TRIGGER SCINTILLATION COUNTERS FOR A BEAM TEST OF THE LHCB VERTEX DETECTOR

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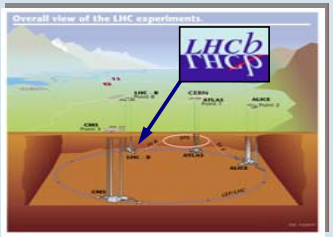
Abstract

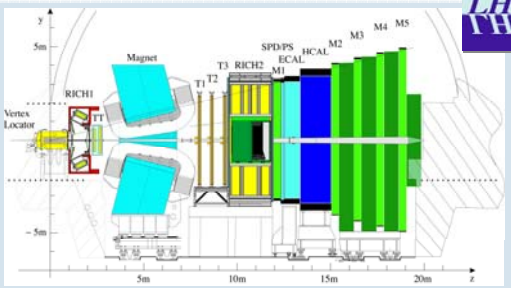
We constructed and tested seven scintillation counters using photomultiplier tubes, in order to create a fast electronic coincidence "trigger" for testing the performance of the VELO charged particle tracking detector in an accelerator beam at CERN, Geneva, Switzerland.

LHC & LHCb

A new Particle Physics experiment called LHCb will be performed at the Large Hadron Collider accelerator (LHC) at CERN in Geneva, Switzerland, starting in 2008.

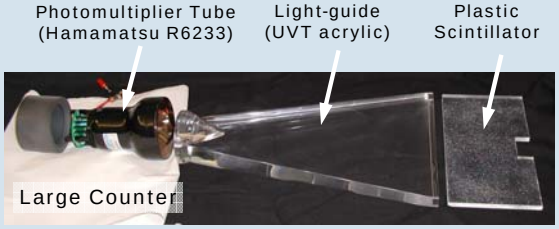


LHCb will study b quarks, and make measurements in the important area of physics known as "CP Violation", which is integral to understanding the imbalance between matter and anti-matter in our universe.



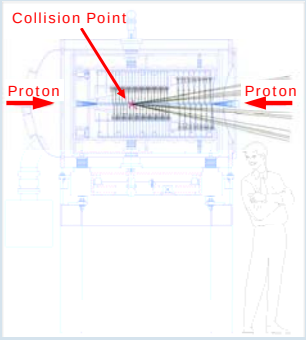
TRIGGER COUNTERS

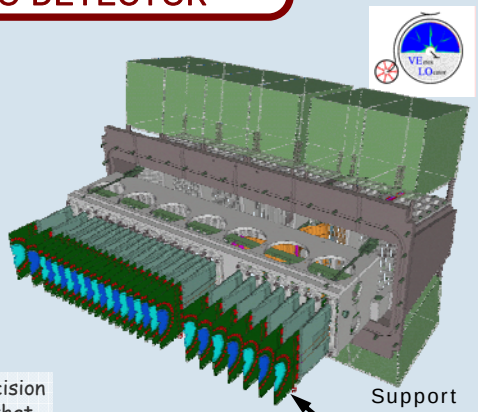
Scintillation counters are used to reliably detect the passage of charged particles. They form a fast signal, and can be used to detect particles in an accelerator beam or particles from a radioactive source or even cosmic ray particles from outer space.



Photomultiplier tubes (PMTs) convert light into a measurable electric current. They consist of a photocathode, electron multiplier section, and an anode from which to collect the charge signal.

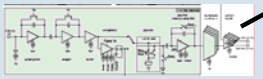
VELO DETECTOR





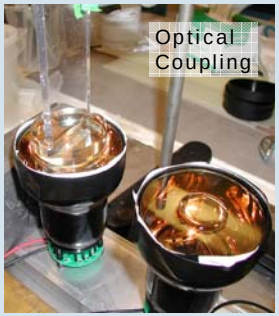
The VELO Detector is a high-precision charged particle tracking device that will be used in the LHCb experiment. It sits at the collision point of the intersecting protons beams.

It consists of many Silicon sensors that give precise spatial information (σ~10 μm) which allows reconstruction of the tracks and provides a "trigger" for interesting events.



CONSTRUCTION

We constructed seven scintillation counters, based on the use of photomultiplier tubes. The details of the fabrication, polishing, gluing and wrapping processes are represented here.



- Scintillators
- Optical cement
- Cookies
- PMTs

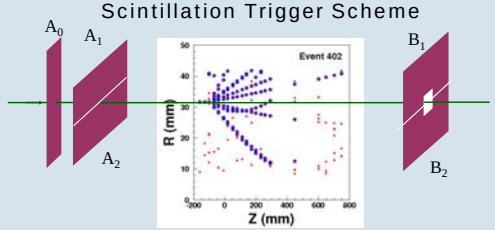
For more info, see: lhcb.cern.ch

- Coarse & fine polish
- Several grades of abrasive paper used (down to 1 micron)
- Orbital polishing motion used

BEAM TEST

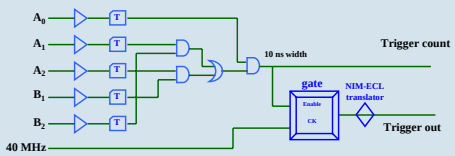
The VELO is a complicated piece of equipment that needs to be tested in an accelerator environment. We will perform such a test in Summer 2006. To properly test this device, we will need to create a "trigger", to start the readout electronics. This trigger consists of several scintillation counters in logical coincidence.

Scintillation Trigger Scheme



TRIGGER = $A_0 \otimes ((A_1 \otimes B_2) \oplus (A_2 \otimes B_1))$ efficiency~60%

Readout Electronics Scheme



TEST RESULTS

The counters were then tested for proper response with a Cesium-137 radioactive source, and with cosmic rays. The setup and some results from these tests are presented below.