Testing Photomultiplier Tube Gain for use in Hall A at Jefferson Lab
Project intro

- Testing PMTs for use in the SuperBigBite spectrometer
What is a PMT?
How does a PMT work?
What is Gain?

- Gain is the final charge vs. the initial charge
- Why do we need to calculate gain?
- For our purposes:

\[ Gain = \frac{\sigma^2}{e\mu} \]
Gain vs. HV

Gain vs. HV

\( \chi^2 / \text{ndf} \quad 4.762 / 3 \)

- Constant: 6.95 ± 0.3737
- Slope: 0.004069 ± 0.0002106

Gain vs. HV

\( \chi^2 / \text{ndf} \quad 1.266 / 5 \)

- Constant: 7.259 ± 0.1316
- Slope: 0.004135 ± 7.64e-05
Large number of PMTs

Testing procedures:
- Increment voltages
- Batches
- 2-inch PMT used to check consistency of light source
Testing Workflow

• Place 7 new PMTs into box
• Update database
• Open HV controller
• Connect to Raspberry Pi for LED control
• Connect to DAQ
• Set HV to first increment
• Wait 30 minutes
• Set LED to off
• Start DAQ
• After 1 minute, turn LED on
• Stop run
• Analyze data
• Repeat for each HV increment
Graphical User Interface (GUI)

- Why do we need a GUI?
- Creating and running a template
Merging Pedestal Information in same file

- What is a pedestal?
- Merging the pedestal and the test in the same file
Raspberry Pi controlled LED

- SSH connection to main computer
- Controls power supply that powers the LED
Conclusions

- 10% of PMTs have been tested
- About 80% good vs. 20% unusable PMTs
- New, fully automated system