

Accelerator Around IP

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2015-1209 ILC Tokusui WS

Thanks to Glen White and Okugi san

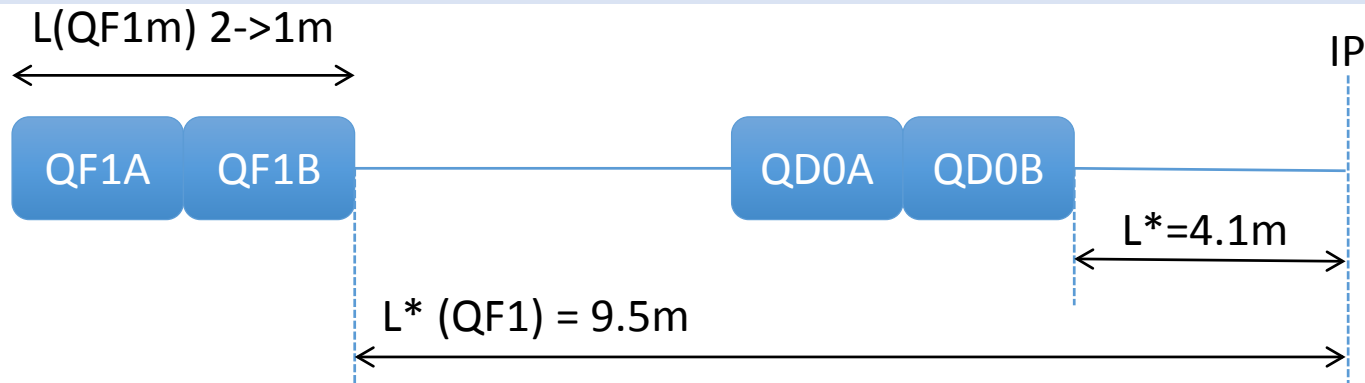
Design Changes Since TDR : Change Requests Related to IP

- CR2: common L*
- CR3: Vertical shaft for the detector hall
 - → Miyahara san
- CR4: Main linac tunnel extension by 2x1.5km
- CR5: Correction of luminosity data in TDR
- CR6: Additional BPM downstream of QD0
- Lattice 2015b

CR2: Common L^*

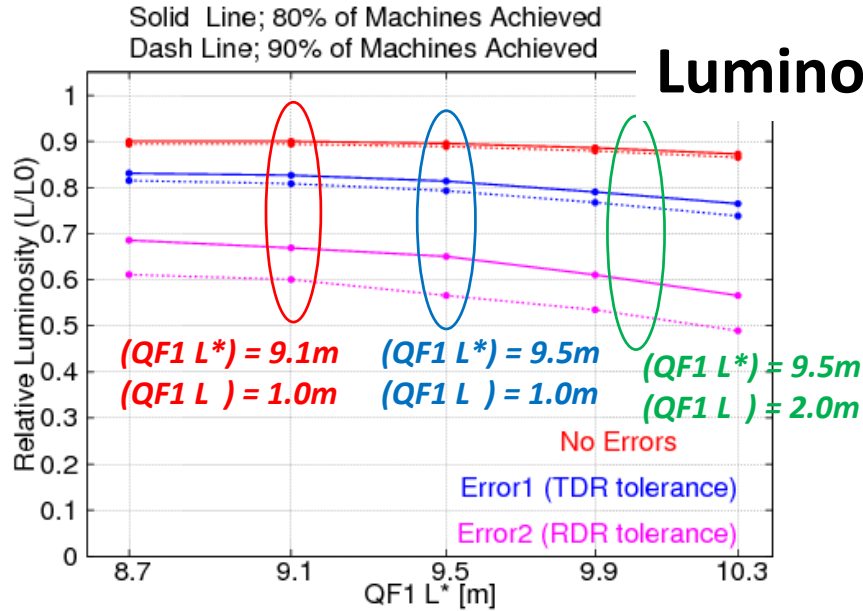
- Change request from accelerator side to make L^* common to SiD and ILD for easier commissioning and tuning
- SiD designed with $L^*=3.5$ m can relatively easily accept L^* between 2.6 and 4.5 meters.
- ILD designed with $L^*=4.5$ m can accept the minimum L^* of 4.1 m by removing the ion pump in front of QD0.
 - Increased pressure seems to be acceptable
 - Backup solution using a distributed NEG system is under consideration. Seems ok.
 - Further modification (e.g., redesign FCAL) needed if $L^*<4.1$ m is required
- The difference between $L^*=4.0$ and 4.1m is negligible from the optics and tuning standpoint.
- Once L^* decided, there is still a choice for QF1 L^* (9.5m in TDR)
 - Shorter QF1 L^* leads redesign of QF1 support structure and Packman both on SiD and ILD.
 - But 9.5m and 9.1m do not cause significant difference in optics

