Two-beam acceleration at the CLIC test facility

Summer Students Project 2010

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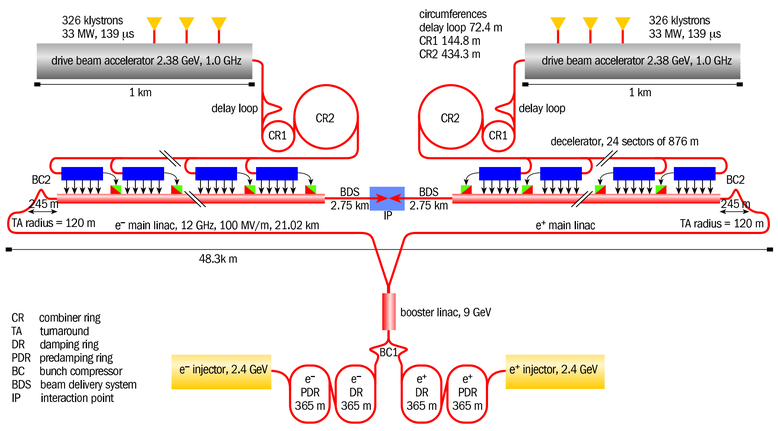
CLIC: Compact LInear Collider

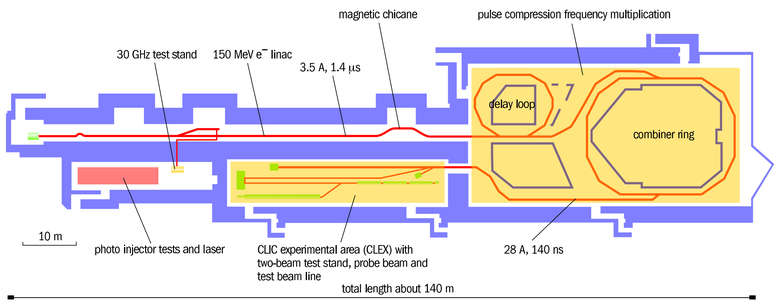
- Multi-TeV e^+e^- collider (up to $E_{CM} = 3\,\text{TeV}$)
- 'Compact' collider (length$< 50\,\text{km}$)
  $\Rightarrow$ High acceleration gradient $\left(100\,\frac{\text{MV}}{\text{m}}\right)$
- Acceleration with a radio frequency at 12 GHz (lower breakdown rate)
  $\Rightarrow$ Cavities at room temperature



CTF3: CLIC Test Facility

Studied at CTF3:

- Generation of a high current drive beam
- Two-beam acceleration (see below)
- Beam deceleration
- Radio frequency breakdown:
  Creation of sparks in the cavity (extraction of electrons and copper atoms), the copper atoms ionize and form a plasma
  $\rightarrow$ interaction with the beam
  $\rightarrow$ cavity becomes damaged



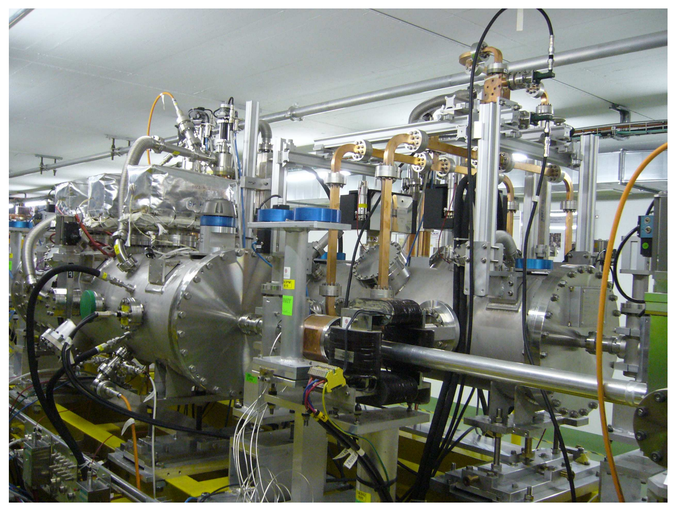
TBTS: Two-Beam Test Stand

Two-beam acceleration:

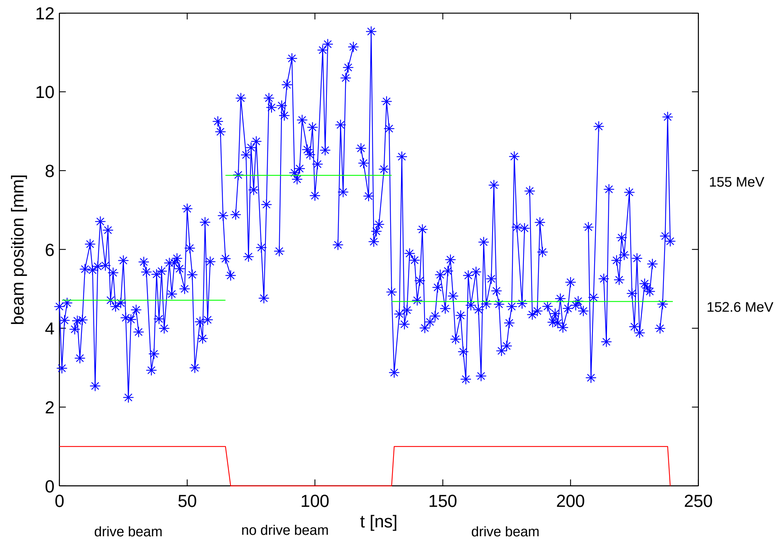
- Drive beam: high current beam, decelerated in a cavity in order to extract the power
- The 12 GHz power is transported to the accelerating structure
- Probe beam: low current beam, accelerated by the extracted power

Studied at TBTS:

- Power production (how efficient)
- Efficiency of the acceleration
- Breakdown: low rate possible?
- Effects on the beam (stability, reliability of the measurements)
- Improve the design of the structure in order to lower the breakdown rates

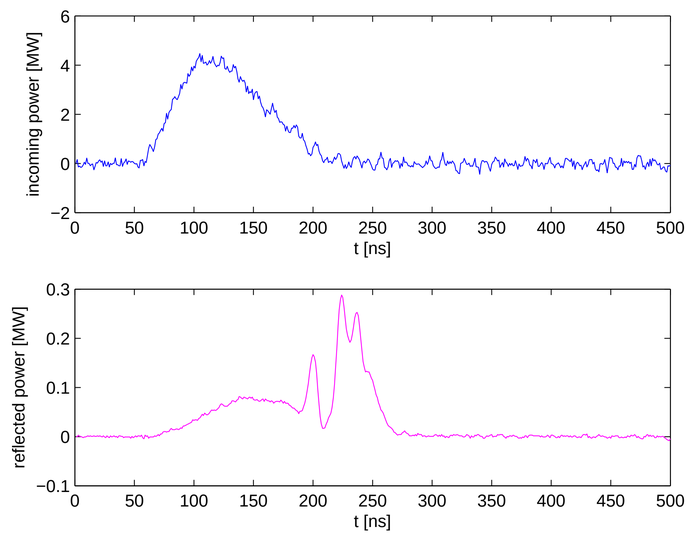


Acceleration



Acceleration of a beam by $-2.4\,\text{MeV}$ using the power produced by decelerating a 108 MeV beam.

Breakdown



Example of a breakdown event in the accelerating structure:
A fraction of the incoming power is reflected backwards.