# Determination ALFA-ATLAS Overlap Detectors mapping

J. Vicha[a], S. Valkar[b], S. Jakobsen[c], P. Beltrame[c], V. Vorobel[b]

[a]*Institute of Physics of Academy of Sciences, Prague, Czech Republic*
[b]*Charles Univerzity, Faculty of Mathematics and Physics, Prague, Czech Republic*
[c]*CERN PH-DT, Geneve, Switzerland*

**Abstract**

The ALFA Overlap Detectors are used for the precise determination of the relative vertical position of the Roman Pots. The accurate knowledge of the mapping of the scintillating fibers to the Multianode Photomultiplier (MAPMT) readout channels is therefore of high importance. We have verified the mapping of 7 ALFA detectors using a setup with a green laser. We have confirmed the mapping previously obtained for ALFA1 and additionally new mapping files for the other detectors have been produced. The files are ready to be used in the analysis codes for the next Test Beam planned for August/September 2010.

*Keywords:* Overlap Detector, mapping, Roman Pot, Scintillating fibers.

## 1. Introduction

The ATLAS collaboration will use the ALFA detector to measure the LHC absolute luminosity. Two ALFA stations, each with two Roman Pots, will be located 240 m away from the IP1, where the ATLAS detector is placed. The Roman Pot devices provide an independent vertical positioning, allowing to approach the LHC beam from the top and the bottom. The purpose of the so-called Overlap Detectors (ODs) is the precise knowledge of the mutual position of the upper and lower ALFA main trackers, by means of simultaneous detection of particles from the beam halo. Each OD consists of 180 scintillating fibers, arranged in 6 layers, read out by three MultiAnode PhotoMultiplier Tubes (MAPMTs) each of 64 channels.[1] A detailed description of the ALFA detector is available on [1] and for the ALFA ODs further information can be found in [2]. A picture of the ALFA detector – i.e. the main trackers, the triggers and the ODs – is shown in Fig.1 right.

## 2. Method of the measurement

To test the fiber readout mapping we used an intense laser beamer. By precisely pointing the laser spot to one single fiber from the connector side, as visible in Fig.1 left, we chose the readout channel number. Then, looking at the light coming out from the illuminated fiber at the opposite end (see Fig.1 right) it was possible to determine the fiber number and consequently the fiber-readout correspondence. [2] The laser was

[1]The scintillating fibers used in the ALFA detectors are made by Kuraray. They are of type SCSF-78, S-type, $0.5 \times 0.5$ mm$^2$ and have peak emission at 450 nm. For the MAPMTs the Hamamatsu R7600-00-M64 types of squared size with side length of 26 mm have been chosen.

[2]The non-read end of the fibers are coated with an Aluminium reflector. Therefore an intense light source is required.

fixed on a micrometric holder to ensure the fine positioning of the beam and a magnifying lens was used to recognize the correct position of the fiber on the layer. The measurement had to be done with great care to ensure an exact fiber identification without touching which would possibly lead to damage of the coating.

