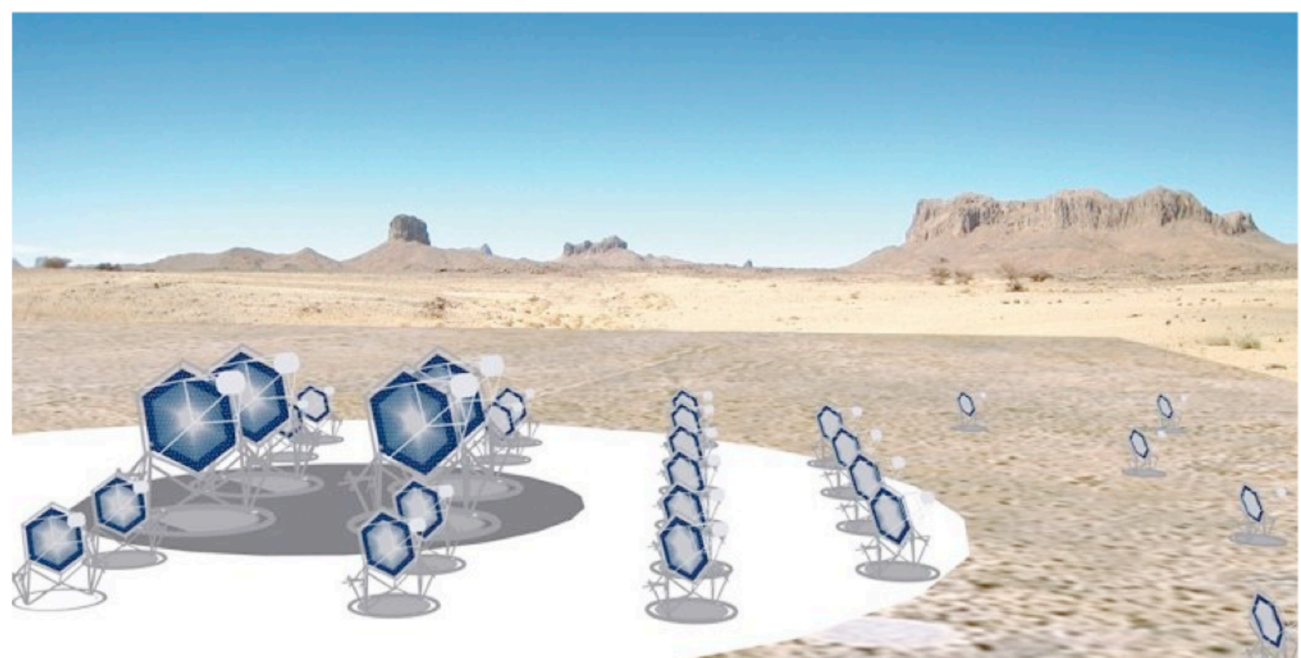
Mechanical characterization of SiPM MPPC S11828-3344M



Prepared by:	Name: Rodolfo Canestrari INAF-OAB	Signature:	Date:	06-04-2012
Measurements taken by:	Name: Rodolfo Canestrari Giuseppe Pagano INAF-OAB	Signature:	Date:	06-04-2012

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DISTRIBUTION LIST

Sergio Billotta	Sergio.Billotta@oact.inaf.it
Giovanni Bonanno	Giovanni.Bonanno@oact.inaf.it
Giovanni Pareschi	giovanni.pareschi@brera.inaf.it
Osvaldo Catalano	Osvaldo.Catalano@iasf-palermo.inaf.it
ASTRI ML	astri@brera.inaf.it

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DOCUMENT HISTORY

Version	Date	Modification
1	06-04-2012	first version

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LIST OF ACRONYMS

PCB	Printed Circuit Board
LTP	Long Trace Profilometer
PV	Peak-to-Valley
SiPM	Silicon Photon Multiplier

APPLICABLE DOCUMENTS

[AD1]

REFERENCE DOCUMENTS

[RD1]

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1. Tested sensors: nomenclature

