

High-Energy Collider Parameters: e^+e^- Colliders (I)

Updated in March 2018 with numbers received from representatives of the colliders (contact E. Pianori, LBNL). The table shows the parameter values achieved. Quantities are, where appropriate, r.m.s.; unless noted otherwise, energies refer to beam energy; H and V indicate horizontal and vertical directions; s.c. stands for superconducting. Parameters for the defunct SPEAR, DORIS, PETRA, PEP, TRISTAN, and VEPP-2M colliders may be found in our 1996 edition (Phys. Rev. **D54**, 1 July 1996, Part I).

| | VEPP-2000 (Novosibirsk) | VEPP-4M (Novosibirsk) | BEPC (China) | BEPC-II (China) | DAΦNE (Frascati) |
|---|--|--------------------------|------------------------------------|--|--|
| Physics start date | 2010 | 1994 | 1989 | 2008 | 1999 |
| Physics end date | — | — | 2005 | — | — |
| Maximum beam energy (GeV) | 1.0 | 6 | 2.5 | 1.89 (2.3 max) | 0.510 |
| Delivered integrated luminosity per exp. (fb^{-1}) | 0.125 | 0.027 | 0.11 | 17.5 | ≈ 4.7 in 2001-2007 ≈ 2.7 w/crab-waist ≈ 1.8 since Nov 2014 |
| Luminosity ($10^{30} \text{ cm}^{-2}\text{s}^{-1}$) | 40 | 20 | 12.6 at 1.843 GeV 5 at 1.55 GeV | 1000 | 453 |
| Time between collisions (μs) | 0.04 | 0.6 | 0.8 | 0.008 | 0.0027 |
| Full crossing angle ($\mu \text{ rad}$) | 0 | 0 | 0 | 2.2×10^4 | 5×10^4 |
| Energy spread (units 10^{-3}) | 0.71 | 1 | 0.58 at 2.2 GeV | 0.52 | 0.40 |
| Bunch length (cm) | 4 | 5 | ≈ 5 | ≈ 1.2 | low current: 1 at 15mA: 2 |
| Beam radius (10^{-6} m) | 125 (round) | H : 1000 V : 30 | H : 890 V : 37 | H : 347 V : 4.5 | H : 260 V : 4.8 |
| Free space at interaction point (m) | ± 0.5 | ± 2 | ± 2.15 | ± 0.63 | ± 0.295 |
| Luminosity lifetime (hr) | continuous | 2 | 7–12 | 1.5 | 0.2 |
| Turn-around time (min) | continuous | 18 | 32 | 15 | 2 (topping up) |
| Injection energy (GeV) | 0.2–1.0 | 1.8 | 1.55 | 1.89 | on energy |
| Transverse emittance (10^{-9} m) | H : 150 V : 150 | H : 200 V : 20 | H : 660 V : 28 | H : 121 V : 1.56 | H : 260 V : 2.6 |
| β^* , amplitude function at interaction point (m) | H : 0.05 – 0.11 V : 0.05 – 0.11 | H : 0.75 V : 0.05 | H : 1.2 V : 0.05 | H : 1.0 V : 0.0129 | H : 0.26 V : 0.009 |
| Beam-beam tune shift per crossing (units 10^{-4}) | H : 850 V : 850 | 500 | 350 | 383 | 440 (crab-waist test) |
| RF frequency (MHz) | 172 | 180 | 199.53 | 499.8 | 356 |
| Particles per bunch (units 10^{10}) | 8 | 15 | 20 at 2 GeV 11 at 1.55 GeV | 3.8 | e^- : 3.2 e^+ : 2.1 |
| Bunches per ring per species | 1 | 2 | 1 | 119 | 100 to 105 (120 buckets) |
| Average beam current per species (mA) | 160 | 80 | 40 at 2 GeV 22 at 1.55 GeV | 851 | e^- : 1250 e^+ : 800 |
| Circumference or length (km) | 0.024 | 0.366 | 0.2404 | 0.23753 | 0.098 |
| Interaction regions | 2 | 1 | 2 | 1 | 1 |
| Magnetic length of dipole (m) | 1.1 | 2 | 1.6 | outer ring: 1.6 inner ring: 1.41 | outer ring: 1.2 inner ring: 1 |
| Length of standard cell (m) | 12 | 7.2 | 6.6 | outer ring: 6.6 inner ring: 6.2 | n/a |
| Phase advance per cell (deg) | H : 745 V : 385 | 65 | ≈ 60 | 60–90 non-standard cells | — |
| Dipoles in ring | 8 | 78 | 40 + 4 weak | 84 + 8 weak | 8 |
| Quadrupoles in ring | 24 + 4 s.c. | 150 | 68 | 134+2 s.c. | 48 |
| Peak magnetic field (T) | 2.4 | 0.6 | 0.903 at 2.8 GeV | outer ring: 0.677 inner ring: 0.766 | 1.2 |

