Geometry and Position Measurements of Forward Endcap Submodules

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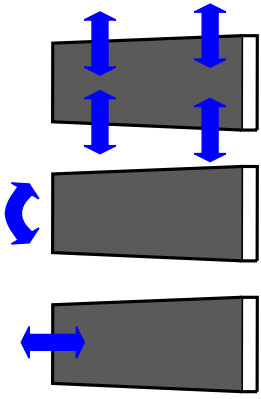
Measurements of the Submodule Geometry and Position

Why?

- Check if the submodules will fit in the FWEC
- No adjustment after glueing possible
- Check the position after assembly on the backplate

What?

- Deviations in the angle to the backside
- Position of submodule on backplate



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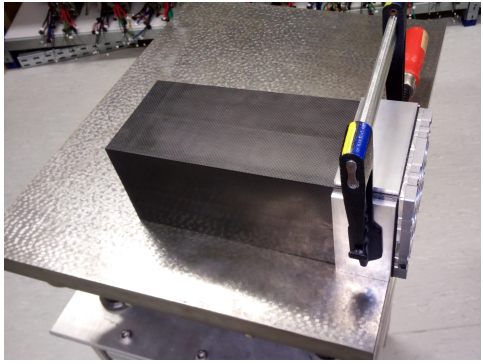
How?

- Leica Absolute Tracker and T-Scan

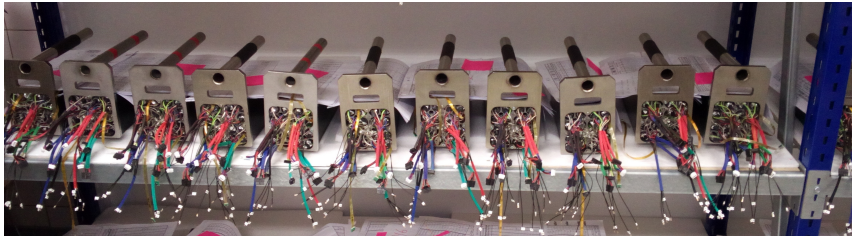
How to Glue an Alveole

- Rotate the submodule
- Place the submodule on meassurement table
- Scan the submodule
- Confirm the angles
- Mix two part epoxy glue (Stycast 1266)
- Inject glue in all channels between inserts and carbon fiber
- Clamp carbon fiber
- Let glue cure (8-16 h @ 25 °C)
- Final scan



Status of Measurements and Glueing

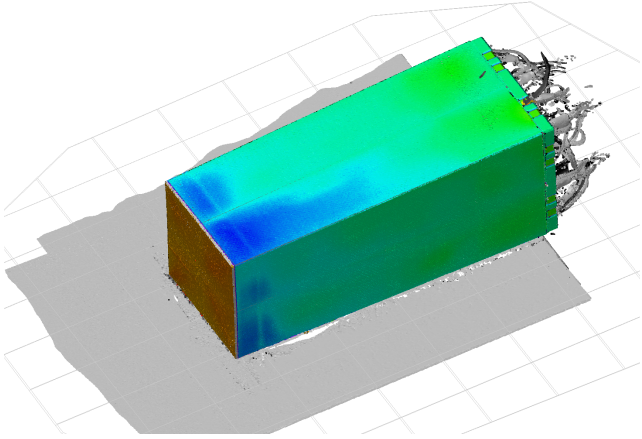
- All 42 full size VPTT submodules have been glued
- All 12 8-Crystal VPTT submodules have been measured, one of them has been glued
- 18 APD submodules have been measuered



Geometry Measurements of Forward Endcap Submodules

Measurements

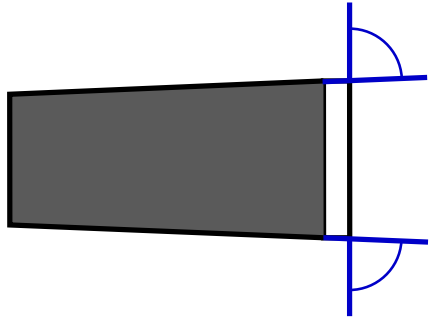
- Measured using T-Scan Line Scanner
- Alveole sits on flat surface
- All visible sides are scanned
- Pointcloud of 2.5 million points
- Pointcloud is compared to a CAD-model
- Deviations to the model are extracted



