# CMS Tracker Upgrade

## TEDD Dee flatness analysis

11/03/2022 update

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# Overview

1. Tracker upgrade for the HL-LHC
2. Dee anatomy and TEDD (Tracker End Cap Double-Disk)
3. Metrology study



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# Why upgrade the CMS tracker?

- HL-LHC:
  - Center of mass energy: 14TeV
  - Integrated luminosity: total=3000-4000 $fb^{-1}$
  - Number of collisions per beam crossing: ~200 (~38 during Run2)

- CMS detector:
  - The detector needs to be upgraded due to aging and radiation
  - Upgrade necessary for detecting a higher number of events per collision

- Physics Motivations:
  - BSM physics research
  - Precision measurements



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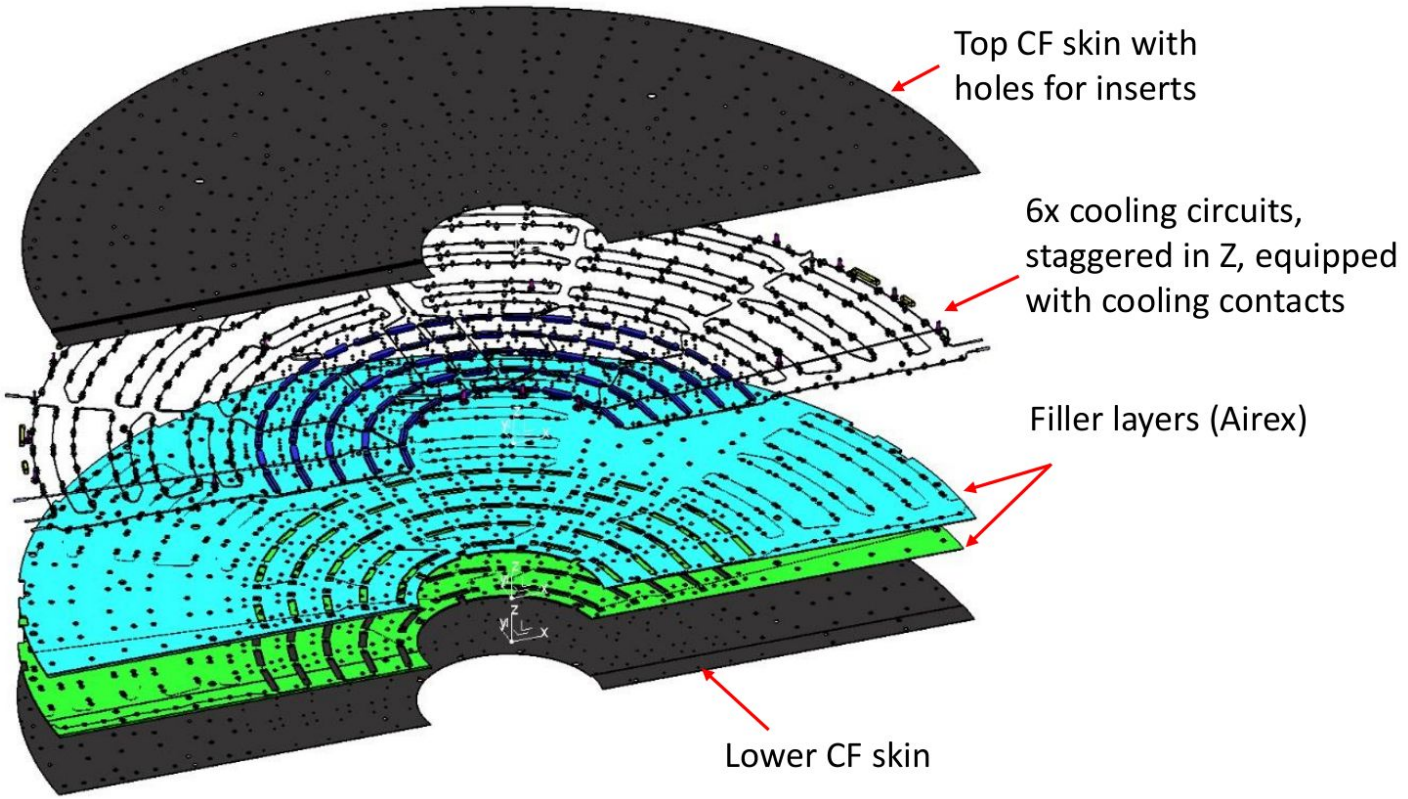
# Dee anatomy




