Luminosity Pair Spectrometer Study

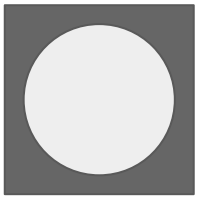
Simple Volume Ratio Simulation for Spaghetti Calorimeter

Comparison to ‘Results of R&D on a new construction technique for W/ScFi Calorimeters’ - Tsai *et al*

https://iopscience.iop.org/article/10.1088/1742-6596/404/1/012023/pdf

Simulation Setup

- Cylindrical polystyrene fibres in cuboid tungsten cases (one module shown to the right).
- Direction of fibres alternated by layer, in the X and Y axis (perpendicular to the beam).
- Detector geometry was 16cm^3.
- Scintillator radius was constant (1mm), tungsten width/height was varied.
- Ratios are given as Tungsten:Scintillator



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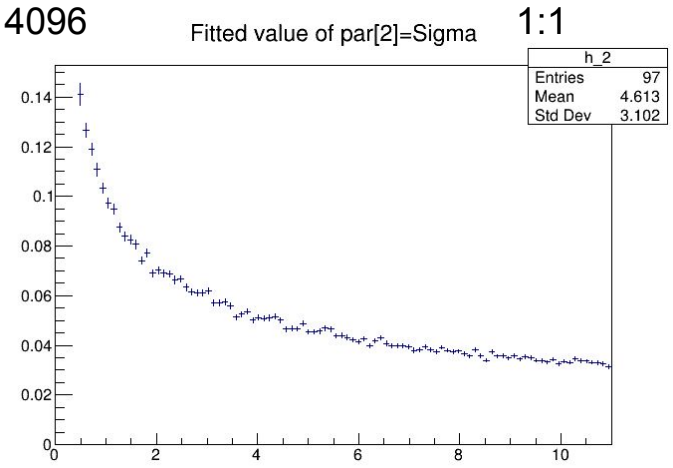

