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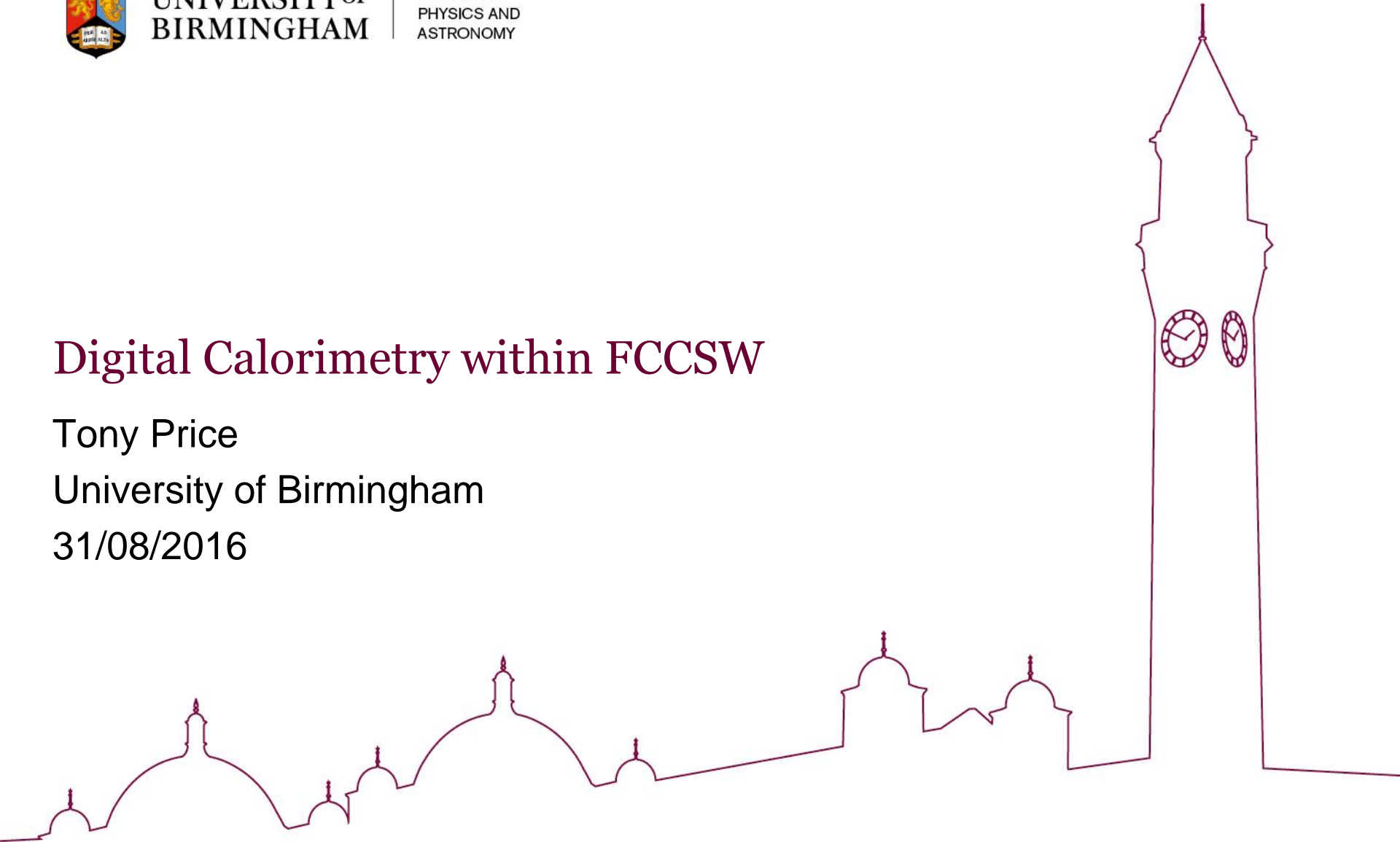
SCHOOL OF
PHYSICS AND
ASTRONOMY

