



Readout System Enhancements for ATLAS ITk Project

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Agenda

Background

ATLAS & the Inner Detector
HL-LHC & ITk

Our Progress

s1

s2

Acknowledgements

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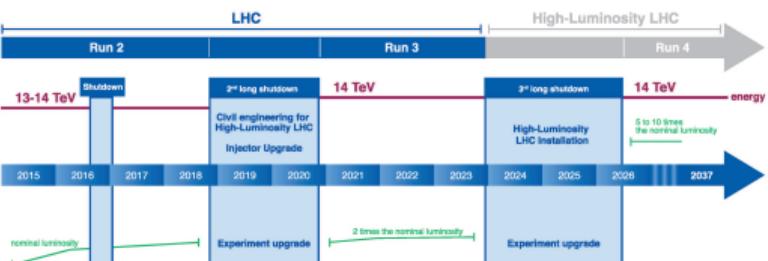
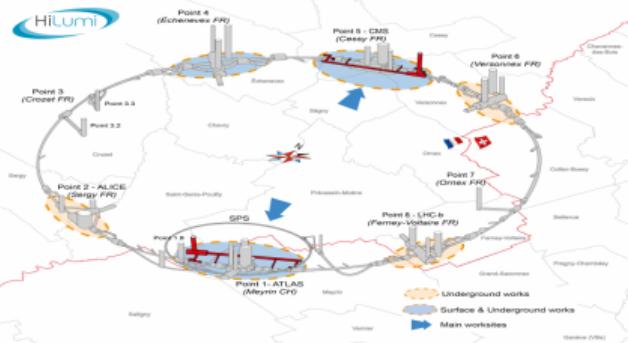
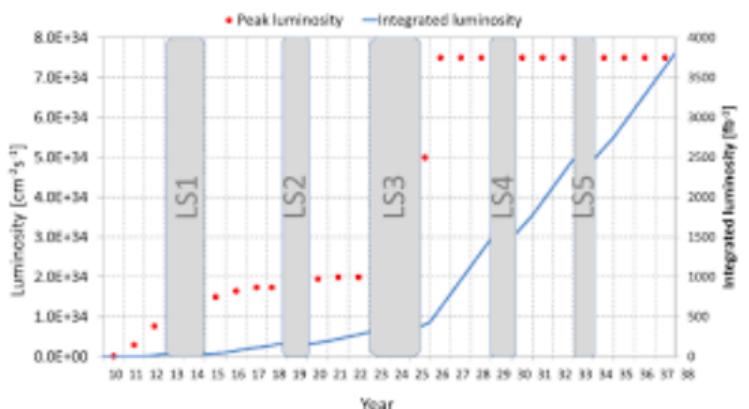
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High Luminosity LHC & ITk Upgrades

x10 increase in instantaneous luminosity!

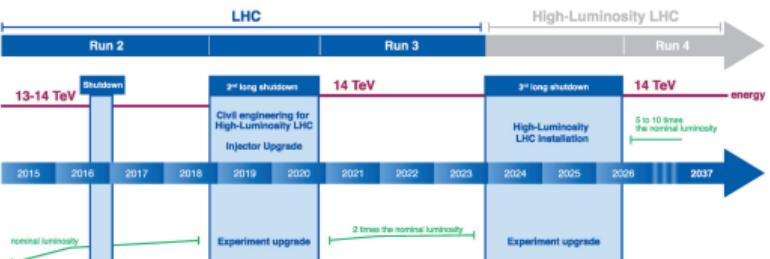
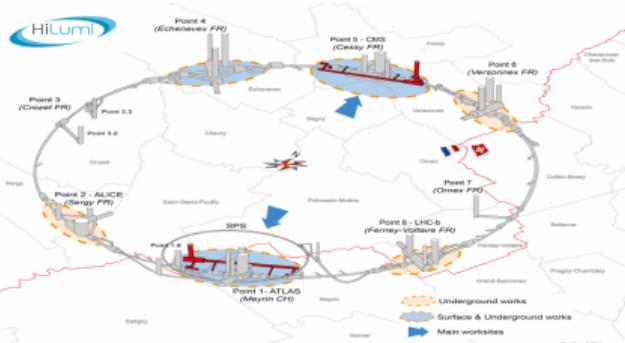
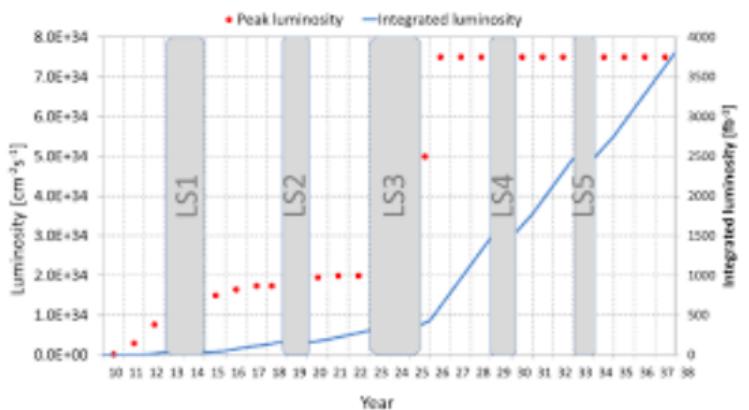
$$\blacktriangleright L = 1\text{e}73 \text{ fb}^{-1} \text{ s}^{-1} \rightarrow L = 1\text{e}74 \text{ fb}^{-1} \text{ s}^{-1}$$