Summary of IR Optics for Single L^*

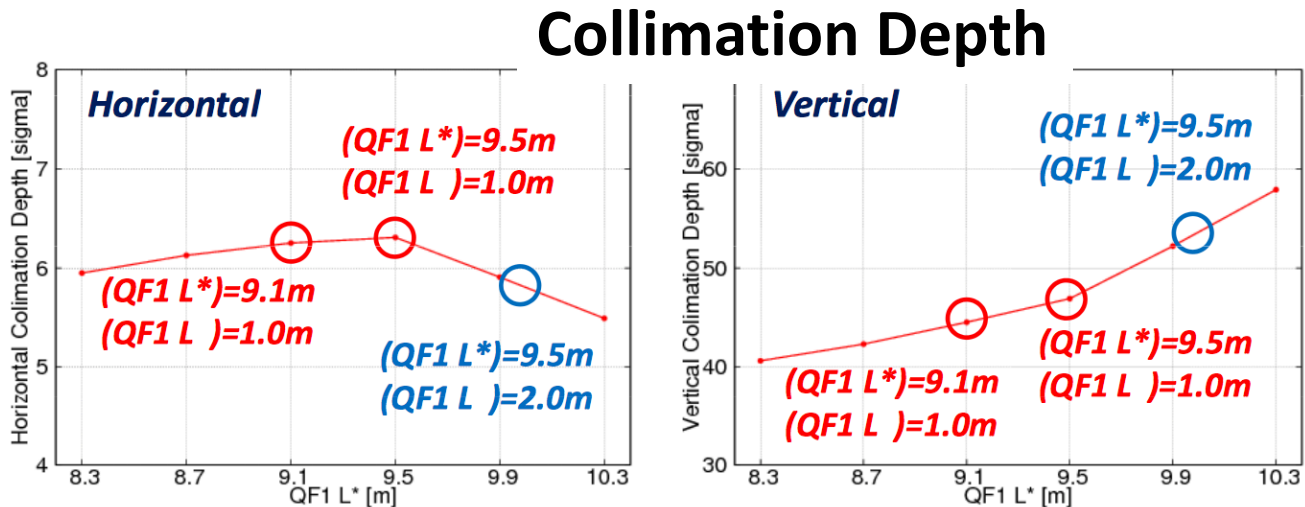


- In general: better performance for shorter L^* if free to set both QF1 and QD0 positions.
- QF1 position fixed by push-pull constraints to $\sim > 9\text{m}$
- Better FFS performance for longer L^* (smaller QF1-QD0 distance)
- Optimal $L^* \sim 4\text{m}$. Choose 4.1m to ensure room with ILD design for BPM d/s QD0 for "IPBPM"
- For $L^* = 4.1\text{m}$ considered QF1 position @ 9.5 or 9.1m
- For expected tolerances, negligible tuning performance improvement for 9.1m. Improvements @ 9.1m become a little more pronounced for degraded parameters (e.g. larger than design ϵ_x)
- Collimation depth optimal @ 9.5m
- No compelling reason to change from 9.5 \rightarrow 9.1m, recommend keeping 9.5m distance.
- QF1 & QD0 powered independently in 2 halves:
Only QD0B & QF1B excited at low energies $< 250\text{GeV}$