The characterized sensors are Silicon Photon Multiplier from the Hamamatsu Company. The product is marked MPPC S11828-3344M

We received 2 sensors, we named it as follow:

a) SiPM_160: a full functioning MPPC S11828-3344M mounted on an additional PCB with connectors and other electronics items;

b) SiPM_mech: a non functioning MPPC S11828-3344M mechanical demonstrator, without any additional PCB mounted on its back

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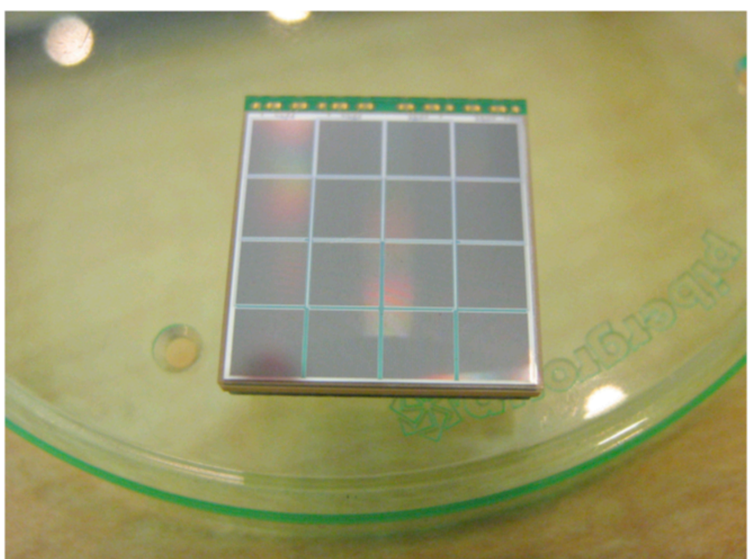
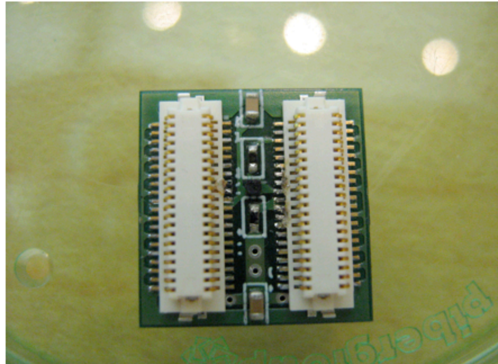
2. Photographic images

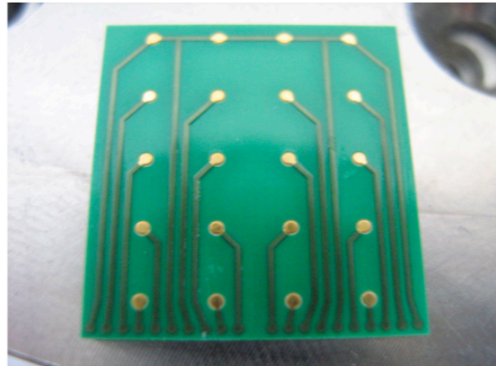
In this chapter some qualitative considerations are reported. Those considerations are based on photographic pictures and naked-eye observations of the sensors.

2.1 Standard pictures

Here below some images of the sensors taken with a standard compact camera. Diffraction effects (rainbow light) are clearly visible from the reflections of ceiling lamps. This is probably due to the regular pattern of the "spads" acting as a grating.







Front-side and back-side views of the sensors measured. Bottom left picture is referred to the sensor SiPM_160 while the right one is the SiPM_mech.

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2.2 Nano-pictures

Here below some nano-pictures taken with a phase-contrast Nomarski Microscope.

