BCM Notes: Post Rutgers Meeting

The BCM consists of two parts:

- BCM1: Located at z=+- 1.9m.
- BCM2: 8 polycrystalline diamonds at x = +/- 13.5 m just behind the HF.(so that the sensors are shielded from the IP, but open to flux coming from upstream.)

BCM1:

- Consists of 4 units mounted on the BCM Carriage (which also supports the PLT).
- The BCM1 unit is composed of two sets of sensors.
- The BCM1A is a polycrystalline sensor or a set of single crystal sensors mounted at an angle of 12.5 deg to the vertical.
- BCM1B is a polycrystalline sensor mounted parallel to the beam axis.

BCM2

- Consists of 8 units mounted uniformly in phi.
- The BCM1 unit is composed of one sensor set, which is either a polycrystalline sensor or a set of single crystal sensors.
- The sensor is mounted perpendicular to the beam axis, and is placed behind the HF in a location that is shielded from the IP by the HF, but exposed to particle flux coming from outside CMS.

Functions of BCM

- Monitor beam conditions on bunch to multiple orbit time scale. Ideally cover the 25ns to 100s range for post mortem purposes.
- Initiate beam aborts/warnings. Abort/warning signals to be based on repeated sampling of between 10 and 100 bunch crossings. NB there are 3564 25ns bins per LHC orbit, so for a staggered buffer postmortem system that covers the bunch to 100s scale, a 1^{st} buffer depth of 99 followed by five 6-deep buffer layers covers this range. Clearly, after the orbit scale bit reduction on the buffer entries is require (ie a two tier buffer scheme)
- Determine which direction bad beam conditions are coming from.
- Monitor the 3 μs orbit gap. Very important that the abort gap be kept clean. See talk by Rainer for experience from CDF.
- Monitor beam halo. This may require sensitivity to single MIPs
- Provide diagnostic and post-mortem analysis of beam accidents and pass information to the LHC operations Group (via FESA).
- Monitor the inter bunch spacing. This will be very challenging.

Frontend Electronics

For the Front end, the limiting bandwidth is the linear laser driver of the AOH, and this is 250 MHz. At present Richard is laying out version 1 of the Frontend chain, including biasing scheme of the sensor, and Ed will review the design. The present frontend concerns are:

- Issues of signal to noise.
- Radiation hardness
- The effect on the amplifier chain due to a voltage spike resulting from the voltage collapse of the diamond during an asynchronous beam abort. Rad hard RF pin diodes have been identified, and are to be incorporated into the biasing scheme. In addition, a reservoir capacitor on the bias line is to be tuned so to have the voltage across the sensors under a sustained high flux.

Readout

Primary readout will be a high-speed amp for detecting mips on a bunch-by-bunch basis.

The Font end electronics is to be a simple rad hard 2-stage amplifier chain that produces a differential signal that feeds into a standard CMS analog optohybrid. This AOH then passes the analogue signal back to the USC.

In the USC, the asynchronous signal has to be digitized and then processed. The backend readout system used by the Beam Loss Monitor (BLM) and Beam Position Monitor groups is to be adopted by the BCM, as they not only have similar requirements, and a developed set of cards, but importantly, the system comes with a fully developed post mortem and machine interface system.

BCM1B readout

For BCM1B the readout is to be as simple as possible with the sensor connected to copper cables that run out to the USC, with no intervening electronics. Secondary readout will be monitoring of current. Possible use of an Analog Devices logarithmic amp is being investigated (Rutgers). This amp covers an input range of 100pA to 10mA with an output of 200mV/decade. Measurements show with approximately a100 m long input cable the amp has a rise time of less than 10μs for currents greater than 300nA.

Action Items and Notes

- Frontend board: Richard to complete first version in August. Ed to review design
- Bob to metalise polycrystalline samples CDS155 and CDS124 with large square pad and guard ring.
- Status of polycrystalline samples CMSP1, CMSP2, CMSP3 and CMSP4 to be confirmed (Alick, Bob) then re metalised with large square pad and guard ring.
- Samples to be fully Characterized and PCVD QA procedure to be written (Bob, Richard, Alick)
- Single crystal samples to be tested with standard TiW metalisation, characterized and then tested under irradiation (in October?)
- Single and Poly samples to be tested under Magnetic field (Alick, Richard, Rainer?)
- Note: Sensor order to be placed with E6 before end of 2005.
- Mechanical Design: 1st draft to be completed by Sept 1st (Nuno) so that optimization of material can be done in September.
- Opto hybrids: Test of AOH components for performance with BCM signals. Alick- ongoing
- Opto hybrid boards: Need to solve layout issues for optohybrid boards. Possibly a task for Dan's team at Princeton. More details to follow.
- Backend DAQ. Use DAB64 VME board with mezzanine card that contains ADC. Possibly a task Rainer, and Wolfgang and Wolfgang (DESY). We need to discuss.
- Power supplies and Cables. Need to be ordered before the end of the year. Alick to handle this.
- Machine interface and DSS and DCS interface. To be done in conjunction with Radmon software engineer (Laura Wright). To be discussed after EDR.
- System Test. Need to understand when/if/how it is possible to get prototype units into CDF. (Rainer)

Details and updates to be posted to the BCM Webpage at
http://cms-project-radiation-monitoring.web.cern.ch/cms-project-radiation-monitoring/default.htm