

SHMS CALORIMETER

A short description of construction

R&D studies, design, assembling and installation of the SHMS calorimeter were performed by Yerevan Physics Institute group as part of Hall C 12 GeV upgrade.

The SHMS calorimeter consists of two parts (see Fig. 1): the main part at the rear (Shower), and Preshower before the Shower to augment PID capability of the detector. Modules from retired HERMES and SOS calorimeters are used in Shower and Preshower parts respectively. The Shower is 18.2 radiative length deep and almost entirely absorbs showers from ~ 10 GeV electromagnetic projectiles, and Preshower is 3.6 radiation length thick.

The SHMS Preshower radiator consists of a layer of 28 TF-1 type lead glass blocks stacked in two columns in an aluminum enclosure (not shown in Fig. 1). The PMT assemblies, one per block, are attached to the left and right sides of the enclosure via 90 mm circular openings. The lead glass blocks and PMTs are same as in the HMS calorimeter (see <https://hallcweb.jlab.org/DocDB/0008/000809/001/NIMarticleOverview.pdf>). The XP3462B 3" PMTs are coupled to the blocks using ND-703 Bycron grease of refractive index 1.46.

To minimize dead material, the blocks are optically insulated by a layer of 50 μm thick reflective aluminized Mylar (with Mylar layer facing the block surface), then 50 μm thick black Tedlar film only. Every other block is wrapped with a 10 cm wide strip of Tedlar, to cover its top, bottom, left and right sides but the circular openings for the PMT attachments. Insulation of the remaining front and back sides of the blocks are provided by facing inner surfaces of the front and rear plates of the enclosure, covered also with Tedlar. In addition, a layer of Tedlar separates the left and the right columns.

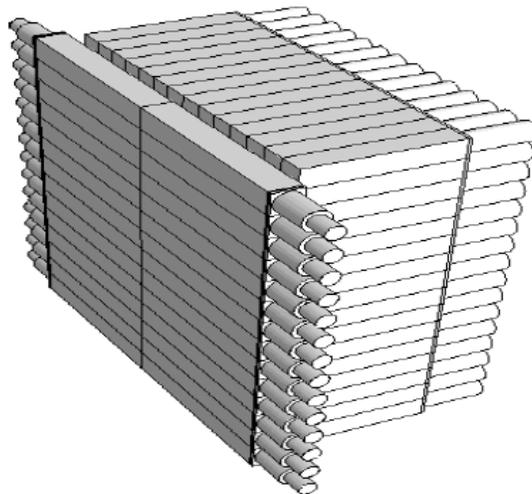


Fig.1: A sketch of SHMS calorimeter. Shown are Preshower (on the left) and Shower parts. Support structures are omitted.

The Shower part consists of 224 modules stacked in a “fly eye” configuration of 14 columns and 16 rows. $\sim 120 \times 130 \text{ cm}^2$ of effective area of detector covers the beam envelope at the calorimeter. Each F-101 block is coupled to a 3” XP3461 PMT from Photonis, with green extended bialkali photocathode, of the same sizes and internal structure as the XP3462B in the HMS calorimeter and in the Preshower. Typical quantum efficiency of the photocathode is $\sim 30\%$ for $\sim 400 \text{ nm}$ light, and the gain is ~ 106 at $\sim 1500 \text{ V}$. Silgard-184 silicone glue of refractive index 1.41 is used for optical coupling of the PMTs to lead-glass blocks.

Calorimeter Electronics: The raw anode signals from the Shower and Preshower PMTs are taken from the detector to the SHMS hut electronics room through ~ 30 feet RG58 cables. The Preshower signals go through 50:50 splitter. Then one output goes to fADC, and another to FAN-IN/OUT Summing Module. The four partial sums shown below are fed to patch panel in the hut. The combination of each sum can be changed if needed, and trigger logic and discrimination of signals shall be set up in the Counting Room. The SUM signals are set up as follows:

Pre-Shower NEG (SUM)	Pre-Shower POS (SUM)	Partial SUM	PATCH PANEL
(1-4)-	(1-4)+	1 - 4	E257
(5-8)-	(5-8)+	5 - 8	E258
(9-12)-	(9-12)+	9 - 12	E259
(13-14)-	(13-14)+	13 - 14	E260

The signals from all Shower PMTs are fed directly to fADC.