BeamCal for ILC Detectors

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The current status of the research work of the ILC Forward Calorimetry Collaboration (FCAL) is described. One of sub-detectors is addressed: BeamCal, which is planned to be positioned just adjacent to the beam-pipe and ensures detector hermeticity to polar angles down to about 5 mrad. Of particular importance is the detection of high energy electrons at low polar angles to provide effective two-photon events veto (see Fig. 1) which is essential for the search for rare events with missing energy and momentum in the acceptance of BeamCal. Such events are predicted in scenarios of super-symmetry and are easily faked by two-photon events, when the electron would escape undetected.

The challenge for BeamCal is that due to beam-beam interaction a large number of electron-positron pairs in the low GeV range is produced by beamstrahlung, a new phenomenon at the ILC. The pairs that will hit the BeamCal carry several 10 TeV of energy per bunch crossing.

The lateral distribution of the pairs is strongly dependent on the beam parameters. Fast analysis of the pairs distribution shape will be used for beam-tuning to maximum luminosity.

Very large energy depositions at low angles are expected, leading to annual radiation doses up to 10 MGy (see Fig. 2 where the distribution is calculated for the nominal beam parameters). The requirements on the sensors are stable operation under high electromagnetic doses, good linearity over a dynamic range of about 10^4, very good homogeneity and fast response.

BeamCal has to be readout after each bunch crossing requiring a specialized fast FE electronics and data acquisition that are currently under development.

BeamCal is designed as a compact fine-grained sandwich calorimeter (Fig. 3). Tungsten is the absorber and different materials are under study as the sensor material to allow stable operation in the harsh radiation environment. Polycrystalline CVD diamond and GaAs sensors (Fig. 4) are currently under investigation. We studied sensor properties at high doses of electromagnetic radiation at the test beam. In addition the results of single crystal CVD diamond studies and their interpretation will be reported in the talk.

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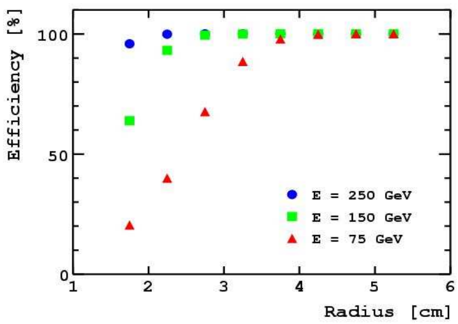

Figure 1: Two-photon events veto efficiency vs distance from the beam.

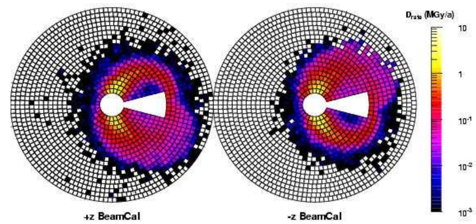

Figure 2: Expected annual dose at the showermax BeamCal sensor plane. Crossing angle 14 $mrad$, anti-DID field.

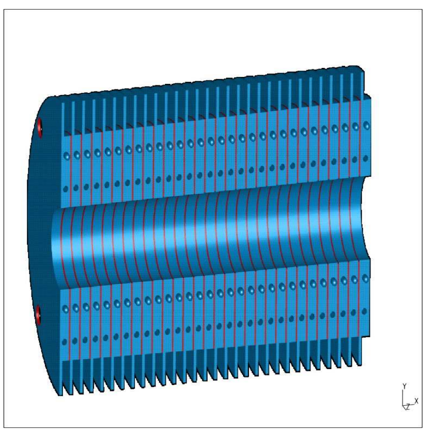

Figure 3: BeamCal design. Sensor planes are sandwiched between W absorber plates.

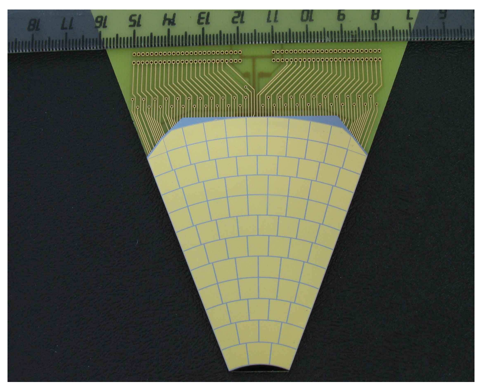

Figure 4: BeamCal GaAs sensor prototype.