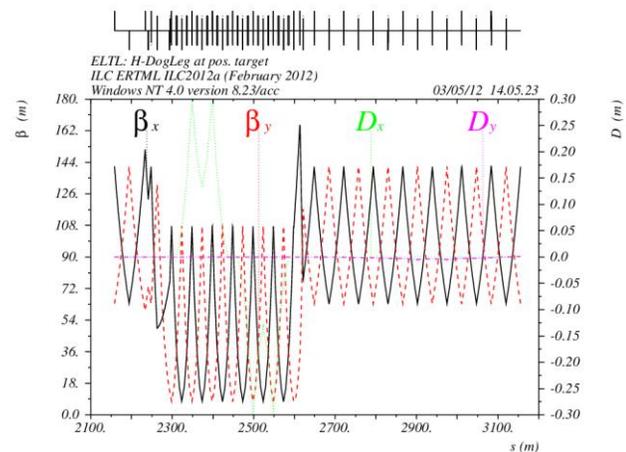


Figure 5: Optics result for ELTL dog-leg.

The PLTL line also includes a dog-leg at the conjunction between Main Linac and BDS system for symmetry of the project, but without the complication of the positron target and radiation.

For reasons related to Helium level in the Cryogenic system, the Main Linac needs to follow the curvature of the Earth, and so does the part of the Return Line system that shares the Main Tunnel with it. To accomplish this task, vertical correctors were added to each quadrupole of the FODO system in the ELTL/PLTL located in the Main Tunnel. Each of these correctors gives to the beam the vertical kick necessary for the beam to be bent down, following the curvature of the Earth (and of the beamline). Clearly these correctors generate a small dispersion that is propagated periodically along the FODO system cells. To match this vertical dispersion with the straight lines other 4 vertical correctors were used before and after the curved lines. In Fig. 6 it is

presented the optics results for the vertical position and dispersion in the ELTL section, obtained with MAD-8.

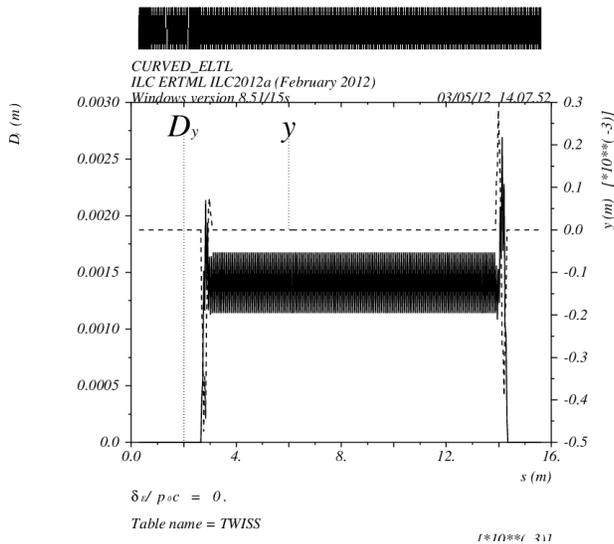


Figure 6: Optics of the curved ELTL FODO system.

The PLTL line has identical optics.

ILC BUNCH COMPRESSOR (BC1/BC2)

Given its flexibility in obtaining the required final bunch lengths for different operation modes [4] and its easier tunability, it has been decided to adopt the 2-stage Bunch Compressor design for ILC TDR [5], with minor modifications, for example number of SRF cryomodules in the BC2 beamline [6]. In BC1, the RF system is now composed of 3 cryomodules, containing 8 cavities and a quadrupole each, for a total voltage of 465 MV. The nominal RF phase is -115 deg, with a gradient of 18.7 MV/m. After the RF acceleration a 6-cell wiggler with nominal $R_{56} = -372$ mm will provide the required compression. After this stage a diagnostic section with a dump line for intra-train extraction or beam abort is foreseen. The BC2 RF system is now composed of 16 RF units, each consisting of 3 cryomodules with only the central cryomodule containing a quadrupole for focusing while the others are 9-cavity cryomodules (same structure is used in the Main Linac). In the previous design there were only 15 RF units used. This choice was adopted to reduce the average gradient needed in the cavities, which is now 27.1 MV/m at a RF phase varying between -27.2 and -24 deg. according to the operation mode, giving a total voltage of 11 GV, and reduce the risk of cavity breakdown. After BC2 RF system a second wiggler with a nominal $R_{56} = -55$ mm will provide the magnetic compression to reach a bunch length of 0.3 mm. Also after the BC2 a diagnostic section and abort/extraction system to a dump line is foreseen. In Fig. 7 MAD-8 results for the optics of the Bunch Compressor are reported. Due to the non-periodicity of the RF system in both the stages, it was not possible to design a FODO lattice. A solution presenting almost periodic regularity was then adopted to avoid possible emittance dilution.

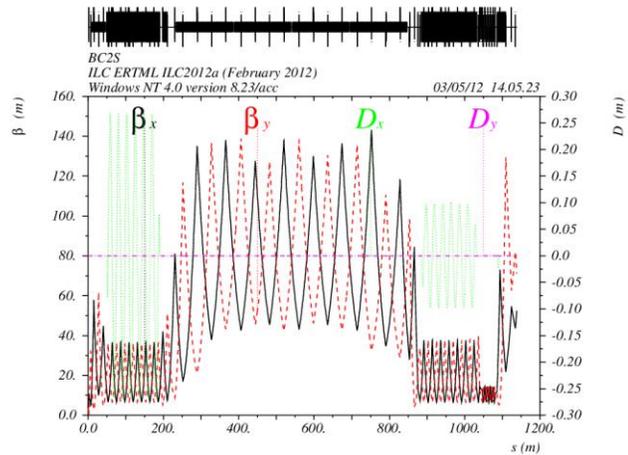


Figure 7: Optics result for the Bunch Compressor.

Due to the changes to the RF system a new set of simulations of the Bunch Compressor performance for different operation modes have been carried out showing positive results [5].

CONCLUSIONS

In this paper we presented the latest changes introduced in the design of the RTML of ILC. The central region design has been modified to fit the new beamlines location. Horizontal dog-legs have been added to the return lines to reflect the geometry of the tunnel shared with Main Linac, BDS and Positron Source. Vertical curvature of the ELTL/PLTL has been designed to follow the curvature of the Earth. The new configuration of the Bunch Compressor RF system has been implemented and simulations of its performance have been carried out.

REFERENCES

- [1] M. Palmer and B. List, "ILC central Region Design Optimization," EDMS D*0969765, ILC Technical Design Documentation.
- [2] S. Seletskiy et.al, "Design of the ILC RTML Extraction Lines", SLAC-PUB-14638
- [3] B. List, "RTML Doglegs," EDMS D*0969955, ILC Technical Design Documentation.
- [4] M. Palmer and S. Guiducci, "Damping Ring Parameters," EDMS D*0960955, ILC Technical Design Documentation.
- [5] S. Seletskiy, "Renovated Two-stage Bunch Compressor for ILC RTML," TUPPP092, these proceedings.
- [6] T. Peterson and B. List, "ILC SCRF Cryogenics Parameters," EDMS D*0975575, ILC Technical Design Documentation.