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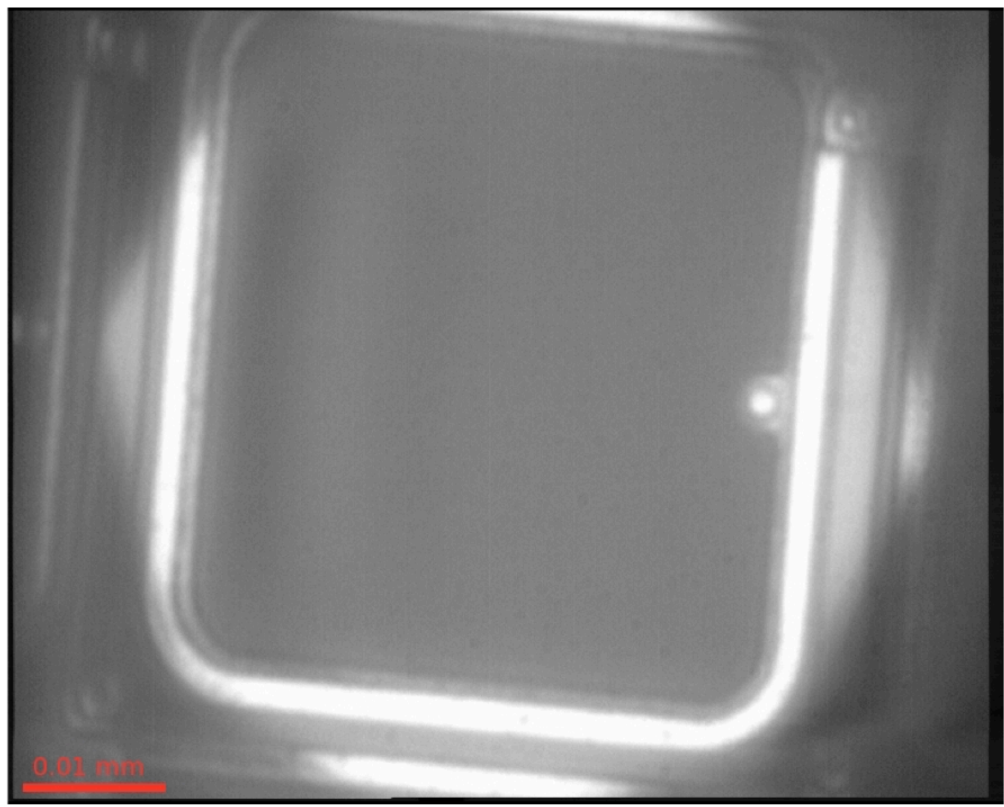

Nano-pictures of the surface of SiPM_mech. Different magnifications ranging from 5X, 10X, 20X, 50X and 100X are shown. It is possible to clearly recognize and measure each single "spad" of about 50x50 micron.

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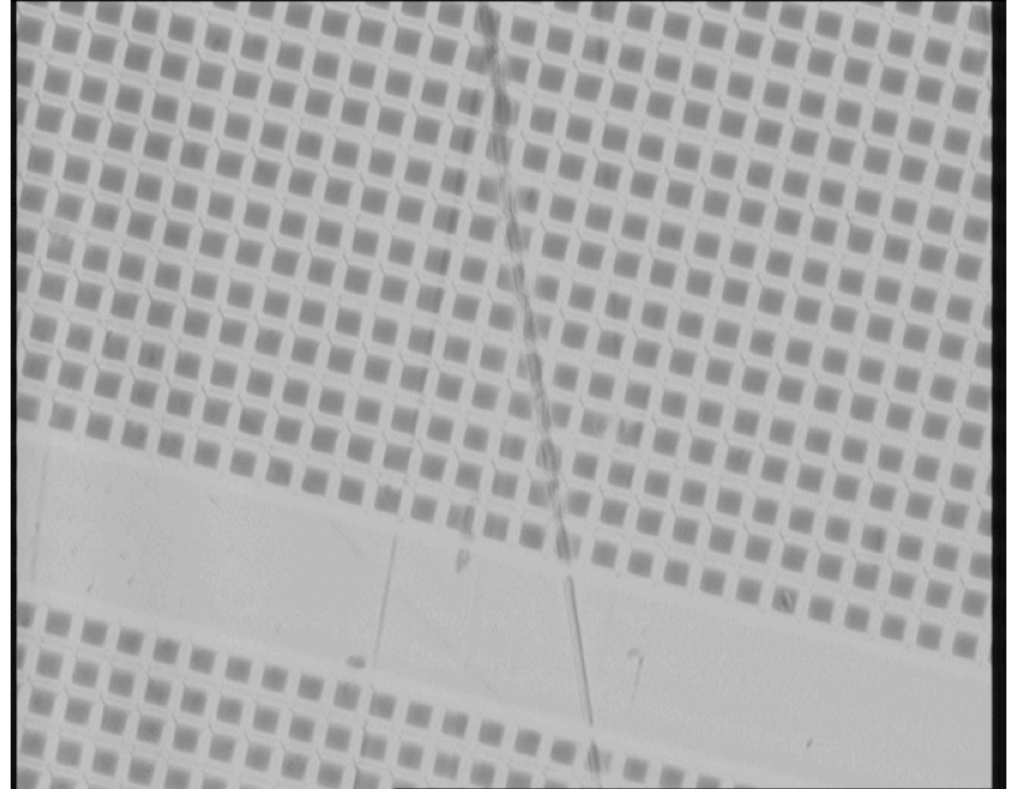