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- $L = 1\text{e}73 \text{ fb}^{-1} \text{ s}^{-1} \rightarrow L = 1\text{e}74 \text{ fb}^{-1} \text{ s}^{-1}$
- More particles, more problems



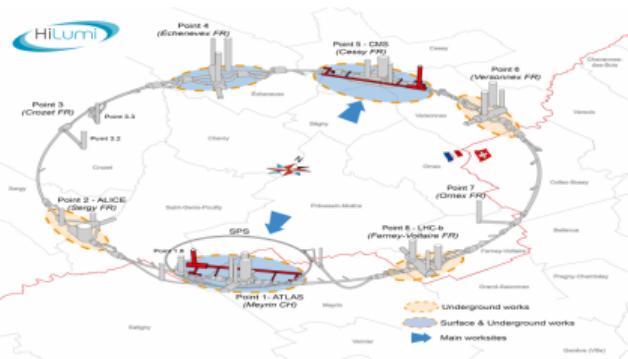
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The inner detector has insufficient:

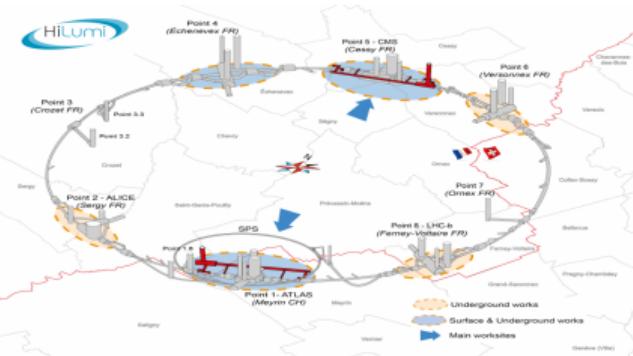
- radiation hardness
- granularity
- readout bandwidth
- trigger readout speed/storage



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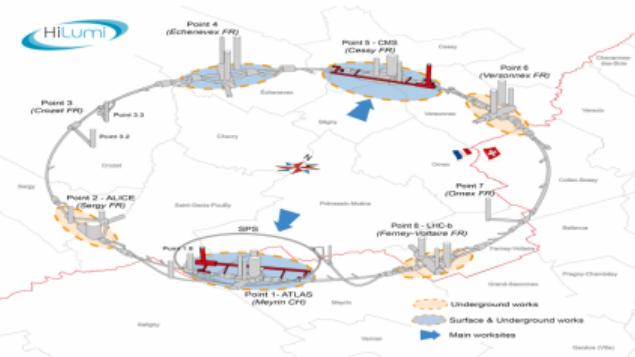
The inner detector has insufficient:

- radiation hardness: HL-LHC will deliver 4000 fb^{-1} fluence. ID PIX is designed for 400 fb^{-1} , ID SCT for 700 fb^{-1} , IBL for 800 fb^{-1}

