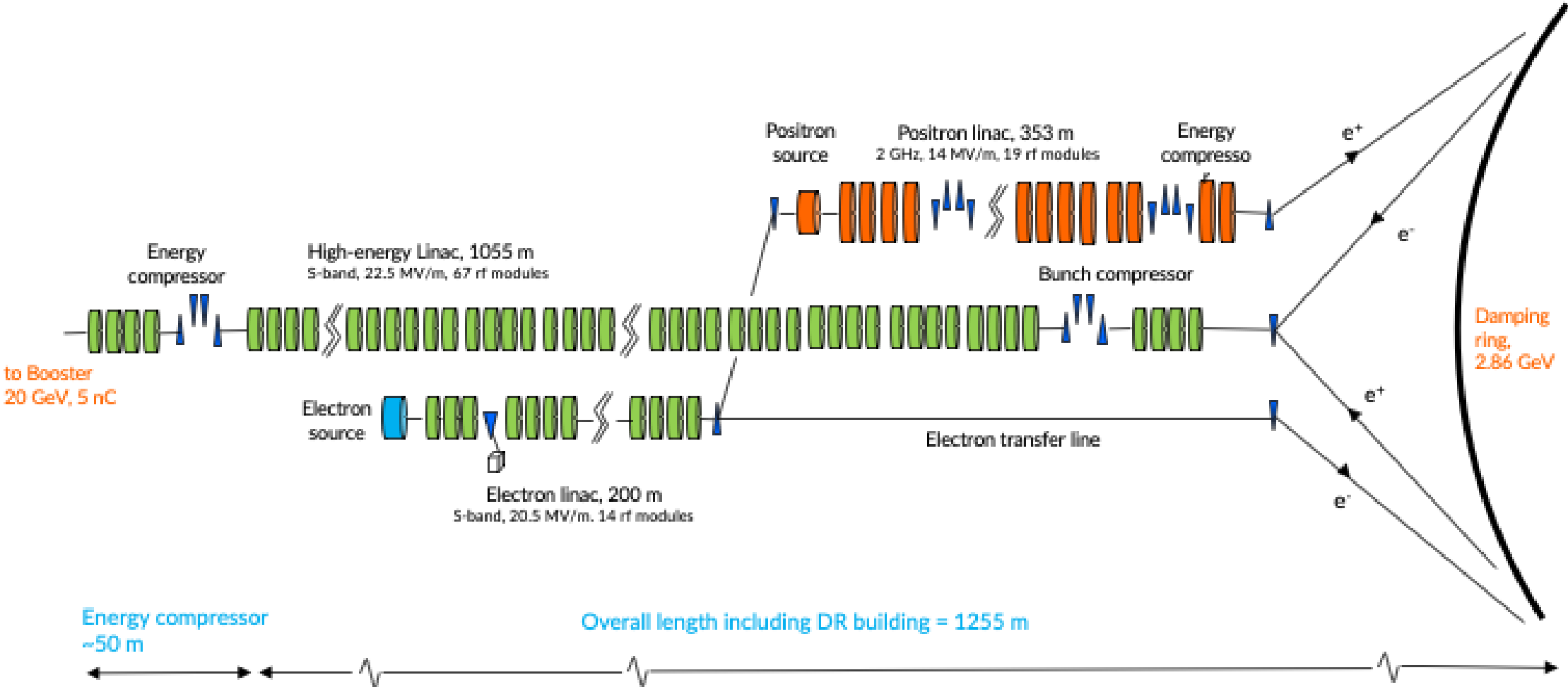


FCC-ee Injector study coordination meeting #19

P. Craievich – 29.08.2024

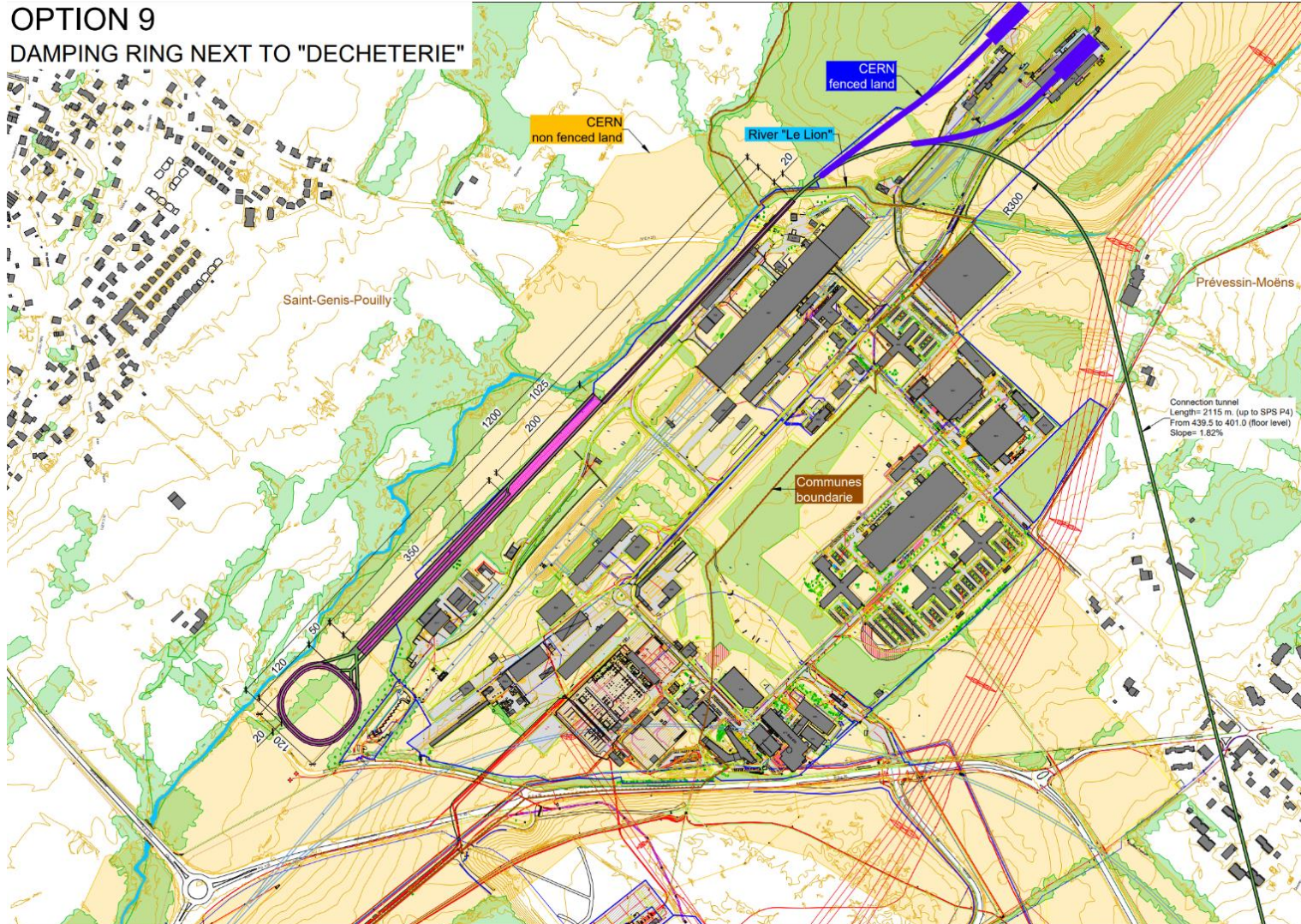
- WP0 - General information: towards the Feasibility Study report (Paolo)
 - FCC injector siting
 - **Open questions for the FS report (Injector)**
 - Beam parameters across the injector complex
 - Documents to be prepared
 - P-cubed: Current status
 - Collaboration with SLAC/FACET II
- WP4 - DR at 2.86 GeV: status and outlook (Catia)
- WP1 - e⁺/e⁻ Injector Linacs: electron-, positron- and HE-linac (Alexej)
- WP3 - Positron source and capture system (Iryna)

