The Micro Vertex Detector (MVD) is the innermost one in the antiProton ANnihilation at DArmstadt (Panda) experiment. It features 4 coaxial barrels (two with hybrid pixel sensors at small radii and two with strip sensors), and 6 forward disks (all with hybrid pixels and the last two completed by strips). The cylindrical structure shows a diameter of about 300 mm, and an overall length of 460 mm. The detector aims to the vertex reconstruction with a spatial resolution better than 100 μm, and to the momentum measurement. Globally there are about 10 M channels of pixel, and 200 k channels of strip.

The hybrid technology was chosen for the pixel layers, due to the high radiation tolerance required for a total fluence of about 1·10^{14} n_{\text{eq}}/cm^{2} relatively to a lifetime of 10 years (50% duty cycle). The sensor is implemented in the epitaxial silicon grown on a Czochralski layer, to obtain a low depletion voltage (about 10 V). The pixel covers an area of 100 × 100 μm², and it is connected to the readout by bump bonding technique. The circuit is then glued on the carbon foam, which has a high thermal conductivity, for helping the dissipation. Due to particles with low momentum down to 150 MeV/c, the material budget is very limited. With respect to the radiation length, it must be hold down to a value of 10% including all the parts making up the detector (sensor, support, cabling, ...) in every direction from the intersection point. The simulation shows that the main component affecting the material budget is the cabling (38%). For that reason the actual layout foresees that the interconnections are made in aluminium instead of standard copper, that have a radiation length respectively of 89 and 14 mm.

The present Topix version features 640 pixel cells, arranged in short columns (32 cells) and long columns (128 cells). The circuit is a prototype of 4.5 × 4 mm², but it is provided of the peripheral electronics needed for the columns readout. All the registers were implemented with a SEU protection methods, as the triple redundancy or the Hamming code. The event information are sent out by an SLVS serial port, with a 156 Mb/s data rate.

The carbon foam is very interesting for the MVD cooling system, but its byvirourcer parameters are not yet investigated. For that reason an irradiation test was performed at the Lena nuclear reactor in Pavia, up to a total fluence of about 2·10^{13} n_{\text{eq}}/cm². The result shows a small change of the thermal conductivity, around the 10% with respect to the initial value.

The CSA produces a triangular shaped signal which base is proportional to the input charge. This waveform feeds a comparator, and it is crucial to reduce the baseline spread. A DAC has been introduced to allow an equalization, on a channel by channel basis. Due to the process parameter distribution a baseline standard deviation of 5 mV has been noticed but, after the correction, it has been cut below than 700 μV. The current prototype for the readout circuit (Topix) is designed in a 130 nm Cmos technology, and it is able to run in a triggerless system. The circuit features an energy loss measurement with a 12 bits resolution by the TOT technique, over an input range from 1 to 50 fC. Topix is working with a 155.5 MHz clock, and it is able to deal at least with a 6·10⁸ hit/(cm²·s) event rate. A noise level of about 0.03 fC was measured, and the circuit was proven to be radiation hard well above the required 100 kGy TID.

The whole MVD system dissipates around 1.4 kW and the chosen cooling solution is composed by a water circuit, working below the atmospheric pressure to avoid leaks. For the evaluation of the cooling performance, a set of dummy circuits for a global power of 94 W were glued on the half disk prototype, reaching the surface temperature of 34 °C in agreement with the simulation.

A beam test has been performed to check the present prototypes at the Forschungszentrum Jülich, with a proton beam at about 3 GeV/c momentum. The setup foreseen a simple telescope made of 4 pixel sensors, while the data acquisition was implemented by a set of FPGA. From the beam spot, the bump bonding process has been evaluated and the present prototypes at the INFN Torino.

The current samples are made of 18 differential pairs, with tracks 1 m long and width of 100 and 150 μm. The total jitter was measured and the threshold value of about 0.3 UI is reached with a data rate of 600 Mb/s, at present a new prototype 1.5 m long has been delivered.

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