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Long Term Testing of VeLo detector modules in Vacuum

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LHCb is the only dedicated B physics experiment on the
Large Hadron Collider (LHC) ring. It is an spectrometer whose
vertex detector(VeLo) has been optimise for the reconstruction of
vertices near the beam. This is achieved by placing the silicon
strip detector modules inside
the primary beam pipe. Hence they are expected to operate in vacuum
(10^{-6}mbar) and withstand high levels of radiation. Long term testing
under vacuum
was performed on these
modules as part of their quality assurance during the VeLo production.
These included thermal
cycling and monitoring its electronic performance. Results will
be presented of the modules tested so far and
the unique challenges of vacuum operation.

Summary

LHCb is the only experiment within the Large Hadron Collider (LHC) whose
geometry has been optimised for the study of B physics. One of its
aims is to study
CP violation phenomena and thus probe for physics beyond the standard
model. LHCb is an spectrometer whose design includes a vertex detector
called the VeLo. It allows the reconstruction of displaced vertices of the
$B - \bar{B}$s which are found close to the beam and decay into shallow tracks.
The aim of the design was to minimise the track extrapolation distance
to obtain a better impact parameter measurement which
led to the modules being inside the primary beam pipe. The VeLo modules
thus not only have to
withstand the high levels of radiation expected but also have to operate in
vacuum (10^{-6}mbar).

Each module has two single sided 300μm silicon n-on-n
strip sensors positioned back to back.
One sensor has its strips radially arranged while the other has concentric
strips allowing the module to provides a three dimensional point for each
traversing charged particle. Each side is instrumented by 2048 strips of
different pitch (38μm to 98μm) and length(6.2mm to 3cm) which are read by 16
$Beetle$ chips. The resolution of the module depends on the angle
of the track and its optimal has been measured to be 4μm. The
detector is composed of two halves which
are centred around the beam. Each half, containing 22 modules placed
orthogonal to the beam, can move towards and away from the beam.

The aim of the long term testing was to uncover any latent defects on the
manufacturing and electronics suffering from infant mortality. This
has been achieved by operating the modules under the extreme conditions
expected during operation in the experiment. This includes thermal cycling (-30C to 30C)
and operation under vacuum for a total of 64 hours. The effect of the
temperature cycling and vacuum on interfaces such as glue are monitored
by the comparison of before and after thermographs while the module
electronics are monitored by periodically exercising them. Results will be

presented of the modules tested so far and
the unique challenges of operating silicon strip detector modules in vacuum.

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