Working Group 1: Microwave Acceleration Summary

10 July 2009

Mandate

The goal for the first three groups is to:

(1)develop self-consistent sets of parameters aimed at a 1 TeV collider with 2e34 total luminosity (an initial version of these should be presented at the beginning of the workshop),

(2) list the critical R&D on the acceleration technology and the implied beam generation and focusing systems that are needed for the technology,

(3) consider the fundamental limits of the technology and describe the impact of approaching these,

(4) consider how new concepts for beam generation and focusing could have a major impact on the designs.

In addition we had a self-imposed mandate to cover our international X-band structure collaboration since this is the time of year for our annual meeting.

We cover our near-term R&D which targets 100 MV/m and which is already very ambitious.

1. Develop self-consistent sets of parameters aimed at a 1 TeV collider with 2e34 total luminosity (an initial version of these should be presented at the beginning of the workshop),

NLC/JLC and in CLIC parameter sets are already extremely well developed and studied.

NLC/JLC were ‘conservative’.

CLIC parameters are an extension made possible by two-beam power generation and are already pushing the limits of existing technology.

We believe that the existing parameters are quite close to the optimum – rf frequency, bunch charge, spacing etc. – given the current state of technology.

2. List the critical R&D on the acceleration technology and the implied beam generation and focusing systems that are needed for the technology.

A main goal is to show a efficient, HOM damped accelerating structure running at 100 MV/m at a low, around 10^{-7}/m, breakdown probability per pulse. We covered this in detail in the ‘structure collaboration’ part of our meeting.

Drive beam generation is addressed by CTF3 although a facility with parameters with parameters closer to nominal is being considered. High efficiency power sources need to be developed.

Additional critical path items include micron precision instrumentation and alignment and nanometer stabilization of accelerator components.

The key advances for the *acceleration* technology would be an increase in the rf to beam efficiency – this makes a collider more politically palatable and opens the possibility for other power source architectures with more efficient rf power sources.

Consider the fundamental limits of the technology and describe the impact of approaching these.

100 MV/m loaded gradient, roughly 80 MV/m real estate gradient, is still the preferred nominal value. We start to understand rather well the physical limits to gradient. This gradient is also close to the cost and efficiency optimum.

The development of an accelerating structure with significantly higher rf to beam efficiency (35% range up over 70%!) would reduce power consumption and cost rather than shift the gradient higher. This could be through rf design or new materials.

4. Consider how new concepts for beam generation and focusing could have a major impact on the designs.

The specific proposal we considered with the collimation and final focus group was to reduce the bunch charge by a factor 100.

This would direct us towards filling every bucket to regain some of the average beam current. This might allow a solution with only light HOM damping.

Still the changes to the rf system which could identify to maintain the rf to beam efficiency did not keep up with the reduction in current. As a consequence power consumption was reduced only about tens of percent rather than an order of magnitude. In addition the subsystems like alignment and stabilization become even more demanding.

For our collaboration meeting…

<u>Simulation, rf design and measurement</u>

Presentations from SLAC, Manchester University and CERN. Key new developments include first simulation of two-beam acceleration, dark current tracking (with comparison to measurement), a manifold damped structure adapted 100 MV/m and a reduced pulsed surface heating structure.

<u>Development of rf power sources</u>

EuroX-band klystron development at SLAC, rf power production in CTF3 plus the mundane but highly essential development of high-power rf components.

For our collaboration meeting continued…

<u>High-power testing</u>

We heard about recent results from structures tested at KEK and SLAC where a second and third 'T18' structures have run at 100 MV/m confirming reproducibility.

Specialized tests and analysis at KEK, SLAC and CERN have also been made to investigate the gradient limited phenomena and there are many interesting new insights…

The detailed structure production and testing program will be discussed in detail tomorrow morning.

Using high-gradient technology and adapting new fabrication technologies to high-gradient were also discussed.