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- Introduction to CTF 3
- Bunch Frequency Multiplication
- Bunch Combination Results
- Conclusions
Introduction to CTF 3

CLIC: Compact Linear Collider (0.5–5 TeV)

Two beam acceleration scheme:
- High charge, low energy drive beam (2 GeV)
- Produce RF power at high frequency – 30 GHz
- High gradient – 150 MV/m
- Low charge, high energy main beam (1.5 TeV)

CLIC Test Facility 3 addresses feasibility issues:
- Test of drive beam generation
- Combination of bunches by RF deflectors
  ⇒ Bunch frequency multiplication
- RF power production at 30 GHz
- Test CLIC components
Frequency multiplication

- basic principle of drive beam generation
- transform very long pulses into many short pulses with higher power and higher frequency
- use RF deflectors to interleave bunches
  - \( \Rightarrow \) double beam power
  - \( \Rightarrow \) double beam frequency

CTF3 deflector, INFN

CTF3 deflector, CERN

Linac (8 structures)

- Gun & bunching system
- Matching section
- Streak camera measurement
- RF deflectors
- Isochronous injection line
- Isochronous ring

**Beam structure**
- In linac (up to 100 Hz)
- Bunch spacing 10 cm (333 ps)
- Bunch spacing 2 cm (67 ps)
- Pulse Length 6.6 ns
- Av. Pulse Current 1.5 A

**Technical Details**
- Total Length 1.7 µs - Av. Pulse Current 0.3 A
- Pulse Length 6.6 ns
- Av. Pulse Current 1.5 A

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Bunch Frequency Multiplication in the CLIC Test Facility CTF 3
PAC 2003, 15.5.2003
Combination by RF deflectors in a ring

1st turn

1st deflector

injection line

septum

local inner orbits

transverse deflector field

2nd deflector

3rd

4rd

Train spacing = M × λ₀ =
ring circumference ± λ₀ / 4

λ₀ bunch spacing

4 trains - l₀ peak current

λ₀ / 4 bunch spacing

1 train - 4 × l₀ peak current

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Bunch Frequency Multiplication in the CLIC Test Facility CTF 3
PAC 2003, 15.5.2003
CTF3 recombination factor 4 - 2 pulses

![Graph showing recombination factor over time](image)

Time axis

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Bunch Frequency Multiplication in the CLIC Test Facility CTF 3  
PAC 2003, 15.5.2003
CTF3 recombination factor 4 - 3 pulses
CTF3 recombination factor 4 - 4 pulses

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Bunch Frequency Multiplication in the CLIC Test Facility CTF 3
PAC 2003, 15.5.2003
Recombination factor 4 - beam current

HR.UMA11

420 ns

turn 1

turn 4
CTF3 recombination factor 5

\[ \lambda_0 / 5 \text{ (2 cm)} \]

\[ \lambda_0 = 10 \text{ cm} \]

- bunch distance 333 ps → 67 ps
- frequency 3 GHz → 15 GHz
Conclusions

- **CTF 3 preliminary phase**
  - bunch *frequency multiplication* by RF deflectors *demonstrated* for factors 2 – 5 at low charge
  - crucial step for the CLIC study

- **CTF 3 initial phase**
  - drive beam linac is being installed now (higher charge)
  - commissioning starts this month

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