CompactLight WP3 project at Eindhoven University of Technology

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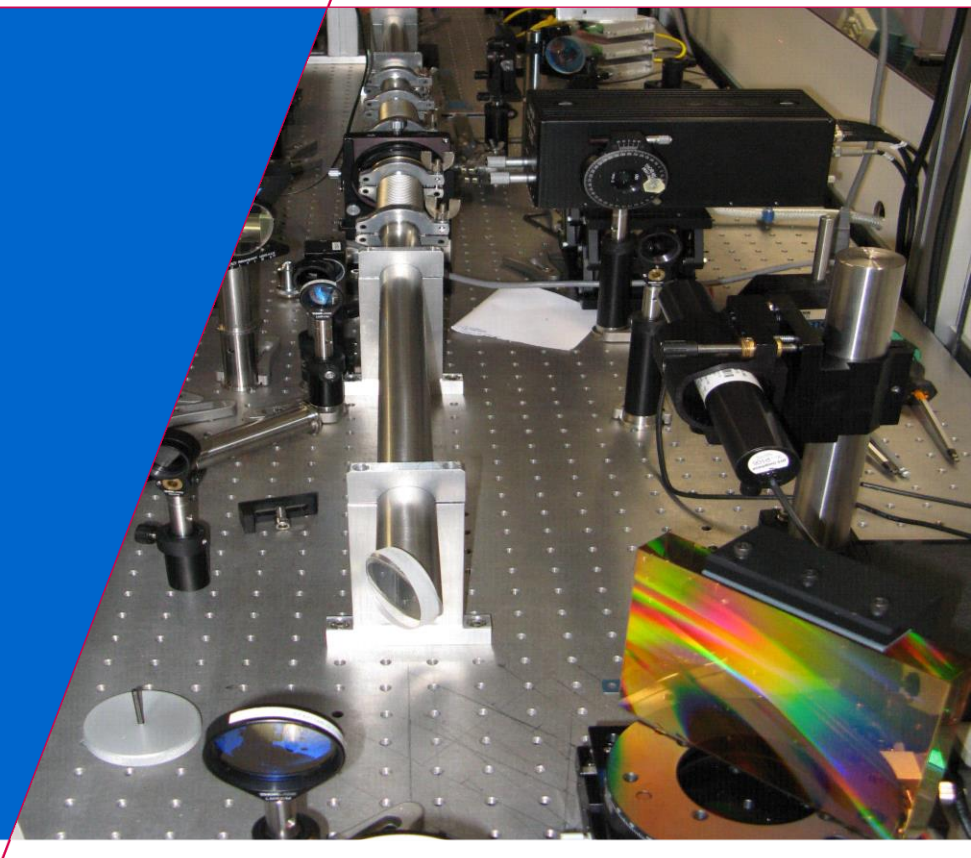
Jom Luiten



