Summary of Inner Tracker Meeting

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This summary is meant to highlight major points of concern raised and decisions taken during the meeting. It is not meant to reproduce the full content of the presentations. Please consult (http://documents.cern.ch/age?a02969) for the transparencies of each presentation.

1 Thermal Tests Detector Box

The aim to reach an ambient temperature inside the box of around 0°C has not yet been achieved. However, the system is well understood and measured temperatures agree very well with cooling models.

Identified weak points are a large heat transfer through the box walls and a too large temperature gradient through the cooling plate. Tests with increased wall thickness will be performed and the design of the cooling plate will be revised.

The box was equipped with a number of balconies and eight dummy ladders produced from thin copper sheets. The thermal conductivity of copper is about a factor of two better than the measured value for the Lausanne ladder (see below), however the cooled surface will be larger for a full box with 28 ladders.

It was suggested to replace the copper sheets by sheets of nickel, which has a thermal conductivity closer to the measured value. However, it will not be possible in time for the TDR to measure the performance of a "full" box with 28 ladders. An extrapolation of the measured performance to a full box seems possible employing the mentioned cooling models.

All tests so far were done without forced gas flow through the box. A test with cold nitrogen will be performed but Frank is sceptical that it will improve the cooling performance.

Olaf suggested to also test the effect of forced air flow along the outside of the box.

2 Thermal Tests Silicon Ladder

Measured temperature profiles agree well with Frank's model, assuming a thermal conductivity of 100 W/(m·K) for the ladder support. This is about a factor of two worse than had been expected from material properties. All plots shown at the meeting were for the "full" ladder support, without cutouts underneath the silicon sensors. Measurements have also been carried out on a second ladder, using a support with cutouts corresponding to about 65% of the silicon surface. Surprisingly, the thermal performance of the two ladders is almost identical. The second support was produced at a later time and it is possible that the production process was changed, resulting in a better thermal conductivity. Additional supports from a third production batch are expected to be delivered soon.

Attempts to directly measure the heat conductivity of the supports will be carried out in Lausanne and by Frank.

The measurements show that temperatures of only about 2°C below ambient are reached at the tip of the ladder support. Calculations show that this result is rather independent of the thermal conductivity of the ladder. However, the temperature profile (along the ladder) changes significantly with thermal conductivity, the average temperature of the ladder decreasing with increasing thermal conductivity. This is felt to be important since it helps to cool the box, i.e. reduce the ambient temperature.

All measurements so far were done with no power dissipation from the sensor area, i.e. assuming that leakage currents in the silicon are negligible. Measurements as function of power dissipation from the sensor area will be done.

3 Ladder Assembly

Once more, the question was raised and discussed, if the "hybrid" and pitch adaptor should be produced as one piece (kapton glued to a substrate), or if a separate pitch adaptor (thin film on glass) should be employed. Assembly is simpler in the first case (there is no need to align the bond pads on pitch adaptor and BEETLE chips), but at the price of increased material budget (the substrate has to be 300μm thicker than in the second case). The testbeam ladders had separate hybrids and pitch adaptors. According to Phillip, alignment and bonding posed no problem. We decided to delay the decision once more, until the Heidelberg meeting. It was suggested that, also in case that hybrid and pitch adaptor will be two separate pieces, these should be treated as one (pre-assembled) object for the "ladder assembly" procedure.

4 Readout Link

The primary aim for the TDR is to provide a "proof of principle" of the link concept. A detailed determination of bit error rates will not be posssible in time for the TDR.

The known incompatibility of TTC clock jitter and GOL requirements can be solved using a low-jitter 80MHz VCXO close to the GOL chips. However, Achim has not yet managed to lay hands on an appropriate chip.

One worry, raised for the first time, is the location of the 12-channel VCSEL transmitters on the frames of the Outer Tracker. The proposed transmitters have operational parameters stored in EEPROMs, and SEU rates have not been measured.

Another worry is the measurement of the performance of the analog transmission from BEETLE to service box. We had agreed that this was an urgent item to be addressed for the TDR. However, the BEETLE output driver has been significantly improved from vs 1.1 to vs 1.2 (vs 1.2 has a truly differential output and drives a higher output current). Thus, the quality of transmission should be measured using the BEETLE 1.2 chip which is expected to be delivered these days. It was agreed to communicate to the ASIC lab that this test is an issue of high priority.

It was agreed to assume a length of 5 m for the link between detector box and service box (previously 10 m).

Achim will prepare specifications and a block diagram of the "readout" part of the service box.

5 Testbeam

Many technicalities have been solved, first (preliminary) results from the analysis can be expected for the meeting in Heidelberg. We agreed that the most urgent issue for the TDR

preparation is to decide between the two strip pitches, i.e. analysis efforts should primarily concentrate on providing the input for this decision. It was agreed that top priority should be given to the determination, for all strip geometries and as function of the depletion voltage, of efficiency vs noise-rate curves and efficiency scans of the interstrip region.

Helge will check vacation plans of the analysis team.

6 HV/LV Distribution

On the question of segmentation, the opinion was raised that it would not make sense to have finer segmentation for HV than for LV. The feasibility of having individual LV lines from service box to detector box, for each ladder instead of for groups of four ladders, should be checked. The main issue is material budget of the cables.

Alfredo will study the question of cables and cross sections, and produce a material budget estimate for the two options. The number of traces implemented in the hybrid tails should serve as reference for the necessary control lines. The length of cables from detector box to service box should be assumed as 5 m (same as for readout link).

The question of cable confectioning was raised: should cables follow ladder segmentation (i.e. one multi-purpose cable, including signal, HV, LV, and control lines, per group of four ladders) or should they follow functionality (e.g., separate cables for signal/LV and for HV/control lines). Opinions on this were divided, but the issue is not urgent for the TDR.

It was agreed to base the cost estimate for HV/LV systems on the CAEN scenario. In addition, Phillip has asked ISEG for price quotations.

Alfredo will prepare specifications and a block diagram of the “slow control” part of the service box.