Digital Calorimetry within FCCSW

Tony Price

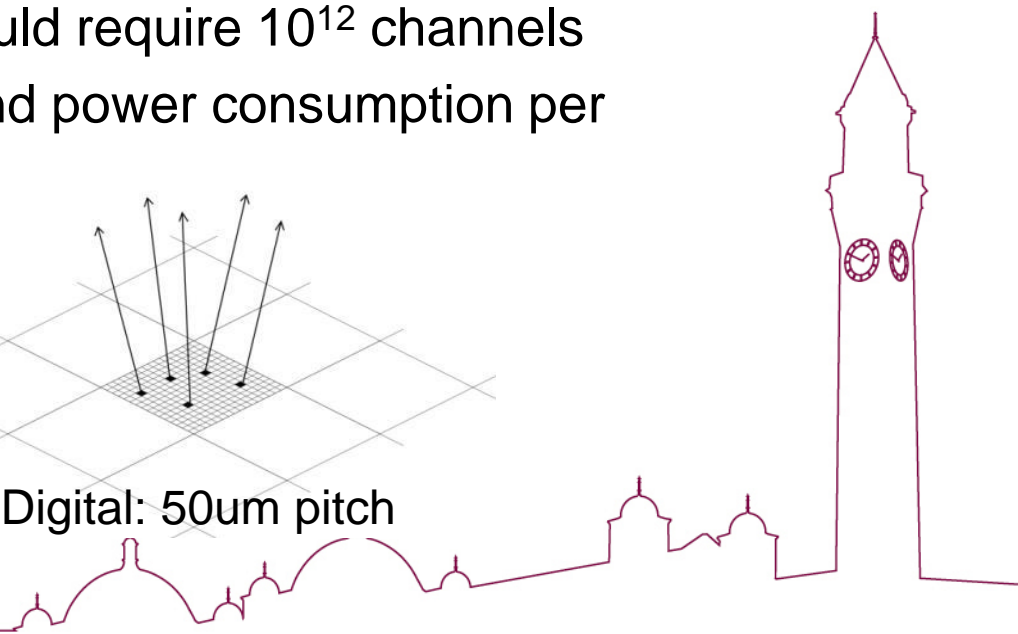
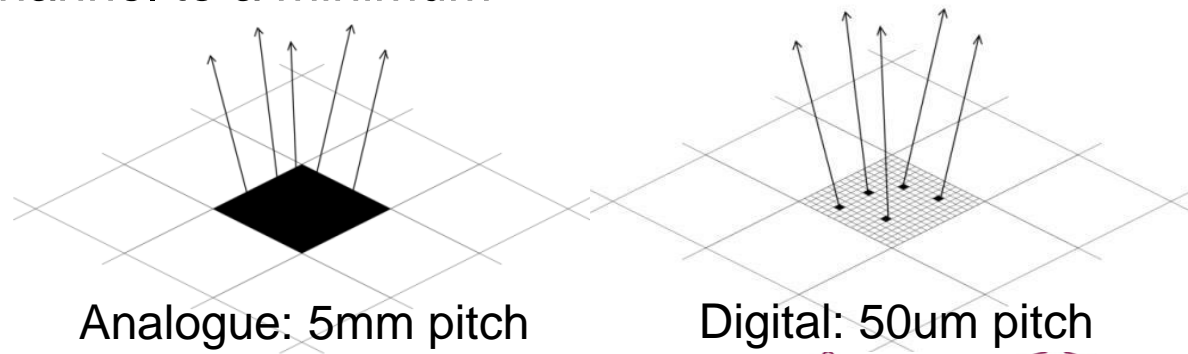
University of Birmingham

31/08/2016



Digital Calorimetry: The Concept

- Dates back to c.2005 work within CALICE
- Make a pixelated calorimeter to count the number of particles in each sampling layer
- Ensure that the particles are small enough to avoid multiple particles passing through a single pixel to avoid undercounting and non-linear response in high particle density environments
- Digital variant of ILD ECAL would require 10^{12} channels
- Essential to keep dead area and power consumption per channel to a minimum



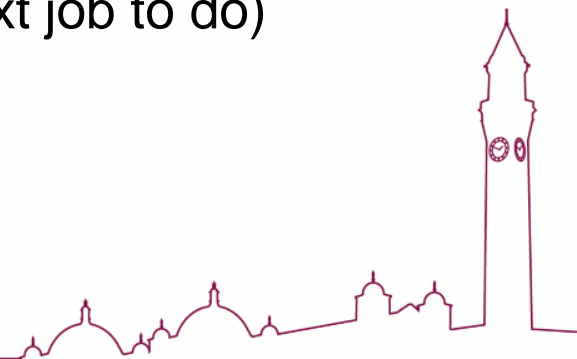
DetFCChhECaDigital Geometry

- Started from DetFCChhECaSimple
- Modified ECAL barrel inner radius to 1700 mm (as discussed at the last meeting)
- Removed cryostat as not required for SiW calorimeter
- Modified geometry such that there are four repeated volumes per module
 - epitaxial (sensitive)
 - Silicon substrate
 - Tungsten
 - Air gap
- Ability to change materials and thicknesses of these layers from xml file
- Ability to change the number of modules from xml file