- "Sandwich" structure with two sides: Z+ and Z-
- Many different inserts on both sides of the structure to support detection modules



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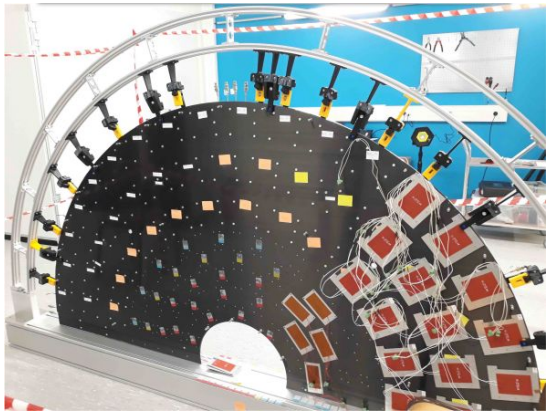
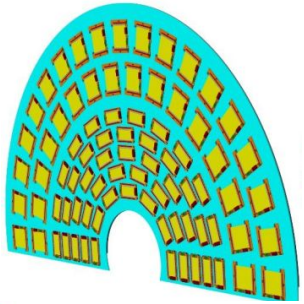
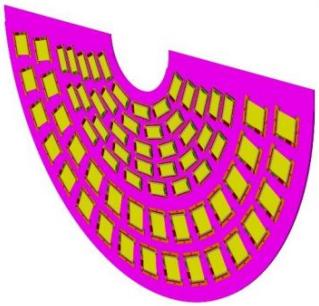
# Dee anatomy

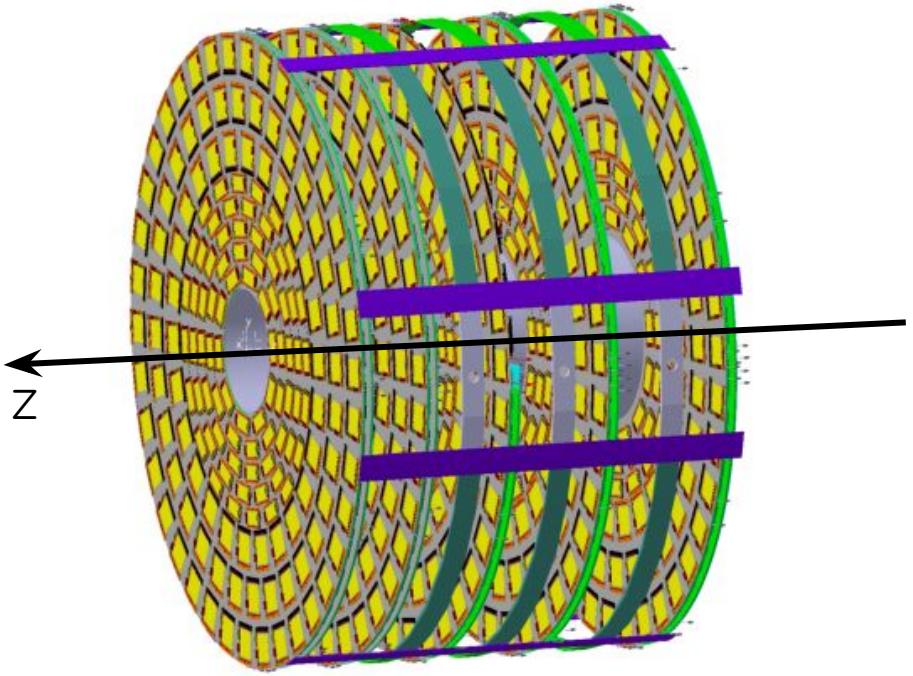
Dee structure prototype at LIO clean room (Lyon)