High-Energy Collider Parameters: e^+e^- Colliders (II)

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| | CESR (Cornell) | CESR-C (Cornell) | LEP (CERN) | SLC (SLAC) |
|---|-------------------------------------|--|---|------------------------------|
| Physics start date | 1979 | 2002 | 1989 | 1989 |
| Physics end date | 2002 | 2008 | 2000 | 1998 |
| Maximum beam energy (GeV) | 6 | 6 | 100 - 104.6 | 50 |
| Delivered integrated luminosity per experiment (fb^{-1}) | 41.5 | 2.0 | 0.221 at Z peak 0.501 at 65 – 100 GeV 0.275 at >100 GeV | 0.022 |
| Luminosity ($10^{30} \text{ cm}^{-2}\text{s}^{-1}$) | 1280 at 5.3 GeV | 76 at 2.08 GeV | 24 at Z peak 100 at > 90 GeV | 2.5 |
| Time between collisions (μs) | 0.014 to 0.22 | 0.014 to 0.22 | 22 | 8300 |
| Full crossing angle (μ rad) | ± 2000 | ± 3300 | 0 | 0 |
| Energy spread (units 10^{-3}) | 0.6 at 5.3 GeV | 0.82 at 2.08 GeV | 0.7→1.5 | 1.2 |
| Bunch length (cm) | 1.8 | 1.2 | 1.0 | 0.1 |
| Beam radius (μm) | H : 460 V : 4 | H : 340 V : 6.5 | H : 200 → 300 V : 2.5 → 8 | H : 1.5 V : 0.5 |
| Free space at interaction point (m) | ± 2.2 (± 0.6 to REC quads) | ± 2.2 (± 0.3 to PM quads) | ± 3.5 | ± 2.8 |
| Luminosity lifetime (hr) | 2–3 | 2–3 | 20 at Z peak 10 at > 90 GeV | — |
| Turn-around time (min) | 5 (topping up) | 1.5 (topping up) | 50 | 120 Hz (pulsed) |
| Injection energy (GeV) | 1.8–6 | 1.5–6 | 22 | 45.64 |
| Transverse emittance (10^{-9} m) | H : 210 V : 1 | H : 120 V : 3.5 | H : 20–45 V : 0.25 → 1 | H : 0.5 V : 0.05 |
| β^* , amplitude function at interaction point (m) | H : 1.0 V : 0.018 | H : 0.94 V : 0.012 | H : 1.5 V : 0.05 | H : 0.0025 V : 0.0015 |
| Beam-beam tune shift per crossing (10^{-4}) or disruption | H : 250 V : 620 | e^- : 420 (H), 280 (V) e^+ : 410 (H), 270 (V) | 830 | 0.75 (H) 2.0 (V) |
| RF frequency (MHz) | 500 | 500 | 352.2 | 2856 |
| Particles per bunch (units 10^{10}) | 1.15 | 4.7 | 45 in collision 60 in single beam | 4.0 |
| Bunches per ring per species | 9 trains of 5 bunches | 8 trains of 3 bunches | 4 trains of 1 or 2 | 1 |
| Average beam current per species (mA) | 340 | 72 | 4 at Z peak 4→6 at > 90 GeV | 0.0008 |
| Beam polarization (%) | — | — | 55 at 45 GeV 5 at 61 GeV | e^- : 80 |
| Circumference or length (km) | 0.768 | 0.768 | 26.66 | 1.45 +1.47 |
| Interaction regions | 1 | 1 | 4 | 1 |
| Magnetic length of dipole (m) | 1.6–6.6 | 1.6–6.6 | 11.66/pair | 2.5 |
| Length of standard cell (m) | 16 | 16 | 79 | 5.2 |
| Phase advance per cell (deg) | 45–90 (no standard cell) | 45–90 (no standard cell) | 102/90 | 108 |
| Dipoles in ring | 86 | 84 | 3280 + 24 inj. + 64 weak | 460+440 |
| Quadrupoles in ring | 101 + 4 s.c. | 101 + 4 s.c. | 520 + 288 + 8 s.c. | — |
| Peak magnetic field (T) | 0.3 / 0.8 at 8 GeV | 0.3 / 0.8 at 8 GeV, 2.1 wigglers at 1.9 GeV | 0.135 | 0.597 |