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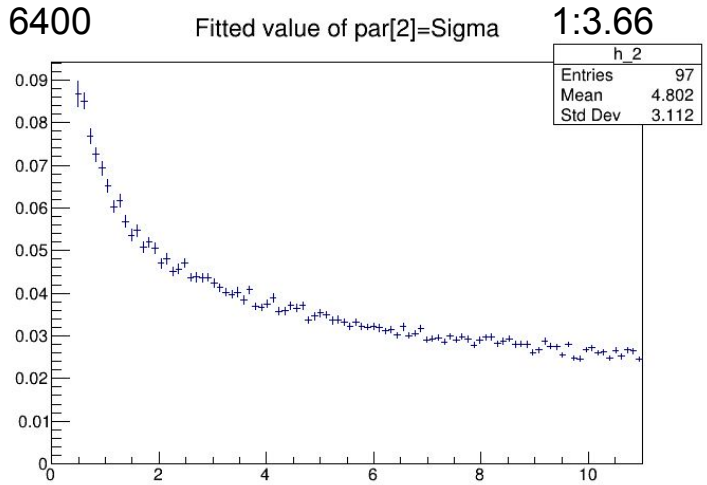
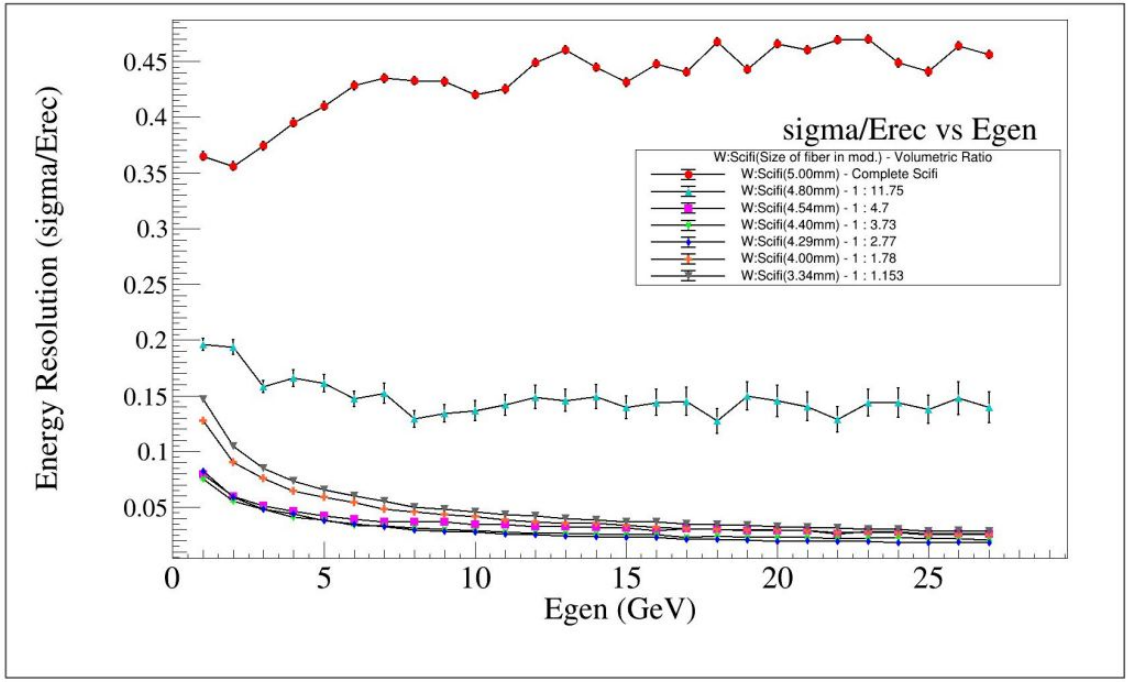
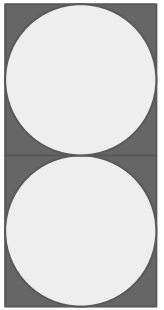
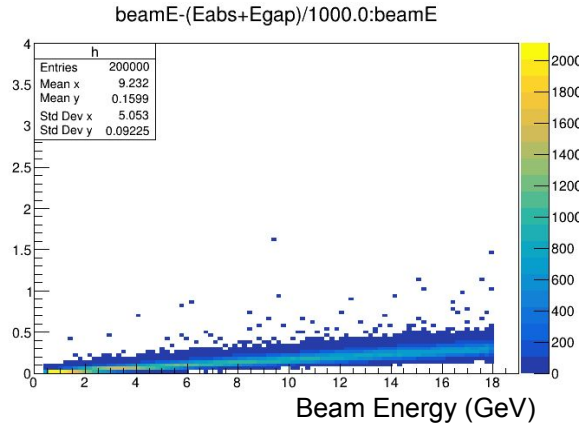


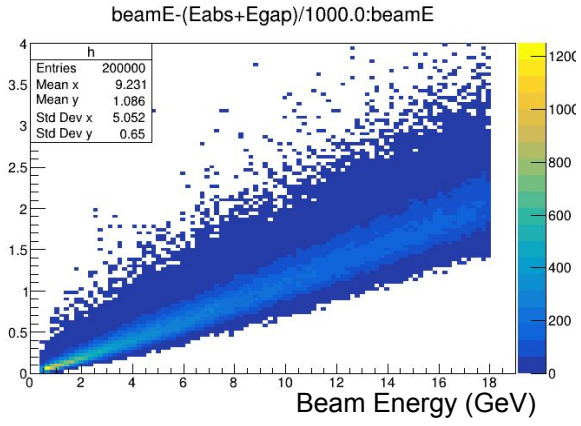


1:3.66 is the limit due to circular fibre shape.
Fibres are touching each other - no tungsten between neighbouring fibres