Technische Universiteit
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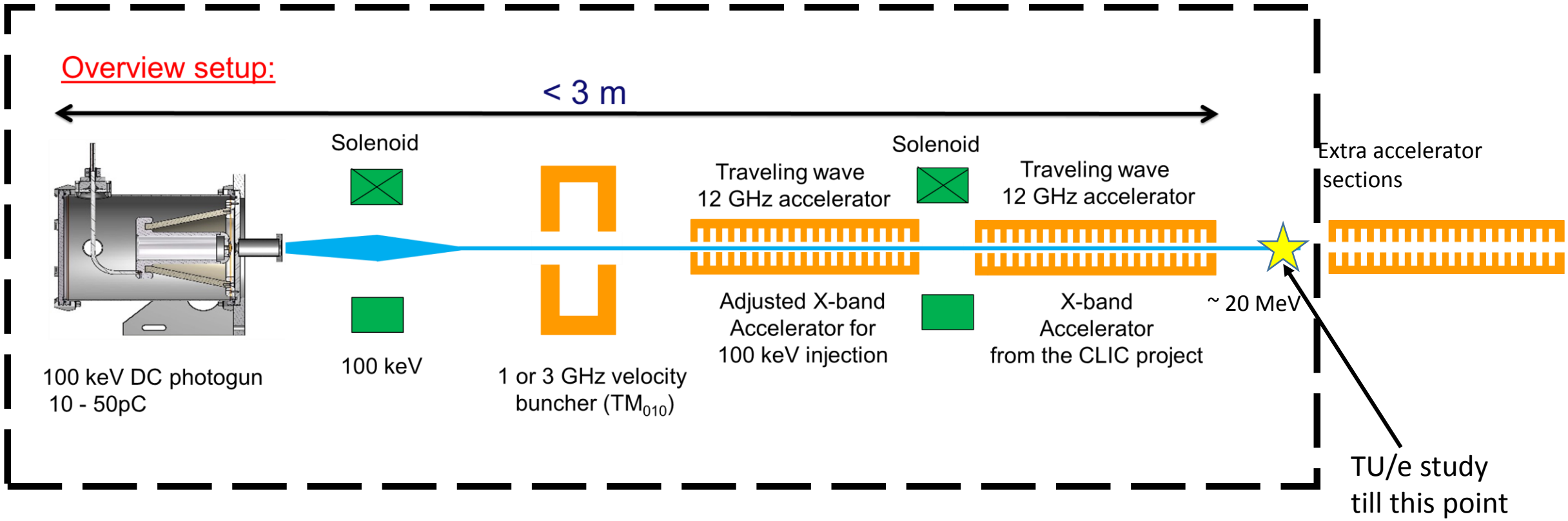
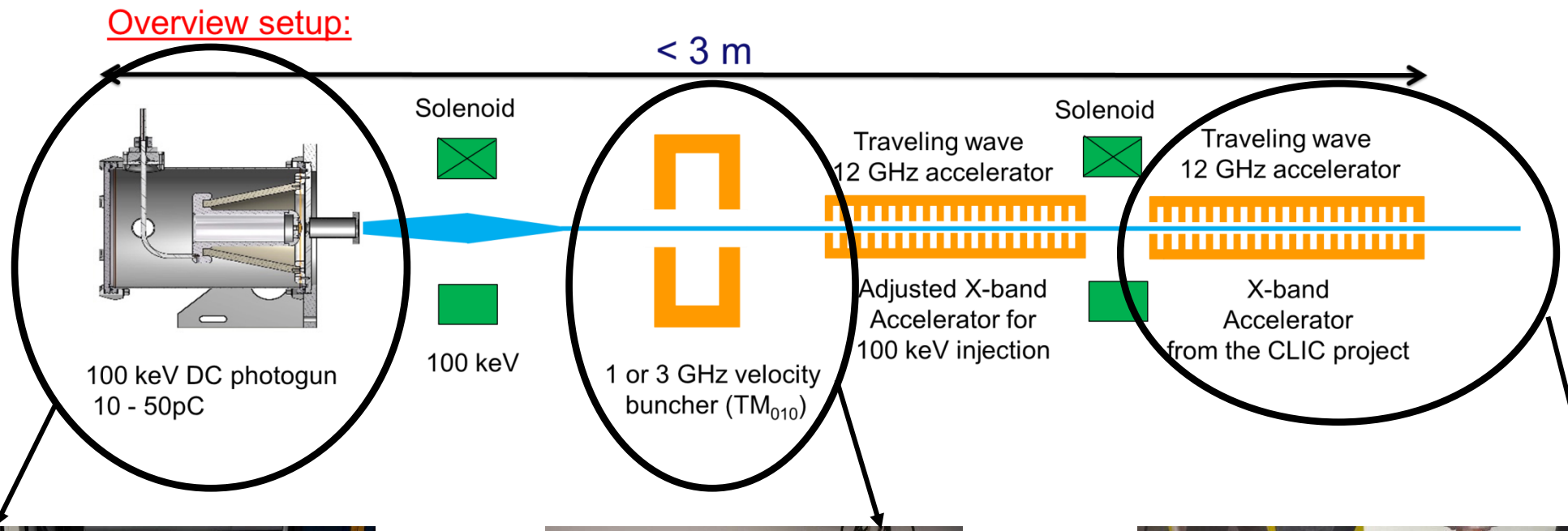
Where innovation starts

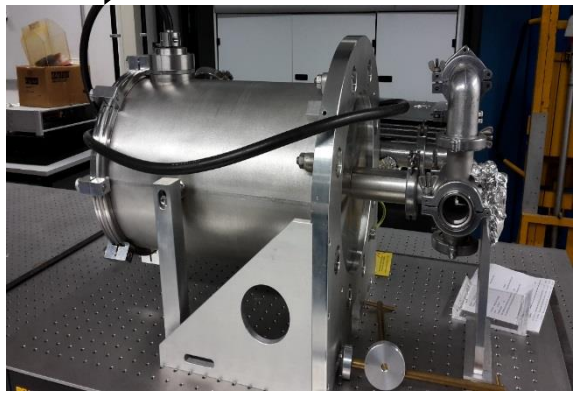
CompactLight @ Eindhoven University of technology



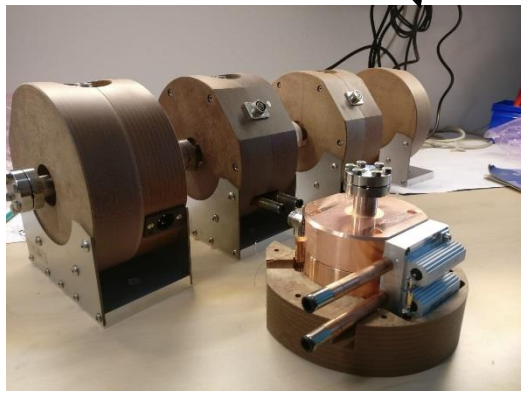
➔Injector = 100 keV gun/buncher/x-band accelerator combination

