Status of the mechanical design of the CBM-MVD

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For the design of the Micro Vertex Detector (MVD) for the CBM experiment, we are following two approaches. The first approach uses advanced technologies regarding sensor integration and interconnections. The second one is a more conventional approach with well defined building blocks (sensor, carrier, cooling, readout cables, FEE), which however incorporates advanced materials and concepts under the aspects of minimisation of the material budget as well as vacuum operation. The latter will be discussed here.

The sensor technology we will use in the MVD is based on Monolithic Active Pixel Sensors (MAPS). The sensor for the final MVD will be MIMOSIS-1, which will be thinned down to a thickness of 50 µm. As this sensor is still to be developed, we are currently working with a precursor named MIMOSA-26[1]. The form factor of this precursor does not fit the one of the final sensor, which will be adapted during the development phase.

The support material in the active area of the MVD will be CVD diamond with a thickness of 300 µm, adding only a small amount to the material budget. An effective cooling is mandatory because of the operation in vacuum. The CVD diamond covers this part by providing an outstanding heat conductivity of about 2000 $WK^{-1}m^{-1}$ at low temperatures.

Outside of the active area of the MVD, copper plates are currently discussed to be used for cooling of the CVD diamond (and sensors) and readout electronics. The diamond on which the MIMOSIS-1 sensors are mounted is cooled via cooling the copper plates. The interconnections ensuring an optimal heat transfer between CVD diamond and copper heat sinks as well as between cooling fluid and copper heat sinks are key points, which are still subject of detailed studies.

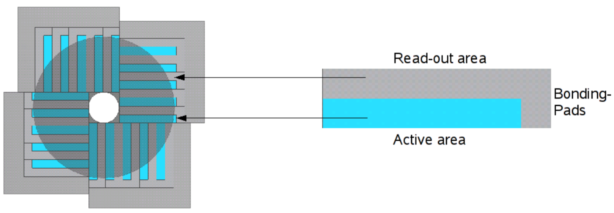

Figure 1: Double-sided sensor arrangement of the first MVD station, acceptance of the first station (grey disk) and MIMOSIS-1 sensor with subdivision into active and passive parts

The design of the MVD, worked out with Autodesk [2], is constrained by the requirements of the CBM experiment. For the first station, a disk featuring an inner radius of 5.5 mm and an outer radius of 25 mm has to be covered with sensors; for the second station, the inner radius is 5.5 mm and the outer radius 50 mm. Based on the form factors of the sensors, which are still under consideration and are not necessarily the same for both stations, this acceptance translates to 40 double-sided arranged sensors for the first and 76 double-sided arranged sensors for the second station (see Fig. 1 for the first station). Figure 2 shows the preliminary concept of the vacuum vessel housing both MVD stations, comprising the support structures, heat sinks for the readout electronics, readout electronics, FPCs, readout cables and cooling tubes (both not in proper numbers). The dimensions of this vacuum vessel are $800\times600\times200$ mm^3.

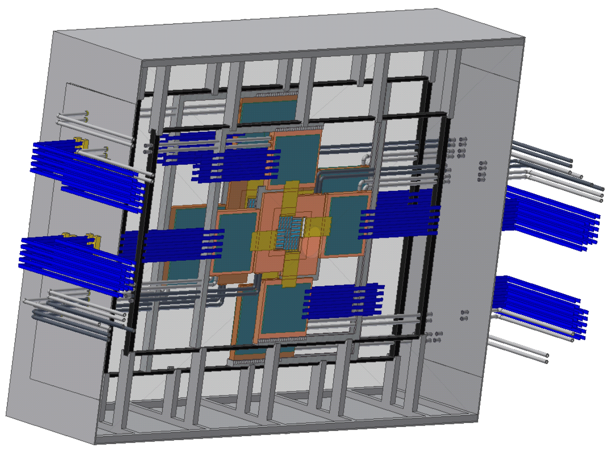

Figure 2: Complete vacuum vessel housing the MVD

For the ongoing physics simulations, a simplified model of the first MVD station containing the support material, the sensors (which were explicitly divided into active and passive areas), the heat sink for the sensors and for the electronics was successfully transformed from CAD to ROOT geometry with a converter provided by the Panda Collaboration [3].

References

[1] MIMOSA-26, IPHC, Strasbourg, France, http://www.iphc.cnrs.fr

[2] Autodesk Inventor 2010, http://www.autodesk.de

[3] Panda CAD-Converter, http://panda-wiki.gsi.de