

Minutes of the Cooling-Meeting in Karlsruhe, 13.1.2011

Present were people from Karlsruhe, Munich, Valencia, Vienna.

The intention of the meeting was to communicate the progress in the field of cooling and to give feedback to the mechanical engineering. Furthermore the next steps had to be discussed.

We heard status reports from Karlsruhe, Valencia and Vienna.

The most important point in this meeting was the demonstration that the stainless steel cooling block from Munich could be cooled under full thermal load (silicon strips with load resistors on the outer and inner surfaces), using an open CO₂-system.

This is something like a milestone, because the mechanical layout of the complete DEPFET system relies fully on the coolability of these blocks. Due to the manufacturing process, not every material is suited. The stainless steel of this prototype is slightly magnetic, so a different material has to be chosen.

Valencia is in contact with another manufacturer who has already delivered some samples, at least one is nonmagnetic. An order of new prototypes made of alloys with higher heat conductivity is already out.

The Valencia prototypes will be sent to Munich for the necessary high pressure test, and afterwards to Karlsruhe for a comparable CO₂ cooling test.

Another problem of the prototypes from both producers are the uneven surfaces. This results in nonuniform thermal contact to the silicon and is an explanation for the inhomogeneous thermal response. Moreover a planned comparison of cooling with and without thermal grease could not be done.

Tobias proposed to produce the cooling blocks coupled to a "handling block" which could serve as a point of reference for the necessary milling and drilling steps and which could then be cut off.

We had a lengthy discussion about CO₂ cooling systems.

Whereas open systems are relatively easy and well suited for short lab tests, it is clear that we need a closed system for Belle-II. Our wish is to have a closed system as soon as possible (before 2012?) to perform system tests and to collect experience on its behaviour at various load situations.

Why is it so difficult to get one?

You cannot buy one from the shelf. But the CERN prototype is well suited (to be demonstrated) and need just to be copied. The problem is, that the Japanese rules about running a high pressure system are different from European rules. Parts (valves, connectors, containers, etc) which are allowed in Europe might be difficult to establish in Japan. This topic has to be discussed with Shuji in Bonn in February.

So the conclusion in our meeting was:

First we perform cooling test at the CERN CO₂-system. This is already scheduled for the week from 23rd of february. The cooling block prototype represents a quarter of the full PXD system (thermally: 100/400Watt); the SVD adds another 800W. Using respective load dummies, we want to learn if such unequal systems can both be cooled satisfactorily.

After the CERN tests we should plan for a closed system for long-term tests, to be ready in 2012 in a lab within the DEPFET Collaboration. This should be done in close collaboration with our Japanese colleagues, so that such a system is also acceptable to be built and installed in Japan.

Vienna plans to perform full ladder tests with an open CO₂-system and has already bought the necessary components.

Another discussion was about mockups and air cooling.

Valencia has already produced a lot of components to complete a full Depfet system mockup with some silicon ladder dummies from Laci which enables us to perform realistic cooling studies.

Yet unsolved is the provision of cold air for flushing the whole tracker volume (including SVD). Valencia will use a heat exchanger within a liquid nitrogen

tank for the lab tests. If such a system is suited for a continuous run at Belle-II is questionable.

In Karlsruhe we are preparing an air cooling system with a chiller and a custom-designed heat-exchanger. According to the data sheet, dry air (10 times SVD-volume per hour) will be cooled down to $\sim -20\text{deg}$. This could be a doable solution for Belle-II.

Next step in the air cooling business is to find out how much air we need and what the air does with the fragile components in the volume (e.g. vibrations). The air should also flush the SVD volume (that is why Vienna is present in our meetings).

To study the full tracker volume, we need a mockup of PXD and SVD combined. Immanuel reported, that a (simple) SVD mockup is produced in Krakow. A first order cooling test could be done by combining the Valencia and Krakow mockups (if compatible), otherwise the Valencia mockup has to be completed with the SVD layers.