FFS Performance Studies



T. Okugi, KEK



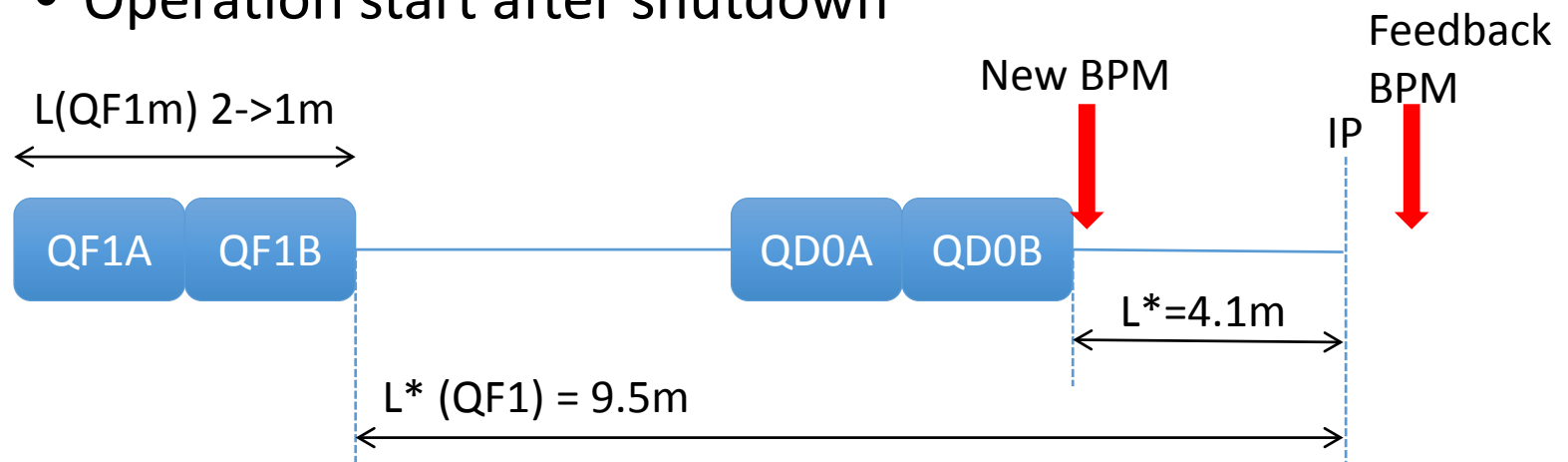
CR5: Correction of luminosity values in TDR

- Typos of the luminosity values in TDR were corrected
- The largest change is 20% decrease at 1TeV A1
- No change in the optics parameter (β 's)
 - Optics created \rightarrow 2015b
(official optics did not exist except at 500GeV)

	Baseline					Lumi upgrade	Energy Upgrade	
	200	230	250	350	500	500	1000	1000
							A1	B1b
TDR	0.56	0.67	0.75	0.99	1.79	3.58	3.65	4.90
Corrected	0.59	0.73	0.82	1.03	1.79	3.60	3.02	5.11

CR6: Additional BPM

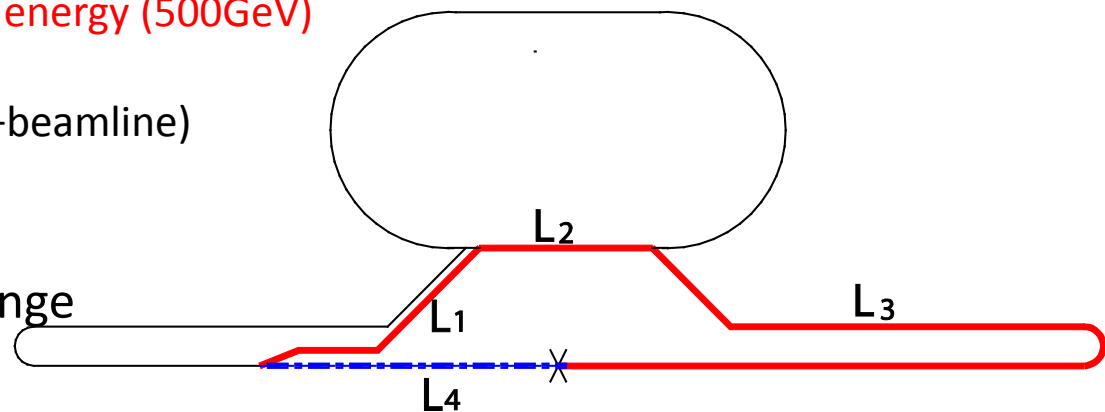
- Add a BPM just downstream of QD0
- Together with the stripline BPM for IP feedback, this will give the IP location to the accuracy better than $10\mu\text{m}$. (Same type BPM will work.)
- Will be useful for
 - Commissioning
 - Operation start after shutdown