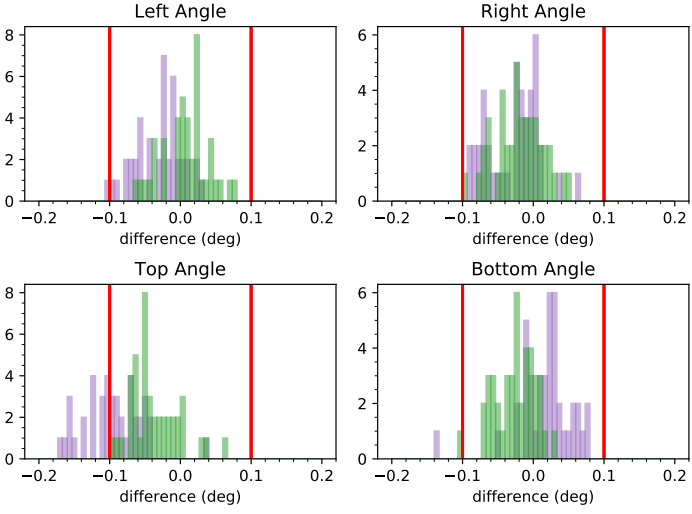
Definition of Angles

- Angle between carbon fiber alveole and back of the alveole
- Four different angles, one for each side
- Nominal value of 89.07°

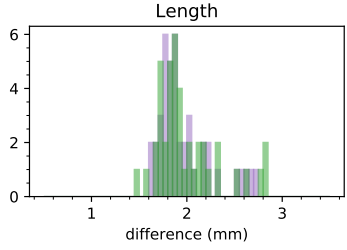
- Direct measurements for top, left and right side
- Indirect measurement for bottom side
- Only deviations shown
- Negative deviations move tip to the center
- Positive deviations move tip to the outside
- 0.1° corresponds to 0.5 mm



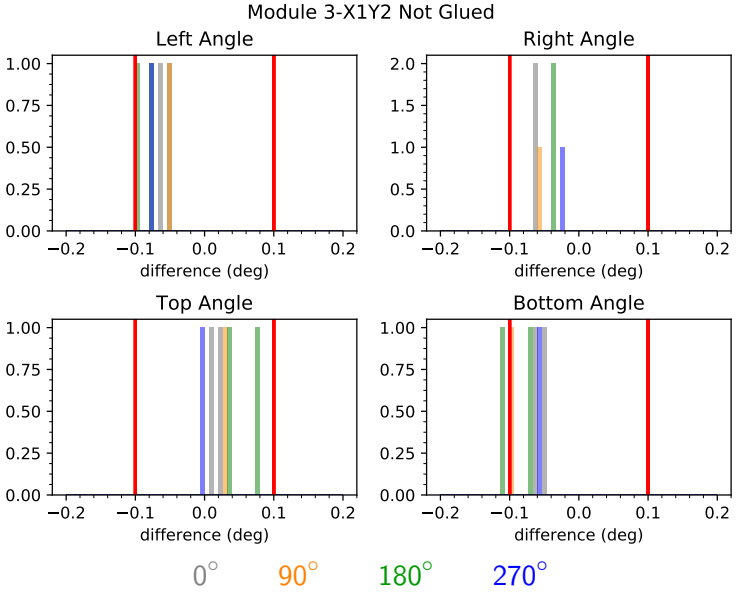
Comparison Before and After Glueing



- Selection of rotation of submodule allows tuning of angels
- Red lines represent half the distance between submodules