Already developed and available material





Made by AccTec BV



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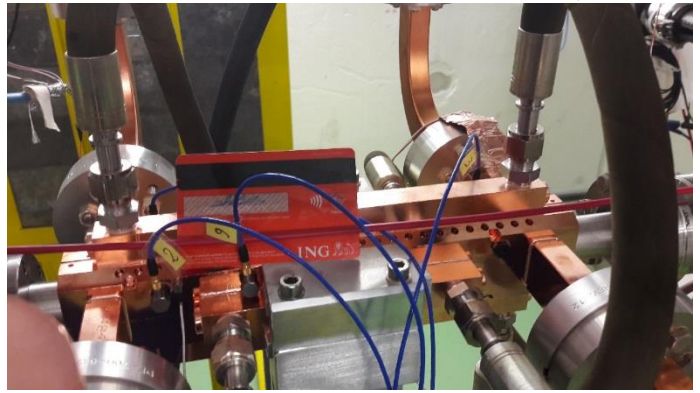
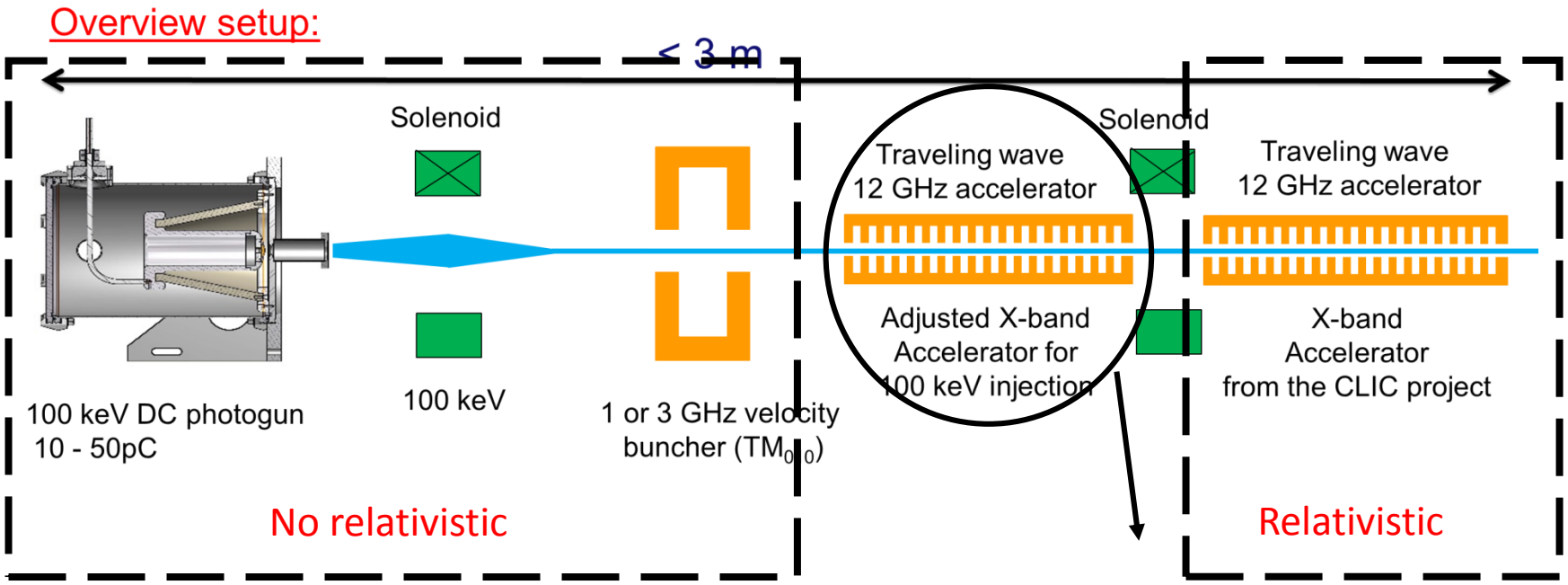
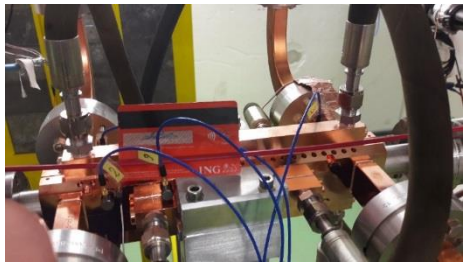


