Introduction

The development work carried out at CERN to push the Micromegas technology to a new frontier is now coming to an end. The construction of the first read-out boards for the upgrade of the ATLAS muon system demonstrate in full-scale the feasibility of the project.

Main design aspects of the anode boards allowing to reach the desired physics performance while making them suitable for industrial production:
- Board dimensions: 50 cm wide, up to 220 cm long. The limitation of the width to <60 cm is dictated by the standard size of the machines available in PCB industries.
- Left-right symmetric boards. The symmetry reduce by a factor two the number of different board types to be produced.
- Copper readout strips running along the large board dimension. The readout strips have a pitch of 415 µm.
- This a design provides the required precision in the coordinate (muon bending) for inclined tracks by exploiting the pTPC operating mode.
- Each board has 1024 readout strips. The total 512 strips are routed to the right of the board, the bottom 512 to the left, ending in a pad-shaped copper pattern. The pads (2 cm long, 200 µm wide strips 200 µm spaced) transmit the signal to the front-end electronics via silicon or a zebra connector. The advantage of this solution is to avoid connectors soldering on the boards.
- The routing of the readout copper strips accounts for the positioning of assembly holes without strip cuts or interruptions.
- Spark protection is provided by interconnected resistive strips (same width and pitch as the copper strips), screen-printed or sputtered on a 50 µm thick Kapton foil. Interconnections are placed every 10 mm in an alternate configuration (see picture) between those lines.
- The strips are interrupted in their middle, thus each board has two independent high voltage sectors (left- and right- side), to achieve a finer granularity in the HV distribution.
- Cylindrical pillars (128 µm high, 230 µm diameter), arranged in a triangular array 7 mm aside, define the amplification gap.

In 2048 boards of 32 different types will be produced for the ATLAS NSW.

Quality control on first prototype boards

The first anode boards to be used for the construction of NSW Micromegas full-scale prototype detectors (Module-0) have been produced in Summer 2015 in two Companies. The boards have then undergone a severe control of quality at CERN to verify the compliance with the construction requirements. While some assumed critical requirements (e.g. homogeneity of the pillar height) where fulfilled on most of the boards, several common issues have been discovered:
- Missing and wrongly attached pillars
- Inaccurate and unclean edge cutting
- Bubbles or dust enclosed between the Kapton foil and the PCB

These issues have been addressed with regular feedbacks and visits to the Company premises, leading to a second delivery of higher quality boards. The board production for the Module-0 will be completed soon. A tender process to assign the production of the 2048 boards needed for the NSW project is going to be initiated soon. The mass production will start in the first half of 2016 and will span over about 18 months.