Disk = two semi-circular Dees structure






Full TED structure at CMS frame of reference



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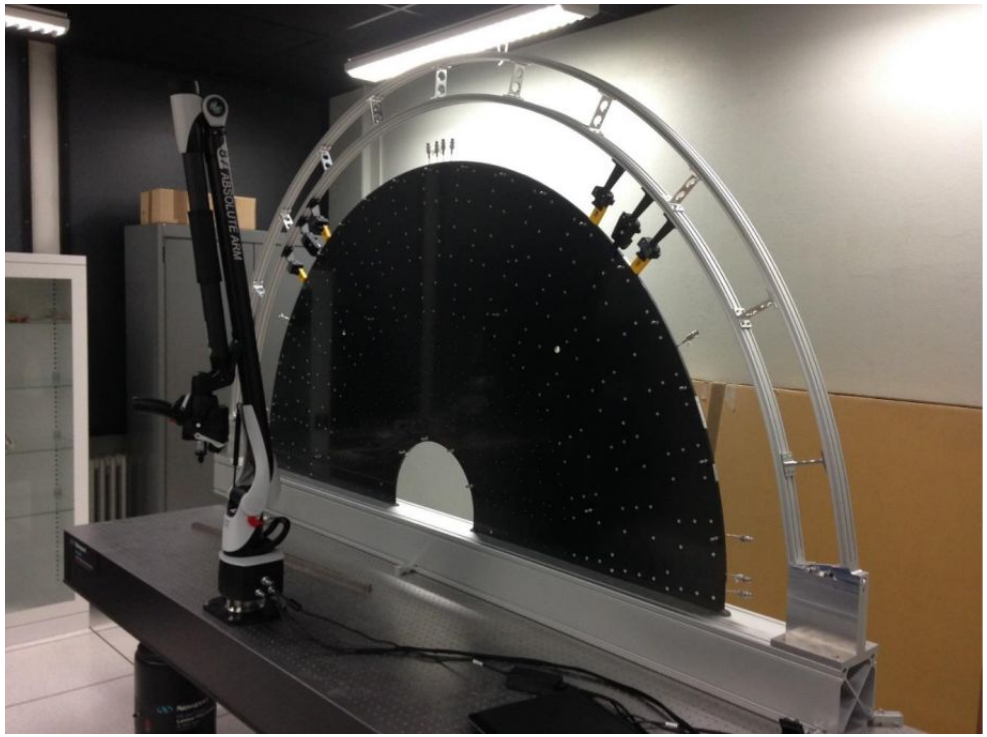
# Laser scan measurements



→ Metrology set-up

Laser head

- The laser measures points on the surface in 3D space
- Around ~$5.10^5$ measurement points taken per side



