The In-house design validation of new version of electronic Read-Out (Bending Plane) of the Second Tracking Station of ALICE-MS

S. Chattopadhyay[1], A. Das[1], Dipankar Das[1], L. Das[1], D. Das[2], W. Shaikh[1], J. Ghosh[1], I. Das[1] and T. Sinha[1*]

[1]*High Energy Nuclear and Particle Physics Division, Saha Institute of Nuclear Physics, Kolkata - 700064, INDIA*
[2]*Applied Electronics Section, Saha Institute of Nuclear Physics, Kolkata - 700064, INDIA*
** email: tinku.sinha@saha.ac.in*

Introduction

The ALICE detector is dedicated to study the properties of the hot and dense matter created in ultra-relativistic heavy-ion collisions. It has been predicted by the theory that this phase of matter (a plasma of quarks, anti-quarks and gluons) called Quark Gluon Plasma (QGP) exists up to a few milliseconds after the Big Bang when the universe originates. There are several strong indications that on the way from the QGP to Hadron formation, the quark will interact as free particle instead of being bound inside the nucleus. This de-confinement state of quarks and gluons can be attained at a high temperature or at high net baryon density. The LHC collider is creating such extreme conditions of matter by colliding high-energy nuclei.

It has been planned that in Long Shutdown 2 (2019-2021), the ALICE detector will be upgraded to cope up with the high luminosity beam ($L = 6 \times 10^{27}$ cm^{-2} s^{-2}) provided by the LHC and to collect 10 nb^{-1} at a collision rate of 50 kHz for the Pb-Pb heavy-ions [1]. In following Run3 stage of LHC experiment, the physics motivation of ALICE detector is to study heavy-flavors, quarkonia, photons and jets with the improved precision. In view of the upgradation of luminosity, the Read-Out (R/O) of five tracking stations of Muon Spectrometer (MS) has to be designed newly to accommodate the frontend chip SAMPA which will be able to read the experimental data with this high collision rate [2].

The Indian collaborators (SINP & AMU) have the responsibilities to work on the design, fabrication, installation and commissioning of new R/O along with new chips and electronics for second tracking station of MS. The conception of the design of the new R/O for Bending (B) and Non-Bending (NB) planes has been described in the reference 2.

Completion of prototype (B & NB planes) of electronic R/O of Second Tracking Station

The chambers of Second Muon Tracking station are of quadrant type where anode wire plane is sandwiched between two cathode planes whose R/O pads are segmented (CPC). The DS12 SAMPA chip will be plugged on the B/NB Read-Out PCB as a part of the new Front End Electronics (FEE) of these MUON chambers. The FEE chip Dual SAMPA DS12 is shown in Figure 1.

Fig. 1 The FEE R/O chips: the MANAS (left) and Dual SAMPA (middle & right).

Each plane of (B/NB) has 221 electronics R/O connectors named as Kapton connectors which are connected with the cathode plane of MUON quadrant chambers. These 221 Kapton connectors will be connected with DS12 SAMPA chips. The data from DS12 will be further forwarded in groups of five. One EHF connector will accommodate each five DS12 chip. The soft-design of both B & NB PCBs had been completed in June, 2019. The prototype of seven Bending PCBs were tested. The prototype of seven NB PCBs had been fabricated by industry and yet to be tested equipping with DS12, EHF connectors and SMD components.

The testing of prototype of B-plane of Second Tracking Station

The testing of prototype of seven PCBs of B-plane had been done in the laboratory at SINP. The In-house setup for testing of prototype of B-plane is shown in Figure 2.

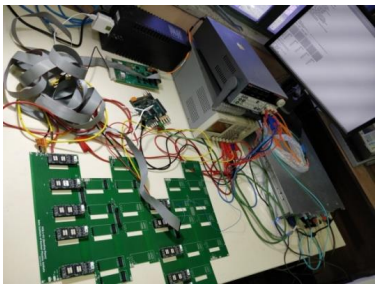

Fig. 2 The In-house setup for testing of prototype of B-plane.

Each of seven prototype-PCBs was tested for pedestal runs. The error in the clock and data reading was found due to fault in soldering, inadequate cleaning and synchronization of timing between clock and data (i.e. brunch crossing error). The good soldering is a critical point for the electrical connection of the connectors and it is very difficult to solder the connectors and SMD manually. The Figure 3 is showing error in electrical connection due to bad soldering during the In-house testing of the Bending PCB-1. There was minimal error in the design. The good response from clock and data connections for the Bending PCB prototype is shown in Fig. 4.

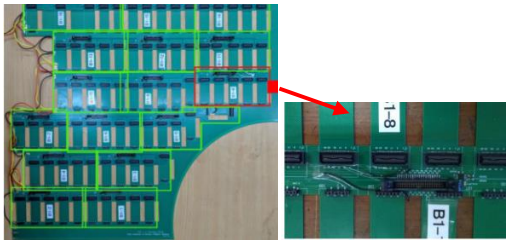

Fig. 3 The In-house testing of Bending PCB-1.

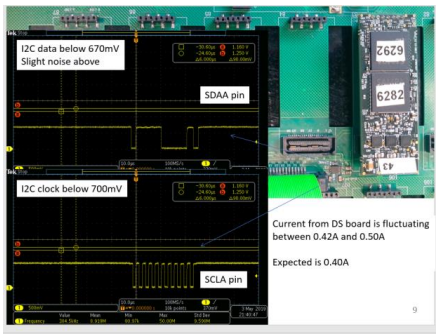

Fig. 4 The response from clock and data connections for the Bending PCB prototype.

Conclusion & Discussions

The prototype of seven PCBs of B-plane had been tested plugging on one MUON chamber using mini Amptek x-ray source at CERN in September, 2019 and the design validation of Bending plane R/O had been completed. The work on the design validation of NB prototype PCB will be done at SINP. The completion of production of PCB (B & NB planes) for upgraded R/O of second tracking station is expected to be done by the end of this year.

References

[1] Nuclear and Particle Physics Proceedings 267–269, 382–391 (2015).
[2] Proceedings of the DAE Symp. on Nucl. Phys. 63, 1184 (2018).