Work Package 2: 30 GHz rf power test stands

Introduction

Two experimental areas will be constructed in CTF3 dedicated to the testing of 30 GHz accelerating structures, power extraction and transfer structures (PETS) and high-power waveguide components: the automated 30 GHz high gradient test stand, work package 2.1, and the two-beam test stand, work package 2.2. In addition a 30 GHz pulse compression system, work package 2.3, is required to extend the performance of the high-gradient test stand up to the nominal CLIC accelerating structure input power. The automated test stand and the pulse compressor may also be duplicated and used in conjunction with the stand-alone power source, work package 9.

The two experimental areas will be used for structure technology developments, see work package 7, and ultimately for demonstrating many key CLIC feasibility issues such as a 150 MV/m accelerating gradient, 560 MW power production and full-gradient two-beam acceleration. Consequently the experimental areas must be equipped to monitor and control rf-breakdown and beam/structure interaction experiments.

The initial design of the test stands is based on previous experiences in CTF2 and other test facilities such as the NLCTA at SLAC. However, many open questions in our understanding of high-power and gradient operation remain and it is expected that the tests stands will evolve substantially as they produce results. Collaborators are required to design, build, operate and understand the experimental areas and the results they produce.

Work package 2.1, Automated 30 GHz high-gradient test stand

This test stand will be used to test accelerating structures and high-power waveguide components. It will be equipped for experimental investigations into rf breakdown, automated conditioning and extended operation. The test stand will be located in the old CTF2 tunnel and use power generated by the already-existing CTF3 beam in a dedicated PETS located partway along the CTF3 linac and be fed through a low-loss transmission line. Some of the features of the test stand include,

- accelerating structures, work package 7.1, and high power waveguide components to test,
- a vacuum chamber which allows quick turn-around between experiments and which is instrumented for residual gas analysis,
- fast current monitors for time resolved emitted currents,
- rf signal detection electronics,
- spectrometers for emitted secondary particles,
- spectrometers for analysis of emitted light spectra,
- acoustic sensors,
- precision cooling-water temperature measurements for calorimetric measurement of rf power,
- a high speed data acquisition and analysis system to monitor conditioning and control automated CTF3 power production mode operation.

Time schedule : Start in 2004, to be implemented in stages from 2005 to 2007
Resources : 2 MCHF and 6 man.years

Work package 2.2, Two-beam test stand

This test stand will be used to test PETS developed in work package 7.2 up to nominal output power and pulse length, and to verify full-gradient two-beam acceleration using accelerating structures developed in work package 7.1. The test stand will be located in the CLEX building and for power production will use the 35 A beam formed after the combiner ring, work package 1, and for measurement of acceleration will use the 200 MeV probe beam, work package 4. Some of the features of the test stand include,

- special PETS to prime CLIC PETS with some power to enable full power to be obtained with a 35 A beam,
- optical design and magnetic elements for transmission of the drive/probe beams through the transfer/accelerating structures,

- beam spectrometers for measurement of energy loss/gain through transfer/accelerating structures,
- time resolved beam current, position and loss measurements,
- rf signal detection electronics,
- rf breakdown diagnostics as in work package 2.1,
- a high speed data acquisition and analysis system to monitor conditioning and control automated CTF3 operation as in work package 2.1,
- vacuum system.

Time schedule : Design and fabrication 2005/2006, operational 2007 together with WP 4 in 2008
Resources : 0.9 MCHF and 4 man.years

Work package 2.3, 30 GHz pulse compression system

A 30 GHz pulse compressor will be constructed in order to ease the difficulties of extracting the nominal CLIC accelerating structure input power of 160 MW from the 5 A beam that is used to power the automated test stand. The design of the pulse compressor is still open but a base-line concept exists which uses the components already being developed for the high-power transmission line to construct a SLEDII type pulse compressor.

Time schedule : 2005
Resources : CERN MTP