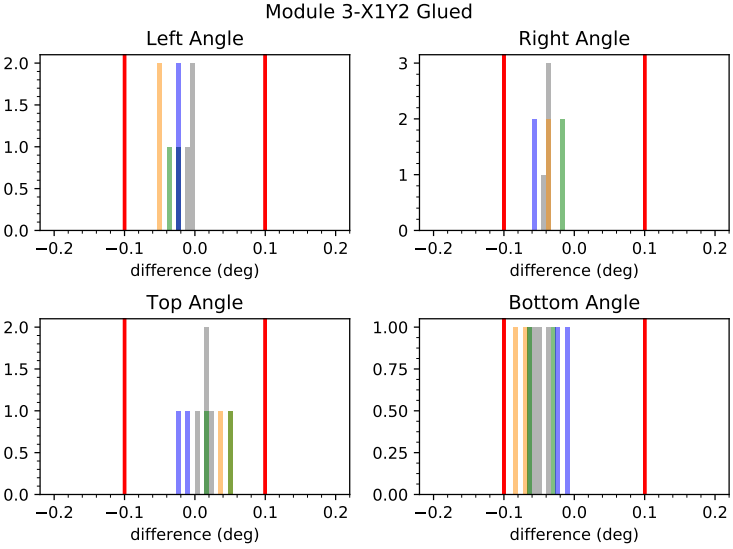


8 Crytstal Module 3-X1Y2



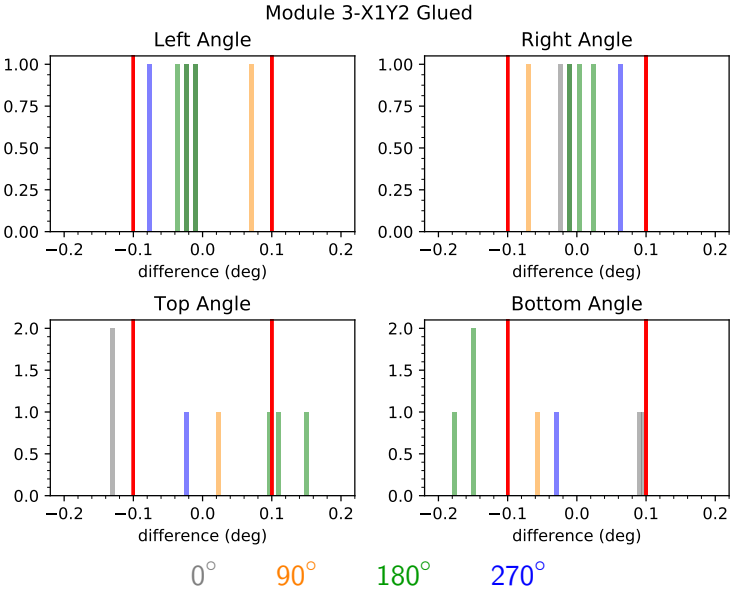
- Each plot is labeled by the orientation the module will be mounted in
- Allways the same face regardless of the measurement orientation
- Top and Bottom are the large sides

- Variations before glueing similar to full sized submodules



- Variations after glueing larger than for full sized submodules
- Almost as large as before glueing

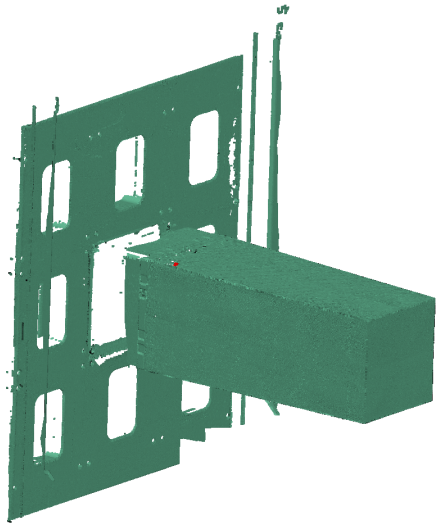
Measurements on a Backplate Mockup



- Variations on the backplate mockup very large
- For some orientations outside of allowed range
- Variation is most likely due to flexing of the carbon fiber, not the joint between carbon fiber and insert
- Only one sample so far, uncertain if the others are the same

