Homework questions for the CLIC lecture – ISLC 2012

1.) General understanding:

a) What is the reason for the fully loaded operation of the Drive Beam linac? What are the disadvantages?

b) Why do you use a Delay Loop upstream the Combiner Rings in the CLIC scheme (i.e. why don't you use only Combiner Rings that provide higher combination factors)?

c) Imagine you have built CLIC for 500 GeV with one Drive Beam linac complex. Then you want to double the collision energy by doubling the length of the main linacs. Keeping a single Drive Beam linac complex, what do you need to change in there and the Drive beam?

2.) Drive beam generation:

Assume you want to generate a 102 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 = 220 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)? (You can neglect the condition from integer/fractional wavelength on the path length.)
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 15 GHz and you have a path length error of ΔL=2.5 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.