

Assembling and Testing the Resistive Bases for the ECAL of JLab Hall A

Mahmoud Gomina



Outline

Background

Bases

LV Test

HV Test

Conclusion/Post testing

Background

JLab Hall A Super BigBite Spectrometer (SBS) and Electromagnetic Calorimeter (ECAL)

- SBS: designed for electric and magnetic form factors measurement.

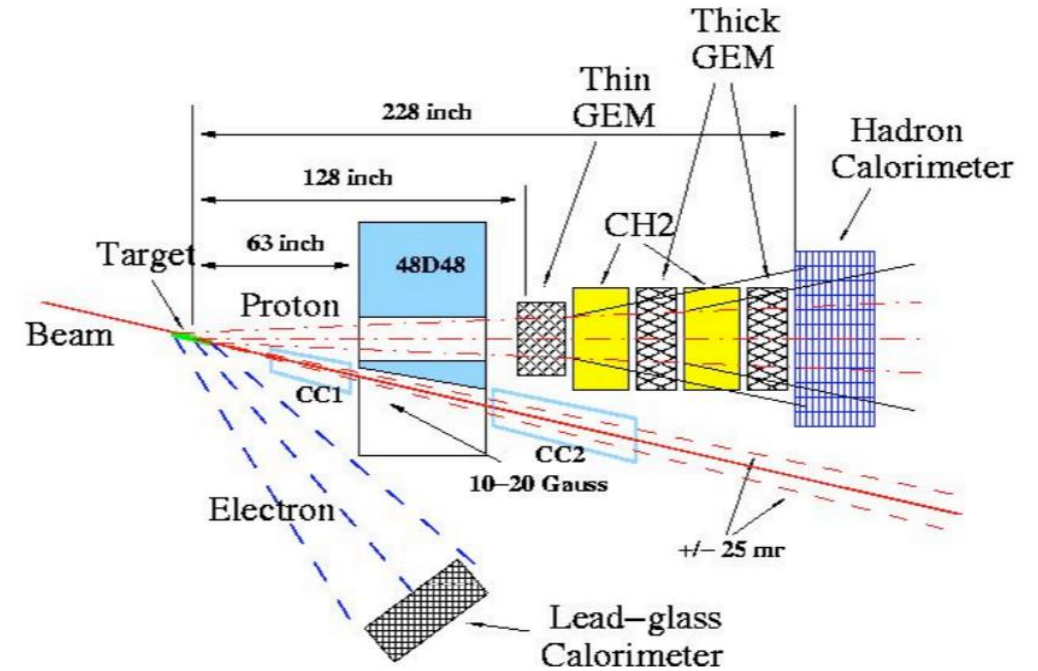


Fig. 1: SBS layout^[3]

Background

JLab Hall A Super BigBite Spectrometer (SBS) and Electromagnetic Calorimeter (ECAL)

- SBS: designed for electric and magnetic form factors measurement.
- ECAL: made up of 193 Super Module (SM) to be assembled for the SBS's electron arm.
- This detector consists of 1737 lead-glass blocks ($42.5 \times 42.5 \times 340 \text{ mm}^3$) viewed via 150-mm long light guides by FEU-84 PMTs.^[1,2]