High-Energy Collider Parameters: e^+e^- Colliders (III)

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| | KEKB (KEK) | PEP-II (SLAC) | SuperKEKB (KEK) |
|---|--|--|--|
| Physics start date | 1999 | 1999 | 2018 |
| Physics end date | 2010 | 2008 | — |
| Maximum beam energy (GeV) | e^- : 8.33 (8.0 nominal) e^+ : 3.64 (3.5 nominal) | e^- : 7–12 (9.0 nominal) e^+ : 2.5–4 (3.1 nominal) | e^- : 7 e^+ : 4 |
| Delivered integrated luminosity per exp. (fb^{-1}) | 1040 | 557 | — |
| Luminosity ($10^{30} \text{ cm}^{-2}\text{s}^{-1}$) | 21083 | 12069 (design: 3000) | 8×10^5 |
| Time between collisions (μs) | 0.00590 or 0.00786 | 0.0042 | 0.004 |
| Full crossing angle (μ rad) | $\pm 11000^*$ | 0 | ± 41500 |
| Energy spread (units 10^{-3}) | 0.7 | e^-/e^+ : 0.61/0.77 | e^-/e^+ : 0.64/0.81 |
| Bunch length (cm) | 0.65 | e^-/e^+ : 1.1/1.0 | e^-/e^+ : 0.5/0.6 |
| Beam radius (μm) | H: 124 (e^-), 117 (e^+) V: 1.9 | H: 157 V: 4.7 | e^- : 11 (H), 0.062 (V) e^+ : 10 (H), 0.048 (V) |
| Free space at interaction point (m) | +0.75/−0.58 (+300/−500) mrad cone | ± 0.2 , ± 300 mrad cone | e^- : +1.20/−1.28, e^+ : +0.78/−0.73 (+300/−500) mrad cone |
| Luminosity lifetime (hr) | continuous | continuous | continuous |
| Turn-around time (min) | continuous | continuous | continuous |
| Injection energy (GeV) | e^-/e^+ : 8.0/3.5 (nominal) | e^-/e^+ : 9.0/3.1 (nominal) | e^-/e^+ : 7/4 |
| Transverse emittance (10^{-9} m) | e^- : 24 (57^\dagger) (H), 0.61 (V) e^+ : 18 (55^\dagger) (H), 0.56 (V) | e^- : 48 (H), 1.8 (V) e^+ : 24 (H), 1.8 (V) | e^- : 4.6 (H), 0.013 (V) e^+ : 3.2 (H), 0.0086 (V) |
| β^* , amplitude function at interaction point (m) | e^- : 1.2 (0.27^\dagger) (H), 0.0059 (V) e^+ : 1.2 (0.23^\dagger) (H), 0.0059 (V) | e^- : 0.50 (H), 0.012 (V) e^+ : 0.50 (H), 0.012 (V) | e^- : 0.025 (H), 3×10^{-4} (V) e^+ : 0.032 (H), 2.7×10^{-4} (V) |
| Beam-beam tune shift per crossing (units 10^{-4}) | e^- : 1020 (H), 900 (V) e^+ : 1270 (H), 1290 (V) | e^- : 703 (H), 498 (V) e^+ : 510 (H), 727 (V) | e^- : 12 (H), 807 (V) e^+ : 28 (H), 881 (V) |
| RF frequency (MHz) | 508.887 | 476 | 508.887 |
| Particles per bunch (units 10^{10}) | e^-/e^+ : 4.7/6.4 | e^-/e^+ : 5.2/8.0 | e^-/e^+ : 6.53/9.04 |
| Bunches per ring per species | 1585 | 1732 | 2500 |
| Average beam current per species (mA) | e^-/e^+ : 1188/1637 | e^-/e^+ : 1960/3026 | e^-/e^+ : 2600/3600 |
| Beam polarization (%) | — | — | — |
| Circumference or length (km) | 3.016 | 2.2 | 3.016 |
| Interaction regions | 1 | 1 | 1 |
| Magnetic length of dipole (m) | e^-/e^+ : 5.86/0.915 | e^-/e^+ : 5.4/0.45 | e^-/e^+ : 5.9/4.0 |
| Length of standard cell (m) | e^-/e^+ : 75.7/76.1 | 15.2 | e^-/e^+ : 75.7/76.1 |
| Phase advance per cell (deg) | 450 | e^-/e^+ : 60/90 | 450 |
| Dipoles in ring | e^-/e^+ : 116/112 | e^-/e^+ : 192/192 | e^-/e^+ : 116/112 |
| Quadrupoles in ring | e^-/e^+ : 452/452 | e^-/e^+ : 290/326 | e^-/e^+ : 466/460 |
| Peak magnetic field (T) | e^-/e^+ : 0.25/0.72 | e^-/e^+ : 0.18/0.75 | e^-/e^+ : 0.22/0.19 |