Surface of the SiPM_160. It is clearly visible one of the scratches introduced during the soldering phase.

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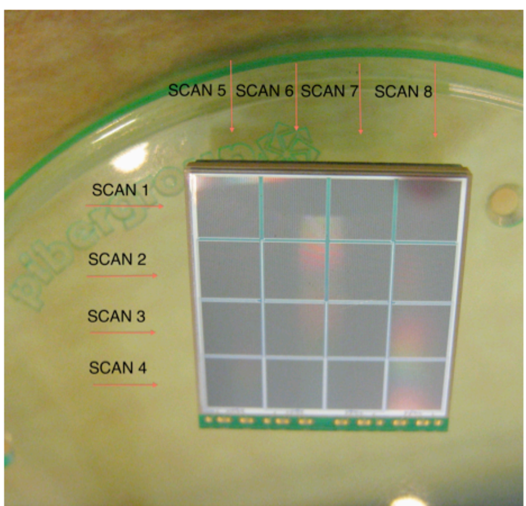
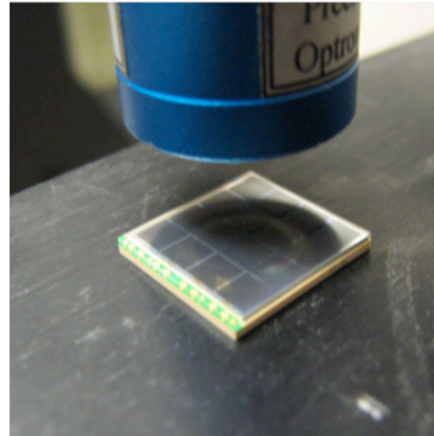
3. Profile measurements

The profiles have been taken using the LTP equipped with a CHRocodile 600 μm optical head. The CHR optical head has a resolution of 20 nm with an accuracy of 0.2μm.

The figure below shows the scan setup (directions and positions). The scan lines are 12.1 mm in length with a sampling of 0.1 mm. Each scan line is centred within the pixels. With respect to the green stripe of the contacts, both parallel and orthogonal scans have been made.

It has to be remarked that using the LTP each scan length is not coplanar with the adjacent ones. No 3D surface mapping can be extracted with this measurement set-up.





Scan lines measurement setup and nomenclature.

