In-Beam Tests of Double-Sided Silicon Microstrip Sensors Employing Flex-PCB Readout for the $\overline{\text{P}}$ANDA MVD*

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Introduction

Detectors close to the interaction point, such as the $\overline{\text{P}}$ANDA Micro-Vertex-Detector (MVD), should feature a low material budget. Hence, the amount of passive material needs to be kept small and materials with high radiation lengths should be used. In terms of detector readout electronics, the utilization of thin flexible PCB technology is favored. Detector modules based on standard rigid-PCB applying flex-PCB pitch-adapters to interconnect between the silicon microstrip detector and the front-end chip, as reported in [1], were succesfully tested. Together with the high-density flex-PCB pitch-adapters, designs for flex-PCB were developed to test the transition from rigid to thin and flexible readout boards [2]. Several beam tests were performed using detector modules based on these designs in beams of electrons at the CERN SPS in Sept. 2012 as well as protons at COSY in Dec. 2013 and Jan. 2014.

Flex-PCB Detector Module

The front-end board is based on a ThinFlex-A® double-sided electrodeposited copper clad polyimide film with a dielectric thickness of 50 µm and 12 µm copper. The total thickness is approximately 100 µm. Figure 1 shows a photograph of the detector module to read out a double-sided silicon microstrip sensor using the APV25 front-end chip [3]. The flexible PCB is glued to a glass-fiber reinforced plastic frame that supports the flex-PCB and the sensor in a way that both sensor sides are accessible for wire bonding. A pitch-adapter fan-out structure is integrated in the 2-layer board to read out every third strip of a double-sided silicon detector with a strip pitch of 50 µm. The front-end board is connected to a transition card by a flex-PCB cable based on the same board specifications.

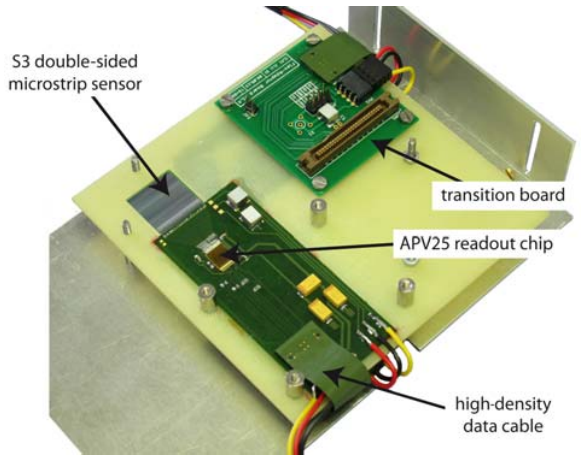

Figure 1: Photo of the detector module based on flex-PCB.

Results

The aforementioned module was used in beam tests with proton beams of 2.95 GeV/c and 0.8 GeV/c momentum. A hitmap from a measurement with 0.8 GeV/c protons can be seen in figure 2. The signal-to-noise ratio that was obtained from this measurement was (54.5 ± 16.2) for the p-side and (15.2 ± 5.1) for the n-side, respectively. The excellent performance proved the concept of this flex-PCB technology for future application in the $\overline{\text{P}}$ANDA MVD.

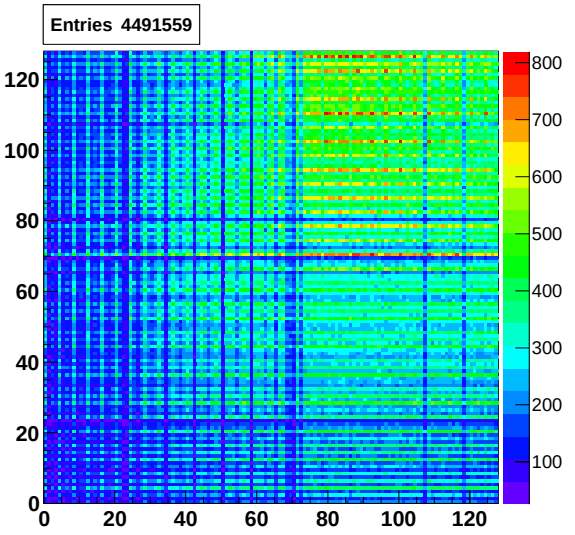

Figure 2: Raw hitmap from test beam with protons at COSY (unordered channel mapping).

References

[1] R. Schnell et al., GSI-SR2012-PHN-HSD-EXP-10, (2013).

[2] GS Swiss PCB AG

[3] L. Jones, "APV25-S1: User guide version 2.2", RAL Microelectronics Design Group, (2001).

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