# Hollow Beam Electron Lens parameters Functional Specifications

| Parameter | Value or range | |
|---|---|---|
| *Collimation functionality* | | |
| Inner betatron cut (for zero dp/p particles), $\sigma_{\beta}^{\text{cut}}$ [$\sigma_{\beta}$] Inner electron beam radius | 3 (3.55) | Consistent with assumption for beam stability |
| Outer electron beam radius [$\sigma_{\beta}$] | > 5.7 (> 6.75) | |
| Time structure of excitations | Batch by batch | |
| Target maximum depletion rate [%/min] | 90 | |
| Local beta beating requirements, [%] | < 20% | New HL-LHC tolerances |
| *Proton Beam and Lattice* | | |
| Beam energy [TeV] | 0.45 to 7 | |
| Beam emittance for beam size calculation, $\varepsilon_{np}$ [µm] | 3.5 (2.5) | $\sigma_{x,y-p}(mm)=\sqrt{\dfrac{\beta_{x,y}\varepsilon_{np}}{\gamma}}$ |
| Amplitude function at electron lens, $\beta_{x,y}$ [m] | 220 ± 40 | |
| Dispersion at electron lens, $D_{x,y}$ [m] | ≤ 0.5 | |
| Proton beam transverse position [mm] | 0 ± 2 | New HL-LHC tolerances |
| *Electron Beam Geometry* | | |
| Length of region overlap e/p beams, L [m] | 3 | |
| Minimum kick to 7 TeV protons [µrad] | > 0.35 | Peak value achieved close to the primary collimator aperture |
| Maximum total residual dipolar kick [µrad] | 12 nrad | Residual dipole field from e-beam imperfections end edges |
| Electron beam transverse position [mm] | ± 5 | ± 3 mm around p beam |
| Main solenoid field of e-lens [T] | 4-6 | To be confirmed for final design |
| *High-voltage modulator* | | |
| Cathode-anode voltage, $V_{ca}$ [kV] | 10 – 15 kV | |
| Rise time (10%–90%), $\tau_{mod}$ [ns] | 200 | |
| Repetition rate, $f_{mod}$ [kHz] | 11 | Option: ~10x revolution freq |
| Amplitude variation pulse to pulse [%] | 100 | Needed for random mode |
| *Magnetic field* | | |
| Requirements for proton beam stability and coupling | Ok for 6 T | Coupling no issue with 6T, margin for higher fields |
| Orbit tolerance for residual dipole kick at edges | ? | To be determined |