Date: Mon, 28 Aug 2006 13:23:22 -0400 (EDT)
From: "Dipangkar Dutta" <ddutta@tunl.duke.edu> Block Address
Subject: Re: Diamond strip detectors (fwd)
To: dd285@msstate.edu

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From: Simon H Connell <connell@psi.phys.wits.ac.za>
To: Dipangkar Dutta <ddutta@tunl.duke.edu>
Subject: Re: Diamond strip detectors

Dear Dipangkar,

Thanks for your query,

I agree your requirements are modest regarding the position resolution and the
count rate. I am not sure about sizes, but I expect these are very modest,
diamond plates are not big, and one may have to go to a set of tiles. The
radiation tolerance for electronic applications is around 10^15 Mips/cm^2, so
the drastic situation of a skew primary beam putting 180 u-amps in a small spot
is not good for diamond either.

There is electronic quality diamond available. It would be diamond grown by the
CVD method and be a single crystal. The best material is commercially available
from Element 6, (It costs about $100/mm^2), and it is about 5x5 mm^2. The
thickness makes a difference to the price, but this may be a reasonable fraction
of a mm. You could have lower quality diamond, even good poly crystal CVD can be
used when you dont need 100% efficiency and are not doing spectroscopy. Perhaps
this may be the case as you get the momentum of the electron through the
position measurement. The PC-CVD would be commercially ten times cheaper, but
also, there are a lot of other sources. One of the best sources in the USA is
from Jim Butler at the NRL.

The metallisation of the strips is usually Ti-Al-Au after a very careful surface
preparation, which is quite important, and probably the cause of the current
debates about diamond contacts.

(Eleni Berderman) GSI at Darmstadt and also RD42 at CERN have special amplifiers
for diamond detectors.

We are mainly involved in characterisation, and very specialised processing for
specific shapes, thicknesses and surface finishes. We have made some detectors,
however, for the strip metallisation, there are specialised groups.

When its an R&D situation, we can generally access diamond preferentially at
lower cost, due to our relationship with Element Six. However, the field is at a
stage where by now most groups are buying their diamond.

As you have been using Silicon in this role, I would presume you already know
much about the technical design issues and the performance, and would to first
order simply change the Si slab with diamond, and keep as much of the set-up the

same.

If you would like to chat further, my contact details are below.
Usually try the
cell phone and then I will move to a landline.

Regards
Simon

Dipangkar Dutta wrote:
>
> Hi Simon,
> My name is Dipangkar Dutta I am part of the QWeak collaboration at
JLab.
> We are building a compton polarimeter for the experiment. We need a
rad hard
> fast recoil electron detector for this polarimeter. We are considering
using a
> diamond strip detector for this purpose.
> We were wondering if you provide us with some informationa on this
technology
> (we heard from Peter Bosted and Rolf Ent that you were an expert on
these
> detectors). Maybe you would be interested in collaborating with us in
building
> this detector. Please let us know what you think.
> Here are some details about the polatimeter.
>
> This detector is needed for the recoiling electrons
> from the green laser photon Compton scattering off an electron beams
ranging
> in energy from 1 to 9 GeV. So the energy of the detected electrons
will also
> be in the 1 - 9 GeV range. The scattered photon will be
> detected in a photon calorimeter (lead scintillator) in coincidence
with the
> recoiling electron. The primary electron beam and the scattered
electron beam
> is
> bent by a is bent by a series of 4 dipoles (which form a chicane) and
so the
> momentum of the recoil electron can be measured my measuring its
deviation
> from the primary beam after these magnets. The range of these
> deviations is usually in the order of 1-2 mm and they are
> usually 4-6 mm away from the primary
> beam (i.e. compton edge is 4-6 mm from the primary beam).
> Thus we need ~
> 200-250 micron resolution to measure their momentum
> accurately. Since the Compton edge is just 4-6 mm from the
> primary beam the detector needs to
> be inside the beampipe. Which makes it vulnerable to
> accidental exposure
> to the primary beam or beam halos for badly tuned beams etc.
> Hence they need to be rad hard. The beam electron current will range
from 10 -
> 180 micro Amps. At 180 micro amps the
> electron rate per strip will be 15-20KHz/strip.
> These are fairly modest requirements. We have used Si strip
> detectors for lower currents but they get damaged by radiation.
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