



Optics in HL-LHC IR4 for BE-BI

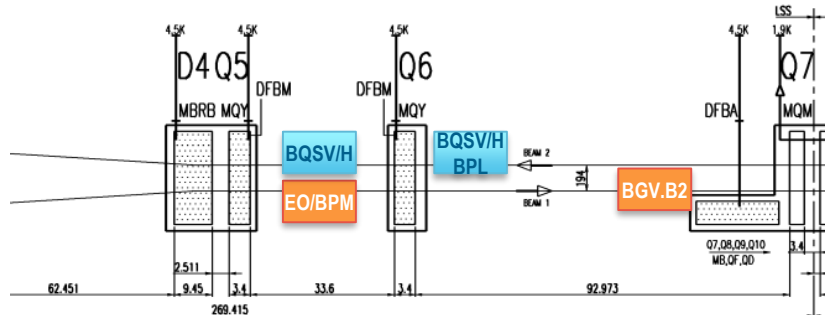
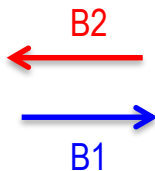
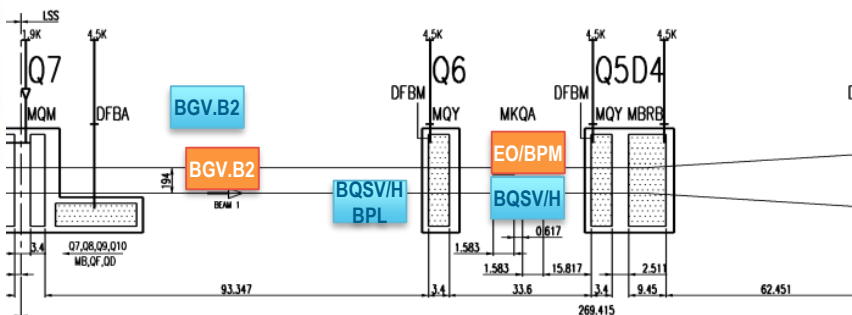
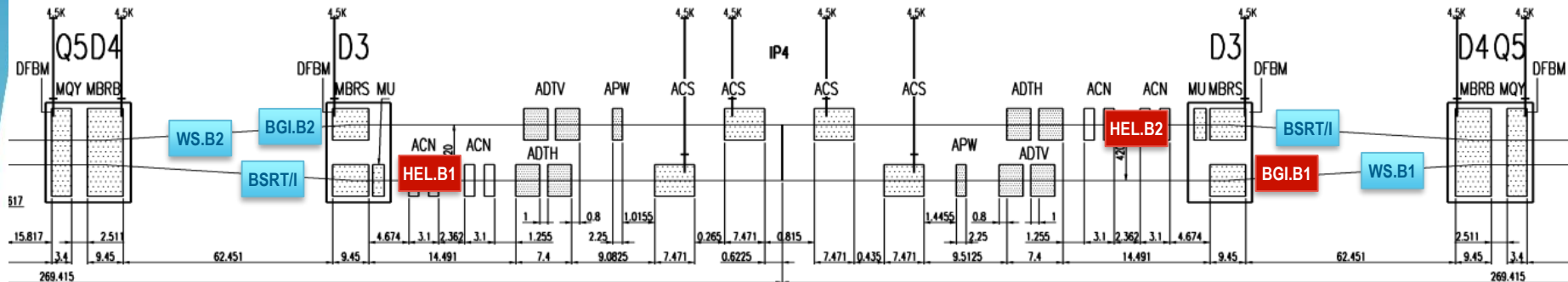
BE-BI



IR4 layout (not to scale)

- existing
- HL fixed position
- HL position tbd

RF INSERTION



Requirements on optics

Device/ instrument	Position (from IP4) and constraints	Phase advance	Beta/beam size	Injection/flattop optics
BGI	~ -63m (B1)	N/A	as large as possible	*
BGI for HL	one on each side – opposite beam from BSRT. (BGI B1 on L, BGI B2 on R)	N/A	as large as possible	*
BGV now	~ -220m (B2)	N/A	as large as possible	*
BGV for HL	1 on B2. Baseline location for HL between Q6 and Q7. Could also consider Q5 to Q6 but more crowded.	N/A	as large as possible circular beam	constant beam size throughout the cycle would be an advantage
BSRT – BSRI	~ ± 59 m	90° from crabs and - 180° from IP in IP1/5	as large as possible	*
E/O BPM	Where phase advance (Q5-Q6 easier to integrate)	90° from crabs and - 180° from IP in IP1/5		-
HEL	~ +40m (B1), -40m (B2)	N/A	as large as possible circular beam	constant beam size throughout the cycle would be an advantage
Schottky BPM BQSV & BQSH	~ 115.3, 174.1m (B1) ~ 114, 176m (B2)	N/A	as large as possible	Orbit must be in the centre throughout the cycle*
Tune BPM BPL	~ 138, 149, 172.7m (B1) ~ - 175, -116.8m (B2)	N/A	as large as possible	*
WS	~ ± 85 m	N/A	as large as possible	*

* change in beta between injection and flattop (if not too large) should be ok, to be evaluated depending on proposed optics. Beta must then be measured throughout the full cycle.

Conclusions

- ❖ An increase in the beta functions in IR4 has a positive effect on all the profile monitors :
 - Reducing the measurements errors: WS, BGV, Orbit and Tune
 - Allowing “meaningful” (not dominated by corrections) measurements at 7 TeV: BSRT, BGI.
- ❖ It makes electron beam more stable: HEL
- ❖ It is no longer necessary to keep same beta, as long as measured throughout cycle.
- ❖ Beta functions should not be excessively high (>400 m) at the D3; it compromises interferometry measurements at injection energy.