*KEKB was operated with crab crossing from 2007 to 2010.

† With dynamic beam-beam effect.

High-Energy Collider Parameters: ep , $p\bar{p}$, pp Colliders

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| | HERA (DESY) | TEVATRON* (Fermilab) | RHIC (Brookhaven) | LHC (CERN) | | |
|---|---|---------------------------------|---------------------------------------|-----------------------------------|-------------------------------------|-------------------------------------|
| Physics start date | 1992 | 1987 | 2001 | 2009 | 2015 | 2026 (HL-LHC) |
| Physics end date | 2007 | 2011 | — | — | | |
| Particles collided | ep | $p\bar{p}$ | pp (polarized) | pp | | |
| Maximum beam energy (TeV) | e : 0.030 p : 0.92 | 0.980 | 0.255 55% polarization | 4.0 | 6.5 | 7.0 |
| Maximum delivered integrated luminosity per exp. (fb^{-1}) | 0.8 | 12 | 0.38 at 100 GeV 1.3 at 250/255 GeV | 23.3 at 4.0 TeV 6.1 at 3.5 TeV | 94.5 | 250/y |
| Luminosity ($10^{30} \text{ cm}^{-2}\text{s}^{-1}$) | 75 | 431 | 245 (pk) 160 (avg) | 7.7×10^3 | 2×10^4 | 5.0×10^4 (leveled) |
| Time between collisions (ns) | 96 | 396 | 107 | 49.90 | 24.95 | 24.95 |
| Full crossing angle (μ rad) | 0 | 0 | 0 | 290 | $300 \rightarrow 240^\dagger$ | 500 |
| Energy spread (units 10^{-3}) | e : 0.91 p : 0.2 | 0.14 | 0.15 | 0.1445 | 0.105 | 0.129 |
| Bunch length (cm) | e : 0.83 p : 8.5 | p : 50 \bar{p} : 45 | 60 | 9.4 | 8 | 9 |
| Beam radius (10^{-6} m) | e : 110(H), 30(V) p : 111(H), 30(V) | p : 28 \bar{p} : 16 | 85 | 18.8 | 10 | 7 |
| Free space at interaction point (m) | ± 2 | ± 6.5 | 16 | 38 | 38 | 38 |
| Initial luminosity decay time, $-L/(dL/dt)$ (hr) | 10 | 6 (avg) | 7.5 | ≈ 6 | ≈ 15 | ≈ 15 (leveled) |
| Turn-around time (min) | e : 75, p : 135 | 90 | 25 | 180 | 150 | 145 |
| Injection energy (TeV) | e : 0.012 p : 0.040 | 0.15 | 0.023 | 0.450 | 0.450 | 0.450 |
| Transverse emittance (10^{-9} m) | e : 20(H), 3.5(V) p : 5(H), 5(V) | p : 3 \bar{p} : 1 | 11 | 0.59 | 0.3 | 0.33 |
| β^* , ampl. function at interaction point (m) | e : 0.6(H), 0.26(V) p : 2.45(H), 0.18(V) | 0.28 | 0.65 | 0.6 | 0.3 | 0.15 |
| Beam-beam tune shift per crossing (units 10^{-4}) | e : 190(H), 450(V) p : 12(H), 9(V) | p : 120 \bar{p} : 120 | 73 | 72 | 45 | 86 |
| RF frequency (MHz) | e : 499.7 p : 208.2/52.05 | 53 | accel: 9 store: 28 | 400.8 | 400.8 | 400.8 |
| Particles per bunch (units 10^{10}) | e : 3 p : 7 | p : 26 \bar{p} : 9 | 18.5 | 16 | 12.5 | 22 |
| Bunches per ring per species | e : 189 p : 180 | 36 | 111 | 1380 | 1868 1868 (i.r. $1/5^\ddagger$) | 2760 2748 (i.r. $1/5^\ddagger$) |
| Average beam current per species (mA) | e : 40 p : 90 | p : 70 \bar{p} : 24 | 257 | 400 | 420 | 1100 |
| Circumference (km) | 6.336 | 6.28 | 3.834 | 26.659 | | |
| Interaction regions | 2 colliding beams 1 fixed target (e beam) | 2 high \mathcal{L} | 6 total, 2 high \mathcal{L} | 4 total, 2 high \mathcal{L} | | |
| Magnetic length of dipole (m) | e : 9.185 p : 8.82 | 6.12 | 9.45 | 14.3 | | |
| Length of standard cell (m) | e : 23.5 p : 47 | 59.5 | 29.7 | 106.90 | | |
| Phase advance per cell (deg) | e : 60 p : 90 | 67.8 | 84 | 90 | | |
| Dipoles in ring | e : 396 p : 416 | 774 | 192 per ring + 12 common | 1232 main dipoles | | |
| Quadrupoles in ring | e : 580 p : 280 | 216 | 246 per ring | 482 2-in-1 24 1-in-1 | | |
| Magnet types | e : C-shaped p : s.c., collared, warm iron | s.c., $\cos\theta$ warm iron | s.c., $\cos\theta$ cold iron | s.c., 2 in 1 cold iron | | |
| Peak magnetic field (T) | e : 0.274, p : 5 | 4.4 | 3.5 | 8.3 § | | |

