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Cost estimate for one module of the LUXE electromagnetic calorimeter

For LUXE a Si-W sandwich calorimeters of area 550 x 55 mm2, and a depth of 20 X0 is forseen for phase 1.

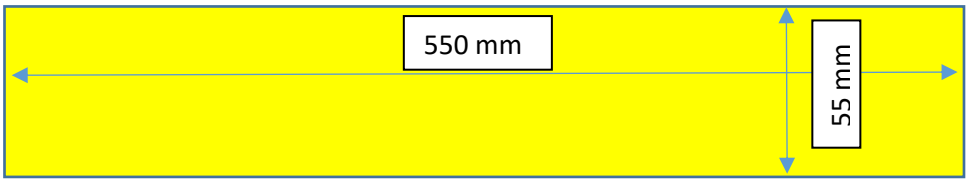

Figure 1 Front view of the calorimeter

Figure 2 Side view of the calorimeter

20 W absorber plates of 3.5 mm thickness, interspersed with silicon sensors encapsulated in C-fiber structures and Kapton flexible PCB for signal transport and HV supply

The calorimeter is subdivided in 5 modules, each 10.5x5.5 cm2 in area.

In the following a cost estimate for one module is given:

Each sensor has a size of 5.5 x 10.5 cm2. Tungsten plates are made of the same size.

The volume of one tungsten plate is 10.5 x 55 x 3.5 mm^3 = 20.21 cm^3. With the tungsten mass density ρ= 19.3 gcm^{-3} the mass per plate amounts to 0.39 kg. For 20 plates this is 7.8 kg.

Assuming a price of 180 $ per kg machined tungsten, the total price amonts to about 1500 $.

The sensor area amounts to 10.5 x 5.5 cm^2 = 58 cm^2. For one module this results to 1160 cm^2. Assuming a price about 6 $ cm^{-2}, the price for one piece is 350$, and for one module is 7000 $.

Each sensor needs two Kapton PCBs for signal transmission and HV supply. Assuming 60 $ per piece, for one module 2400 $.

In addition carbon fibre supports are needed. For these supports a price of 300 $ per piece is assumed.

The number of readout channels depends on the pad-size. Assuming 5 x 5 mm^2 pads, the number of channels per sensor is 231, and per module 4620. Assuming for ASIC production a price of 1.5 $ per channel, the cost for ASICs is about 7000 $.

In addition expenditures for ASIC prototyping, probe-cards, PCBs for FE electronics, LV and HV supplies, Crates, receiver cards and tooling are forseen. A summary is given in the following table.

LUXE calorimeter

Mechanics			
	number	price	total
tungsten plates	20	70	1400
support frames	1	4000	4000
sensor support structures	20	300	6000

Connectivity			
fan out Kapton HV	20	60	1200
fan out Kapton, signal	20	60	1200

Silicon sensors	20	350	7000

Front-end ASICs			
prototyping, ASICs	50	1000	50000
channels	5000	1,5	7500
probecard for tests	1	20000	20000

front-end electronics			
PCB and assemply	20	70	1400
auxiliary components			5000

Power supplies

HV			2000
LV			2000
cables and connectors, patch panels			5000

Data acquisition

Receiver cards	20	300	6000
crates	1	1000	1000
crate computer	1	1000	1000
racks	1	2000	2000

Tooling			30000
sum			

Engineering Personpower			1 FTEyear

The total cost estimate amounts to about 150 k$. The engineering person power is assumed to be 1 FTE year.