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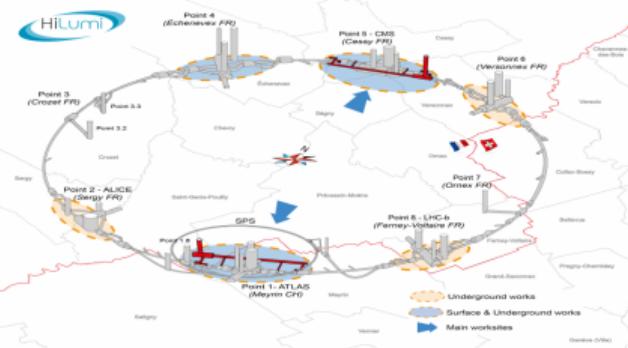
The inner detector has insufficient:

- granularity: Increasing fluence means higher granularity is needed to maintain performance; compensate for intrinsic dead time

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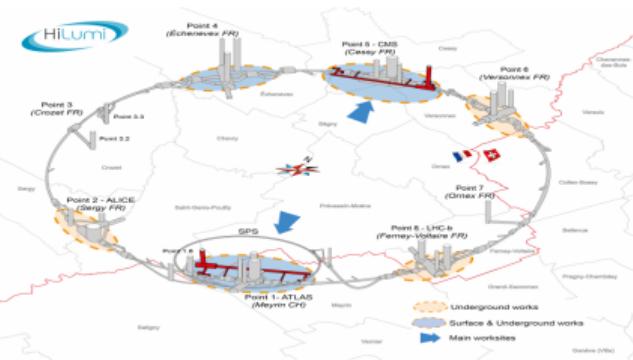
The inner detector has insufficient:

- ▶ readout bandwidth: HL-LHC will roughly quadruple ID designed bandwidth saturation

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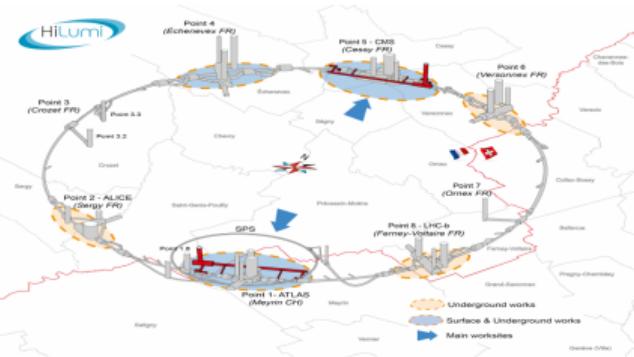
The inner detector has insufficient:

- trigger readout speed/storage: readout chain must accomodate much higher hardware (level 1) trigger rate

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x10 increase in instantaneous luminosity!

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Goal of ITk:

Same or better performance than ID in harsh environment of HL-LHC

ITk design

ITk will have:

- ▶ Strip detector: 70M channels (6M currently)
- ▶ Pixel detector: 600M channels (80M currently)

