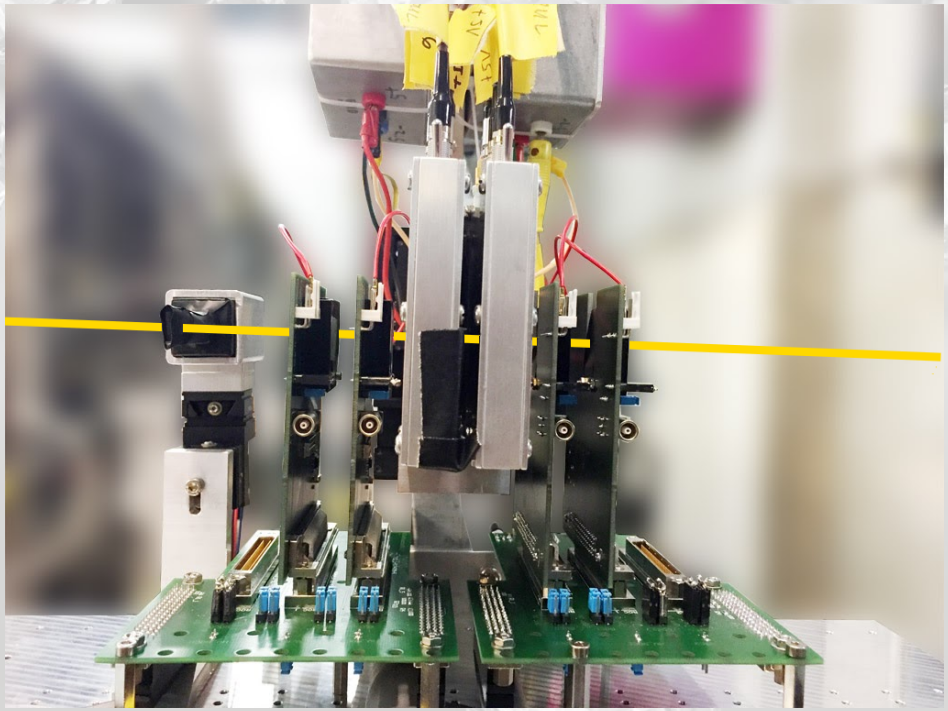

Beam Tests Investigating Diamond as Detector Material

Michael Reichmann

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Section 1

Motivation

Motivation

- diamond as possible future material for the tracking detectors of the LHC
- innermost layers $\rightarrow$ highest radiation damage
- current detector designed to withstand $250\,\mathrm{fb}^{-1}$ of integrated luminosity
  - High-Luminosity LHC: replace detector every 12 month
- $\rightarrow$ **look for more radiation hard detector designs and/or materials**