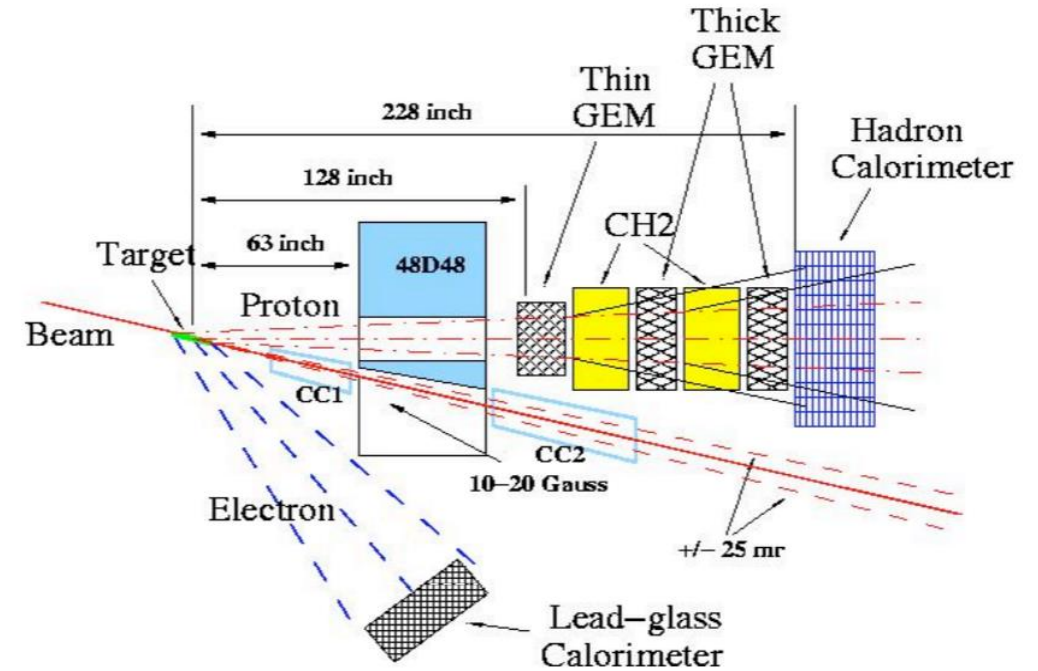


Fig. 1: SBS layout^[3]

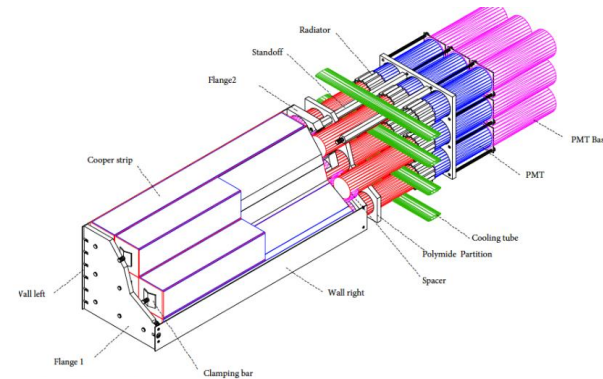


Fig. 2: SM (with 9 Pb glass blocks) schematic^[4]

Background

JLab Hall A Super BigBite Spectrometer (SBS) and Electromagnetic Calorimeter (ECAL)

- SBS: designed for electric and magnetic form factors measurement.
- ECAL: made up of 193 Super Module (SM) to be assembled for the SBS's electron arm.
- This detector consists of 1737 lead-glass blocks ($42.5 \times 42.5 \times 340 \text{ mm}^3$) viewed via 150-mm long light guides by FEU-84 PMTs.^[1,2]
- The PMT HV bases have been modified and are now being tested before final assembly of the ECAL.

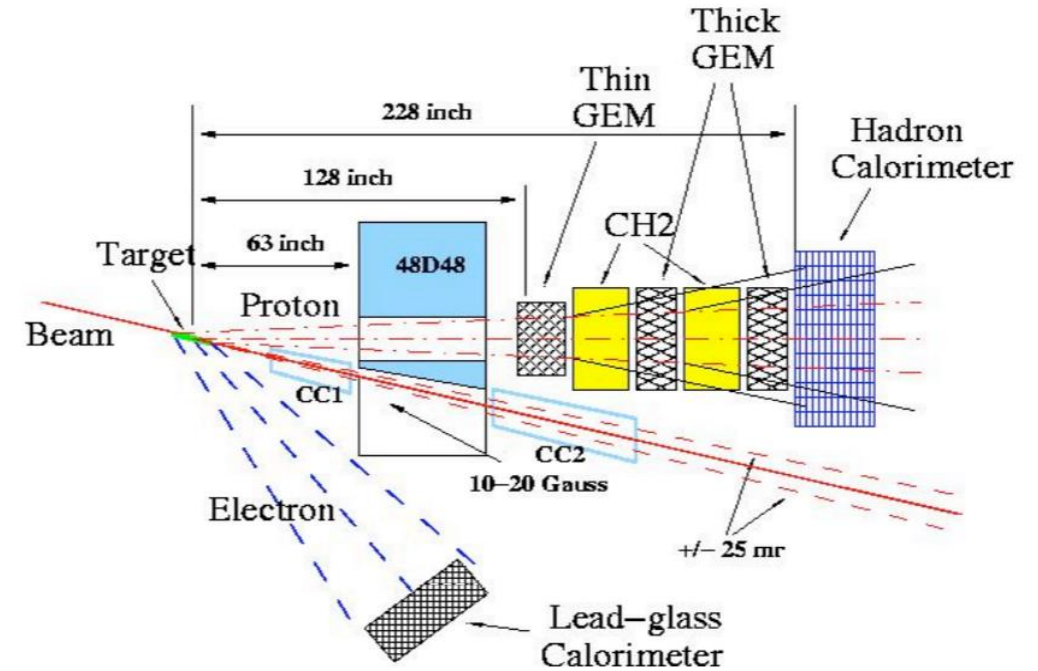


Fig. 1: SBS layout^[3]