CLIC accelerator

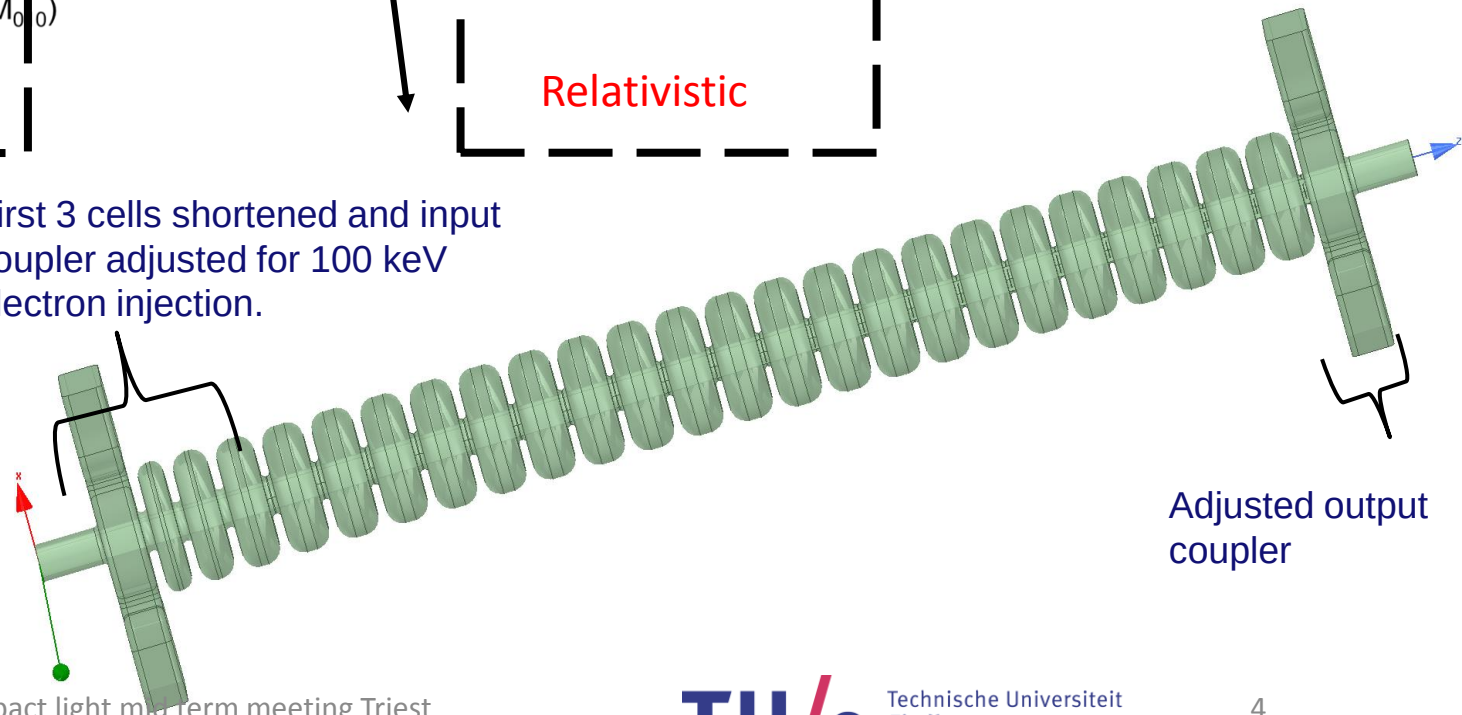
TW Accelerator needs to be designed with a non-relativistic front end.



An accelerator section designed for the CLIC project needs to be redesigned for 100 keV electron injection.



First 3 cells shortened and input coupler adjusted for 100 keV electron injection.



Adjusted output coupler

How to determine the optimal change in length of the first cells.

1. Scale on axis field maps for different combinations of cell lengths in steps of 500 micrometer
2. Use scaled field maps to track electron bunch in GPT
3. Choose best solution (high energy gain, low energy spread, short bunch length and low emittance)

1

$$s_{\mathrm{str}} = s + \frac{\Delta l_{\mathrm{c}}}{2}\left[1 - \cos\left(\frac{\pi s}{l_{\mathrm{c}}}\right)\right]$$

PHYSICAL REVIEW ACCELERATORS AND BEAMS **19,** 072001 (2016)

Mattia Schaer,* Alessandro Citterio, Paolo Craievich, Sven Reiche, Lukas Stingelin, and Riccardo Zennaro

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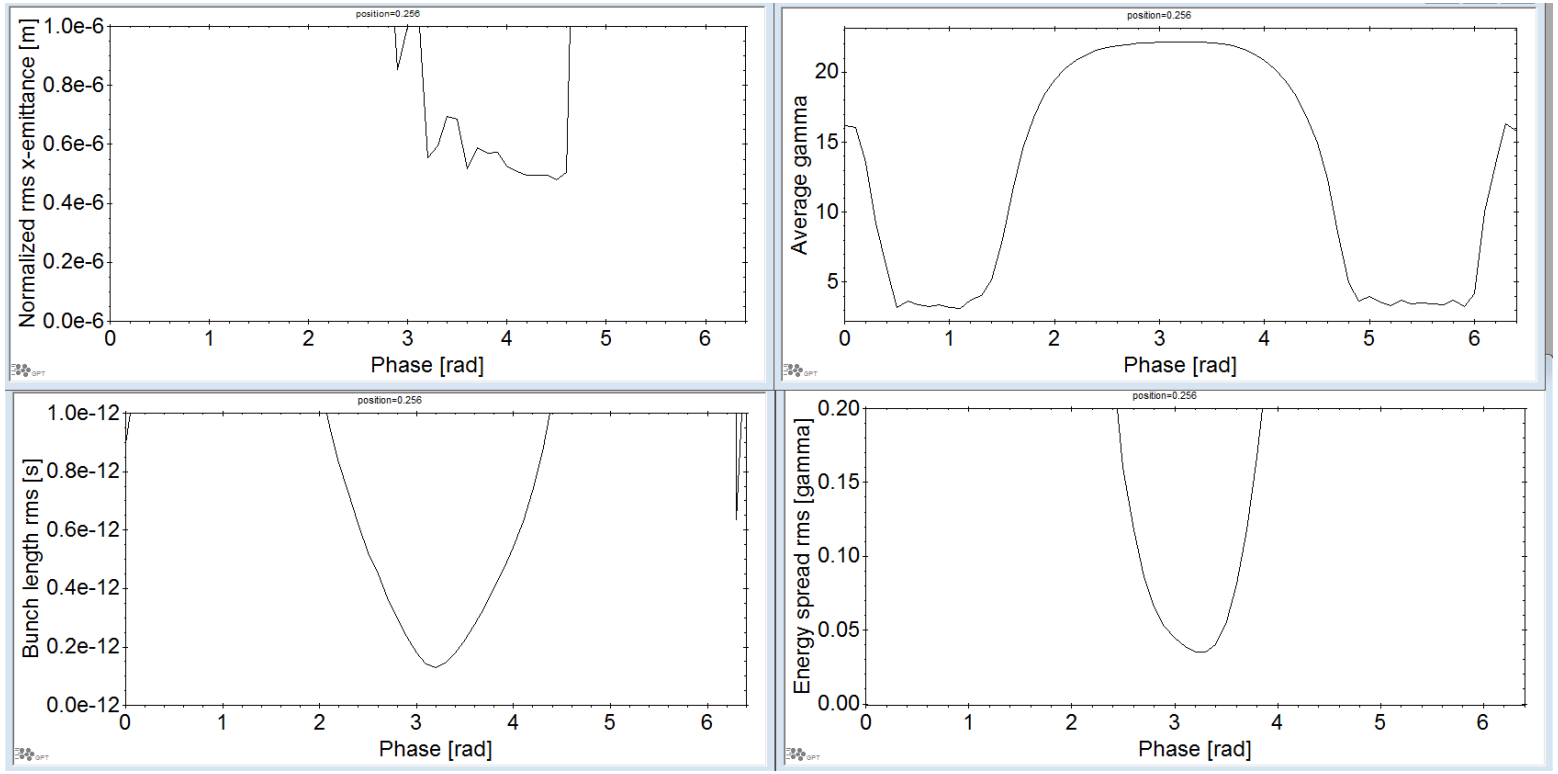