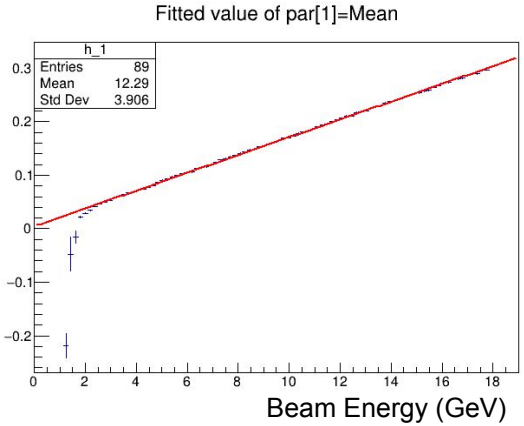


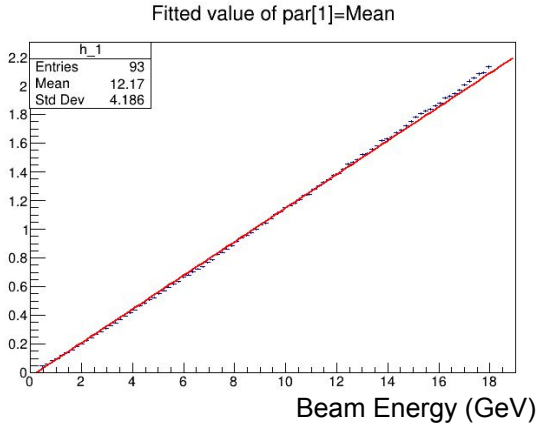
Energy leakage for 1:1(left) and 1:3.66 (right)





These plots show the amount of energy not deposited in either the tungsten or scintillator





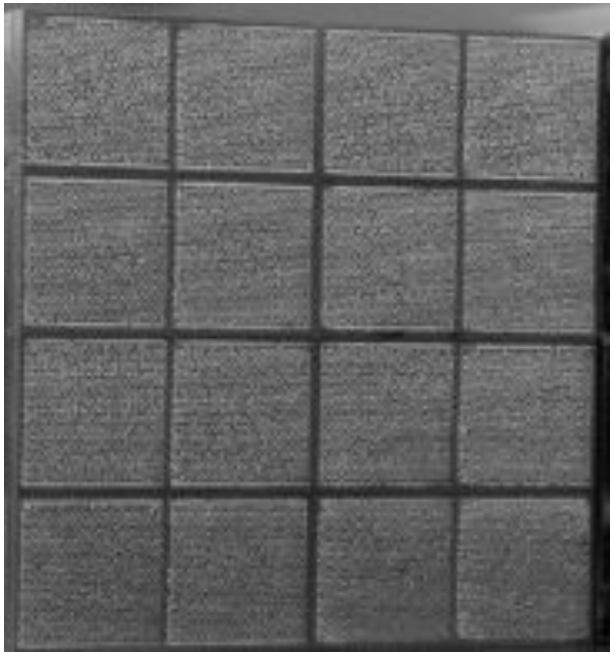
Energy losses (graph gradient) at 1:1 are roughly 1.6% compared to 12% for 1:3.66

Results of R&D on a new construction technique for W/ScFi Calorimeters

Aimed to recreate the results, primarily energy resolution.

Geometry used circular fibres with tungsten powder as an absorber.

Fibres were aligned in the X direction only.



Energy resolution results

Simulation was run with both a pencil beam (top) and a beam with spread of 2cmx2cm (bottom)

Resolutions were higher than found by Tsai *et al* and resolution was higher with beam spread.

