Scintillator Tiles Studies

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**CLIC detector concept**

**Tracking system:** records the paths taken by charged particles

**Electromagnetic calorimeter (ECAL):** measures energy of photons and electrons as well as the early parts of showers initiated by hadrons.

**The Hadron Calorimeter (HCAL)** measures the energy of hadrons.

**4-5T Solinod**

**Muon system**

**Return yoke:** is type of iron used for confining the magnetic field that’s why it’s compact detector.
ECAL for Linear Collider (LC)
Scintillator calorimeter for LC

- Photons: Pair production
  - Absorber
  - Scintillator
  - Strip
- Electrons: Bremsstrahlung
- Tile
- SiPM: Photoelectric effect
  - Readout system
  - Electronics
  - Acquisition
Before building, we need testing

The first step in building calorimeter with millions of cells, is building one cell. And to build this unit cell, we made test to get answers on that these questions

- What is the best cell size?
- How much light do we collect?
- Does it have a uniform response?
The Task

Do lab test on different plastic scintillators tiles to answer these questions
Procedures

✓ Experimental setup
✓ Calibration
✓ Measurements (Scan)
✓ Data acquisition
✓ Data Analysis
✓ Results (Answers)
A. Experimental setup

Electron gun

Feedthrough to lab next door

Device Under Test (DUT)

Translation axes
The system Ingredients

- **Electron gun**

- It's sr90 source.
- double beta emission.
Triggering system

Goal: trigger on particles that went through scintillator

- Crossed scintillating fibers (20x1x1 mm³) as trigger, fixed underneath DUT
- Each fiber is read out by a SiPM
- Both SiPM signals are put in coincidence
Scintillator is direct coupling with SiPM using optical grease.
Calibration

With the gun off, perform self-triggered run to measure gain at reference temperature

Measurements

Place selected DUT in setup
  Switch electron gun ON
  Start automated scan

At each scan step (~60 sec):
• define position(x, y)
• Recording integration of SiPM signals for each trigger.
• Measure temperature
Data acquisition

- Feedthrough to dark room
- High voltage power supply for SiPM bias
- Low voltage for amplifier
- Current source for electron gun coil
- Coincidence circuit for triggering system (NIM)
- Scalers
Data Analysis:

- Each scintillator is divided into number of positions; each position is 1 x 1 mm².
- Get average light yield of each position.
- Create light-yield map for the whole scintillator.
Data Analysis:

- Every scanned position is affected by two main factors:
  - The position of SiPM
  - Temperature variation.
### Uniformity Study

<table>
<thead>
<tr>
<th>Deviation (%)</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>+/- 5%</td>
<td>92.5</td>
<td>98.9</td>
<td>100.0</td>
</tr>
<tr>
<td>+/- 10%</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>+/- 20%</td>
<td></td>
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</tbody>
</table>
Full scan for 20x20x1 mm³ wrapped scintillator
Thank you
The Task

Before building the whole scintillator, we need first built one cell. So we do lap test on different plastic scintillator cells to answer that questions.

- What is the best cell size?
- How much can cell collect light?
- Is it have uniform response?
Calorimeter for Linear Collider (LC)

ECAL
- Tungsten
  - analog
    - Silicon
  - digital
    - Scintillator
- MAPS

HCAL
- Tungsten
- Iron
  - analog
    - Scintillator
  - digital
    - RPC
    - GEM
    - Micromegas
A. Experimental setup
Backup
CLIC: The Basis

Goal: Lepton energy frontier

Drive Beam Generation Complex

Main Beam Generation Complex

CLIC at 3TeV shown

819 klystrons 15 MW, 142 µs

Drive beam accelerator 2.4 GeV, 1.0 GHz

2.5 km
delay loop

CR1 293 m
CR2 439 m
circumferences delay loop 73 m

decelerator, 24 sectors of 878 m

819 klystrons 15 MW, 142 µs

drive beam accelerator 2.4 GeV, 1.0 GHz

2.5 km
delay loop

Main Beam

booster linac 2.86 to 9 GeV

e^+ injector, 2.86 GeV

e^- PDR 389 m  e^- DR 427 m

e^+ DR 427 m  e^+ PDR 389 m

Ta
turnaround
Damping
ring
PDR predamping ring
BC bunch compressor
BDS beam delivery system
IP interaction point
- dump

D. Schulte, Future Collider Technologies, CERN