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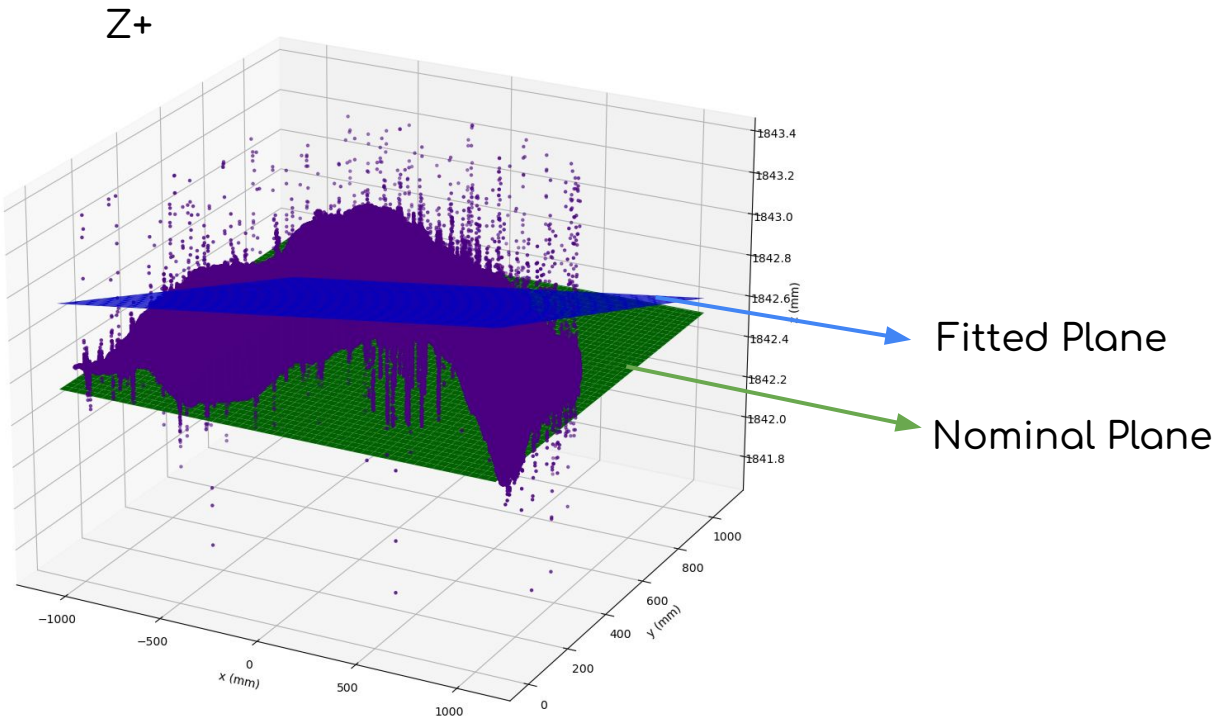
# Measurements representation in 3D space




- We **fitted** a plane using a statistical $\chi^2$ reduction method with the data points
- The nominal plane corresponds to the 'perfect plane"
- Angle between nominal and fitted plane ~0.033 deg



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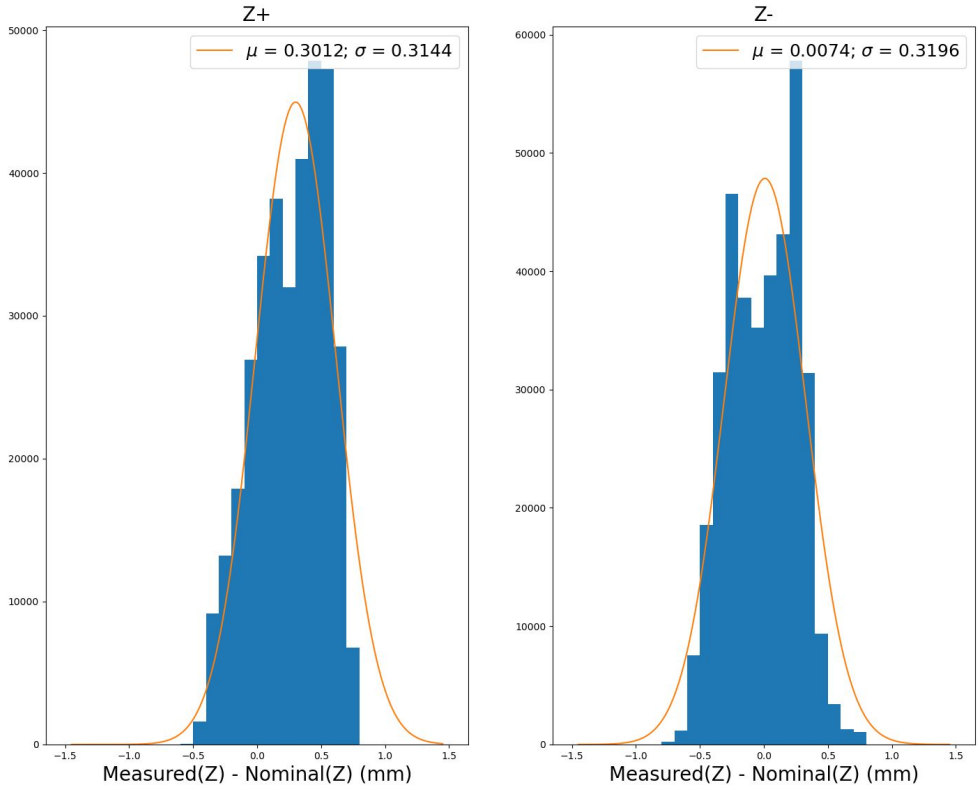
# Distance between nominal plane and measurement




