Cost optimization for S-CEPCal

(Segmented Crystal Electromagnetic Precision Calorimeter)

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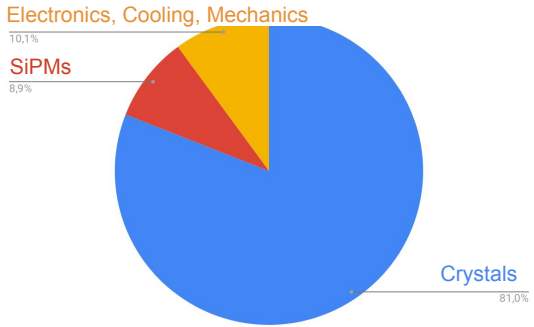
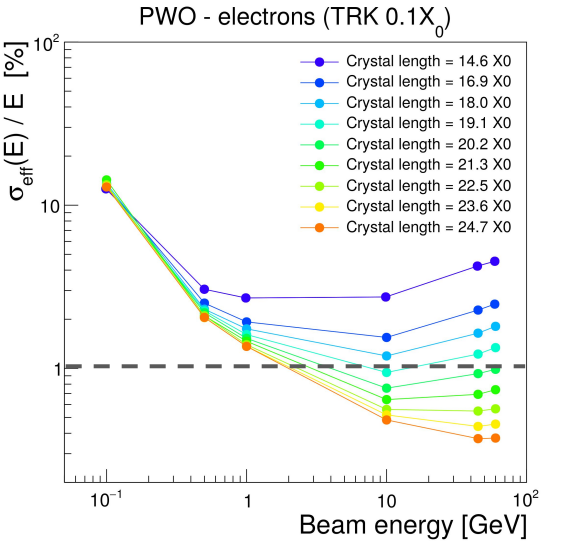
Recap of cost drivers and layout choice

- **Channel count** in **S-CEPCal** is limited to **~2.5M**
  - 625k channels/layer
- Cost drivers in **ECAL** layers (tot ~95M€):
  - **~81% crystals**, **9**% SiPMs, **10**% electronics+cooling+mechanics
  - **~19% of cost scales with channel count**
- Power budget driven by electronics: ~74 kW
  - 18.5 kW/layer
- Room for fine tuning of the segmentation and of the detector performance / cost optimization ?

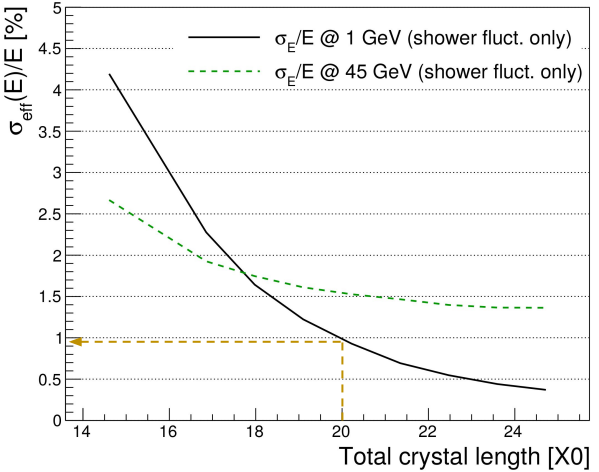


Optimization of crystal volume

- Crystal pointing geometry
  →reduce by ~20% crystal volume and channel count

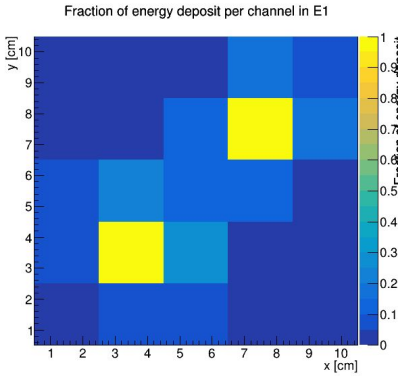


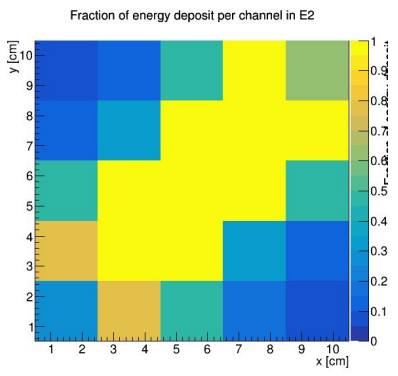
- Optimizing crystal length vs energy resolution
  - with 20 X_0 contribution to constant term from shower leakage comparable to intercalibration precision: O(1%)
  - no substantial impact on stochastic component (negligible wrt photo-statistics term of ~4-5%)