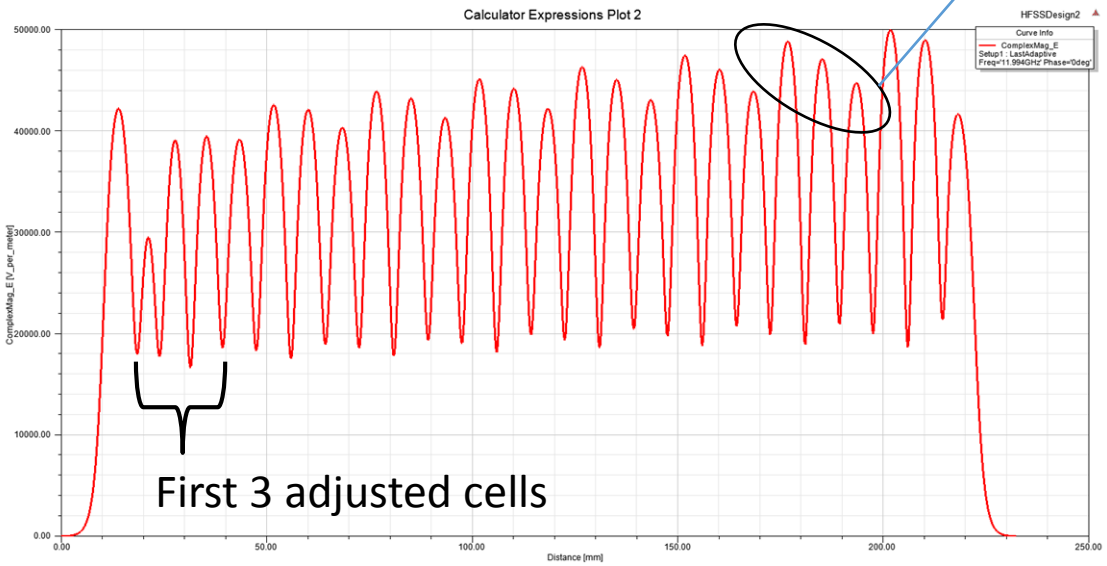
3

Cell 1: -2.5 mm
Cell 2: -1 mm
Cell 3: -0.5mm

Preliminary results of the RF design of the adjusted TW accelerator bases on the PSI design in collaboration with CLIC team