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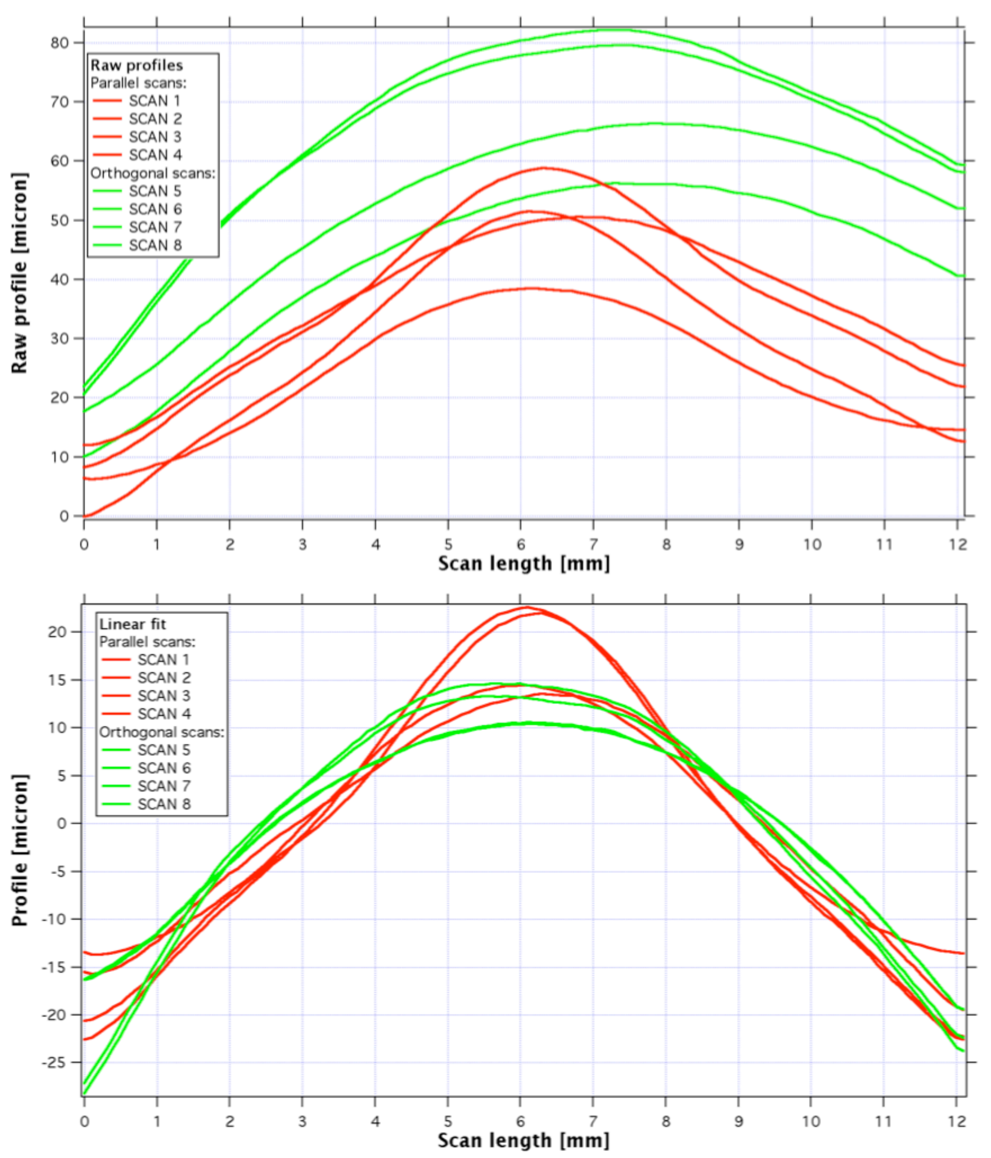
3.1 SiPM_mech profiles



The top panel shows the profiles as taken by the instrument. The bottom panel shows the profiles where the tilts have been removed. A PV error of about 40 μm is visible.

