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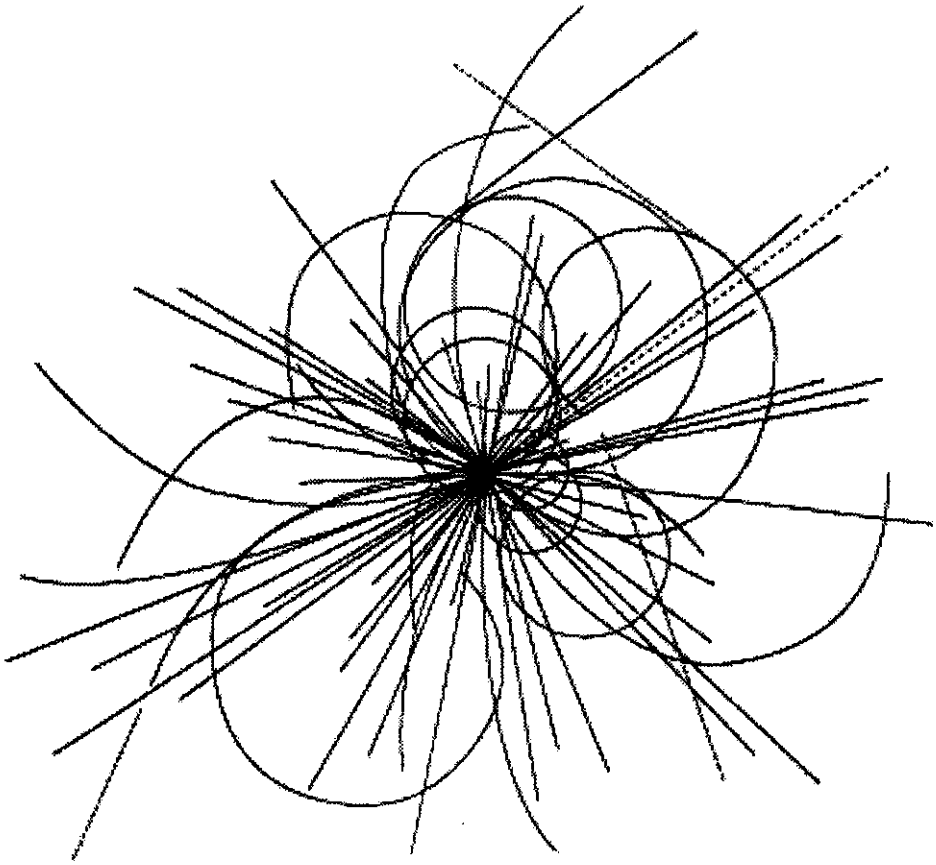

Superconducting Super Collider Laboratory

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Beam Loss Monitor System Specifications for the SSC Low Energy Booster

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Abstract

Specifications for the Beam Loss Monitor system for the Superconducting Super Collider Low Energy Booster 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 Low Energy Booster (LEB) at the Superconducting Super Collider (SSC) has the following requirements:

- Time response $\leq 10\ \mu s$
- Dynamic range $\geq 10^4$
- Sensitivity
  - At Injection 1.0×10^9 p/s (10 mrad/s)
  - At Extraction 1.0×10^8 p/s

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: Loss will be integrated with a ~0.1-s time constant. Instantaneous losses are detected at the 1.0-mrad level (*i.e.*, 10^8 to 10^7 protons).

Note: Discussions about sensitivity down to 10^6 protons were underway. This sensitivity could be obtained using a proportional counter but with reduced detector lifetime.

- Number of detectors

LEB	90;	one after each quadrupole
LEB–MEB Transfer	18;	one at each point of large beta, one at injection and extraction septa, and two at the dump line absorber

Note: If the highest sensitivity is required, the BLM should be placed as close to the beam line as possible.

2.0 SYSTEM DESCRIPTION

The BLM system for the LEB has the following components:

- **Detector** 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 10-μs time constant and a unity voltage gain. *Linac prototype produced and tested.*
  - **Digital.** A 1-MHz ADC and 32k words (16 bit) of memory per channel. *Produced and tested.*
  - **Compare.** The FPGA attached to each ADC channel shall be able to digitally compare the incoming data with two preset levels, a warning level and an inhibit level. The FPGA shall also integrate the incoming data over a 50-ms period and compare the integrated data with two additional preset levels. *Being designed.*
- **High Voltage** The PC requires 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 1-MHz rate at the start of the LEB cycle and continue for a period of ~50 ms. Data would be stored in memory and the memory would wrap.

The output of the BLM module shall be primarily over the VXI backplane. The control system shall be able to read the integrated 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. 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 integrating 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.