*Other TEVATRON parameters: \bar{p} source accum. rate: $25 \times 10^{10} \text{ hr}^{-1}$; max. no. of \bar{p} stored: 3.4×10^{12} (Accumulator), 6.1×10^{12} (Recycler).

† Variable crossing angle decreasing during the fill with the reduction in bunch population

‡ Number of bunches colliding at the interaction regions (i.r.) 1 (ATLAS) and 5 (CMS).

§ Value for design beam energy of 7 TeV.

High-Energy Collider Parameters: Heavy Ion Colliders

Updated in March 2018 with numbers received from representatives of the colliders (contact E. Pianori, LBNL). The table shows the parameter values achieved. For the LHC, only maximum values for the ATLAS and CMS experiments are provided (ALICE and LHCb have different requirements for energy and luminosity). Design values for a high-luminosity upgrade are also given. Quantities are, where appropriate, r.m.s.; unless noted otherwise, energies refer to beam energy; s.c. stands for superconducting. pk and avg denote peak and average values.

| | RHIC (Brookhaven) | | LHC (CERN) | | | |
|--|-------------------------------|--|--------------------------|----------------------|----------------|---|
| Physics start date | 2000 | 2012 / 2012 / 2004 / 2014 2002 / 2015 / 2015 | 2010 | 2012 | 2017 | ≥ 2021 (high lum.) [§] |
| Physics end date | — | | — | | | |
| Particles collided | Au Au | U U / Cu Au / Cu Cu / h Au d Au / p Au / p Al | Pb Pb | p Pb | Xe Xe | Pb Pb |
| Maximum beam energy (TeV/n) | 0.1 | 0.1 | 2.51 | p: 6.5 Pb: 2.56 | 2.72 | 2.76 |
| $\sqrt{s_{NN}}$ (TeV) | 0.2 | 0.2 | 5.02 | 8.16 | 5.44 | 5.5 |
| Max. delivered int. nucleon-pair lumin. per exp. (pb ⁻¹) | 2639 (at 100 GeV/n) | 21 / 167 / 60 / 43 169 / 124 / 63 (all at 100 GeV/n) | 30.3 | 194 | 0.05 | $\approx 150/y$ |
| Luminosity (10 ²⁷ cm ⁻² s ⁻¹) | pk: 15.5 avg: 8.7 | pk: 0.4 / 12 / 21 / 170 850 / 880 / 7600 avg: 0.6 / 10 / 8 / 100 500 / 450 / 3800 | 3.6 | 900 | 0.4 | 6 (leveled) |
| Time between collisions (ns) | 107 | 107 / 107 / 321 / 107 107 / 107 / 107 | 99.8 / 149.7 | 99.8 / 149.7 | ≈ 5500 | 49.9 |
| Full crossing angle (μ rad) | 0 | 0 | 290 | 280 | 300 | > 200 |
| Energy spread (units 10 ⁻³) | 0.75 | 0.75 | 0.11 | 0.11 | 0.11 | 0.11 |
| Bunch length (cm) | 30 | 30 | 8.0 | p / Pb: 9 / 11.5 | 11 | 7.9 |
| Beam radius (10 ⁻⁶ m) | 114* | 123* / 163* / 145* / 136* 124* / 147* / 128* | 55 | 19 | 12 | 16 |