CR4: Extension of Main Linac Tunnel

- Global timing issue
 - $(L_1 + L_2 + L_3) - L_4 = n \times C_{DR}$
 - Linac (positron) tunnel length discrete by $C_{DR}/2$
 - TDR values $(L_1 + L_2 + L_3) - L_4 = 9 \times C_{DR} + 294\text{m}$
 - Near-TDR solution
 - Decrease BDS by $294\text{m}/2$
 - Increase C_{DR} by $\sim 40\text{m}$
- Perhaps more reasonable solution is to increase the linac tunnel length by $2 \times 1.5\text{km}$
 - Empty tunnel (with beamline) in the first construction
 - Future margin $\sim 14\%$ for
 - Acceleration gradient ($31.5\text{MV}/\text{m}$)
 - Maximum reachable energy (500GeV)
 - Cost impact
 - ~ 100 MILCU (tunnel+beamline)
- Additional equipment
 - Positron chicane in L1 to adjust 10's of cm range

No direct effects on IP region

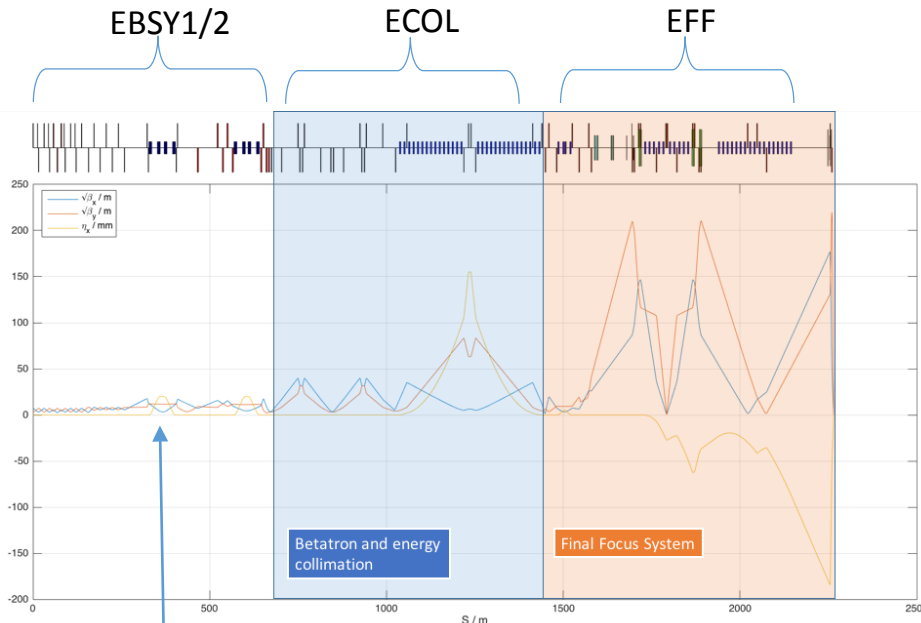


Lattice 2015b

- Reflects the changes
 - CR2: Common L^*
 - $L^* = 4.1\text{m}$, $L^*(\text{QF1})=9.5\text{m}$
 - $L^* = 6.3\text{m}$ for dumpline
 - CR6: Additional BPM
 - CR4: extension of the ML tunnel (2x1.5km)
 - Global timing adjustment (chicane, path length difference $10 \times C_{\text{DR}}$)
 - Energy margin, gradient margin
 - CR10: Bunch Compressor belongs to ML
 - Correct BSY laserwire chicane length (-23.87m)
 - And many other small changes
- To be public by end of this year?
- Mark Woodley

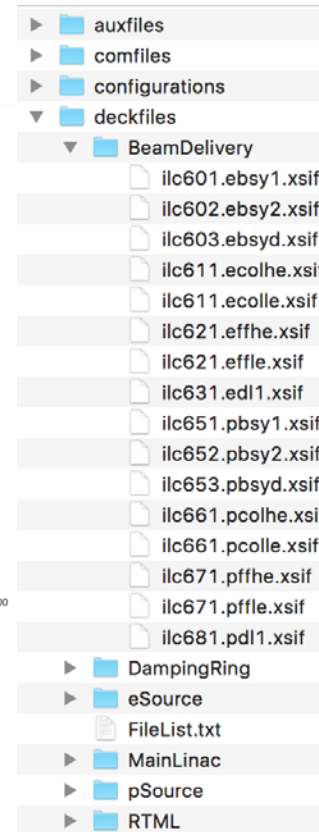
BSY Changes & Structural Changes to Lattice Files