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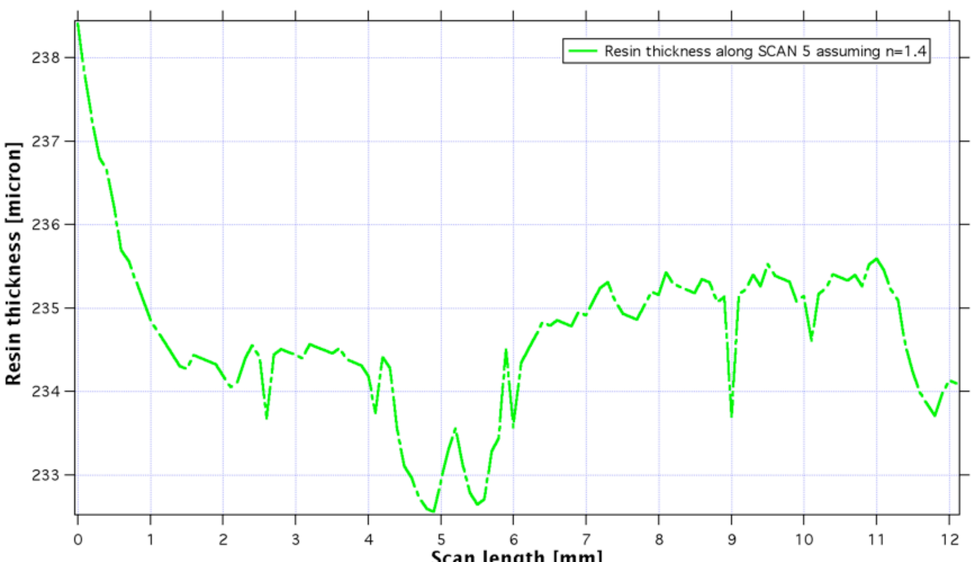
Using the same equipment it has been possible to evaluate also the resin thickness. Assuming an index of refraction of 1.4, the thickness results to be of approximately 235μm as shown by the following figure.



Measurement of the resin thickness variation along the SCAN 5 profile.

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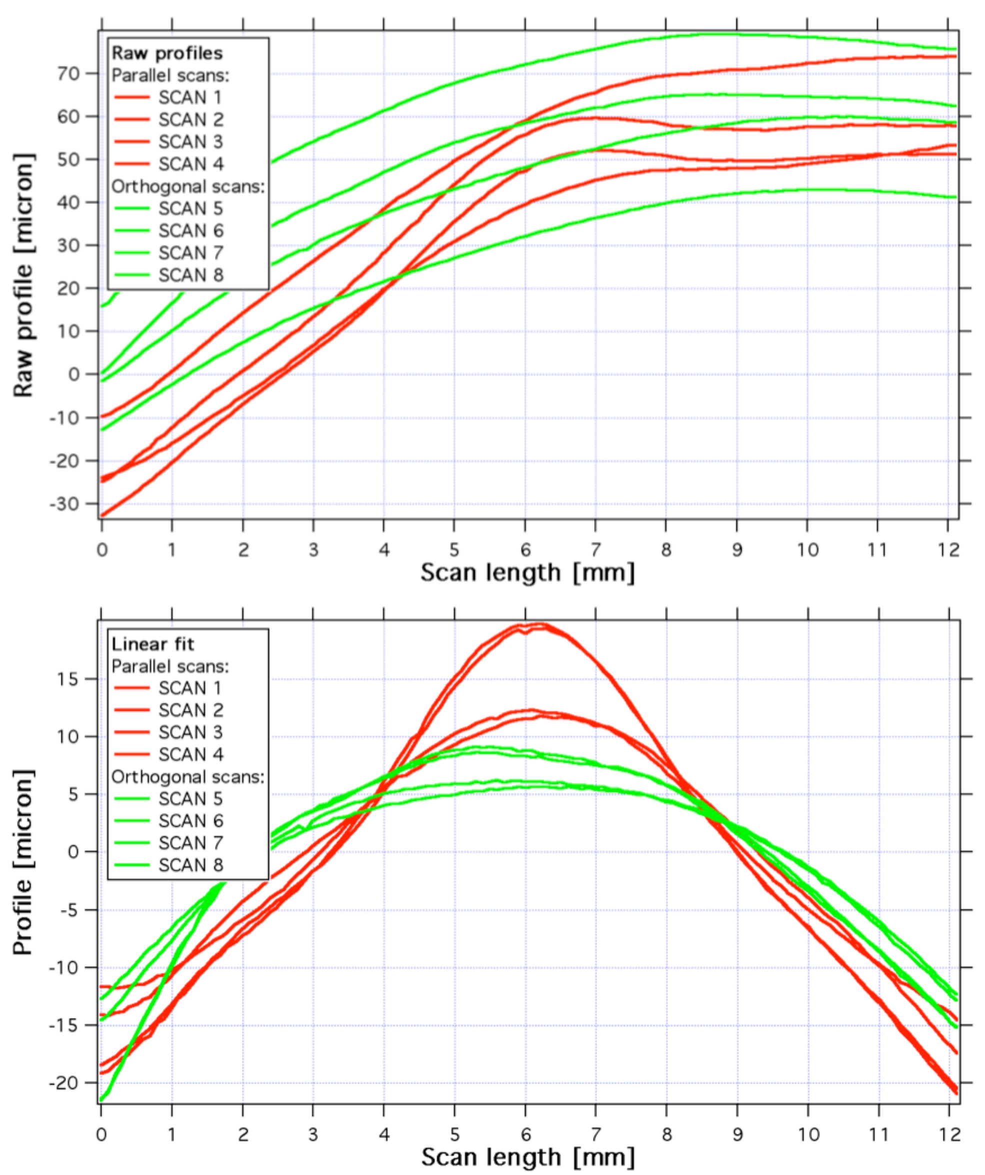
3.2 SiPM_160 profiles



