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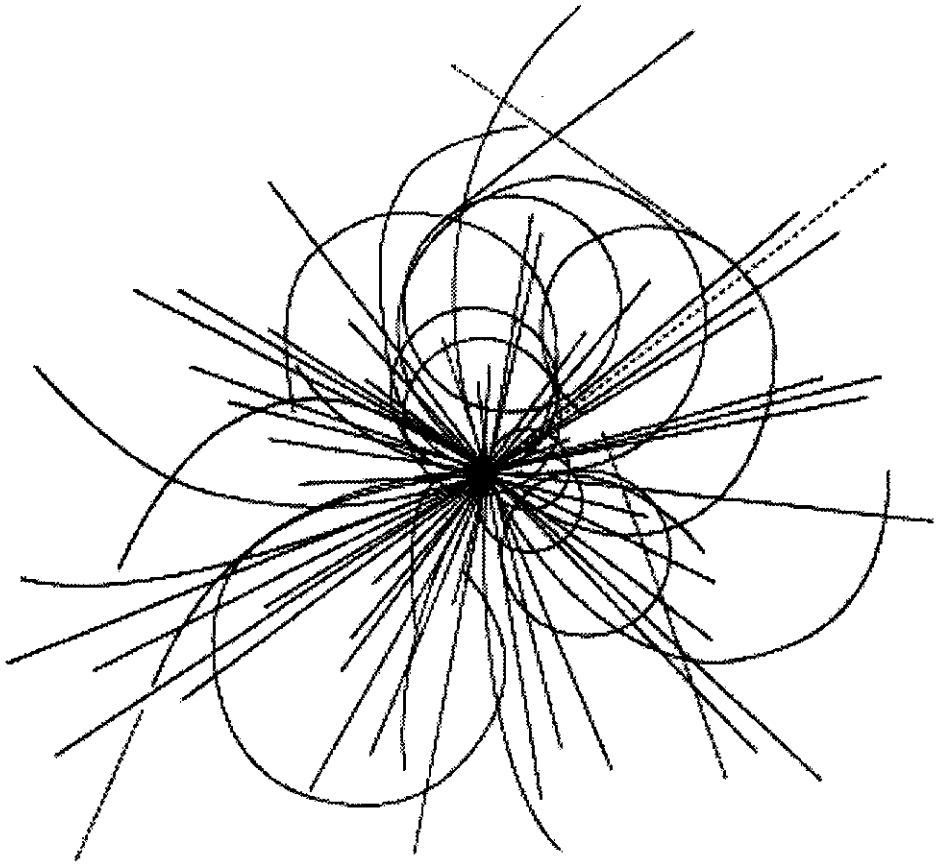

Superconducting Super Collider Laboratory

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Beam Loss Monitor System Specifications for the SSC Linear Accelerator

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Beam Loss Monitor System Specifications for the SSC Linear Accelerator

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Abstract

Specifications for the Beam Loss Monitor system for the Superconducting Super Collider linear accelerator are presented. These specifications include the requirements, a system description, the control system interface, and the operator interface.

1.0 REQUIREMENTS

The Beam Loss Monitor (BLM) system for the linear accelerator at the Superconducting Super Collider (SSC) has the following requirements:

- Time response $\leq 10\ \mu s$
- Dynamic range $\geq 10^4$
- Sensitivity $E = 13.6$ MeV $\Delta I/I_{max} = 0.1\%$
  $E \geq 30$ MeV $\Delta I/I_{max} = 0.01\%$

Note: Sensitivity is defined for a point loss at 1 m and near 0° upstream of the BLM. The loss is integrated over the required response time, *i.e.*, 10 μs.

Note: For a 1-μs response the sensitivity is decreased by an order of magnitude.

- Number of detectors

DTL	4;	one after each DTL tank
DTL/CCL	2;	one each after Q2 and Q4
CCL	9;	one after each CCL module
Transport	6;	locations TBD
Transfer	14;	locations as specified in NO: E10-000026, REV: B

Note: The BLM should be placed as close to the beam line as possible.

2.0 SYSTEM DESCRIPTION

The BLM system for the linac has the following components:

- **Detector** E ≤ 200 MeV: 25-mm diameter by 100-mm cylindrical plastic scintillator viewed by a 38-mm photomultiplier tube (PMT). *Prototype produced and tested.*

  E > 200 MeV: 51-mm diameter by 174-mm cylindrical, gas filled, ionization/proportional chamber (IC/PC). *Prototype produced and tested.*

- **Electronics** The electronics module for the BLMs shall be based on the same VXI module as the Beam Position Monitors (BPMs), *i.e.*, a 4-channel card with analog electronics, ADCs, and memory. Changes shall be a different analog circuit and redefinition of the averaging FPGAs. *BPM model produced and tested; BLM model being designed.*
  - **Analog.** The system shall consist of a fast integrator with a 2.0-μs time constant and a unity voltage gain. *Prototype produced and tested.*
  - **Digital.** A 2-MHz ADC and 32k words (16 bit) of memory per channel. *Prototype produced and tested.*
  - **Average.** The FPGA attached to each ADC channel shall be able to average over 1 to 2048 conversions (as for the BPM). Added to its function will be a digital comparison with two preset levels, a warning level and an inhibit level. *Being designed.*

- **High Voltage** Both the PMT and the IC/PC require high voltage of less than 2500 V. This shall be provided by a modified version of an eight-channel VME module developed for D0 at FNAL. *A four-channel VXI card is being designed.*

3.0 INTERFACE AND CONTROL

The interface to the control system is through the VXI backplane. Since the BLM module is based on the BPM module, all the control information applicable to the latter is applicable here. See ADA-818242 for a description.

In addition, the control system shall supply a trigger pulse (TTL) to the front panel. The most likely mode of operation is that the trigger would start digitization at the 2-MHz rate and at some time (~10 μs) before the linac pulse and continue for a period of ~100 μs. Data would be stored in memory and the memory would wrap. Averaging would be delayed to the start of the pulse and would complete at the end of the pulse.

The output of the BLM module shall be primarily over the VXI backplane. The control system shall be able to read the averaged value and/or the individual digitized values representative of beam loss.

The BLM module shall send interrupts when either the warning or inhibit level is exceeded (for a TBD number of digitizations). When the inhibit level is exceeded, the module will remove a permit at the front panel (*i.e.*, permit +5 V, inhibit 0 V).

4.0 OPERATOR PRESENTATION

In normal operation the expected display shall be a histogram of Loss (V) versus BLM number, which is the numerical value of the averaging register plotted for each BLM.

In special situations, where the maximum available information is required, a histogram of Loss (V) versus Time (μs) for one or more BLMs could be displayed. If a warning or inhibit level is exceeded, the normal color of the BLM display should change, *e.g.*, to yellow for warning and to red for inhibit.