Baseline layout: 4 ASs for module, 4 bunches (25 ns), 100 Hz



Injector siting

OPTION 9 DAMPING RING NEXT TO "DECHETERIE"



- Meetings on going. Decision in September
- Linac within the Prévessin site, DR outside but limited impact on the surrounding area, meeting with the municipality in the coming weeks
- Location of the injection into the booster will be also fixed soon

Courtesy T. Watson, W. Bartmann (CERN)

Open questions for the FS report (Injector)

- New baseline needs a new DR at 2.86 GeV to be included in the FS report!
- Working RF frequency for the linacs: The power source (klystron) with a commercial S-band frequency can be used if slightly different time separations (presently around 25 ns) between bunches in the injector and booster can be accepted, otherwise, the klystron should be slightly tuned, e.g., from 2999 to 3006 MHz.
- Positron capture and linac: presently the working frequency is 2.0 GHz! New optimization to use 3 GHz is necessary, some options to be discussed, i.e., an option could be the re-use SC solenoids around the rf structures (also a reduction in energy consumption, currently 4-5MW!) or recovery the yield increasing the drive beam energy (new layout is flexible for this). Positron bunch charge is 13.5 nC at the DR entrance!!
 - o Optimization MUST include dynamic acceptance and aperture in the DR!
- Electron source: bunch-by-bunch charge variation using a Digital Micromirror Device (MDM) in the laser optical path
 - o DR for electrons → can we exclude the use of another type of electron sources and intensity modulation schemes?
- Polarized positrons (and electrons) from the injector. Impact on the present layout, i.e., dedicated DR?, polarized electron source?
 - o Decision: we don't include this option in the FS report

Beam parameters along the injector and injection chain (Z-mode)



- First (and last) discussion during the FCC week, Hannes chaired the meeting
- ...I would like to include the table o part of it in the FS report, we should keep it updated
- Now on <https://cernbox.cern.ch/>, (thanks to Adnan)

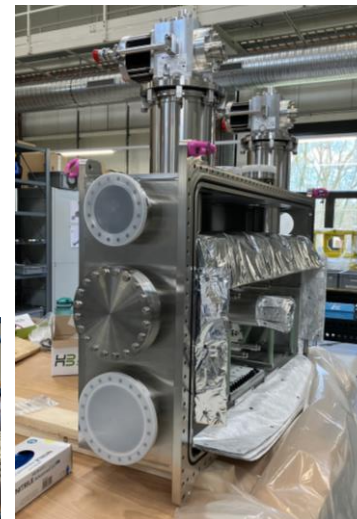
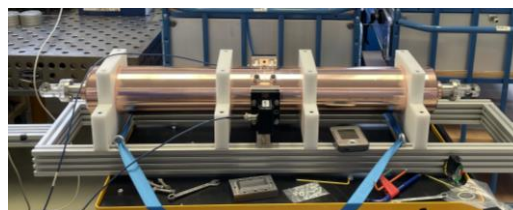
		energy (GeV)	bunch population (1e10)	bunch charge (nC)	transmission	bunch length (mm)	rms mom. spread (1e-3)	normalized transverse emittances		geometric transverse emittances	
								horizontal (um)	vertical (um)	horizational (nm)	vertical (nm)
Positron Pre-injector	LE Linac injection	0.2	2.16	3.47		1	2	3	3	7.67	7.67
	LE Linac exit	2.86	2.14	3.43	0.99	1	7	4	4	0.71	0.71
	Positron source target	0.1	11.99	19.21	5.6	1	huge	10000	10000	51100.00	51100.00
	Positron Linac injection	0.2	6.00	9.61	0.5	1.5	huge	10000	10000	25550.00	25550.00
	Positron Linac exit	2.86	4.20	6.72	0.7	3	<40	10000	10000	1786.71	1786.71
	Energy Compressor	2.86	4.16	6.66	0.99	Antonio	20	10000	10000	1786.71	1786.71
	DR injection	2.86	3.12	4.99	0.75	Antonio	20	10000	10000	1786.71	1786.71
	DR extraction	2.86	3.09	4.94	0.99	3	0.7	10	1	1.79	0.18
Electron Pre-injector	LE Linac inection	0.2	3.50	5.60		1	2	3	3	7.67	7.67
	LE Linac exit	2.86	3.46	5.55	0.99	1	7	4	4	0.71	0.71
	DR injection	2.86	3.12	4.99	0.9	1	7	4	4	0.71	0.71
	DR exit	2.86	3.09	4.94	0.99	3	0.7	10	1	1.79	0.18
	Bunch Compressor	2.86	3.09	4.94	0.99	1	7	15	1.5	2.68	0.27
	HE Linac injection	2.86	3.05	4.89	0.99	1	7	15.5		2.77	0.00
	HE Linac exit	20	3.02	4.84	0.99	1	7.5	16		0.41	0.00
	Energy Compressor	20	2.99	4.80	0.99	4	0.9			0.00	0.00
	Transfer line	20	2.84	4.56	0.95	4	0.9			0.00	0.00
	Booster injection	20	2.70	4.33	0.95	4	1	20	2	0.51	0.05
	Booster extraction	45.6	2.68	4.29	0.99	2.43	0.38	10.71	0.89	0.12	0.01
	Collider injection	45.6	2.14	3.43	0.8	2.43		10.71	0.89	0.12	0.01
					injection efficiency could vary for different intensity in collider						

