Homework questions for the CLIC lecture

1.) Pulsed surface heating:

What is the maximum RF pulse length for a normal conducting linac with the following parameters (assume ΔT_{max}=50K)?

E_{acc} = 100 MV/m accelerating gradient
f = 12 GHz RF frequency

What is it for E_{acc} = 150 MV/m and f = 30 GHz?

2.) Drive beam generation:

Assume you want to generate a 100 A drive beam for a CLIC type collider with a frequency of 12 GHz. Further assume that the initial beam pulse must have a beam current below 5 A (not included!), the initial bunch repetition frequency can be in the range of 0.5 – 2 GHz.

a) What configuration of Delay Loop (DL) and Combiner Ring(s) (CR) can you use? Remember you need one Delay Loop, and keep the multiplication factor in each CR ≤ 5. (Can you comment on why you have this last restriction?)

b) What is your initial beam current?

c) What is your initial bunch repetition frequency?

The final RF pulses (= bunch train pulse length) are to have a length of t_p = 200 ns. (Hint: this determines the length of the DL. If you have more than one CR, keep the highest multiplication factor for the last combination stage. (Do you have an idea why?))

d) What is the length of the DL and the CR(s)?

e) What are the frequencies of the RF deflectors?

3.) Drive beam generation (CR path length error):

The drive beam generation has to produce a beam with the correct bunch repetition frequency. Assume you have a final beam frequency of 12 GHz and you have a path length error of ΔL=3.125 mm in a factor 3 Combiner Ring in the combination process. How is the beam power generated in the PETS structure reduced?

Hint: Assume that the field vectors that the bunches produce in the PETS add up. If you have a path length error, this results in a phase error between the field vectors of the bunches that make a different number of turns in the CR.

4.) CLIC Damping Ring (optional – not topic for exam questions)

The CLIC damping ring used to be designed for an energy of E=2.424 GeV. Take a bending radius of ρ=25 m and calculate the transverse damping time for a simple ring with this radius without any wigglers.

Assume you want to decrease this damping time to 2.6 ms. Calculate the total wiggler length L_w you need to reduce the damping time to this value, assuming a peak wiggler field of B=1.8 T and sinusoidal field distribution in the wiggler.