

# Development of Single Crystal Chemical Vapor Deposition Diamonds for Detector Applications

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## Project Summary

Progress in experimental particle physics depends crucially upon the ability to carry out experiments in high radiation areas. Existing tracking devices and monitoring systems are presently based on the mature silicon technology which functions very well in relatively low radiation environments but may fall short of what is required for future experiments. Hence new radiation hard technologies must be developed to fill this gap. Diamond is one such technology.

With the commissioning of the LHC expected in 2009, and the LHC upgrades expected in 2013, all LHC experiments are planning for detector upgrades which require radiation hard technologies. Chemical Vapor Deposition (CVD) diamond has now been used extensively in beam conditions monitors as the innermost detectors in the highest radiation areas of BaBar, Belle and CDF and is planned for all LHC experiments. As a result, this material is now being discussed as an alternative sensor material for tracking very close to the interaction region of the super-LHC where the most extreme radiation conditions will exist.

This proposal addresses the further development of the new material, single-crystal Chemical Vapor Deposition diamond, towards reliable industrial production of large pieces and new geometries needed for detector applications. The important points of the proposal are:

- Polycrystalline CVD (pCVD) diamond material has been demonstrated to be grown reliably by industry and has been measured to be more radiation hard than silicon.
- Several of the authors of this proposal pioneered the research and development of CVD diamond detectors and are world leaders in this technology.
- Polycrystalline CVD material inherently has grain boundaries and defects which limit the collected charge.
- Single-crystal CVD (scCVD) diamond has been grown (in small sizes) and solves many if not all of the issues associated with pCVD material.

With the resources requested in this proposal, the following will be accomplished.

- Work with the two companies most advanced to develop a reliable method to grow larger area scCVD diamond.
- Develop and transfer the metalization techniques required for proper radiation hard operation of this material to industrial partners.
- Explore new geometries in scCVD diamond such as 3D structures.