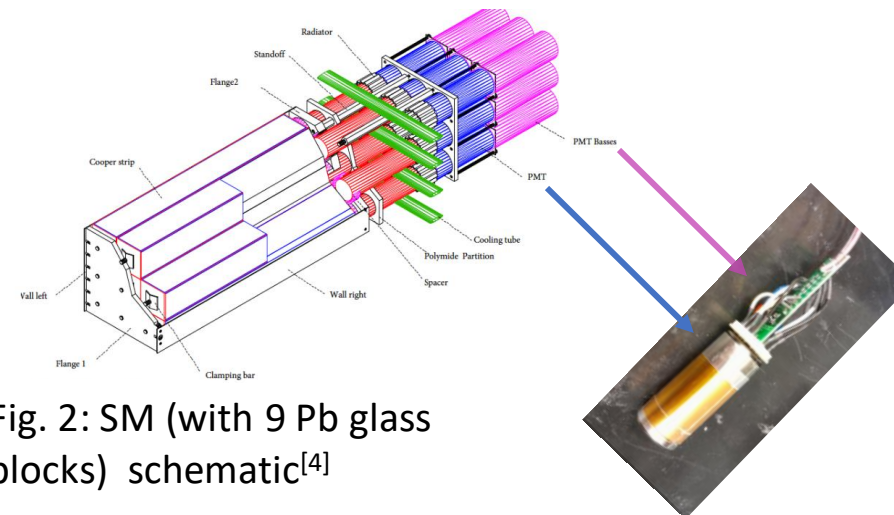
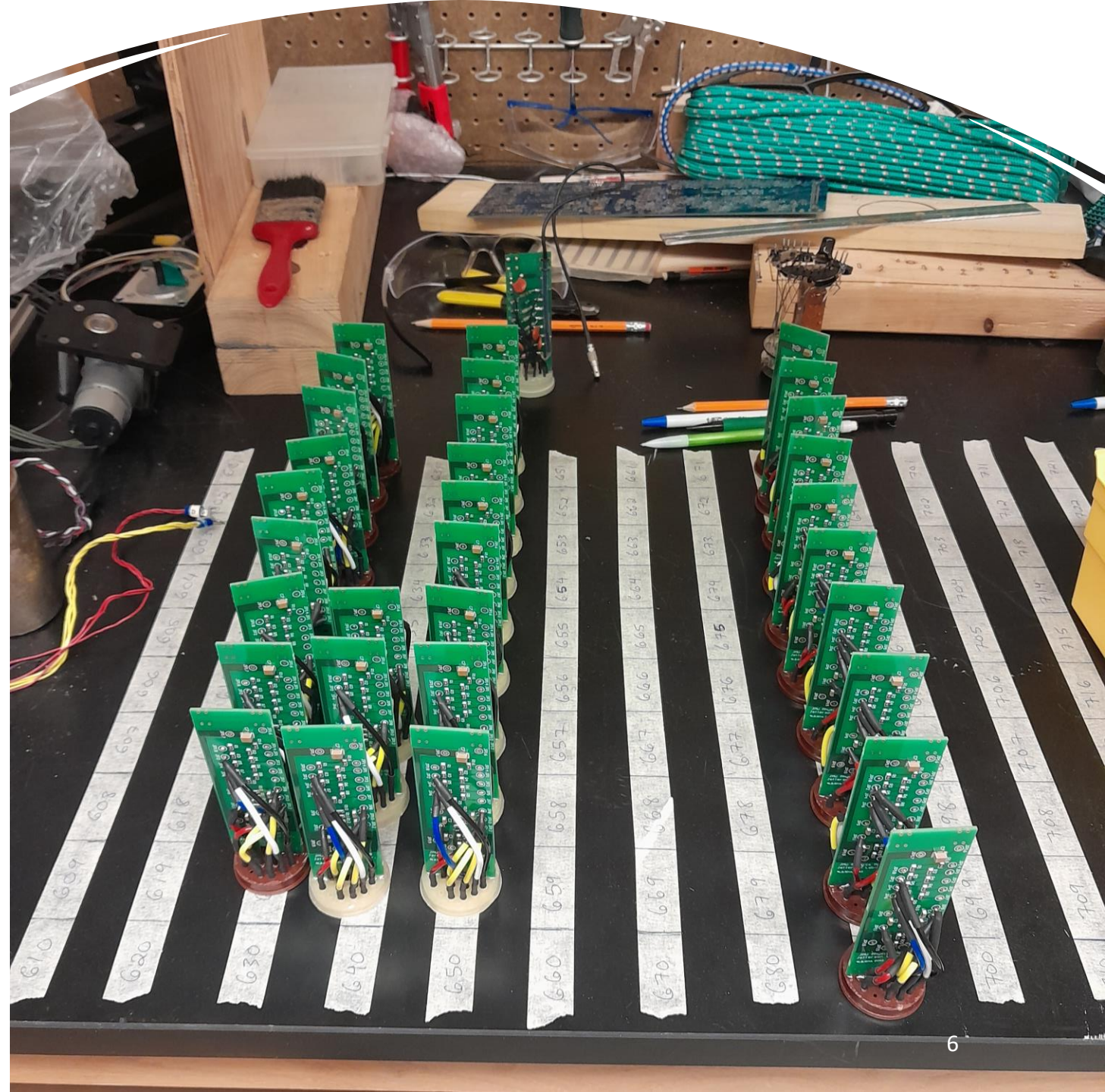