Position Determination by Frontface

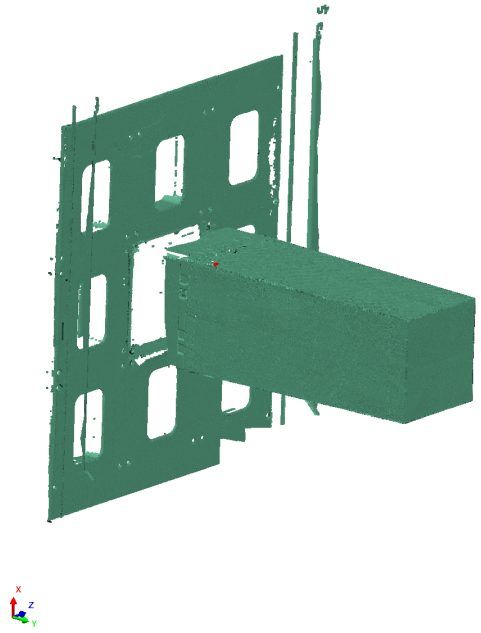
- Is it possible to reconstruct the submodule position if only the frontface is visible?



Position Determination by Frontface

- Is it possible to reconstruct the submodule position if only the frontface is visible?

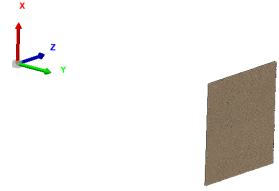
- Scan submodule on the backplate



Position Determination by Frontface

- Is it possible to reconstruct the submodule position if only the frontface is visible?

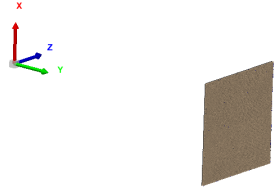
- Scan submodule on the backplate
- Select points of the frontface



Position Determination by Frontface

- Is it possible to reconstruct the submodule position if only the frontface is visible?

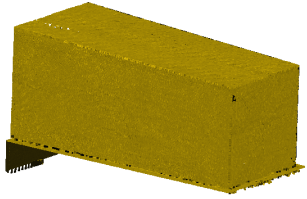
- Scan submodule on the backplate
- Select points of the frontface
- Create a mesh an use it as reference



Position Determination by Frontface

- Is it possible to reconstruct the submodule position if only the frontface is visible?

- Scan submodule on the backplate
- Select points of the frontface
- Create a mesh an use it as reference
- Import scan from table



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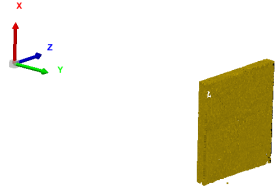
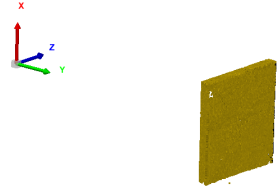


Position Determination by Frontface

- Is it possible to reconstruct the submodule position if only the frontface is visible?

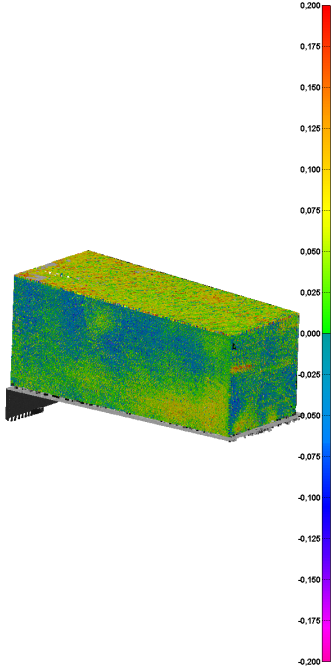
- Scan submodule on the backplate
- Select points of the frontface
- Create a mesh an use it as reference
- Import scan from table
- Select points of the frontface
- Align scan from table to reference using fit



