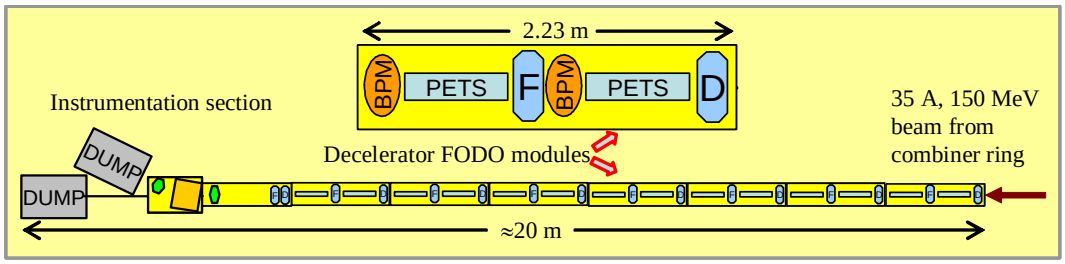
WP6 35 A Test Beam Line (TBL)

Time schedule: Construction 2006/2007, ready for tests in 2008
Resource estimate: 1 MCHF and 8 m*y

Design, construction, installation, exploitation and bench-marking simulation tests of a 20 m long, well-instrumented test decelerator with typically 10-16 RF power-extracting structures (PETS), to validate the CLIC drive beam stability and losses with the CTF3 beam. The making of the PETS for the TBL is part of WP 7.

The TBL has the goal to demonstrate the feasibility of the CLIC drive beam decelerators [1]. The main concern for the drive beam decelerators of CLIC is that a beam of very high current and a total energy spread of up to 90% at the end of deceleration will be difficult to operate with acceptable losses and sufficient stability. These worries were expressed as an R2 feasibility item for CLIC in the ILC-TRC report [2].
The TBL as a scaled model of a CLIC drive beam decelerator sector will give the opportunity to test the operation of such a decelerator and the predictions of the numerical simulation tools which are used for its design. The TBL beam energy is down by a factor 13 and beam current down by a factor 4.3 compared with a CLIC decelerator. The FODO period length is the same as for CLIC, but the total length is about 30 times smaller than a CLIC decelerator sector.
A tentative layout of the TBL is shown in the figure below. Here we assume the use of 7 FODO modules, however, this number needs further discussion to determine the best compromise between the space available in the CLEX building and the minimum number required to perform well thought-out tests of drive beam tuning procedures.



Each TBL module corresponds to one full FODO cell equipped with two quadrupoles, two PETS, two BPM's and appropriate monitors for beam loss. The PETS girders and the quadrupole supports have motors for independent remote control of their transverse position. The quadrupole currents are individually controlled and the quadrupole strength should be sufficient for a phase advance per FODO cell of up to 120^0 with a 300 MeV beam (the maximum beam energy available from the drive beam accelerator and combiner ring with minimum beam current).
An instrumentation section at the end of the TBL will allow determining energy, energy spread and emittance growth of the beam after passage through the TBL. All beam instrumentation needs the capability to make time resolved measurements with a resolution of 10 ns or better to observe the build up of instabilities along the 140 ns long bunch train.
Sophisticated software for automated steering and position feedback has to be developed in close collaboration with the team working on the CLIC decelerator design, to mimic with the TBL the tuning and operation procedures foreseen for CLIC.

[1] H.H. Braun et al., "The CLIC RF power source, A Novel Scheme of Two Beam Acceleration for $e^{\pm}$ Linear Colliders," CLIC note 364, 1998
[2] G. Loew et al., "International Linear Collider Technical Review Committee, 2nd report," SLAC-R-606, 2003