Cost estimate for the LUXE phase 1 electromagnetic calorimeter

July 31, 2020

One rectangular Si-W sandwich calorimeter of area 550 x 55 mm2, and a depth of 20 X0 is assumed.

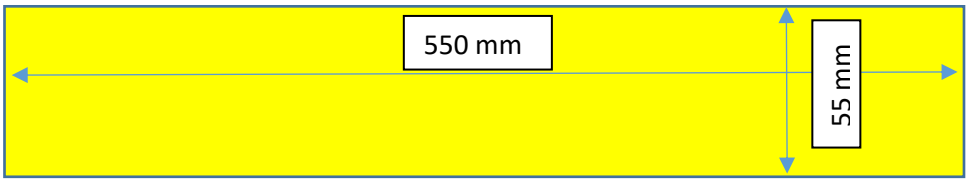

Figure 1 Front view of the calorimeter

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 cm^2 in area.

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, and for the full calorimeter 39 kg.

Assuming a price of 180 $ per kg machined tungsten, the total price amonts to about 7000 $.

The sensor area amounts to 10.5 x 5.5 cm^2 = 58 cm^2. For one module this results to 1160 cm^2 and for the whole calorimeter to 5800 cm^2. Assuming a price about 6 $ cm^{-2}, the price for one piece is 350$, for one module is 7000 Euro, and for the calorimeter about 35000 $.

Each sensor needs two Kapton PCBs for signal transmission and HV supply. Assuming 60 $ per piece, for one module 2400 $ are needed, and for the calorimeter 12000 $.

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, per module 4620, and for the calorimeter 23100. Assuming for ASIC production a price of 1.5 $ per channel, the cost for ASICs is about 35000 $.

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	100	70	7000
support frames	1	4000	4000
sensor support structures	100	300	30000

Connectivity			
fan out Kapton HV	100	60	6000
fan out Kapton, signal	100	60	6000

Silicon sensors	100	350	35000

Front-end ASICs			
prototyping, ASICs	50	1000	50000
channels	24000	1,5	36000
probecard for tests	1	20000	20000

front-end electronics			
PCB and assemply	100	70	7000
auxiliary components			15000

Power supplies

HV			8000
LV			8000
cables and connectors, patch panels			20000

Data acquisition

Receiver cards	100	300	30000
crates	5	1000	5000
crate computer	5	1000	5000
racks	1	2000	2000

Tooling			30000
sum			324000

Engineering Personpower			2 FTEyears

The cost for one Luxe ECAL amount to 324 k $. The engineering person power is estimated to be 2 FTE years.