| Maximum(Zp) - Minimum(Zp) | = 1.6mm

| Maximum(Zm) - Minimum(Zm) | = 1.6mm



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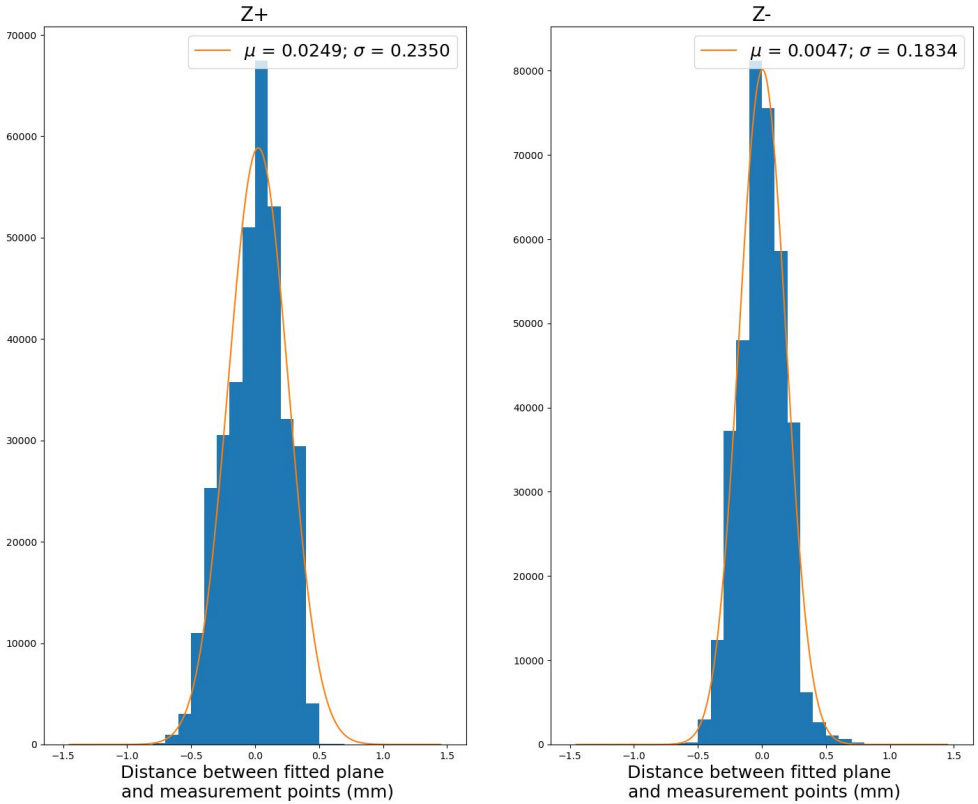
# Distance between fitted plane and measurement