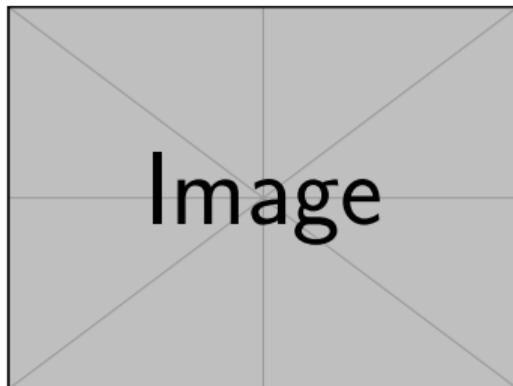


Figure: Design of ITk

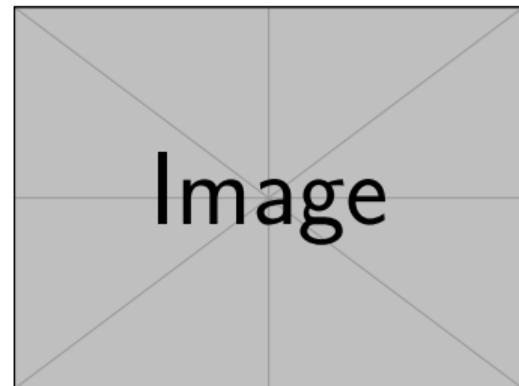
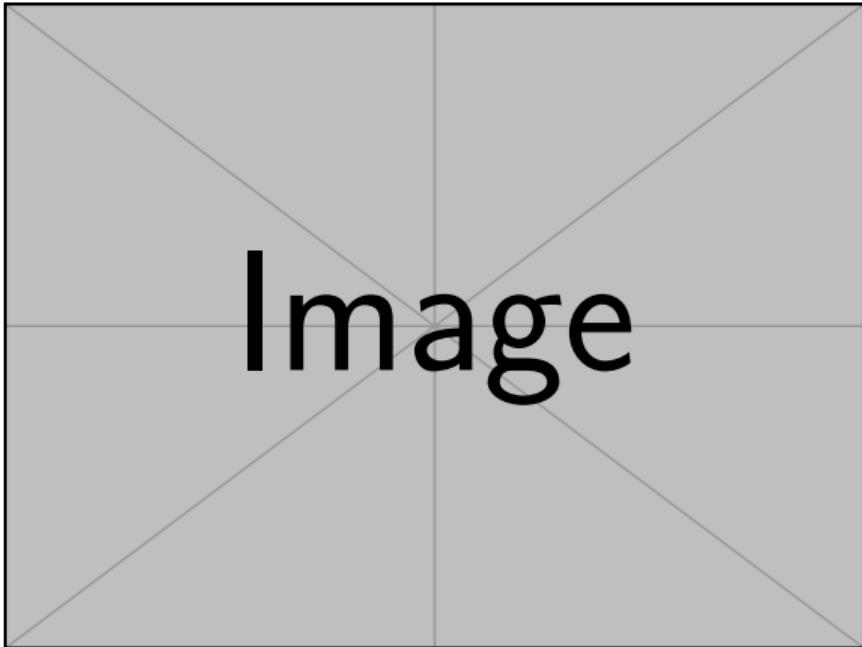


Figure: ITk radiation length v. η

ITk Design: Strip Detector



- ▶ barrel staves
- ▶ endcap petals

Strip Detector Readout

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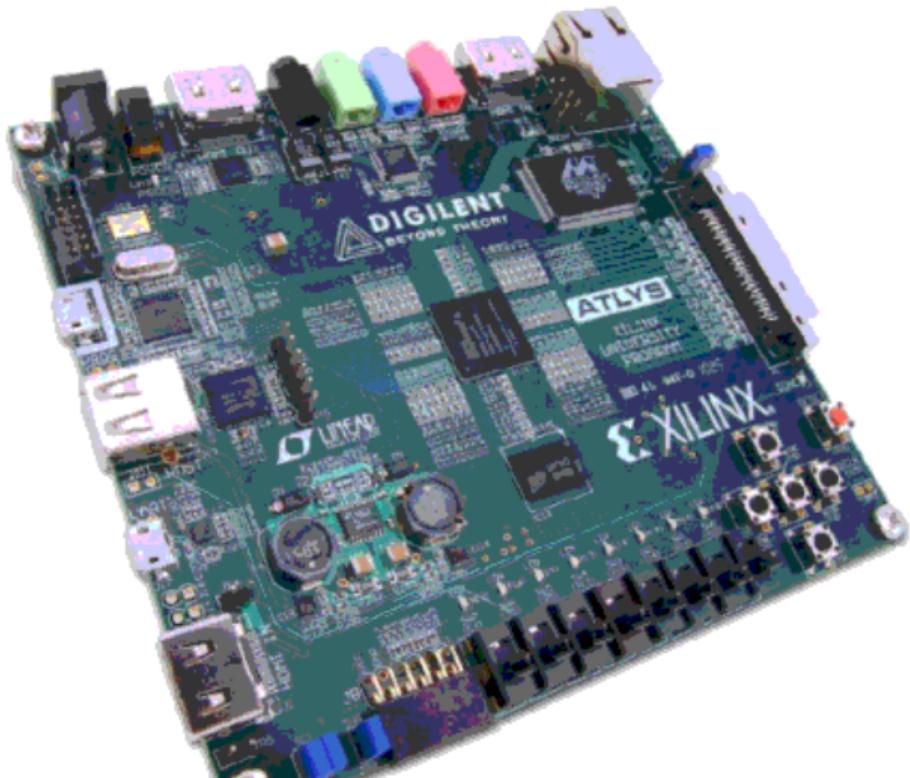
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ATLYS Board



Obstacles

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s1

s2

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We would like to acknowledge the University of Michigan Department of Physics, specifically Jean Krisch, Tom Schwarz, and Steven Goldfarb. We would also like to acknowledge the support of the Lounsbury foundation.





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