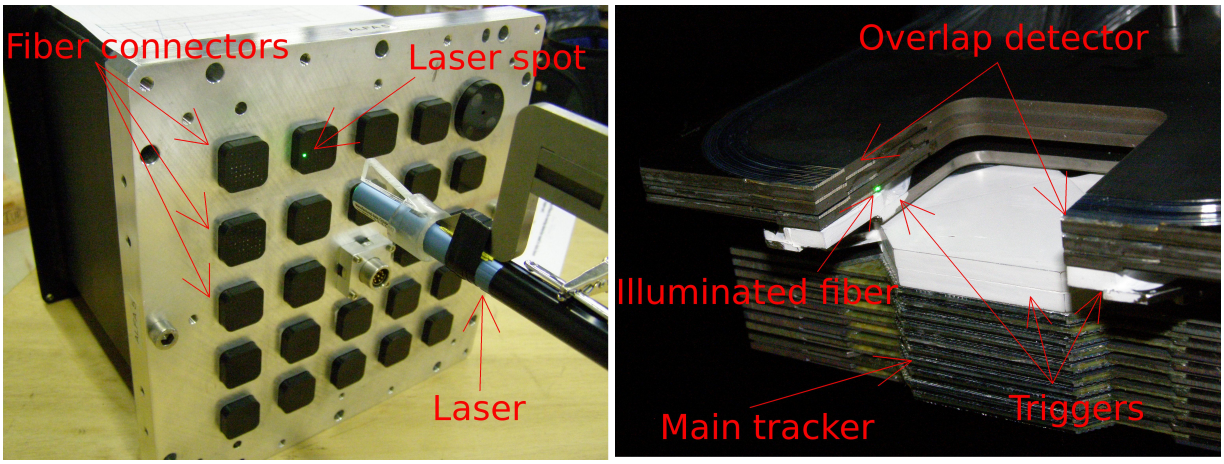



Figure 1: *Left*: fiber connectors and laser beamer mounted on the micrometric holder. The green spot illuminating a single fiber on the black readout connector – where the MAPMT will be positioned – is also visible. *Right*: the whole detector during the measurement. Notice that green laser light is coming out from the illuminated fiber through the reflective coating.

## 3. Results of measurement: mapping

We mapped 7 ALFA ODs (ALFA1 and ALFA3 to ALFA8) and we produced the corresponding mapping files for each of them. They are ready to be implemented into the ALFA software and available for the Test Beam 2010.

The labelling is expressed in terms of the readout electronics coordinates according to the convention established in [3] and shown in Fig.2. In this convention: *MAPMT #* corresponds to the number of the 64 channel multi anode tube (4, 3 and 2), *layer #* stays for the layer number (from 1 to 6), *OD #* is the Overlap Detector tile (from 1 to 3), *side* is 0 for odd layers and 1 for the even layers, *channel #* corresponds to the number of the readout channel (going from 1 to 64) and *fiber #* is the number of the fiber (from 1 to 30).[3]

For each ALFA station a mapping file was produced. A few example lines of the mapping file in `.txt` format are represented below

| MAPMT# | layer# | OD# | side | channel# | fiber# |
|---|---|---|---|---|---|
| 4 | 1 | 1 | 0 | 1 | 7 |
| 4 | 1 | 1 | 0 | 2 | 15 |
| 4 | 1 | 1 | 0 | 3 | 22 |
| ... | | | | | |

[3]The fibers which are not connected to the read out have been numbered as 99.

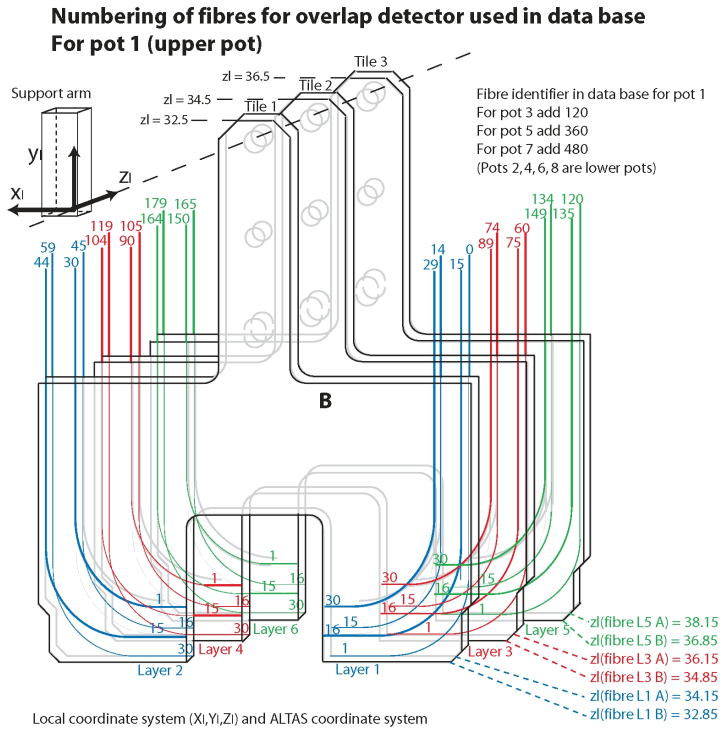



Figure 2: Drawing of the ALFA detector whose convention is taken for the Overlap Detector mapping file.