| Maximum(Zp) - Minimum(Zp) | = 1.17mm

| Maximum(Zm) - Minimum(Zm) | = 0.96mm



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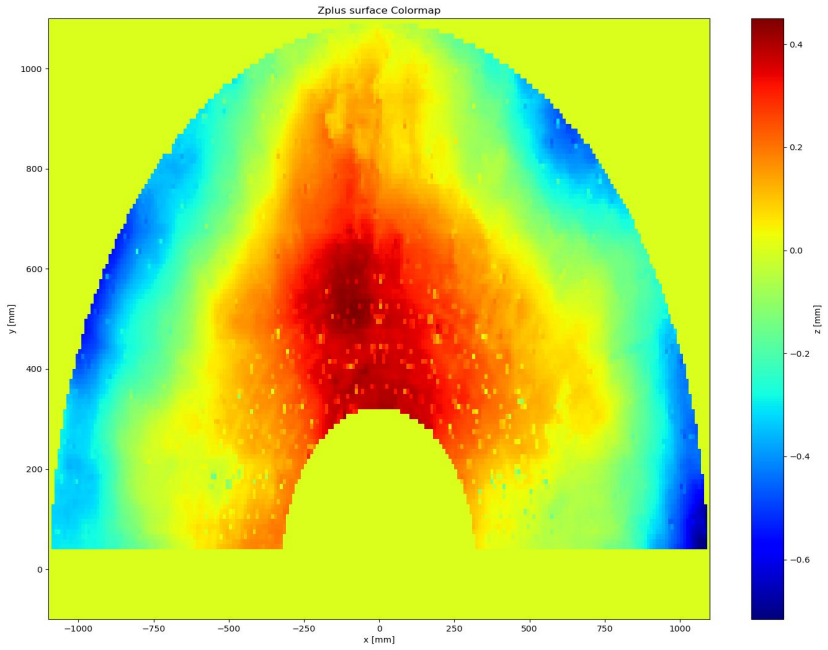
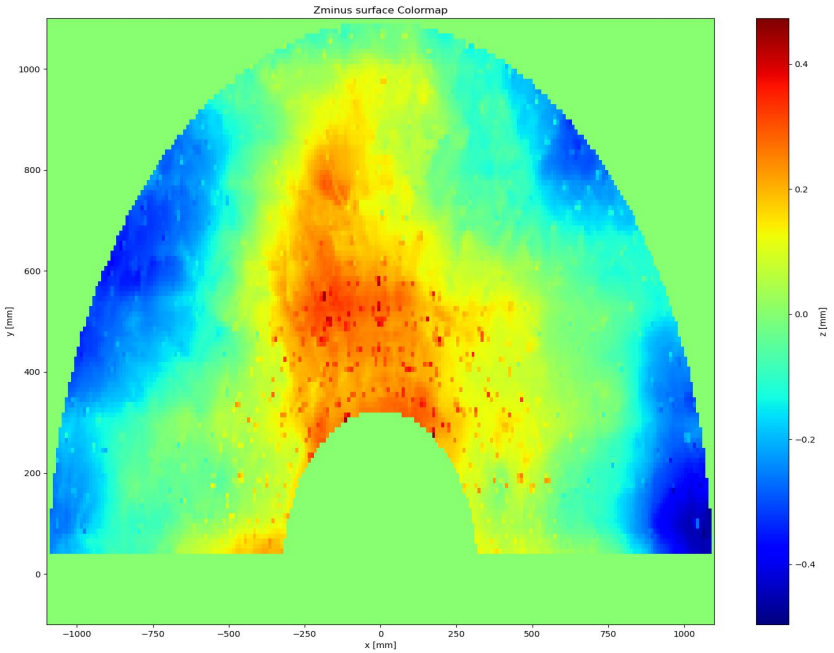
# Colormap distributions for fitted plane




- Dee divided in areas of 10*10mm$^2$



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# back-up slides



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