Complex magnitude of the on-axis E-field

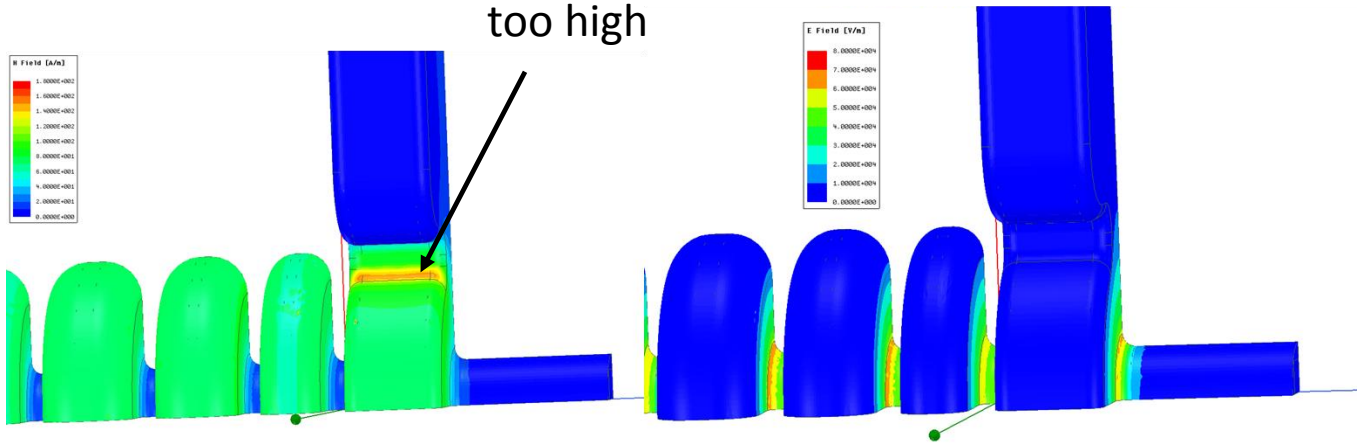
Standing wave component



On surface H-fields

Field slightly too high

On surface E-fields



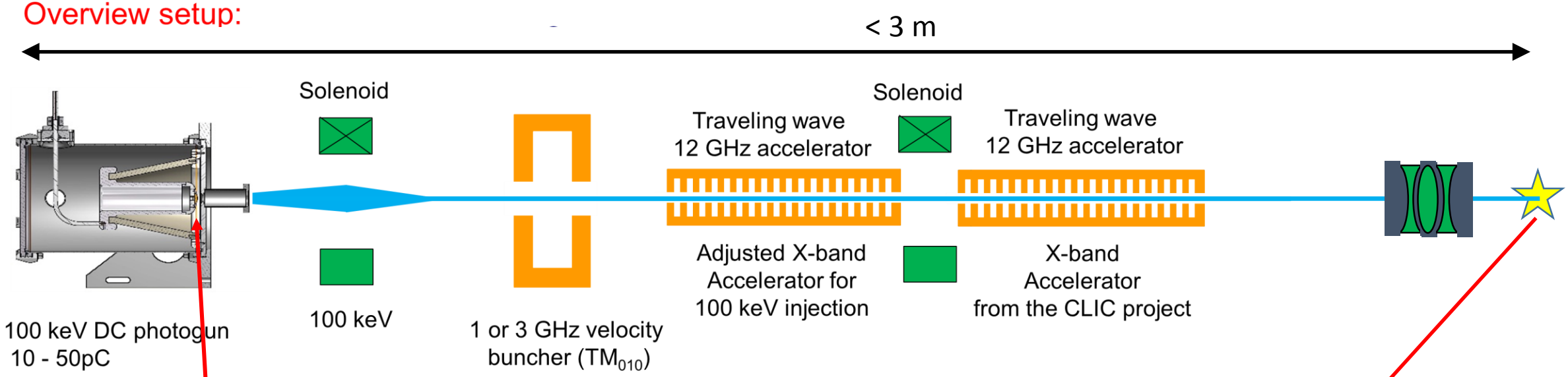
To do:

➔ fine tune the RF design for production

➔ remove the standing wave component

Preliminary GPT simulations including adjusted accelerator RF design:

Overview setup:



Bunch properties at cathode:

- 10 pC
- 100 keV
- 500 fs laser pulse
- Bunch radius 200 µm RMS
- 0.1 µm thermal emittance

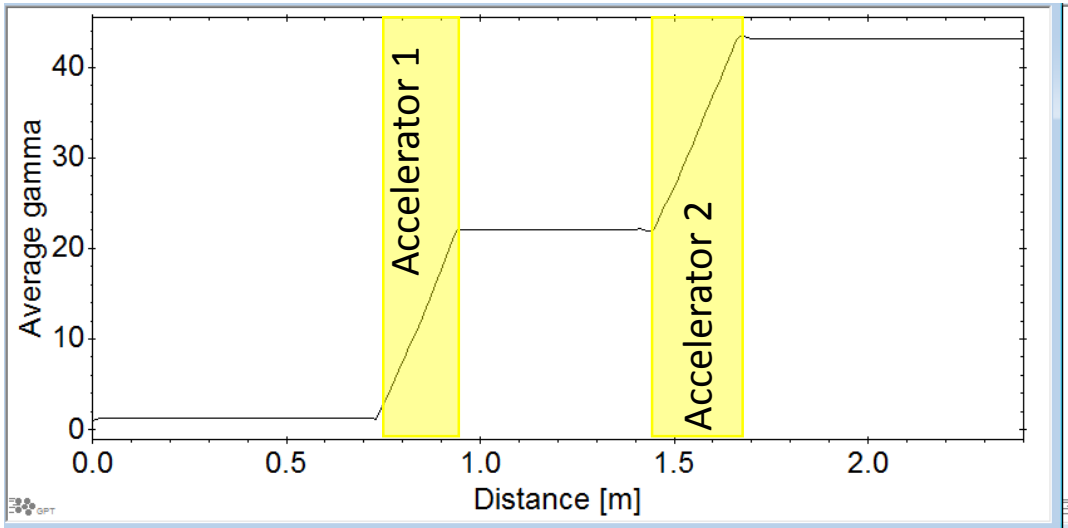
Including 3D field map of:

