

ESPP white paper preparation meeting for LHeC



LHeC synergies with FCCee and Accelerator Technologies

Oliver Brüning and Yannis Papaphilippou,
CERN

15th November 2024

Synergies with FCCee



- Synergy with **FCCee injector design** option with **recirculating LINAC (RLI)** based on **LHeC ERL** (even with a 1st stage @ 20 GeV as presented today by Krzysztof)
- Could even be extended to cover **full FCCee energy range** (i.e. replacing **FCCee booster**)
- Synergy with **SRF pre-series production** (including **High-Temperature SRF @ 4.5 K**) while building **CERN SRF expertise (project/team)** and **industrial validation**
- Synergy with **high-efficiency klystrons development**
- **Cryogenic system** towards reduced power and cost
- **CE optimization** based on CO2 emission (J. Osborne)
- **Cost to be updated** based on 2018 **LHeC estimate** document (consistent with Oliver's cost and resource estimates)
 - Do we need some comparison with **FCCee injector cost**?
- **Schedule** to fit **HL-LHC era** and towards **FCCee (2035-...)**
- **Risk mitigation** for certain **FCCee accelerator technologies** by **prototyping** and **testing**
- **Training opportunities** for building **ERL expertise** (collaboration with Orsay PERLE and bERLinPRO, operational experience)

RLI for FCCee



- Need to update parameters for RLI to replace LINAC pre-injectors + Booster, including positron production

Tentative injector parameters with RLI @ 50 GeV (FCC week 2021)

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
RLI # bunches (800 GHz RF)	832		1000		328		48	
RLI bunch population [10^9]	3.0	0.15	1.3	0.04	1.9	0.06	2.8	0.08
RLI injections	1400		140		100		100	
#of BR cycles	-		1		1		1	
# of injections/collider bucket	70		1		1		1	
Total number of bunches	16640		2000		328		48	
Filling time (both species) [sec]	0.3	0.3	5.8	5.8	4.9	4.9	8.0	8.0

LHeC Accelerator technologies



- **ERL Design options and optimization** (K.Andre et al.)
 - Separate **FFAG arc design** and impact on **emittance preservation**
 - **Lattice and robustness studies** (imperfections) with **improved simulation framework (X-suite)**
 - Impact of **Coherent Synchrotron Radiation** and **micro-bunching instability** handling
- **IR optics design** (B. Holzer et al.)
 - **Asymmetric magnets** using **HL-LHC short model coils**
- **Machine-detector interface** (L. Forthomme et al.)
 - **SR radiation handling/shielding** in IR for machine and detector protection
- **Super-conducting RF development including** (including **High-Temperature SRF @ 4.5 K**)
- **Fast Reactive Tuner (FRT)** for microphonics mitigation
- **High-efficiency klystrons** development
- **Cryogenic system** for reduced power and cost
- **PERLE** as stepping stone for proving several **accelerator physics concepts** and prototyping/testing **technologies**