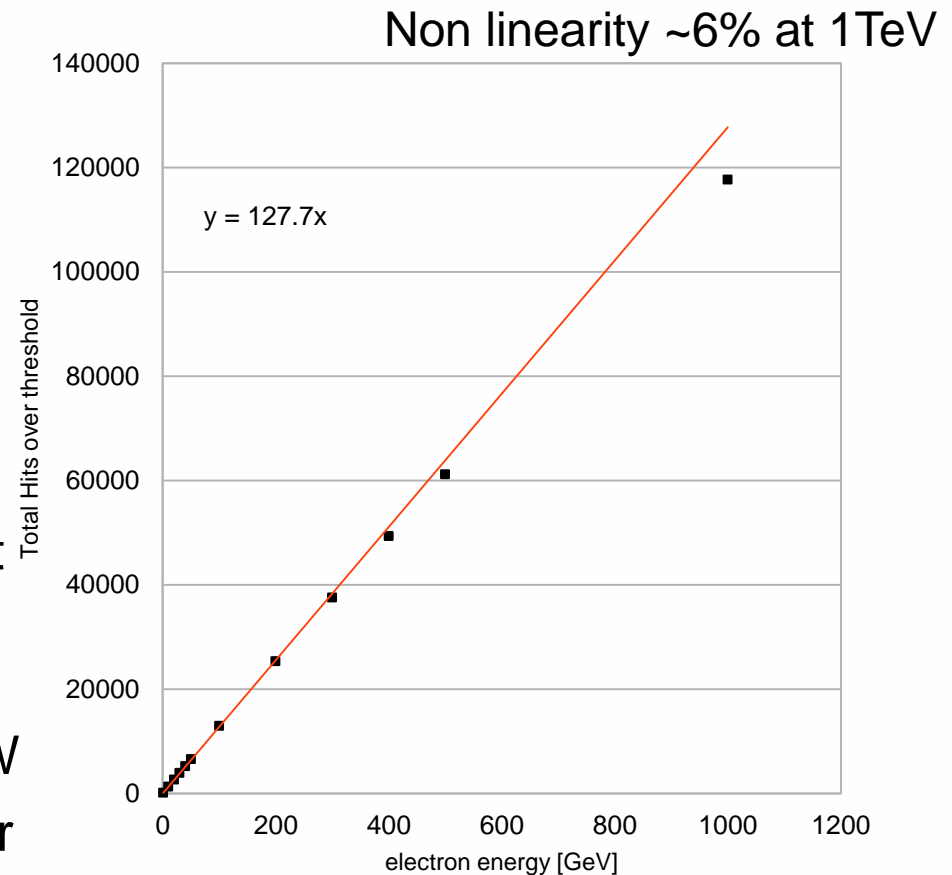
DetFCChhECalDigital Readout

- ❑ Started from SimpleCalorimeterSD
- ❑ Sum all the energy deposited in a cell (aka AggregateCalorimeterSD)
- ❑ Added an “EndOfEvent” function to SD class so can apply a threshold to the hits
- ❑ Currently score
 - Number of pixels above threshold
 - Number of particle per pixel (for pile-up non linearity studies)
 - Energy deposited (to allow threshold studies to be applied)
- ❑ Need to pass this to the proper readout chain (next job to do)

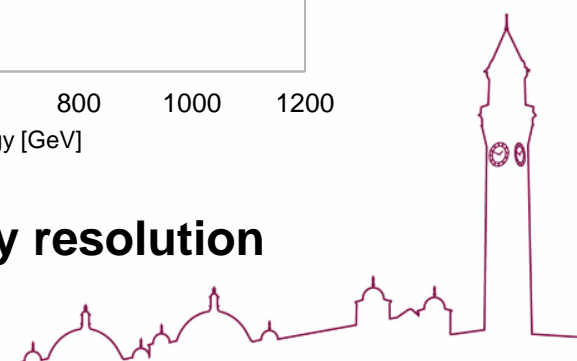


First linearity checks

- 15um Si epitaxial layer
- 450um Si substrate
- 3.5 mm W as absorber
- 0mm air gap (all sqashed together for now)
- No B field
- Electrons $|\eta| < 0.1$
- Segmentation XYZ used at 50x50x50um grid
- Not correct but best option available this far in FCCSW
- Anna is working on a better solution 😊

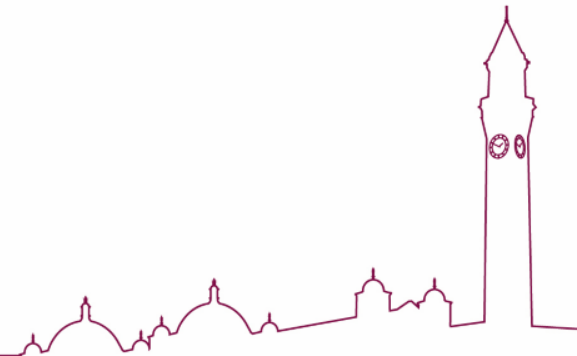


Currently debugging strange behaviour in energy resolution



Acknowledgements

- Martin Aleksa and his group for meeting with me and helping me understand some of the requirements for FCC-hh calorimeters
- Jana Faltova for sitting and introducing me to FCCSW, and for providing her code as a base
- Anna Zaborowska for helping me with segmentation issues and working on improved implementation
- Joschka Lingemann and Valentin Volkl for replying to mailing list and technical questions promptly and clearly (and offering to meet for coffee to discuss more technical issues)



Conclusions

- Lots of work still to do but good progress has been made.
 - Basic Geometry and readout implemented
 - Need to pass my output to ROOT files
- Investigating strange behaviour regarding the energy resolution and “reflections” in Geant4 (observed in MOKKA, standalone, and FCCSW)
- Currently we get 6% deviation from linearity at 1TeV but expect this to improve with better segmentation
- 30 layer DECAL with 50x50um pixels, starting at 1700 mm leads to 2.12×10^{12} channels in the barrel
- Thank you again to all who have helped me!