As result of our study, we have confirmed the mapping of ALFA1 as it was previously measured. Fig.3 shows the fiber-to-readout channel correspondences for the first tile (called OD1), which consists of the layers 1 and 2. The information of all tested 7 detectors are included. The same information for OD2 and OD3 is shown in Fig.4 and Fig.5. Ideally, all figures would show identical patterns. Identical patterns have been observed for ALFA3, ALFA4 and ALFA7, except for layer 2; and also for ALFA5 and ALFA8, except for layer 3.

Some fiber-channel swaps have been found in the following positions:

in ALFA1: layer 5, fibers 2 ↔ 3,
in ALFA3: layer 1, fibers 17 ↔ 16,
in ALFA4: layer 1, fibers 1 ↔ 2, 3 ↔ 4,
layer 5, fibers 1 ↔ 2,
in ALFA6: layer 1, fibers 27 ↔ 28 .

These irregularities are recorded in the above mentioned mapping files and so this will have no impact on the spatial resolution of the ODs.

## 4. Additional information

In addition to the mapping also a quick quality assessment of the OD fibers has been performed. We have found 25 damaged mirror coatings, applied on the fiber ends, for a total number of 448 fibers. We observed

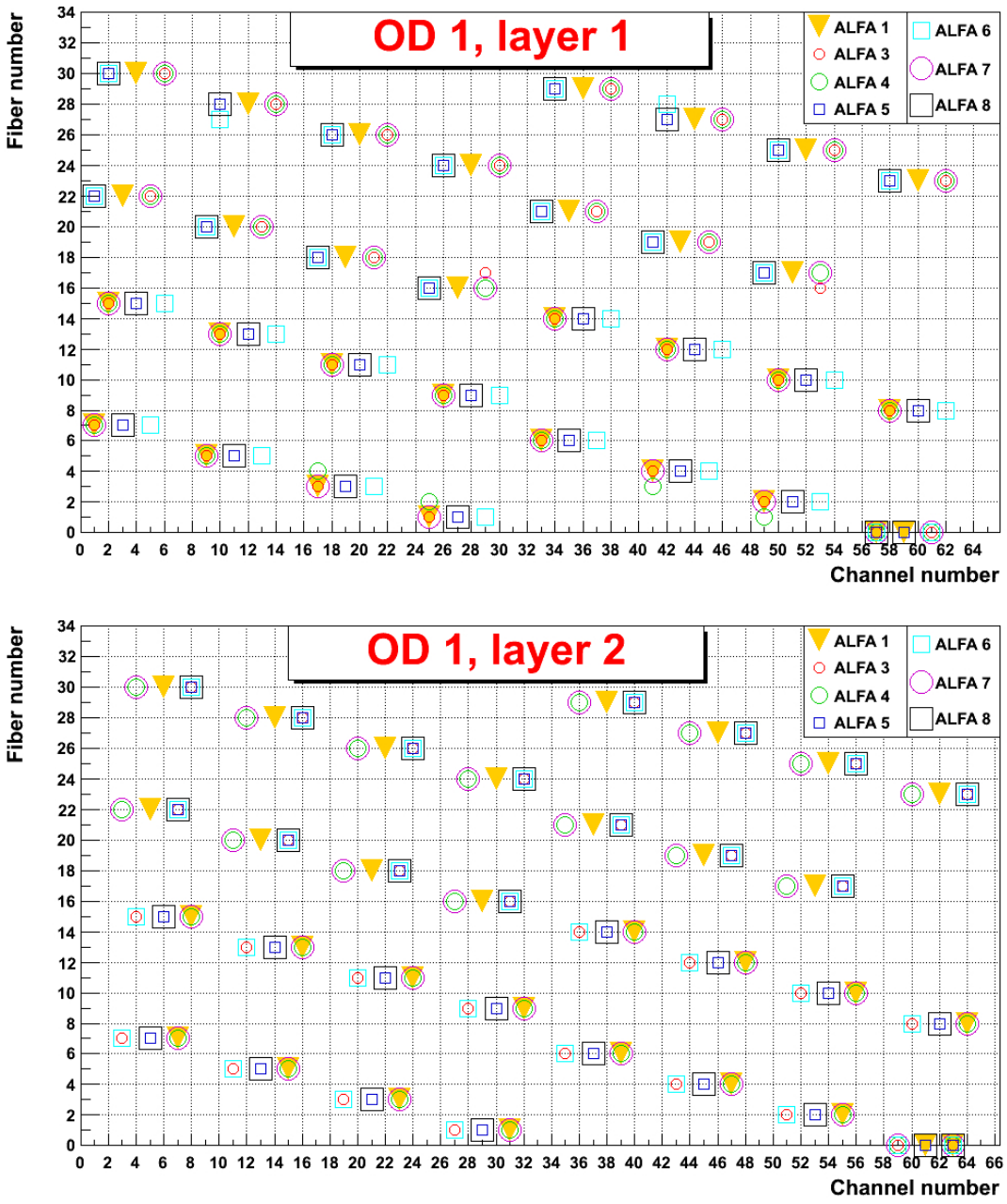
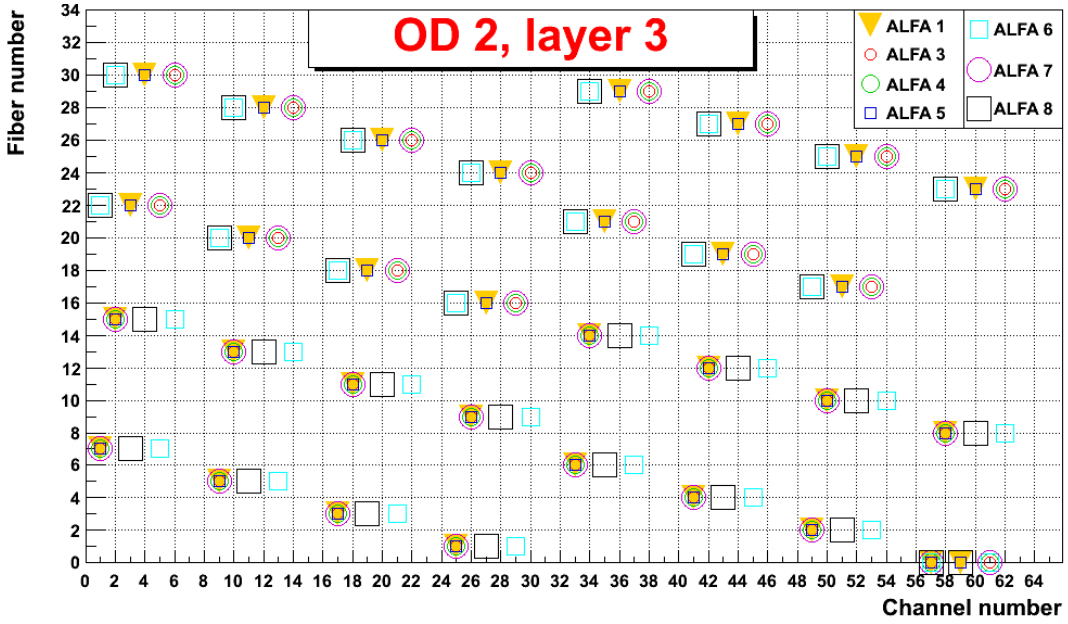



Figure 3: Fiber-readout channel mapping for all tested ALFA detectors for the first tile (OD1), corresponding to the layer 1 and 2. Channels not connected to fibers are displayed as fiber number 0.

that this can cause significant light loss and cross-talk towards the fibers on the opposite layer. Moreover, fiber 12 on layer 5 in ALFA5 appears to be uncoated.



