





FCC-ee injector baseline parameters

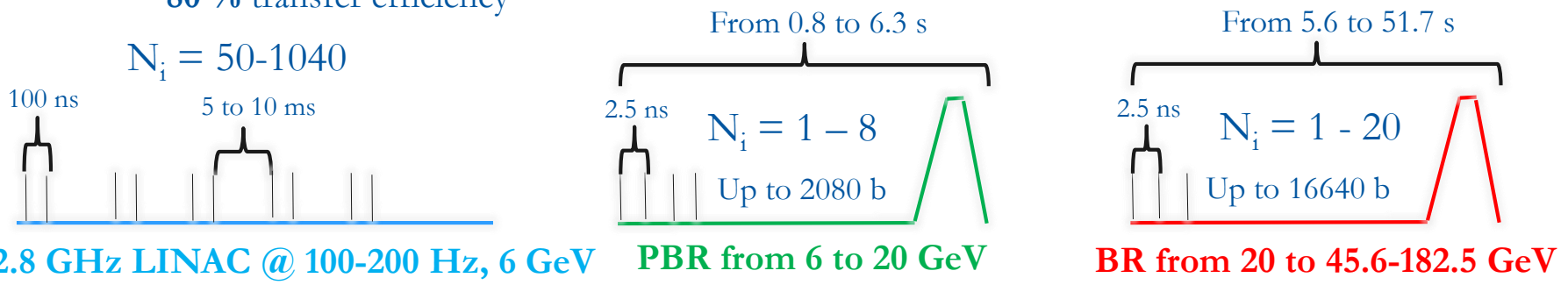
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FCC-ee injector baseline scheme

- **Baseline** established based on SLC/SUPERKEKB-like linac (higher gradient)
 - Based on collider parameters of December 2017 (CDR)
 - Longer pulses with **1 or 2** bunches with repetition rate of **100-200 Hz, 2.8 GHz RF**
 - Maximum linac bunch intensity $\sim 2.13 \times 10^{10}$ **particles** (both species).
 - Twice as much will be needed for e^+ production, i.e. **4×10^{10} particles/bunch**
 - Injected several times (from **50 to 1040**), @ **6 GeV** into of PBR (SPS or new ring) with 1 linac bunch to 1 ring bucket (**400 MHz RF system**), up to **2080** bunches
 - PBR ramp to **20 GeV** with **0.2 s** ramp rate and cycle length **below 6.3 s**
 - Transferred to main Booster (**1 - 8 PBR cycles**), with **400 MHz RF** frequency, to a bunch structure required by the collider (from **50 to 16640** bunches)
 - Accelerated to corresponding energy with ramp time of **0.32 - 2 s**, and total cycle length up to **51.7 s**
 - Transferred to the collider by accumulating current for the full filling or single injection for top-up
 - **Interleaved** filling of e^+/e^- and continuous top-up (able to accommodate **bootstrapping**)
 - Full filling below **20 min** for both species, but also able to accommodate bootstrapping
 - Top-up target time, based on **5 %** of current drop due to corresponding lifetime, always achieved
 - **80 %** transfer efficiency



FCC-ee injector parameters



Accelerator	FCCee-Z		FCCee-W		FCCee-H		FCCee-tt	
Energy [GeV]	45.6		80		120		182.5	
Type of filling	Full	Top-up	Full	Top-up	Full	Top-up	Full	Top-up
LINAC # bunches, with 2.8 GHz RF	2				1			
LINAC repetition rate [Hz]	200		100					
LINAC/PBR bunch population [10^{10}]	2.13	1.06	1.88	0.56	1.88	0.56	1.38	0.83
# of LINAC injections	1040		500		393		50	
PBR bunch spacing [ns]	2.5		22.5		57.5		450	
# PBR cycles	8		1					
PBR # of bunches	2080		1000		393		50	
PBR cycle time [s]	6.3		11.1		4.33		0.9	
PBR duty factor	0.84		0.56		0.35		0.08	
BR # of bunches	16640		2000		393		50	
BR cycle time [s]	51.74		13.3		7.53		5.6	
#of BR cycles	10	1	10	1	10	1	20	1
# of injections/collider bucket	10	1	10	1	10	1	20	1
Total number of bunches	16640		2000		393		50	
Filling time (both species) [sec]	1034.8	103.5	288	28.8	150.6	15.6	224	11.2
Injected bunch population [10^{10}]	2.13	1.06	1.44	1.44	1.13	1.13	2.00	2.00

Power estimates



- Revising power estimates (see <http://accelconf.web.cern.ch/AccelConf/ipac2016/papers/thpor024.pdf>)
 - Linacs, PBR, BR (magnets and RF)

lepton collider	Z		W	ZH	$t\bar{t}$	LEP2
luminosity / interaction point [$10^{34} \text{ cm}^{-2}\text{s}^{-1}$]	207	90	19	5	1.3	0.012
total RF power [MW]	163		163	145	145	42
collider cryogenics [MW]	3	2	5	23	39	18
collider magnets [MW]	3		10	24	50	16
booster RF & cryogenics [MW]	4		4	6	7	N/A
booster magnets [MW]	0		1	2	5	N/A
pre-injector complex [MW]	10		10	10	10	10
physics detectors (2) [MW]	10		10	10	10	9
cooling & ventilation [MW]	47		49	52	62	16
general services [MW]	36		36	36	36	9
total electrical power [MW]	276	~ 275	~ 288	~ 308	~ 364	~ 120

Some further consideration



- Considerations for pros/cons for new PBR or SPS or **linac up to 20 GeV** injecting to MB parameters (cost impact)
 - Other options also considered, i.e. CLIC type linac, ERL, etc.
- Refine Booster injection energy, based on magnet field quality considerations
- Considerations for **single linac** for positron production and e^+/e^- acceleration
 - Doubling number of bunches for Z and frequency for the rest (i.e. linacs working at 200 Hz)
- Converging on **emittance requirements** across the injectors
 - Including **radiation damping** + **IBS effect** for PBR and Main Booster
- **Beam transfer** details are being worked out
- Considerations on **RF frequencies** for the injectors
- Finalise **positron production** design