Project name

Investigation of Linear Collider Control System Requirements and Architecture

Classification (accelerator/detector:subsystem)

Accelerator

Institution(s) and personnel

Lawrence Berkeley National Laboratory:
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Project Overview

The Control System of a modern accelerator provides the tools to achieve design goals for overall performance, especially of luminosity, but also including ease of commissioning, ease of maintenance, repair and upgrade, to provide stability and reliability, *etc*.

We propose to study some of the features of Control Systems which are novel or of paramount importance for the Linear Collider. Our goal will be to expose fundamental requirements, and to use these to help define the system architecture, both in hardware and software.

Description of first year project activities

Our focus will be on the Control System data, its' acquisition, utilization and storage. We will be primarily interested in the signals generated by beam sensors and monitors of the beam injecting, accelerating, guiding and delivery systems; i.e., we want to study the control and monitoring that is the heart of the Linear Collider. This is the area where performance is established, and where it may well be lost unless the control system is powerful and flexible enough to meet as yet unknown challenges.

The key feature of a Linear Collider that distinguishes its' control from that of a storage ring is the absence of stable orbits: each pulse has a life cycle from injector to beam dump that must be individually controlled. There is thus a premium on control and monitoring devices that are all activated on each (and every) individual pulse.

We will study two Collider subsystems, the Machine Protection System (MPS) and the Feedback System, as exemplars that determine requirements on latency, bandwidth, real-time processing power, and, possibly, data storage. In collaboration with accelerator physicists, we will explore the crucial use cases (scenarios) that help define where, how and when the control data is manufactured, transported, and used. An examination of the usage requirements will lead us to consider the electronics, processors, crates, cabling, and networks which must reside in the accelerator tunnels (as well as in possible distributed control centers).

We also wish to study a major subsystem of the Linear Collider, the Damping Rings, from the perspective of Controls. This study will lead to elucidation of issues of independence and interdependence of control devices. We also wish to study issues of the characterization of DR pulses - whether a digest of the beam properties can suffice to interface to upstream and downstream subsystems, or whether the full complement of raw measurement information must be capable of being forwarded.

The other broad investigation we wish to initiate is that of the Operator interaction with the Control System. The corollary to the notion that the accelerator must be sufficiently instrumented to enable an understanding of both performance and limitations, is that the outputs of these instruments must be available for study (on and off-line) by the Operator. Here we envision an analysis that includes the various developmental stages of the accelerator, including commissioning, tune-up and debug phases, as well as steady-state operation.

We expect that simulations will be a valuable complement to the use case analyses, allowing us to explore both qualitatively and quantitatively issues of instrumentation and of usage. The input of experiences from Linear Collider test facilities into simulations should help us understand functional requirements, and perhaps desired features, of the control environment.

Budget

Institution	Item	Cost
LBNL	Travel	$9,600
LBNL	Summer salary for one undergraduate	$5,000
LBNL	LBNL total	$14,600