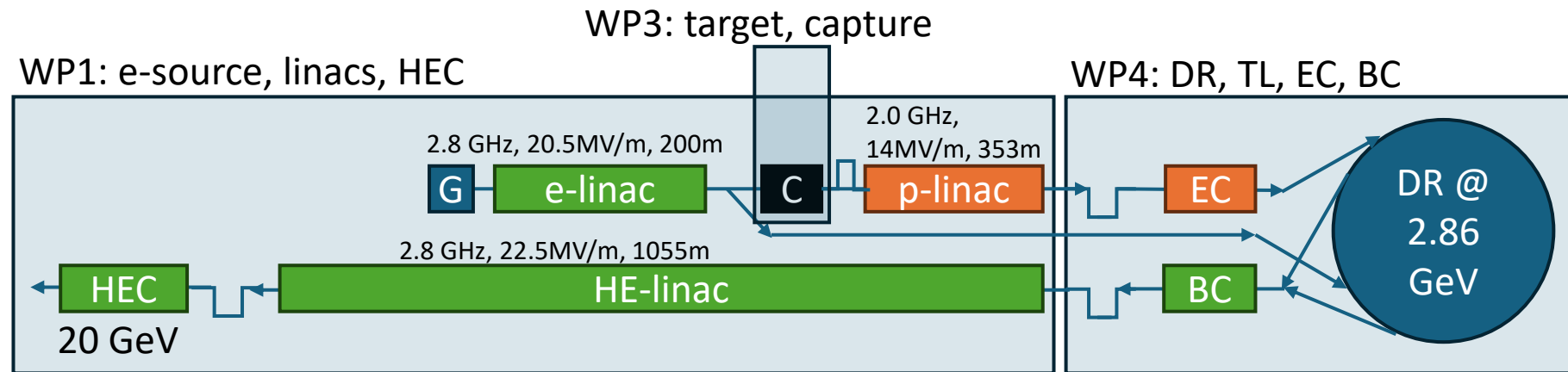


SY-RF contribution to FCCee injector design study (CHART)