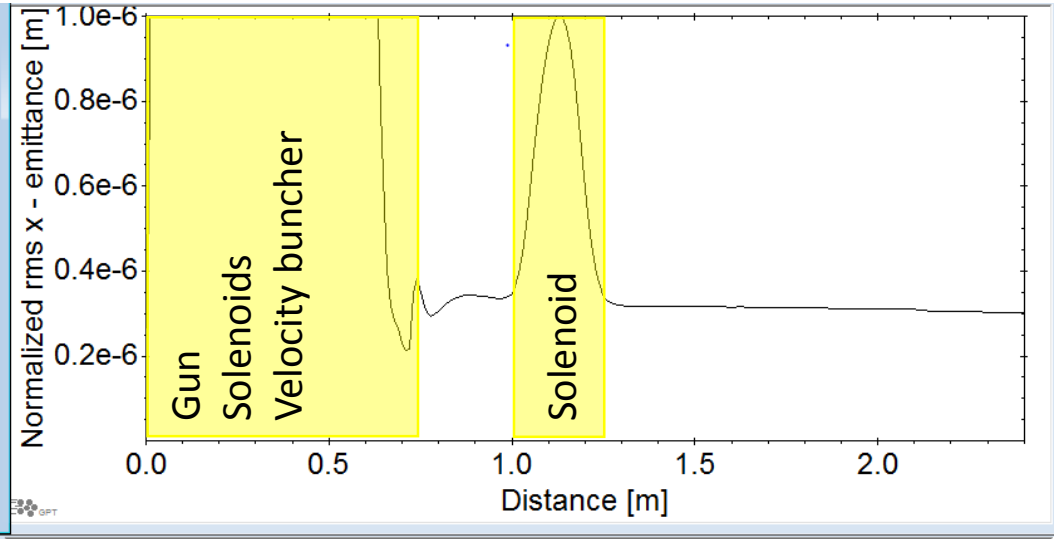
- DC-gun
- 1 GHz buncher
- Adjusted X-band accelerator
- Field expansions of the on axis Ez field of a ClIC accelerator

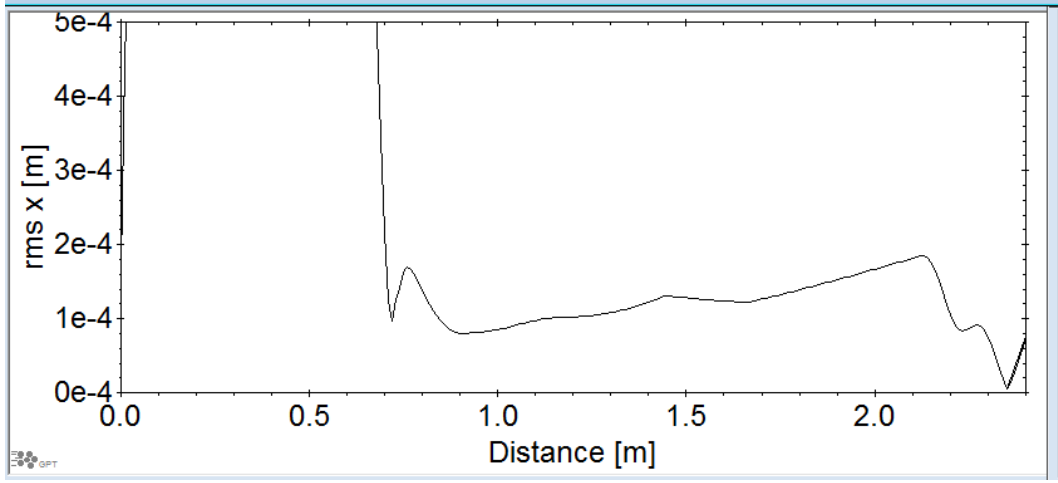
Bunch properties at and 2 X 10 MW klystron power

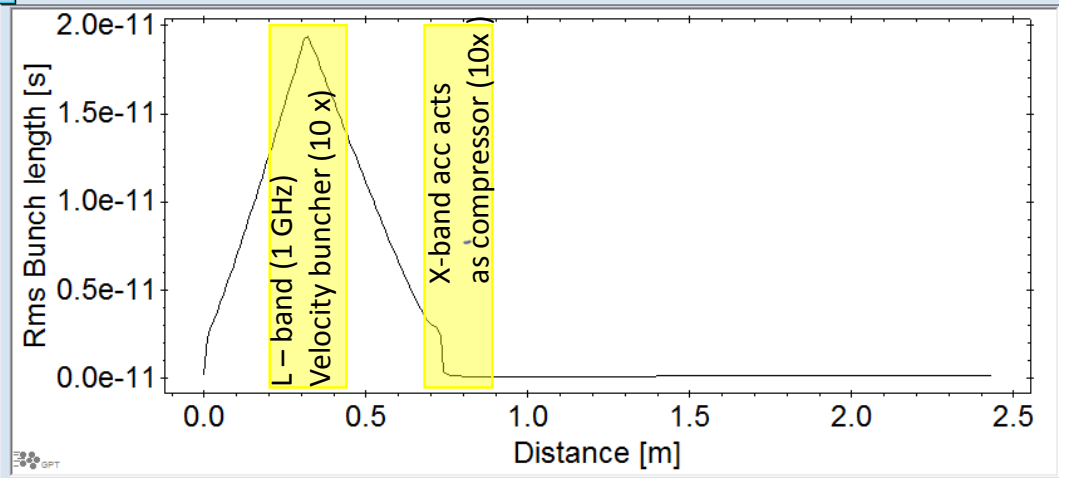
- 10 pC
- 21 MeV
- 0.5 % energy spread
- ~150 fs bunch length
- 0.3 µm emittance
- 5 µm spot RMS in x and y direction