Fig. 2: SM (with 9 Pb glass blocks) schematic^[4]

Bases Assembly



Soldered Resistive Bases



Figure 3: Soldering workstation

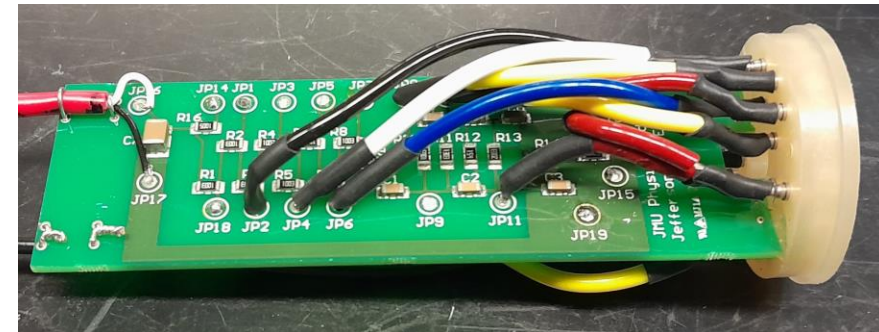
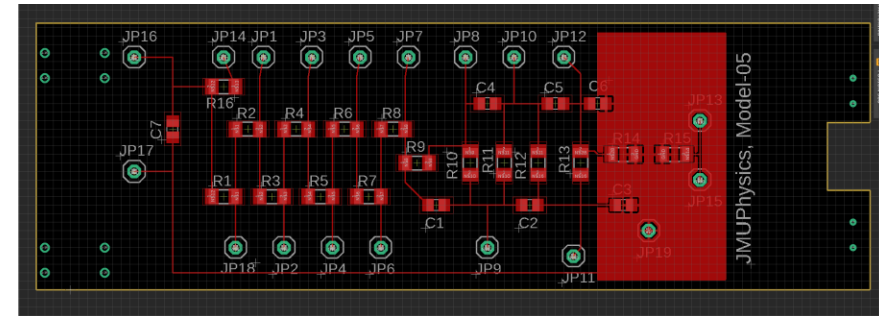


Figure 4: JMU EAGLE Board View and Soldered Board (Model 5)