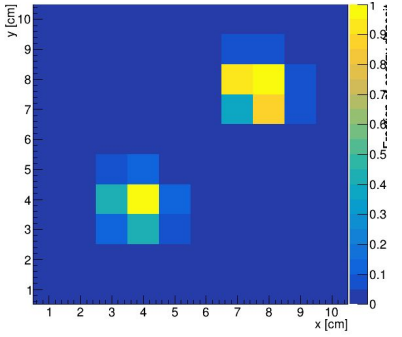
Transverse segmentation (visual impact)

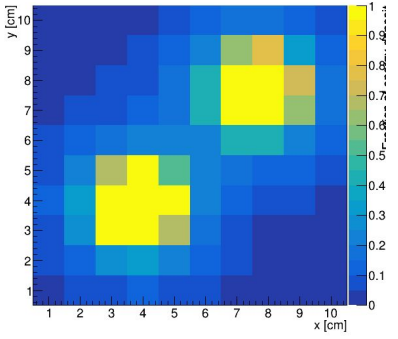
cell size: 2x2 cm²



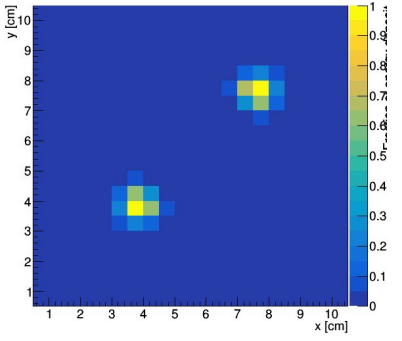


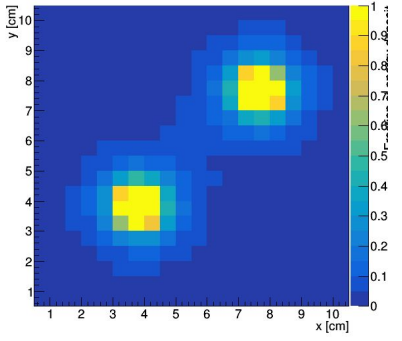
cell size: 1x1 cm²





cell size: 0.5x0.5 cm²

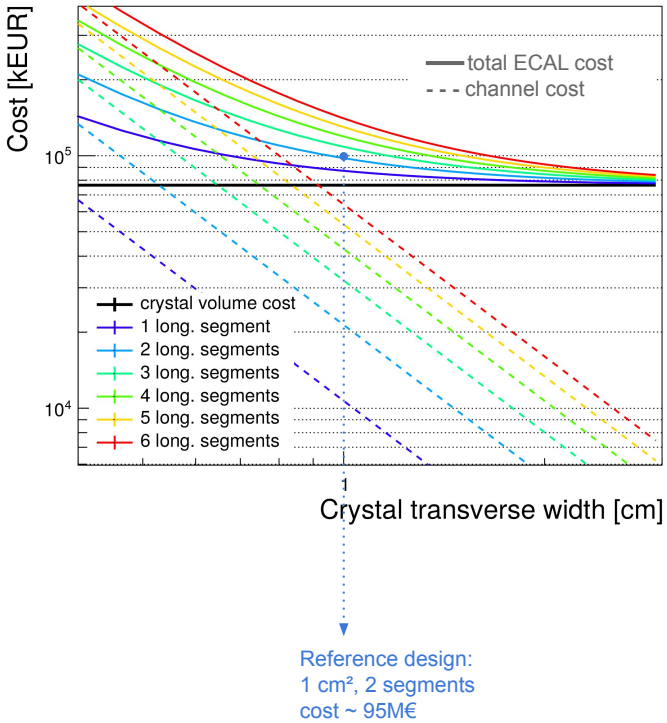




Optimization of segmentation

- Segmentation optimized for performance/cost:
  - **Transverse** segmentation:
    → 1 cm ~ R_M / 2 (half Molière radius)
  - **Longitudinal** segmentation: 2 segments
    →particle ID with no dead material at shower max
    →simple for readout and services (front and rear)

- Impact of ch. count on overall detector cost <20% for baseline segmentation choice
- Total cost ~ 95 M€



De-scoping / further cost saving options?

- Reduce transverse segmentation from 1x1cm² to 2x2cm²
  → impact of ~7% on overall cost

- Decrease of crystal length (20→18 X_0) at the price of larger constant term (0.8→1.5%)
  → impact of ~8% on overall cost

- SiPM cost (recent quotes from some vendors)
  → decrease of 20% on SiPM cost (6€→ 5€ per SiPM of 9 mm²)
  → impact of ~3% on overall cost

- Recycling raw material from previous experiment? (re-growing the CMS ECAL)

backups