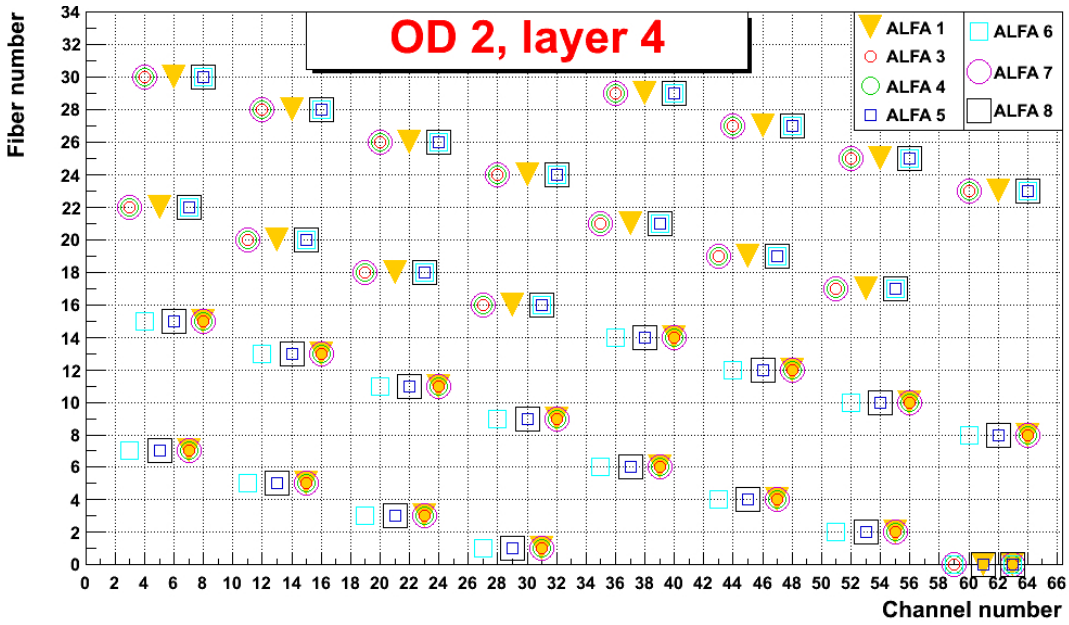
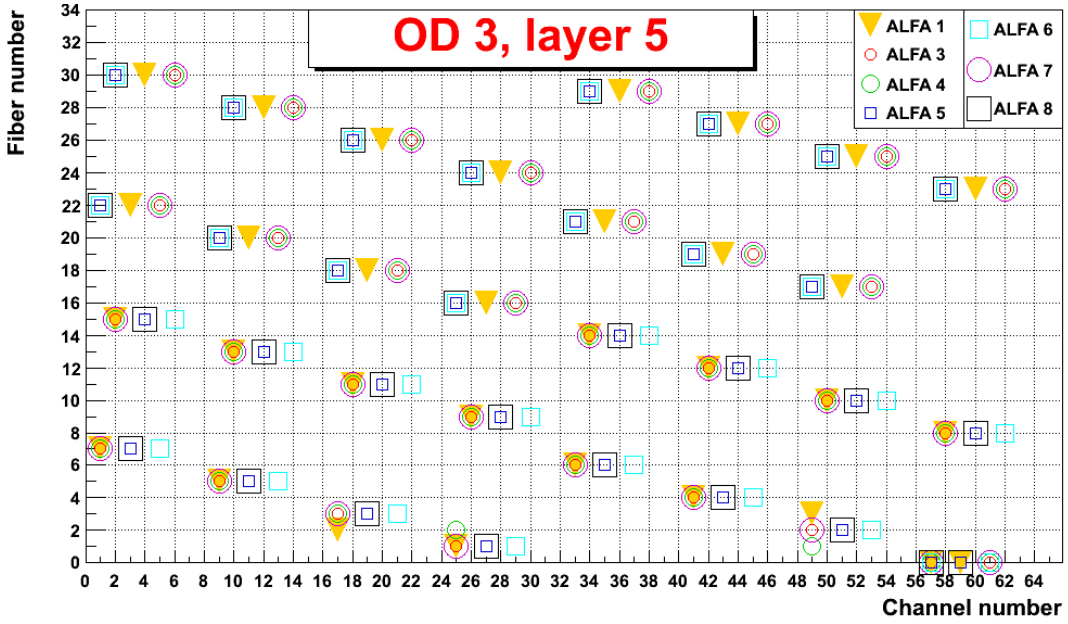




Figure 4: Fiber-readout channel mapping for all tested ALFA detectors for the second tile (OD2), corresponding to the layers 3 and 4. Channels not connected to fibers are displayed as fiber number 0.