Resistive Bases Test

LV Test



Fig. 6: LV test system with raspberry pi

LV Test



Fig. 6: LV test system with raspberry pi

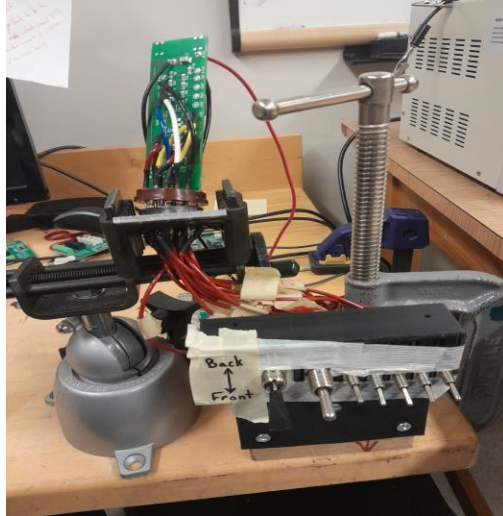


Fig. 7: Mounted base for LV test

Fig. 8: EAGLE Schematic and expected JP ratio for LV test

LV Test



Fig. 6: LV test system with raspberry pi

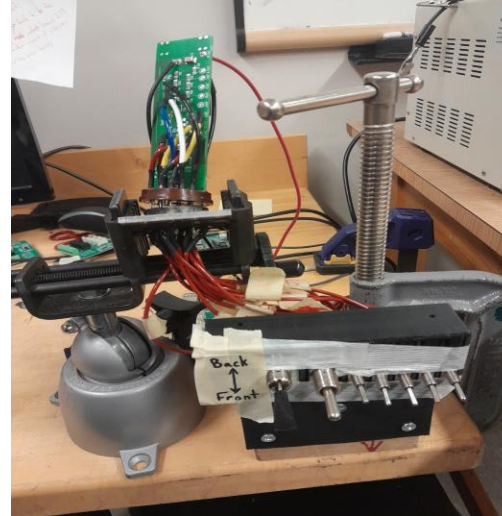


Fig. 7: Mounted base for LV test

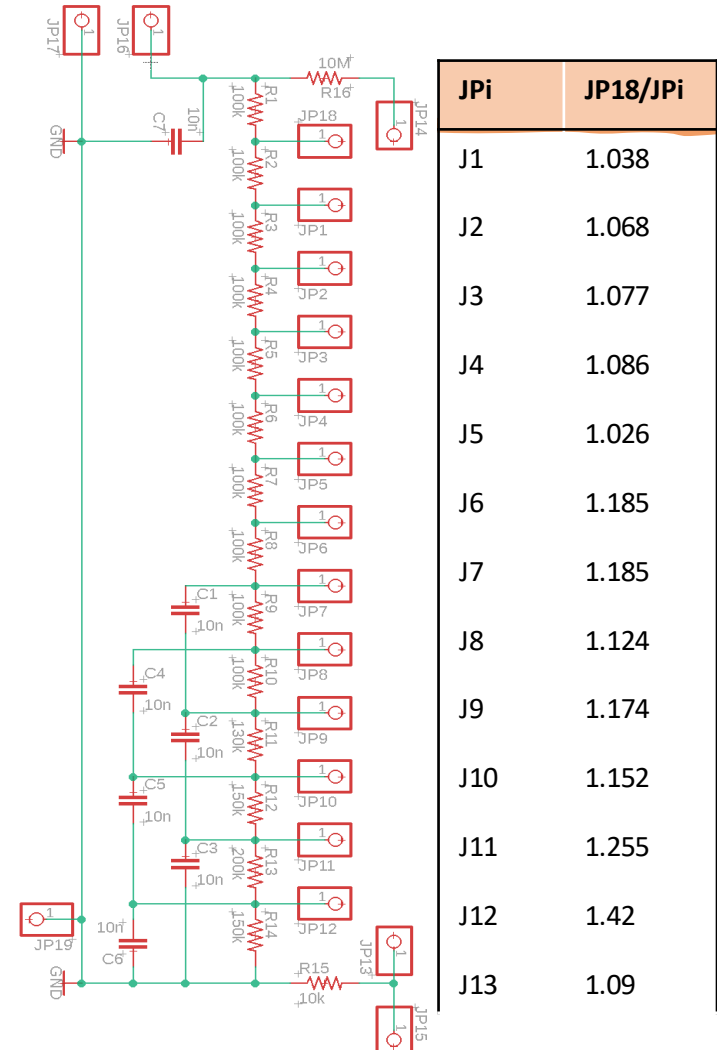


Fig. 8: EAGLE Schematic and expected JP ratio for LV test

LV Test



Fig. 6: LV test system with raspberry pi

The ratio $JP18/JPi$ is independent of input voltage and indicates faulty JP that may have resulted from bad soldering and/or bad resistor.