| Free space at interaction point (m) | 16 | 16 | 38 | 38 | 38 | 38 |
| Initial luminosity decay time, $-L/(dL/dt)$ (hr) | 1 | -0.35 [‡] / ∞^{\ddagger} / 1.8 / 0.6 ∞^{\ddagger} / 0.5 / 0.25 | 2.6 | ≈ 2 | ≈ 6 | ∞ |
| Turn-around time (min) | 30 | 60 / 160 / 90 / 45 90 / 60 / 50 | ≈ 180 | 150 | 180 | ≈ 180 |
| Injection energy (TeV/n) | 0.011 | 0.011 | 0.177 | p / Pb: 0.45 / 0.177 | 0.188 | 0.177 |
| Transverse emittance (10 ⁻⁹ m) | 19* | 22* / 38* / 23* / 19* 22* / 26* / 21* | 1.5 | 0.29 | 0.3 | 0.5 |
| β^* , ampl. function at interaction point (m) | 0.7 | 0.7 / 0.7 / 0.9 / 1.0 0.7 / 0.8 / 0.8 | 0.8 | 0.5 | 0.4 | 0.5 |
| Beam-beam tune shift per crossing (units 10 ⁻⁴) | 39 [†] | 6 [†] / 14 [†] (Cu), 14 [†] (Au) / 30 [†] 42 [†] (h), 22 [†] (Au) / 40 [†] (d), 27 [†] (Au) 53 [†] (p), 41 [†] (Au) / 80 [†] (p) 59 [†] (Au) | 9 | 15 | ≈ 10 | 10 |
| RF frequency (MHz) | accel: 28, store: 197 | accel: 28, store: 197 | 400.8 | 400.8 | 400.8 | 400.8 |
| Particles per bunch (units 10 ¹⁰) | 0.20 | 0.03 / 0.4 (Cu), 0.13 (Au) / 0.45 4.5 (h), 0.13 (Au) / 13 (d), 0.20 (Au) 22.5 (p), 0.16 (Au) / 24 (p), 1.1 (Al) | 0.019 (r.m.s.) | p: 2.6 Pb: 0.022 | 0.027 | 0.017 |
| Bunches per ring per species | 111 | 111 / 111 / 37 / 111 111 / 111 / 111 | 518 | p: 540 Pb: 684 | 16 | ≈ 1100 |
| Average beam current per species (mA) | 224 | 38 / 160 (Cu), 138 (Au) / 60 125 (h), 143 (Au) / 181 (d), 213 (Au) 313 (p), 176 (Au) / 334 (p), 199 (Al) | 14.9 | p: 16 Pb: 15 | 0.54 | 28 |
| Circumference (km) | 3.834 | | 26.659 | | | |
| Interaction regions | 6 total, 2 high \mathcal{L} | | 3 high \mathcal{L} + 1 | | | |
| Magnetic length of dipole (m) | 9.45 | | 14.3 | | | |
| Length of standard cell (m) | 29.7 | | 106.90 | | | |
| Phase advance per cell (deg) | 93 | 84 / 84 / 84 / 93 84 (d), 93 (Au) / 84 (p), 93 (Au) 84 (p), 93 (Al) | 90 | | | |
| Dipoles in ring | 192 per ring, + 12 common | | 1232, main dipoles | | | |
| Quadrupoles in ring | 246 per ring | | 482 2-in-1, 24 1-in-1 | | | |
| Magnet Type | s.c. $\cos\theta$, cold iron | | s.c., 2 in 1, cold iron | | | |
| Peak magnetic field (T) | 3.5 | | 8.3 | | | |

*Initial value, smaller after cooling

[†]Initial value, possibly larger after cooling

[‡]Negative or infinite decay time is effect of cooling.

[§]High luminosity upgrade expected ≥ 2021 ; will extend throughout HL-LHC running. Very preliminary, conservative estimates.