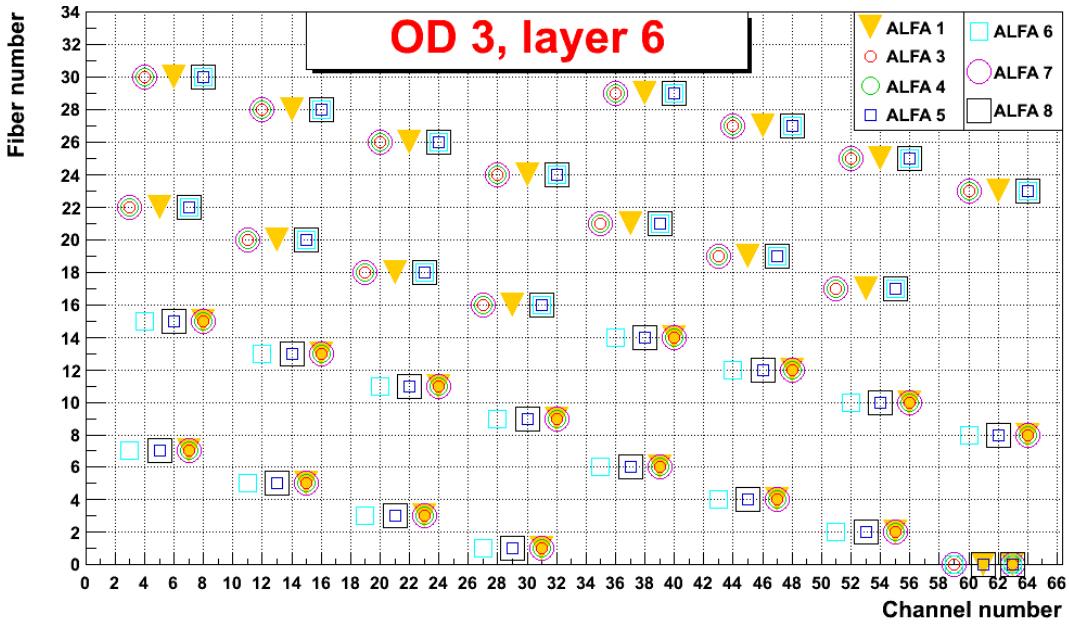




Figure 5: Fiber-readout channel mapping for all tested ALFA detectors for the third tile (OD3), corresponding to the layers 5 and 6. Channels not connected to fibers are displayed as fiber number 0.

## 5. Summary

The fiber-to-readout channel mappings of ALFA1 and ALFA3 - ALFA8 Overlap Detectors have been determined and recorded in specific text files for each detector. The files, named `ODAlfa#Mapping.txt`, have been produced according to the software structure and uploaded on the ALFA web page [4].
A quality assessment of the fiber end coating revealed damage on about 5% of the fibres.

## References


[1] Atlas Collaboration, *ATLAS Forward detectors for Measurement of Elastic Scattering and Luminosity*, Technical Design Report, `https://twiki.cern.ch/twiki/pub/Main/AlfaDocuments/lhcc-2008-004.pdf`, ATLAS TDR 018, CERN/LHCC 2008-04, (2008).

[2] C. Joram and H. Stenzel, *The Overlap Detectors*, Technical Design Report `https://twiki.cern.ch/twiki/pub/Main/AlfaDocuments/TDR_Overlap_Detectors.pdf`.

[3] `https://twiki.cern.ch/twiki/pub/Main/AlfaTracker/overlapmetro100415.pdf`.

[4] `https://twiki.cern.ch/twiki/bin/view/Main/AlfaSoftware` named `ODALFA#Mapping.txt`.