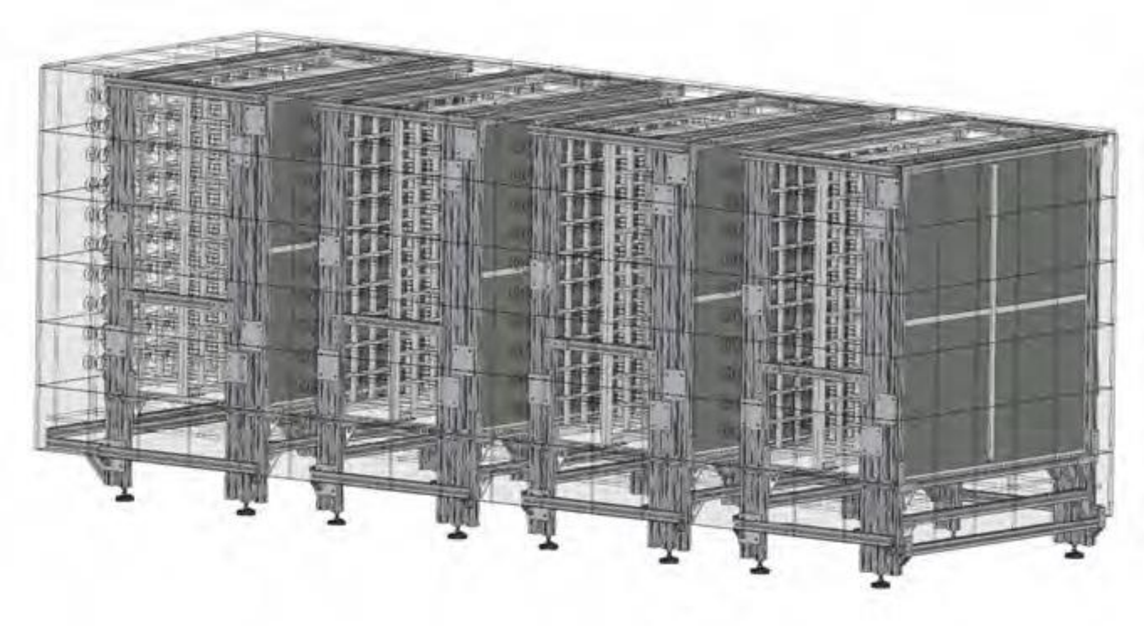


Richard Soluk – MoEDAL Collaboration (Technical Coordinator)
University of Alberta

MAPP LHCC REFEREE QUESTIONS

PMTs

MoEDAL

- *It's mentioned that the HZC PMTs will be partially replaced by Hamamatsu PMTs (100). Would you be able to clarify more how this is implemented and the possible differences, as the two types of PMTs presumably have a different performance?*

  Also, are the 100 PMTs from Hamamatsu just put together in the same section? What I am wondering is possible differences and asymmetries between the different PMTs that would need to be taken into account.

- The first two MAPP frames will already be installed so the 100 Hamamatsu PMTs will be distributed in the 3rd and 4th frame. Intermixing detectors with HZC and Hamamatsu PMTs will allow one to one comparisons between the two using both cosmic ray and LHC muons

PMT Characteristics

- The HZC and Hamamatsu PMTs have very similar characteristics
- The HZC tube has a lower dark current but also a lower gain
- The photocathodes have slightly different responses
- Difference between PMTs not expected to be observable

	HZC Photonics XP72B22	Hamamatsu R14374
Tube Size	3-inch	3-inch
Tube shape	Circular	Circular
Window material	Borosilicate glass	Borosilicate glass
Photocathode	Bialkali	Bialkali
Spectral response	300 -650nm	300-650nm
Quantum efficiency	25% at 404 nm	27% at 380nm
Gain	3×10^6	10^7
Rise time	3.5 ns	2.9 ns
Anode dark current	10 nA	50 nA
Maximum operating voltage	1300 V	1500 V

Detector Calibration

MoEDAL

- *Could you clarify the calibration or pre-calibration performed before the scintillators and PMTs are installed. You mention that in section 2.1.2, but it would be good to highlight what "pre-calibration" is done in the lab and whether it appears in the resource-loaded spreadsheet.*

- A pre-calibration will be carried out on 25% of the bars using cosmic rays in a system that allows us to test 4 bars at a time. Test will be performed with the bars placed both vertically and horizontally.

