MAPS Technology in the SiD Digital Electromagnetic Calorimeter to Optimize Higgs Boson Measurements

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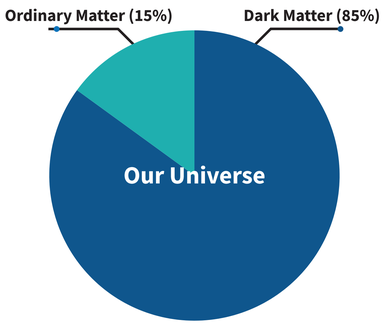
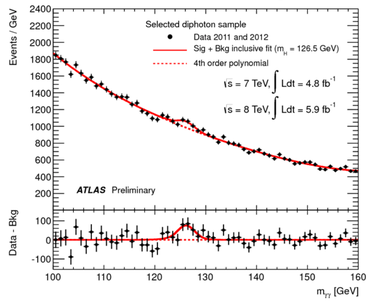
Dark Matter & The Higgs Boson



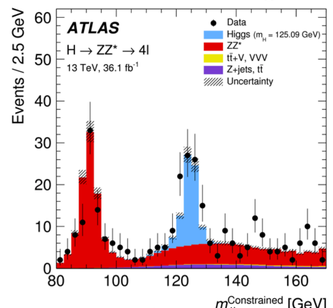
- Dark matter has been a mystery since the 1930s.
  - Invisible.
  - Observed through its gravitational effects.
  - Universe contains 5–6 times more dark matter than ordinary matter.
- One promising portal to understanding dark matter is the Higgs boson.

Initial Discovery



γ γ

Published Findings



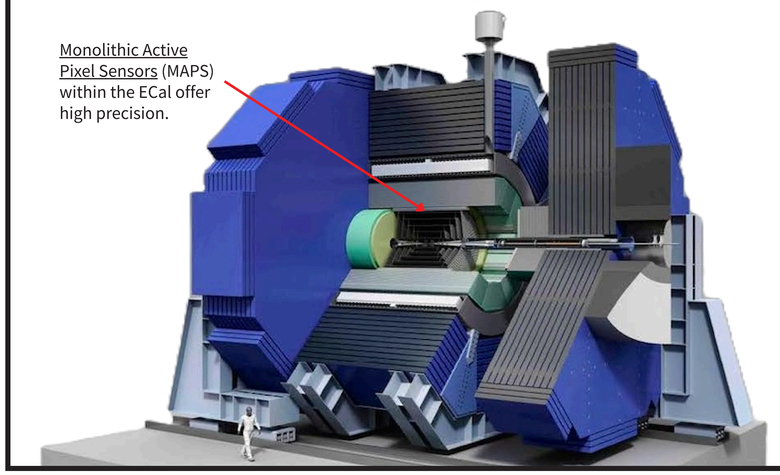
4 leptons

- The Higgs boson is a fundamental particle discovered in 2012 by the ATLAS and CMS collaborations.
  - Gives other fundamental particles their mass.
  - Studying the Higgs boson may lead to dark matter and possible new particles.

The SiD Digital ECal

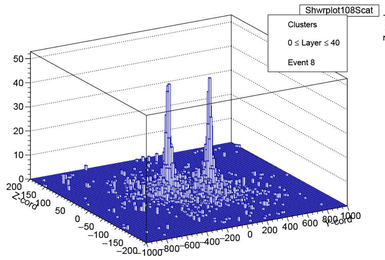
- The Electromagnetic Calorimeter (ECal) within the Silicon Detector (SiD) is our proposed detector for a Higgs factory.

Monolithic Active Pixel Sensors (MAPS) within the ECal offer high precision.