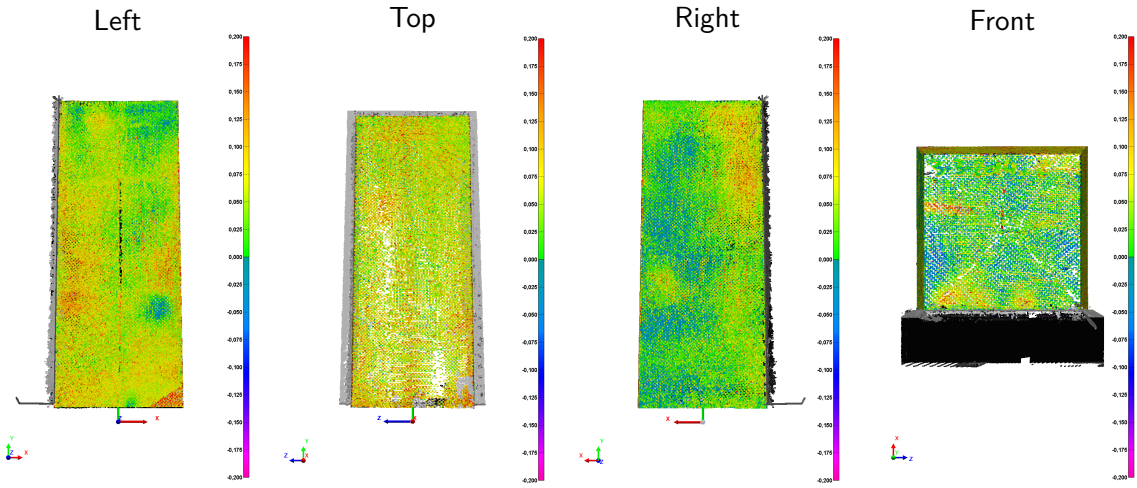
Position Determination by Frontface

- Is it possible to reconstruct the submodule position if only the frontface is visible?

- Scan submodule on the backplate
- Select points of the frontface
- Create a mesh an use it as reference
- Import scan from table
- Select points of the frontface
- Align scan from table to reference using fit
- Calculate angles to backplate using rotation of alignment and table measurement

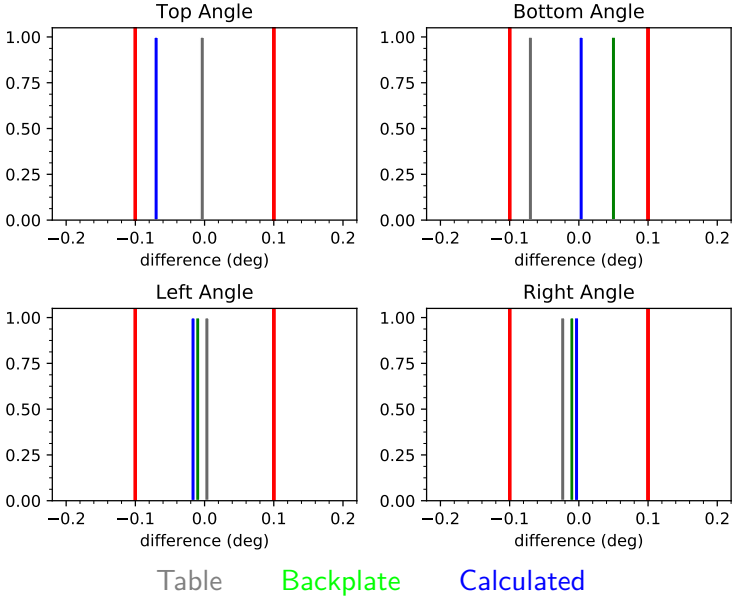


Difference between Backplate and Table Measurement



Deviations between the measurements is less than 0.2 mm after alignment using only the frontface

Submodule 4-X4Y1



- Comparison of measurements on the table and on the backplate
- Measurement on the backplate has been reproduced by calculating the deviations on the backplate from the measurement on the table and the fit of the frontface.

Summary

- All full size VPTT submodules have been glued.
- 8 Crystal submodules show larger deviations.
- Carbon fiber alveole can deform slightly when mounted on backplate.

- Position of the submodule can be reconstructed to better than 0.2 mm with only the frontface visible.
- Holders for reflectors on the detector will be needed to determine the position of the crystals to each other and in the global reference frame.