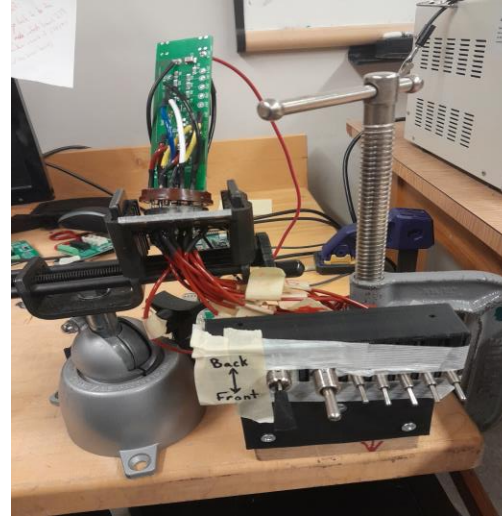


Fig. 7: Mounted base for LV test

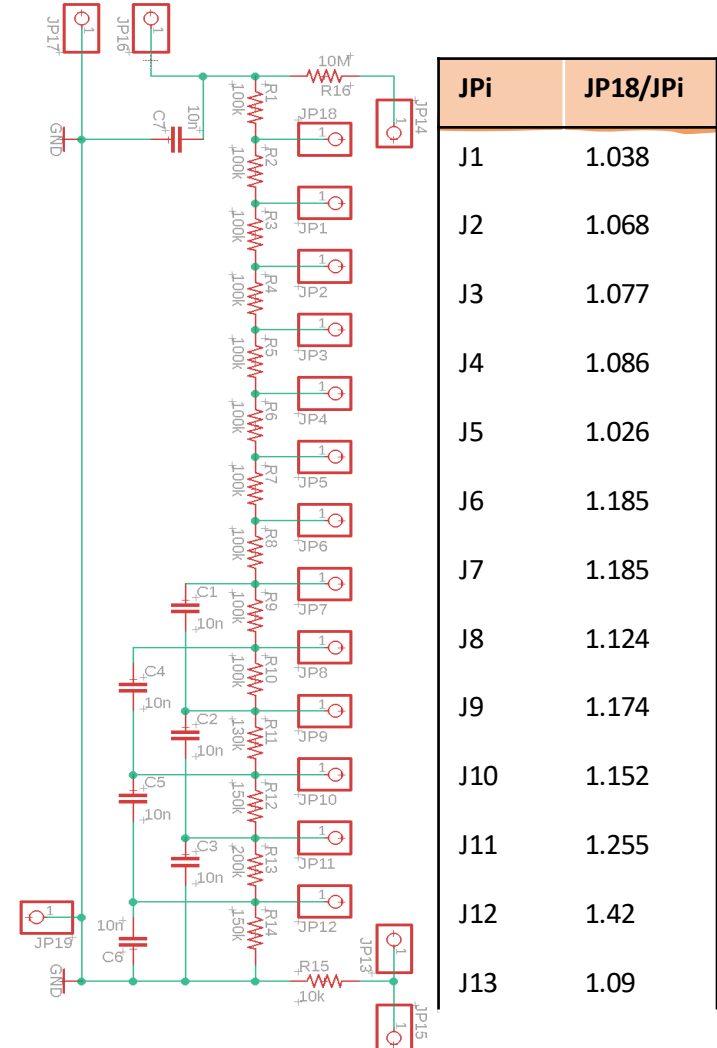
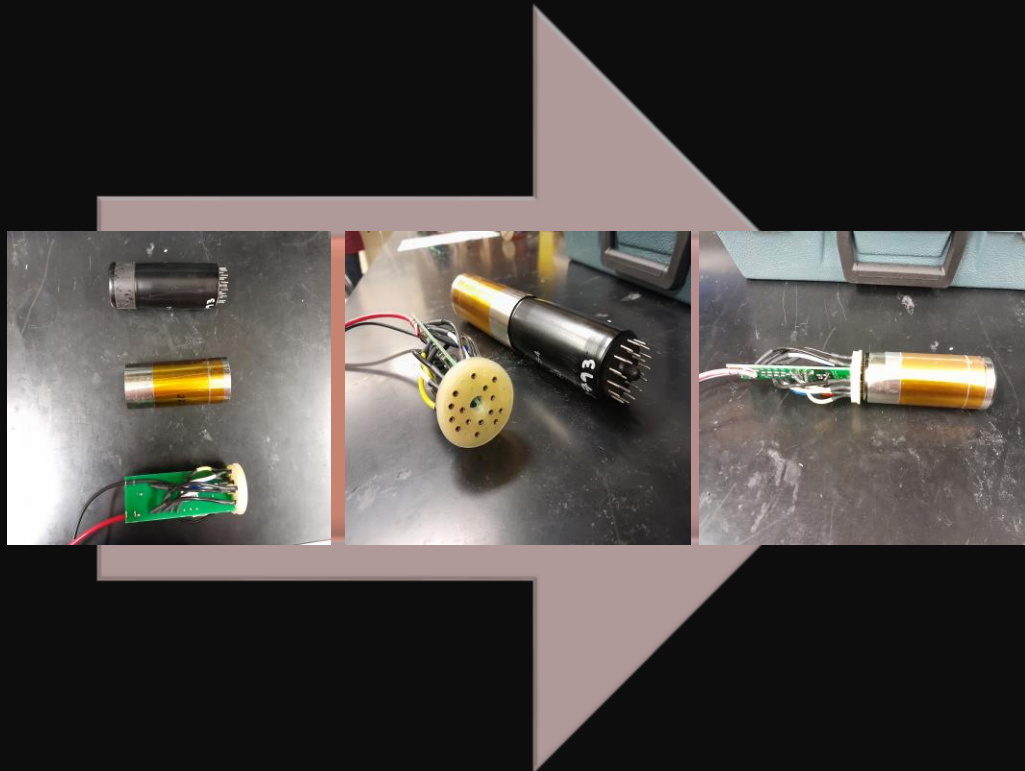


