

## Full-size prototype microstrip sensors for the CBM Silicon Tracking System

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The CBM Silicon Tracking System will comprise double-sided microstrip sensors of three basic geometries. Those differ in the lengths of their strip-shaped sensing elements, chosen to match the hit densities in their location of deployment in the tracking stations. Strip lengths of about 2 cm, 4 cm and 6 cm have been found adequate to achieve a sufficiently limited hit occupancy even under the harshest running conditions of the CBM experiment [1].

### Sensor layout

The sensors have in common the number of 1024 strips per side at a read-out pitch of 58  $\mu\text{m}$ , arranged parallel to the sensor edge (n-side) and under a tilt angle of 7.5° on the p-side. This will allow reconstructing space points within a sensor, with the required spatial resolution and at limited combinatorics resulting from the projective geometry. The strips are read out from one edge only, as to integrate the sensors into detector modules with the read-out electronics located at one end. On the stereo side, the strips in one corner of the sensor are not reached directly. They require further electrical connections to their partner strips in the other corner which are attached to the read-out electronics. Two technical solutions are being evaluated, one with metal lines integrated on a second aluminum layer on the sensor, another utilizing an extra thin cable layer bonded onto the sensor. The overall dimensions of the sensors are 6.2 cm width and 2.2 cm, 4.2 cm and 6.2 cm height. A depiction of their layouts can be seen in [2]. This allows producing them with 4" wafer technology, a pre-requisite for a sufficiently large circle of vendors. Also the on-sensor cable as an alternative to the routing lines on a second metal layer are shown there.

### Prototypes CBM05

In 2013 the production of prototype sensors in all three sizes has been achieved. All sensors of this CBM05 series have a compatible layout of their bonding pads which was worked out within the CBM collaboration and its technology partners. The prototypes were produced in cooperation with the CiS Research Institute for Micro Sensorics and Photovoltaics, Germany, and Hamamatsu Photonics, Japan. The large prototype sensor with double-metal interconnections came from CiS on a GSI bill. The mid-sized sensor has been realized with Hamamatsu with support to GSI from BMBF. The small sensor was ordered at Hamamatsu through JINR. All sensors but the small one are double-sided. The small sensor was made as simple as

possible, therefore single-sided, with the specific aim to verify the viability of the on-sensor cable concept. Some of the large sensors were employed in new prototype modules and tested extensively in lab and beam. Such sensor with its integrated double-metal lines is shown in Fig. 1.

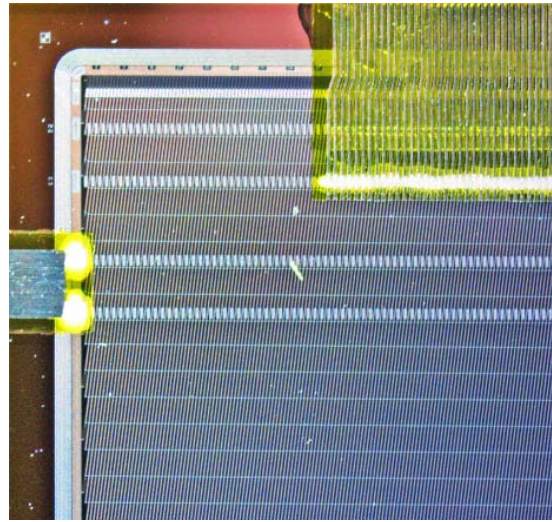


Figure 1: Corner region of a CBM05 sensor produced at CiS. The sensor has been fitted with a bias cable (left) and has a micro read-out cable tab bonded to it (top).

### Prototypes CBM06

A further series of prototype sensors, CBM06, has been designed and launched for production with CiS and Hamamatsu to be available in 2014. They will serve extended effort with the development of prototype detector modules. In view of the preparation of tooling for the technical integration of their components, larger amounts of dummy sensors and dummy ASICs have been produced in 2013, providing no active functionality but the the same contact patterns on the same metallic surfaces as the full sensors.

### References

- [1] J. Heuser et al., Technical Design Report for the CBM Silicon Tracking System, GSI Report 2013-4, <http://repository.gsi.de/record/54798>
- [2] J. Heuser et al., GSI Scientific Report 2012, GSI Report 2013-1, PHN-NQM-EXP-16, <http://repository.gsi.de/record/51950>