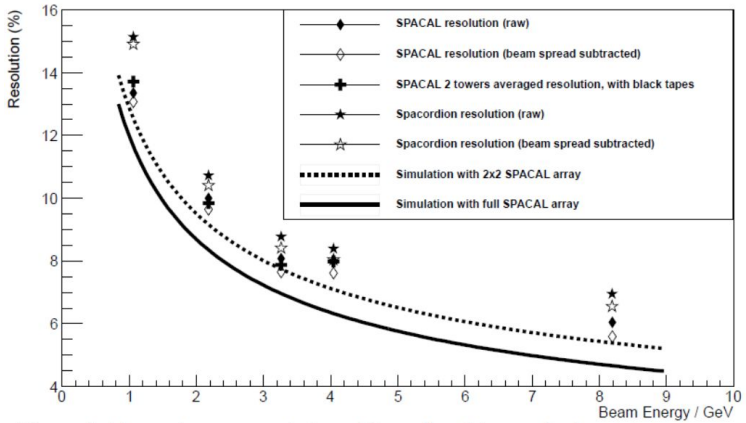
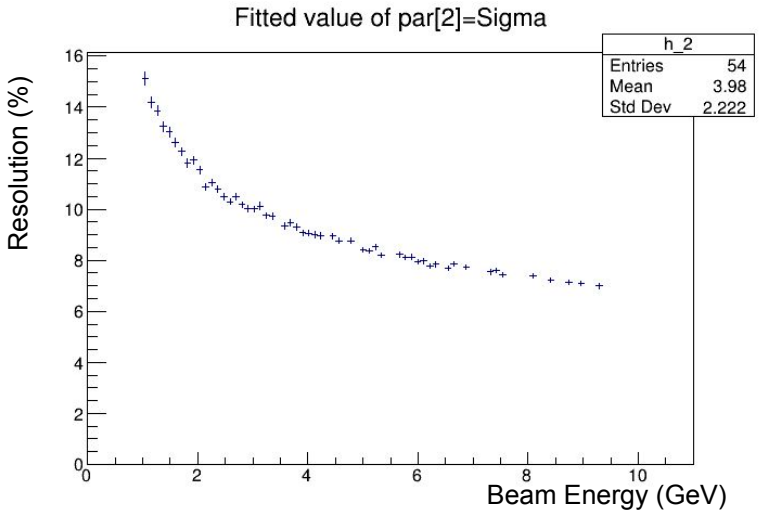
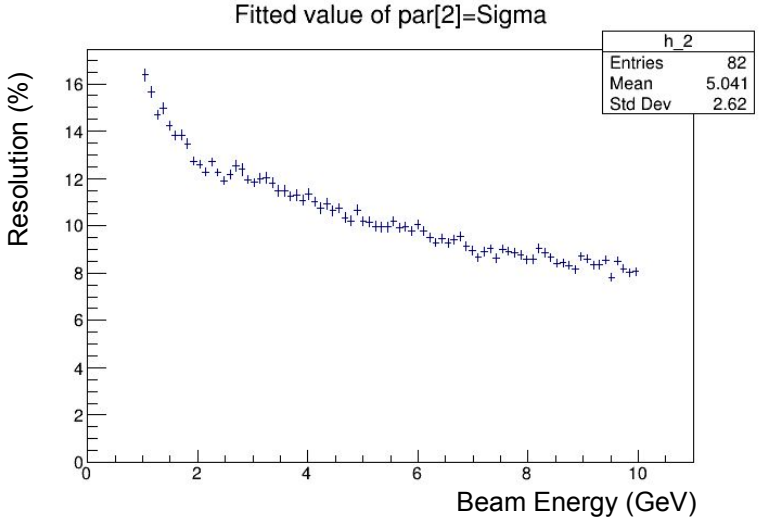


Figure 4. Measured energy resolution of 'spacal' and 'spacordion' prototypes compared with GEANT4 prediction.





Comments

- Circular shaped fibres will limit the volume ratio.
- Fibres of a smaller radius would allow for more flexibility.
- So far simulation have assumed an absorber of pure tungsten - tungsten powder has a lower density.

- Issues replicating more closely the results of Tsai *et al* may be due to slight differences in how the geometry is simulated.