Fig. 8: EAGLE Schematic and expected JP ratio for LV test

HV Test

Couple base and PMT then plug into test port.

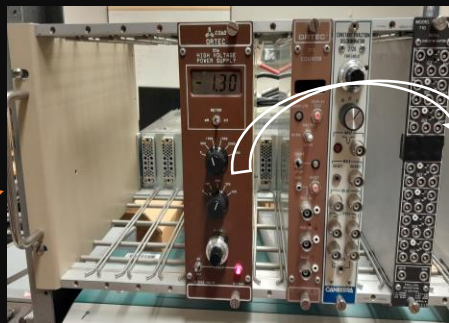
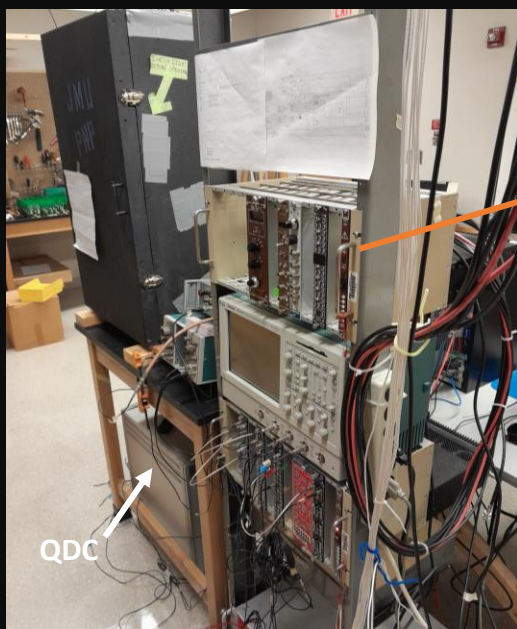


Check (OFF): HV supply and pulse generator before opening test box

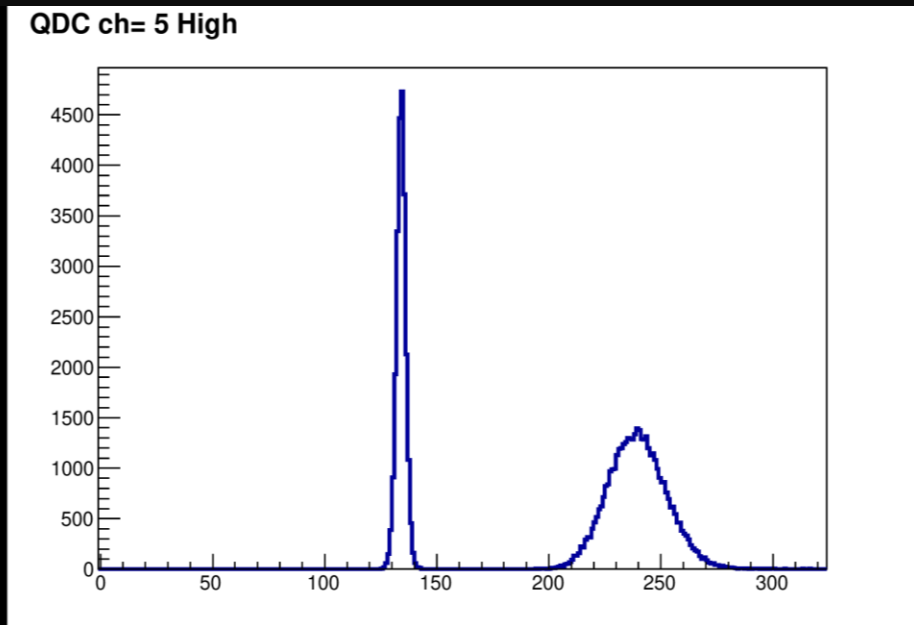


Close box then **turn ON** the HV source...