Documents to be prepared

- FS report by January/February 2025 (we must finalise the studies by the end of the year)
 - as presented in FCC Week 2024 it will consist of 3 separate volumes:
 - Vol. 1: Physics, Experiments and Detectors (~200 pages)
 - Vol. 2: Accelerators, Technical Infrastructures, Safety Concepts (~370 pages)
 - ... Injector... ~20-30 pages?
 - Vol. 3: Civil Engineering, Implementation & Sustainability (~200 pages)
- Risk management by September 2024
 - Excel file (for the [risk register](#)) with the identified risks related to the injector complex including proposal for mitigation measures for further discussions.
- Update of the cost estimate, with a view of reducing the uncertainty level [from cost class 4 to cost class 3](#), when relevant;
- Environment aspect report for the FCC feasibility study also needs to feature a chapter describing the injector complex
 - Report for non-technical readers and authorities

P-cubed: Current status

- The installation works at SwissFEL are progressing smoothly during the SwissFEL shutdown (three for year):
 - parts of the dedicated extraction line and the 50 m long RF waveguide installed in the tunnel.
 - procurement and assembly of most accelerator and diagnostics components is progressing on schedule.
 - HTS solenoid: some tests with low grade tape, first coils with high grade tape in next weeks
 - radiation tests on a dedicated HTS solenoid in the beamline of the PSI cyclotron (HIPA) is under discussion.
- P-cubed target at CERN: any news?
- Based on the current progress, the major part of the installation work is expected to conclude by the end of 2025, making it possible to start the operation with e+ in 2026.



Collaboration with SLAC – tests in FACET II



We are discussing a possible collaboration with colleagues working on FACET II to find some topics where they can support the FCC-ee injector activities. For now:

- Study jitter amplification (single and multi-bunch instabilities) in the FACET-II linac;
- Study beam intensity modulation in the injector;
- Study high power e-beam on positron target (30 Hz, 3 nC, 12 GeV, x2 bunches → 2160 W)
- ...any suggestions are welcome

- Non-collider science applications for FCC-ee (please refer to Frank Zimmermann)
 - Brainstorming last week
 - Next event at CERN 28+29 Nov. 2024
 - Photon science (light source, CBS)
 - HEP applications (QED, dark sector,)
 - e+ applications (surface science, Ps BEC, 511 X-ray laser)
- Paper on the Injector study to be submitted to EPJ – first draft by Ozgur, the content should reflect the FS report.
- CHART 3, FCC-ee Injector 2025-2028: positive feedback on the re-funding of the CHART programme, started some preliminary discussions
 - Main topic: drafting of the TDR including prototyping phases and testing of some components.
 - From FCC week (M. Benedikt): By the end of 2028, the Technical Design Report (TDR) for both the accelerator and the technical infrastructure will have been completed.

Any question?