Preliminary GPT simulations: bunch properties along the beamline







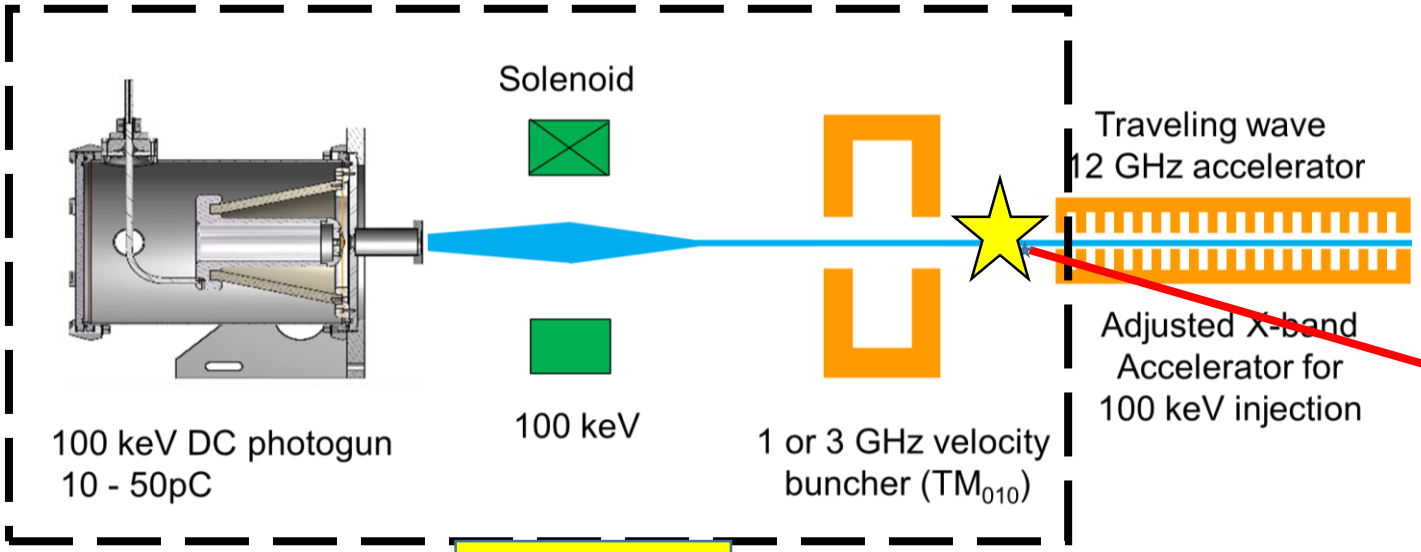


Outlook for next months:

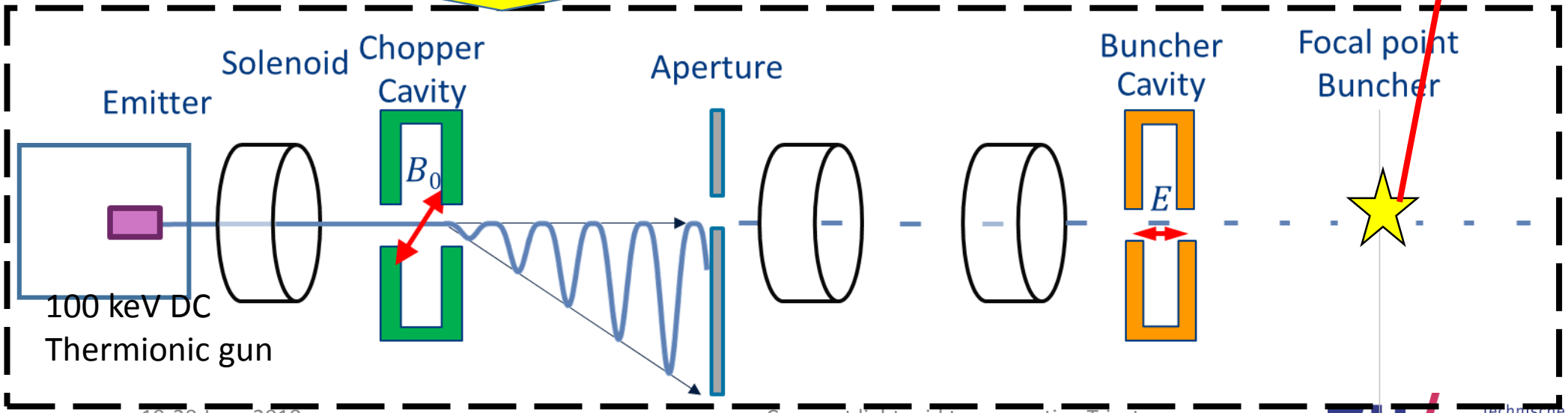
- Finalize GPT simulations with 3D fields from RF simulations
- Fine tune the RF-structure of the accelerator and make technical drawings for production.
- Investigate the possibility to upgrade from 10 pC bunch charge to 100 pC (250 pC?) ➔ scale the dimensions of the photogun by a factor of 2 and increase the high voltage to 200 keV.

What's next?
How to go to an injector with extreme rep rates in a compact and cheap setup?

Ongoing thermionic gun project at TU/e:



comparable bunch properties
as DC photogun
but at 1GHz + rep rate



Thank you!