HV Test

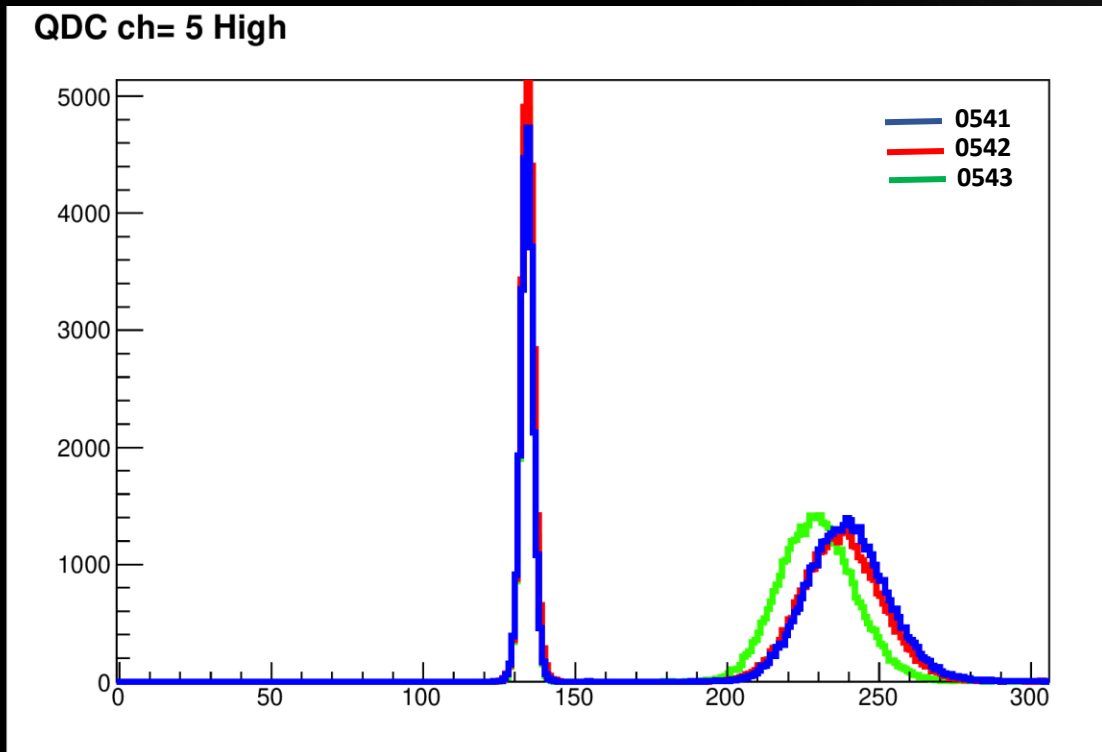


tune (gently) to 1.3kV



QDC HV Test read-out for single base (0541)

PMT Dependence on the Resistive Bases?



| Run # | Base | Gain ($\times 10^5$) |
|-------|------|------------------------|
| 8160 | 0544 | 2.38 |
| 8161 | 0545 | 2.35 |
| 8162 | 0546 | 2.32 |
| 8163 | 0547 | 2.40 |
| 8164 | 0548 | 2.44 |
| 8165 | 0549 | 2.42 |
| 8166 | 0550 | 2.47 |
| 8167 | 0541 | 2.38 |
| 8168 | 0542 | 2.43 |
| 8169 | 0543 | 2.36 |

Remark:

- The HV tests were done separately for different bases but with the same FEU-84 PMT.
- Bases 0541 and 0542 pulses overlap indicates similar pulse feedback, with minimal gain over 0543.
- Similar performance is expected for all bases to be connected to the the FEU-84 PMTs.

Conclusion

- 1000+ bases assembled and tested at JMU.
- Assembled bases are scheduled to be delivered to JLab for final ECAL & SBS assembly this summer (2023).

References

[1] https://www.jlab.org/exp_prog/proposals/19/E12-07-109%20Update.pdf

[2] https://www.jlab.org/div_dept/physics_division/dsg/notes/2019-32%20Assembly%20of%20Electromagnetic%20Calorimeter%20Supermodules%20for%20the%20Hall%20A%20BigBite%20Spectrometer.pdf

[3] <http://epd.yerphi.am/12.02.2020A.Shahinyan.pdf>

[4] https://hallaweb.jlab.org/wiki/images/4/43/Ecal_update_may2017.pdf

Thank you