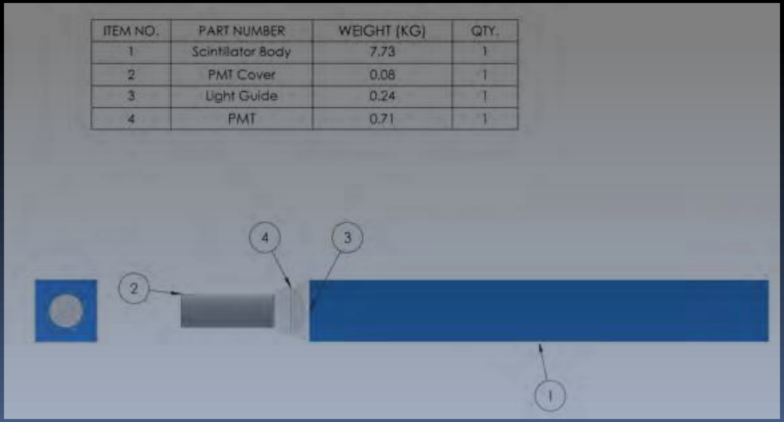
- These bars will be placed on the top layer of each section. During the run, vertical cosmic rays that traverse all layers of scintillator will be recorded allowing a cross-calibration of all bars against these pre-calibrated ones.

Muon Trigger

MoEDAL

- *What is the efficiency of the muon trigger described on page 11?*

- Trigger = Hits in 4 bars and 3 photon tagging with no veto
- The muon signal in the main bars is too large to be missed unless it falls into the detector deadtime between events
- Pb-scintillator photon tagging detector efficiency for MIPS will be high but must be directly measured with final detector
- Effect of VETO panels on muon trigger efficiency depends on rate, must be measured in situ. However, we use software not hardware triggers so these events are not automatically rejected



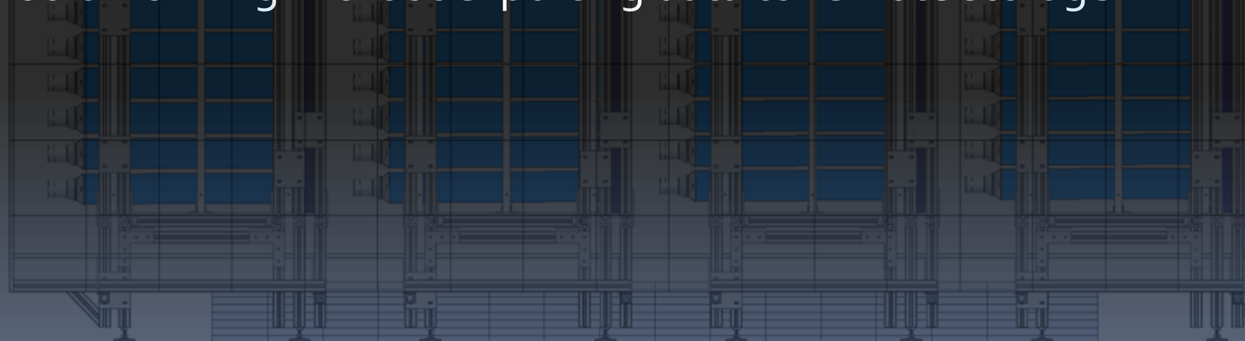
ITEM NO.	PART NUMBER	WEIGHT (KG)	QTY.
1	Scintillator Body	7.73	1
2	PMT Cover	0.08	1
3	Light Guide	0.24	1
4	PMT	0.71	1

Data Storage

MoEDAL

- *Could you clarify what the storage is with the onsite computer in case the 1 Gbit/s ethernet link to an external computer doesn't work? Would you lose any data in case of a failure or inability to send the data outside?*

- The DAQ server will have local disk storage of 40TB
- Initially the fewest possible restriction will be applied to the trigger and the data rate will be limited by storage write speeds
- During normal running the data rate will be well below 1TB/day allowing an extended period of running without exporting data to remote storage



Signal Yield

MoEDAL

- *What is the signal yield you expect out of a bar for a muon that travels the whole length? In the calibration section (2.1.2), it is said that a MIP will produce 3 x 10^6 photons in 4 bars. What is much more relevant to judge the possible limits on fractional charges is however how many of those photons will be detected by their system. We don't think this is mentioned.*

- Nominal output from the scintillator is 9.7k photons/MeV
- A MIP traversing a bar should produce roughly 1.5M photons
- Realistic light collection efficiency about 5%
- If light production goes as Q^2 then a charge of 0.004 should produce approximately 1PE per bar