The top panel shows the profiles as taken by the instrument. The bottom panel shows the profiles where the tilts have been removed. A PV error of about 30 μm is visible.

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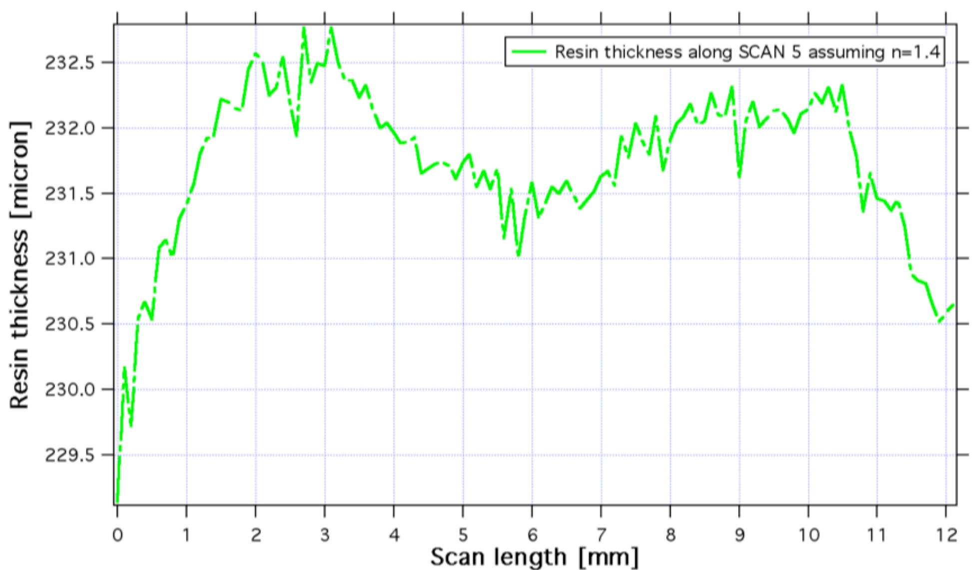
Using the same equipment it has been possible to evaluate also the resin thickness. Assuming an index of refraction of 1.4, the thickness results to be of approximately 232μm as shown by the following figure.



Measurement of the resin thickness variation along the SCAN 5 profile.

3.3 Comparison between SiPM_mech and SiPM_160

The main difference between the two sensors relies in the post-process undergone by the SiPM_160, i.e. the soldering over the PCB. The measurements show that this post-processing does not influence in a significant way the planarity of the sensor.

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