Alexej Grudiev, SY-RF

4/10/2024

FCCEe injector design study (CHART2): structure

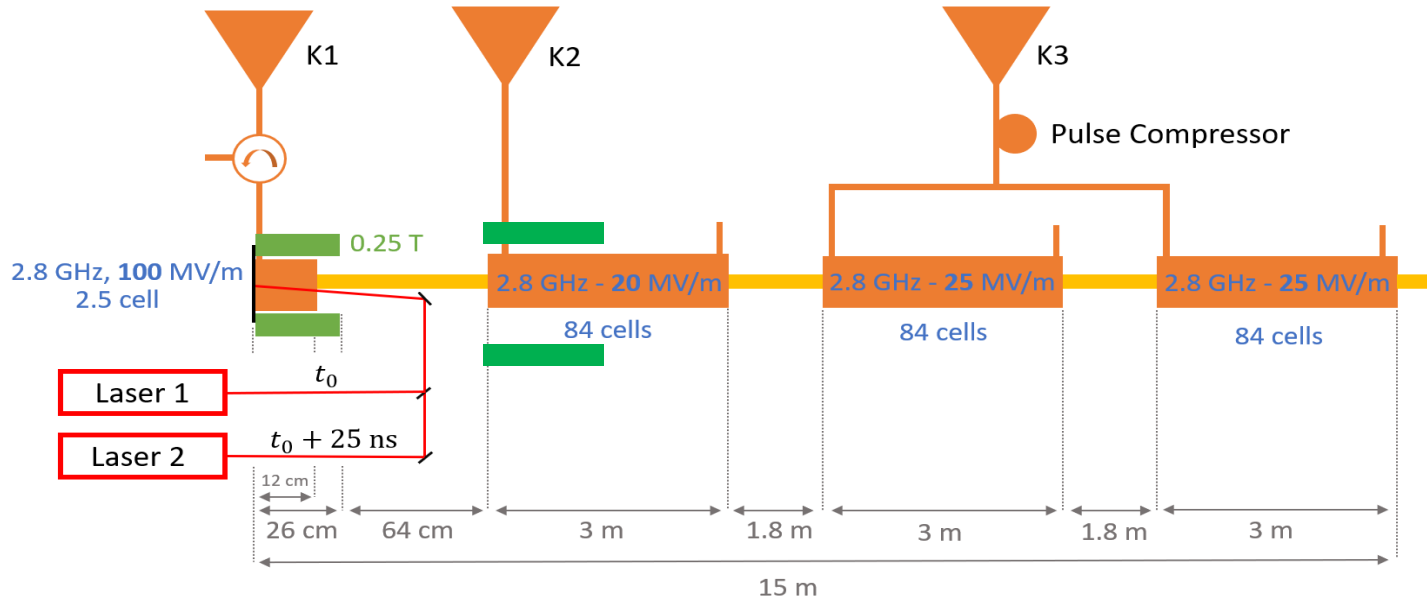


- WP0: Coordination (PSI), P. Craievich
- WP1: Design of e-source, linacs and HEC (CERN), A. Grudiev
- WP3: Design of positron production: target and capture systems (IJCLab), I. Chaikovska
- WP4: Design of the damping ring and transfer lines (INFN), C. Milardi
- WP6: P3 experiment (PSI)

WP1 structure

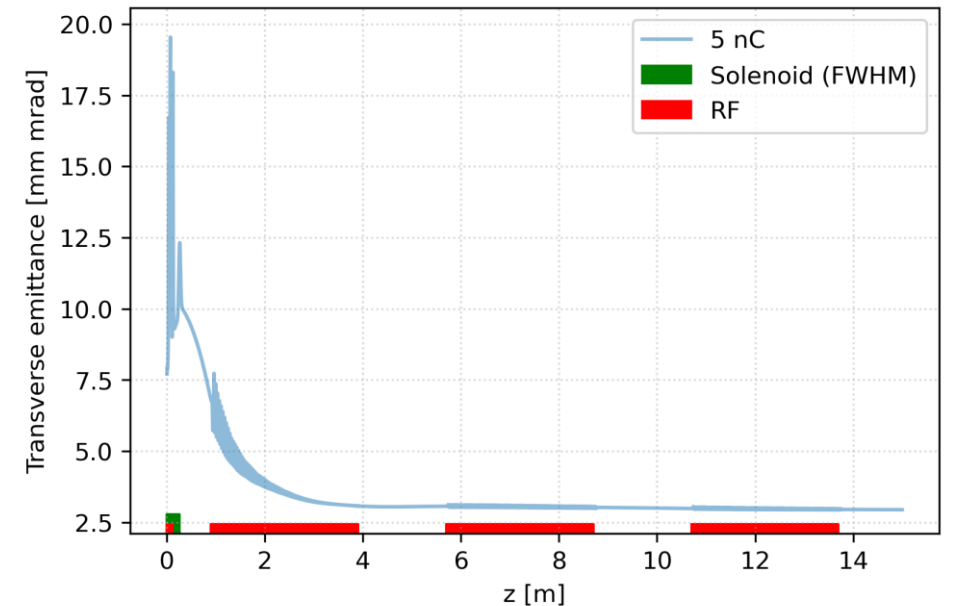
- Task 1.1: Electron source design (CERN): Steffen Doebert
 - TECH: Tomas Brezina 2020-2021
 - TECH: Zdenek Vostrel 2022-2023
- Task 1.2: RF design of the linacs (CERN): Alexej Grudiev
 - FELL: H. Pommerenke (2020-2022)
 - GRAD: Adnan Kurtulus (2023-...)
- Task 1.3: Beam dynamics design of the linacs (PSI), Simona Bettoni
 - Typically, PSI staff works part time on this
 - Strong participation of CERN, BY-ABP
- Task 1.4: RF module, power and cost (PSI), Jean-Yves Raguin