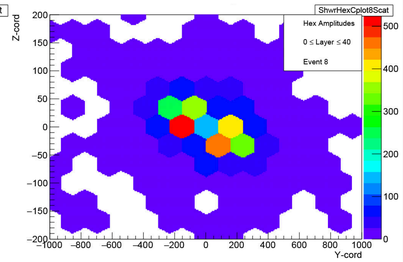


MAPS Upgrade

MAPS Technology (New Concept)

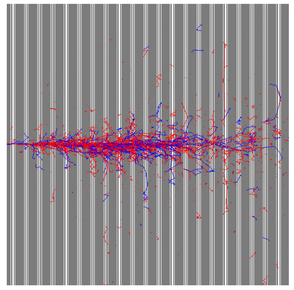


TDR Sensors (Old Concept)

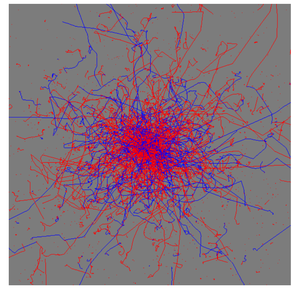


Visualizations

Geant4 Simulation: 10 GeV γ shower → e^-s and e^+s

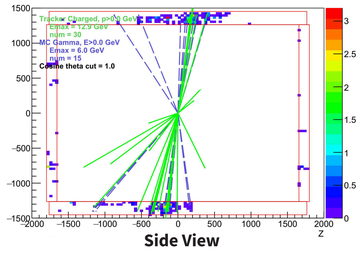


Side View

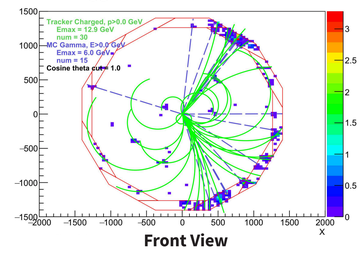


Front View

Event Visualization: $e^- + e^+ \rightarrow$ Higgs + Z



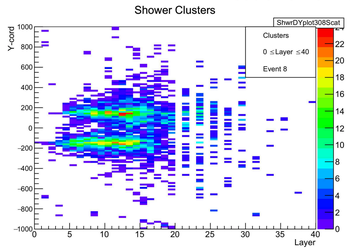
Side View



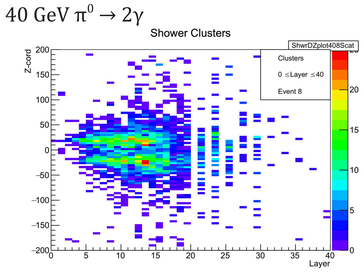
Front View

ECal Shower Plots: 40 GeV $\pi^0 \rightarrow 2\gamma$

Shower Clusters

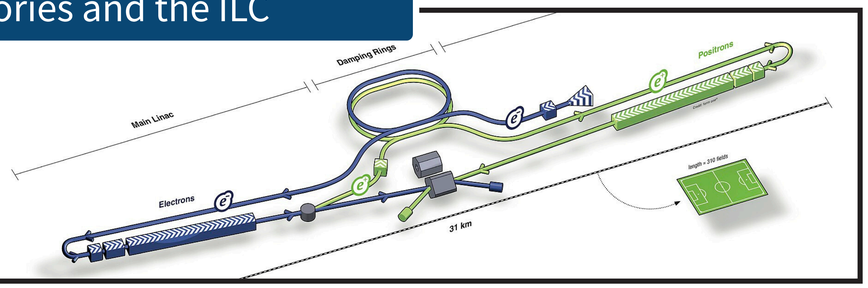


Shower Clusters



Higgs Factories and the ILC

- A Higgs factory is a particle accelerator specially designed to produce large datasets of Higgs-producing events.
  - Currently, while the Large Hadron Collider creates Higgs bosons, its measurements are limited in precision.
- One of the leading Higgs factory designs is the International Linear Collider (ILC), pictured to the right.



Conclusion

- The Standard Model of particle physics predicts the properties of the Higgs boson.
  - Discrepancies between predictions and measurements may indicate undiscovered physics, such as dark matter.
- As such, we propose implementing the MAPS technology into the ILC to precisely measure the Higgs boson and test the boundaries of the Standard Model.

References

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