G.White LCWS2015



LW chicane shortened

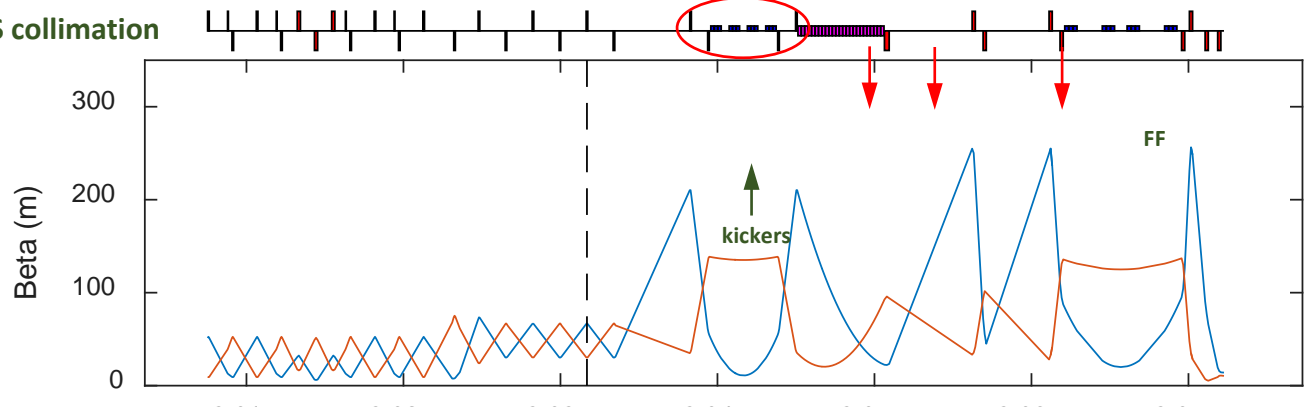
- BSY length decreased by 23.87 m
- photon path length (undulator exit to target) decreased by 12.23 m



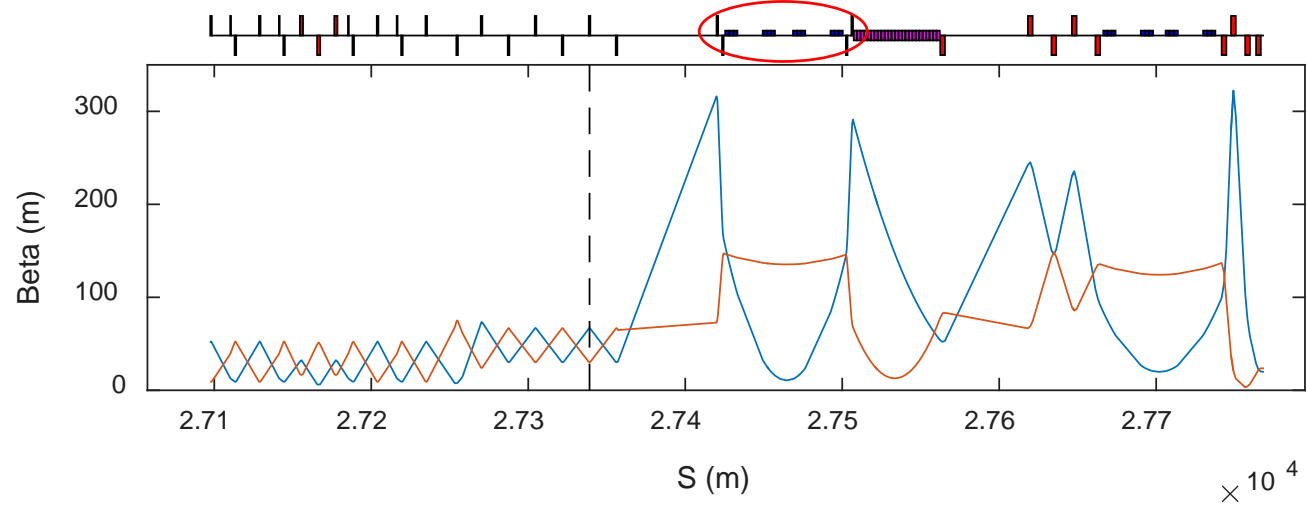
- R2015a EFFS1
- -> R2015b:
 - ECOLLE / ECOLHE
 - EFFLE / EFFHE
 - LE: $E_{CM} \leq 500$ GeV
 - HE: $E_{CM} > 500$ GeV
- (E = electron, P = positron)
- Identical

ILC2015b: pBSY

MPS collimation



ILC2015a: pBSY



Expected Changes in the Near Future

- Perhaps no big changes around IP
 - But listen to Miyahara san for CFS
- Several changes are still expected in the central region
 - Layout of positron line
 - Timing chicane
 - Muon wall
 - Dump region
 - Dump line, etc.
 - All related to CFS
 - → Central Region Working Group set up