

Project name

Low Emittance Electron Beams for Wakefield Measurements

Classification (accelerator/detector:subsystem)

Accelerator

Institution(s) and personnel

University of Chicago, Kwang-Je Kim

Argonne National Laboratory: Wei Gai and Stephen Milton

Contact person

Kwang-Je Kim

Project Overview

One of the fundamental concerns for the NLC is the beam-induced wakefield. The wake acts back on the beam and degrades its quality both longitudinally and transversely. Wakefield effects and schemes to suppress these effects have been studied mainly with numerical calculations. It is becoming increasingly important to carryout a thorough experimental study of wakefield effects on the beam before full-scale construction of the main linacs. A GeV scale linear accelerator would be ideal for this purpose. However, a low energy electron beam could also be used if the beam emittance is sufficiently low. We propose to study the generation of low emittance electron beams and the wakefield behavior at the Argonne Wakefield Accelerator (AWA) facility in ANL.

The AWA facility has recently commissioned a new 1 ½ Cell L-band (1.3 GHz) gun. The primary purpose of this gun is to generate high intensity beams, with the bunch charge about 100 nC, for studying wakefield acceleration schemes. The normalized beam emittance in this high-charge operation is rather large, about 100 mm-mrad. However, preliminary study showed that the gun may also be operated in a low-emittance (1mm-mrad), low bunch-charge mode, if properly optimized. Such beams are suitable for measurement of the wakefield effect. We propose to carryout a detailed simulation study of the AWA gun to determine the optimum configuration for the low emittance mode. The low emittance beams will then be used to study wakefields.

This is an ideal project for student training. The funding requested is mainly for student support for 2 years.

Description of first year project activities

In the first year, a detailed numerical parameters study for the AWA photocathode gun will be performed. The tools that will be used are PARMELA and MAFIA. We will examine to output beam quality vs laser profiles (spot size, laser pulse lengt, etc.), the RF injection phase, and magnetic field settings.

In second year, we will perform beam experiments at the AWA based on the simulation results. Extensive diagnostics for emittance and bunch length measurements will be

needed for the proposed work. We can then use this beam to measure beam-induced wakefields in the LC structures.

Budget Justification

The funding requested is mainly for student support for 2 years. Although most of diagnostics already exists at the AWA, some will have to be modified to make them suitable for lower charge diagnostics.

Budget

FY 2003 (Then-year k\$)

Institution	Item	Cost
U of C	Student :Salary	20.9
	Tuition	12.5
ANL	Equipment (sensitive camera, emittance plates)	10
Total		43.4
U of C Indirect		11
Grand		54.4

FY 2004(Then-year k\$)

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