Electron source



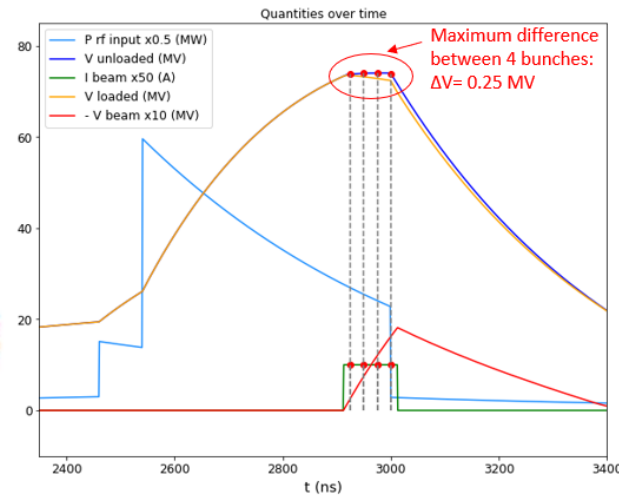
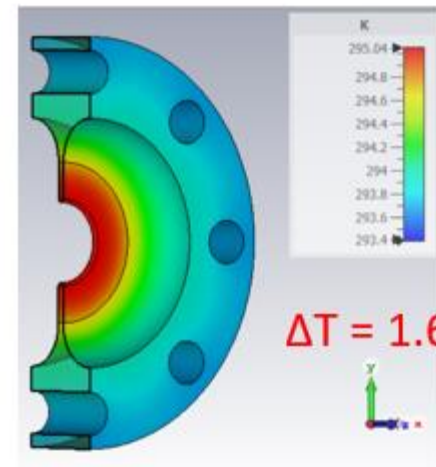
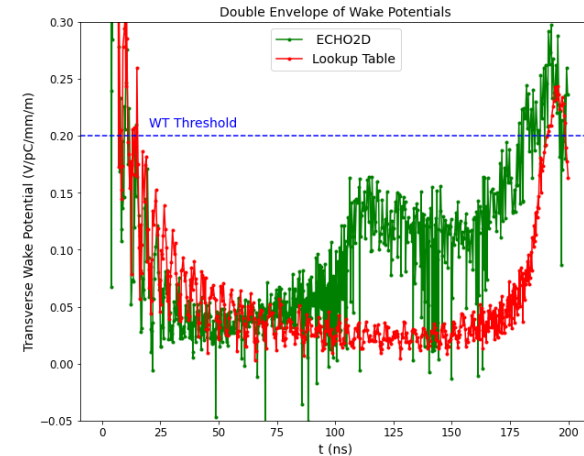
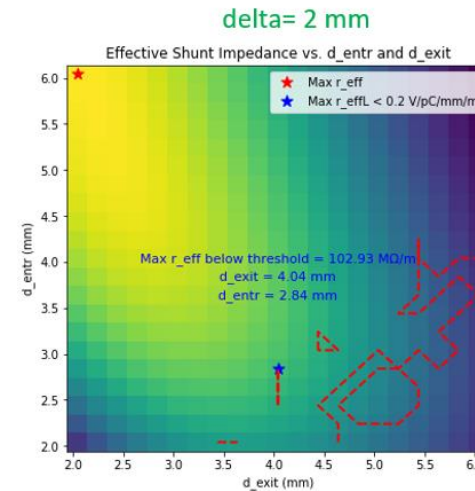
- Detailed baseline design studied with errors.
- Top-up mode studied: Robust solution to preserve the shot-by-shot emittance for different bunch charges (Digital Micromirror Device).
- Design documented and published in <https://doi.org/10.1016/j.nima.2024.169261>
- Next steps: Prototyping of hardware and testing of top up mode charge variation

Bunch parameter	Simulation	Target
Transverse emittance	3.14 mm mrad (rms)	< 4 mm mrad
Bunch length	0.96 mm (rms)	~ 1 mm
Energy	~ 190 MeV	~ 200 MeV
Energy spread	390 keV (0.2 %)	< 0.5 %
Bunch charge	5 nC	5 nC



RF design of accelerating structures for electron, positron and high energy linacs

- Acc. Structures RF design based on BD specs (short- and long- range wakefields)
 - Electron linac: 200m, $\langle a/\lambda \rangle = 0.15$, 2.8 GHz
 - Positron linac: 400m, $a > 30$ mm, 2 GHz
 - High energy linac: 1100m, $\langle a/\lambda \rangle = 0.12$, 2.8 GHz
- RF design includes:
 - Optimization of effective shunt impedance including RF pulse compressor
 - Long range wake-field suppression to operate with 4 bunches
 - Thermo-mechanical simulations
 - Beam-loading and energy spread minimization



Summary

- Strong contribution to the FCCee injector design study (CHART2)
- Important input to the mid-term report and to the FS report
- The effort continues and will need similar or more resources for the next design phase: TDR/CHART3