

## Hall D BCAL Calculations - 2m Module

Z. Papandreou

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### Assumptions:

- BCAL length (L): 443.87 cm
- inner BCAL radius ( $r_{in}$ ): 0.65m
- outer BCAL radius ( $r_{out}$ ): 0.90m
- Volume ratio: SciFi:Pb:Glue = 48:42:10

### Constants:

- $\rho_{Pb} = 11.35 \text{ g/cm}^3$
- $\rho_{SciFi} = 1.05 \text{ g/cm}^3$

### Volumes:

- BCAL volume:  $\pi[r_{out}^2 - r_{in}^2] L = 5403527.6 \text{ cm}^3$
- $V_{Pb} = 2269481.6 \text{ cm}^3$
- $V_{sciFi+glue} = 3134046.0 \text{ cm}^3$
- $m_{Pb} = 25758.6 \text{ kg}$
- $m_{SciFi} = 3290.8 \text{ kg}$
- $mass_{tot} = 29049.4 \text{ kg}$

That's almost 30 metric tons!

### 2m-Module Construction Considerations

- Construct Module-0 with dimensions **195cm (l) x 13cm (w) x 25cm (t)**.
- Using the standard horizontal and vertical fiber pitch values (0.135cm and 0.118cm), we will require **212 layers** (i.e. 212 sheets of lead) and with 96 fibers/layer we will need **20352 fibers**.
- The procured fibers from PHT are 410cm long. Each should be cut in 2 equal length (205cm long) pieces.
- Then, they need to be glued into lead sheets so that  $\approx 2.5\text{cm}$  protrude from each side. This means that the lead, after swaging, must be around 200cm long, and the pre-swaged sheets thus have to be 194cm long (3% elongation after swaging).
- The galvanized steel mask needs to be 194cm (length) x 13cm (width). This will allow the final machining to yield a module that is 195cm long.