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Development of CVD Diamond Beam Monitors at cryogenic and room-temperature for LHC, CNGS and the ATLAS Experiment

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In recent developments we have studied CVD diamonds as beam monitors for a large variety of applications. We will present test results on diamond detectors used as beam loss monitors operating at ultra-cold temperatures (1.9K) for future use at LHC, as muon beam monitor in the CERN CNGS facility and as diamond pixel modules to monitor luminosity near the interaction point of the ATLAS experiment.

For the new series of triplet magnets, the LHC Beam Instrumentation Group seeks a detector concept that provides full functionality at ultra-cold temperatures (1.9 K). We will present results of measurements of the temperature dependence of fundamental diamond quantities such as carrier drift mobility and velocity, total charge yield, lifetime and detrapping time constants.

The presentation will also show recent results of two applications of CVD diamonds: For CNGS (CERN Neutrinos to Gran Sasso) CVD diamonds have been used since October 2011 to measure in the CNGS facility at CERN the time structure of the muon beam. The diamond system allows to independently measure the 'start-signal'for the neutrino time-of-flight measurements and to study any systematic effects along the CNGS secondary beam-line. For the ATLAS Experiment a diamond pixel detector is currently under development. The diamond pixel modules are based on the new ATLAS FEI4 pixel chip and will provide bunch-by-bunch luminosity measurements through charged particle tracking near the interaction region of ATLAS

Optional extended abstract

In recent developments we have studied CVD diamonds as beam monitors for a large variety of applications. We will present test results on diamond detectors used as beam loss monitors operating at ultra-cold temperatures (1.9K) for future use at LHC, as muon beam monitor in the CERN CNGS facility and as diamond pixel modules to monitor luminosity near the interaction point of the ATLAS experiment.

Poly-crystalline and single-crystal Chemical-Vapour-Deposited (pCVD and scCVD) diamonds serve as detectors in these applications: They offer fast response time, excellent radiation hardness, long durability and reliability in a compact package. They can operate over a very wide temperature range and in harsh radiation environment. Combined with dedicated electronics the detector system gives good signal to noise performance, offers single-particle counting or burst measurements and provides a broad dynamic range to cope with losses differing by orders of magnitude.

For the new series of triplet magnets, the LHC Beam Instrumentation Group seeks a detector concept that provides full functionality at ultra-cold temperatures (1.9 K). A set-up for Transient Current Technique (TCT) measurements for CVD diamonds at ultra-cold temperatures has been used to study the basic charge carrier properties in CVD diamond. We will present results of measurements of the temperature dependence of fundamental diamond quantities such as carrier drift mobility and velocity, total charge yield, lifetime and detrapping time constants. The precise knowledge of those basic quantities enable the dedicated design of the detector systems based on diamonds.

The presentation will also show recent results of two applications of CVD diamonds: For CNGS (CERN Neutrinos to Gran Sasso) CVD diamonds have been used since October 2011 to measure in the CNGS facility at

CERN the time structure of the muon beam; the muons are produced together with the muon neutrino beam that is sent to Gran Sasso.
The diamond system allows to independently measure the 'start-signal'for the neutrino time-of-flight measurements and to study any systematic effects along the CNGS secondary beam-line, ie from the protons hitting the target until the production of the muons and muon neutrinos.
For the ATLAS Experiment a diamond pixel detector is currently under development. The ATLAS Diamond Beam Monitor (DBM) comprises 24 diamond pixel modules (20x18mm2) arranged in eight telescopes. The diamond pixel modules are based on the new ATLAS FEI4 pixel chip and will provide bunch-by-bunch luminosity measurements through charged particle tracking near the interaction region of ATLAS. Recent results of first lab and source measurements on first diamond modules will be shown.

Primary author: Dr PERNEGGER, Heinz (CERN)

Presenter: Dr PERNEGGER, Heinz (CERN)

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