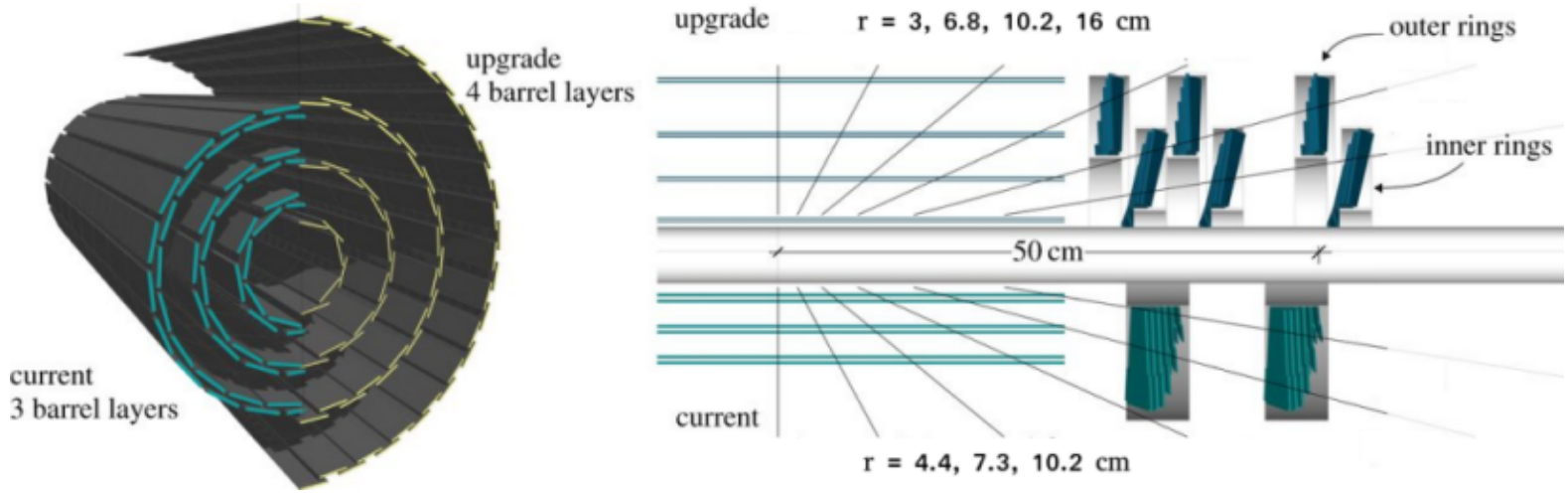


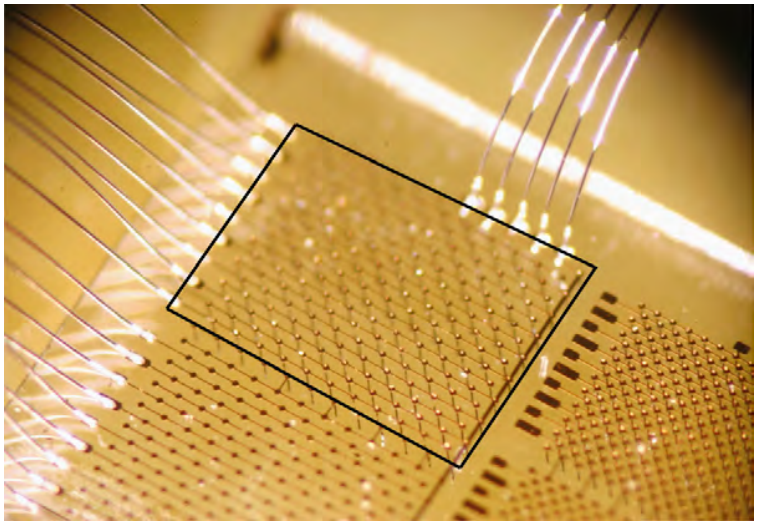
Figure: CMS Barrel Pixel Detector upgrade with end caps

Section 2

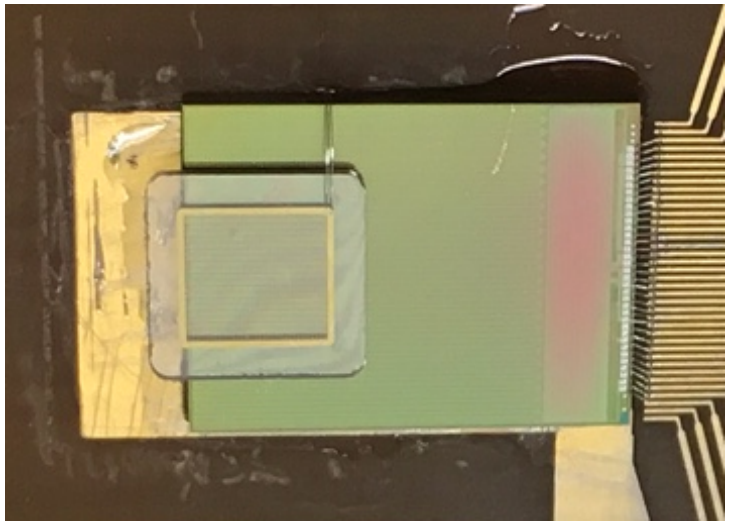
Diamond as Detector Material

Detector designs

- Investigation of two different detector designs
  - **planar diamonds**
    - ★ exchange of material
  - **3D diamonds**
    - ★ new type of detector



(a) prototype



(b) on CMS-Pixel chip

Figure: 3D diamond detectors

Detector material

- 7 – 10 times smaller charge loss due to radiation damage then in silicon
- signals (electrons created by a charged particle) two times smaller than in silicon
- → diamond becoming superior than silicon at a certain irradiation
- other advantageous properties:
  - isolating material → negligible leakage current → power saving
  - high thermal conductivity → heat spreader for electronics
  - large band gap → no cooling required
  - high charge carrier mobility → fast signals
  - working principle like a solid state ionisation chamber → no pn-junction required
- disadvantages:
  - high price
  - some not fully understood behaviours