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AIDA

Advanced European Infrastructures for Detectors at Accelerators

Seventh Framework Programme, Capacities Specific Programme, Research Infrastructures, Combination of Collaborative Project and Coordination and Support Action

MILESTONE REPORT

ELECTROMAGNETIC CALORIMETER OF AT LEAST 18X18 CM^2 AREA

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Abstract:

This is the report for the Milestone 46 of the Workpackage 9 of AIDA. It reports on the production of a first layer of a electromagnetic silicon tungsten calorimeter of 18x18 cm^2 surface.

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1. INTRODUCTION

The objective of the activity is to make the next technological step towards a highly granular electromagnetic calorimeter with tungsten as absorber and pixelised silicon as sensitive material.

The SiW-ECAL detection elements are built upon one or several 18x18 cm^2 modular units coupled to an interface board. The total surface is subdivided into four 9x9 cm^2 wafers of segmented in 5x5 mm^2 cells, readout by 16 SKIROC2 ASICs [1], through a thin PCB. These units are also called ASUs that is short for *Active Signal Units*. The ASU are maintained by a Carbon-Fibre structure. The design and production of these units is a complex task implying intertwined instrumental, mechanical, electronics and thermal aspects. AIDA contributed to support these activities. A scalable and compact DAQ system based on the hardware that has been developed in the EUDET project has been brought into operation. The detector is configured using XML and python scripts [2]. A series of beam tests in 2012 and 2013 with a 9x9cm^2 wide calorimeter that comprised up to 8 layers formed the basis for going one step further. Results of the mentioned beam tests can be found in [3].

2. CONSTRUCTION OF A FIRST DETECTOR LAYER

With the conclusion of the beam tests in 2012 and 2013 small design effects were found and corrected validating the concept and implementation of the SiW ECAL layers. The next step is to produce a stack of layers with dimensions 18x18 cm^2 (four wafers). For this interface cards for 16 ASICs (in contrast to 4 up to know) have been developed, see left part of Fig. 1 These are at hand since the middle of 2014 and were validated successfully in the laboratory [4]. The fabrication of the final ASUs requires gluing of four wafers onto the interface cards. This is a delicate procedure since the wafers are fragile and expensive. Successful gluing requires e.g. a precise positioning of the wafers w.r.t. to the PCB. In addition mechanical stress to the wafers during and after the gluing process has to be minimised. A gluing robot has been developed and the technology has been tested during 2014 with glass plates and unprocessed wafers that have the same mechanical characteristics as 'real' wafers, for details see [5]. These studies lead to the conclusion that the production of 'real' ASUs can now be addressed.

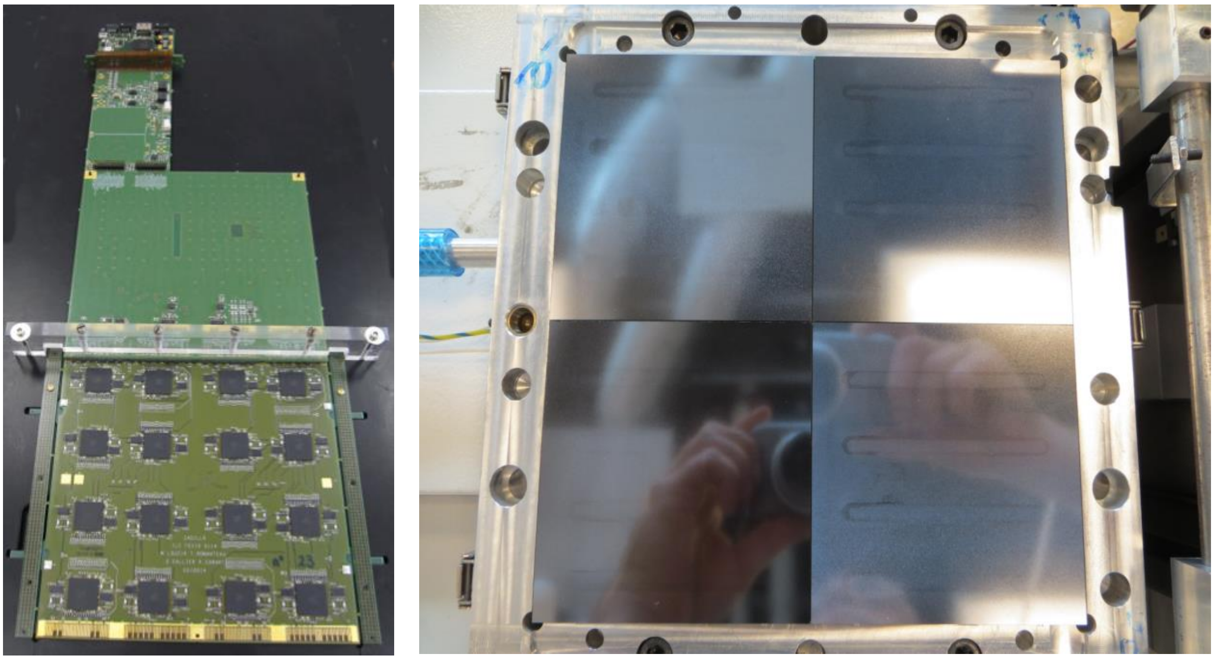

Figure 1: Left: Top view of an ECAL layer showing the (packed) 16 ASICs. Right: Bottom view of the ECAL layers with four glued silicon wafers.

A first ASU has been produced in the beginning of 2015. A picture of the wafers glued upon the backside of an ASU is shown in the right part of Fig 1.

Visual inspection revealed no damage of the wafers. In case no further short comings will be observed, the ASU will be assembled into a real layer. The tools and material for the assembly are at hand.

3. SUMMARY AND OUTLOOK

The successful production of the first ASU is considered as the achievement of Milestone 46 of the AIDA project. This first ASU will be followed by a small production series of a few layers during Spring 2015. Therefore

a small calorimeter prototype of a highly granular silicon tungsten calorimeter using state-of-the-art technology will be available by the end of 2015.

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