

PMT Calibration

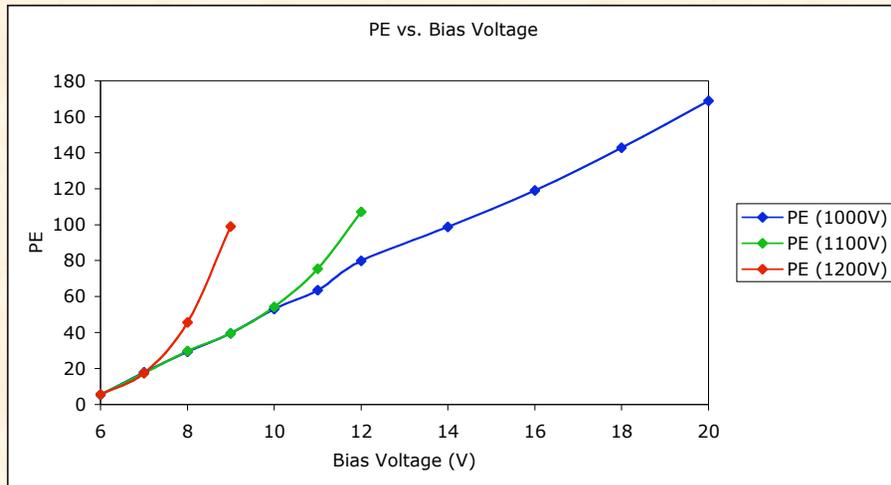
Bryan Musolf

Goals

- Transform raw data into graphs for 30 PMTs
- Observe how the gain and # of photoelectrons (PE) change as a LED intensity changes
- Observe how the gain and # of PE change as high voltage changes
- Find the stable region of each PMT by analyzing the noise
- Extrapolate PMT data
- Ensure the linearity of each PMT
- Further test the PMTs

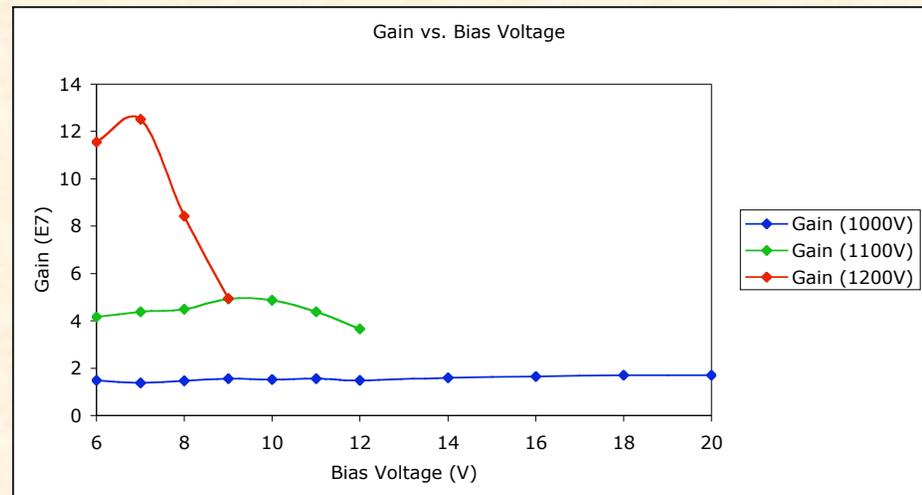
LED intensity

- Increasing the LED intensity while keeping the high voltage constant



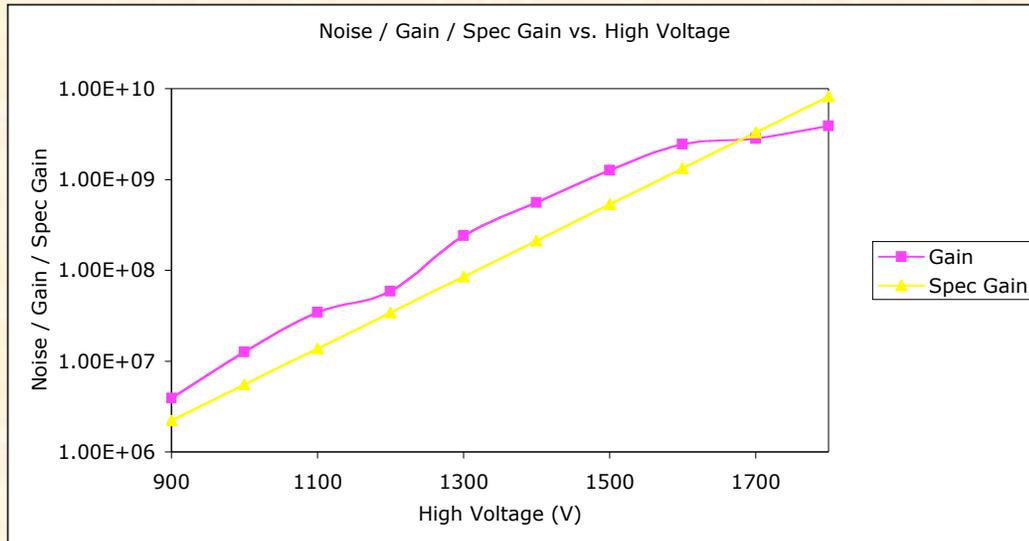
As the PMTs become saturated the PE cannot be measured accurately

As the PE cannot be measured the gain is no longer constant



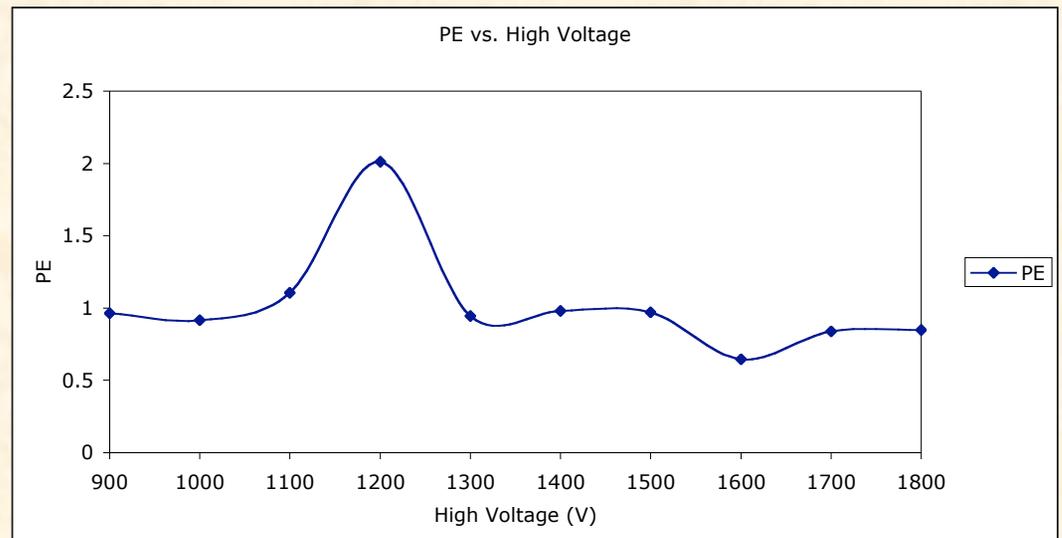
High Voltage

- Increasing the high voltage while keeping the LED intensity constant



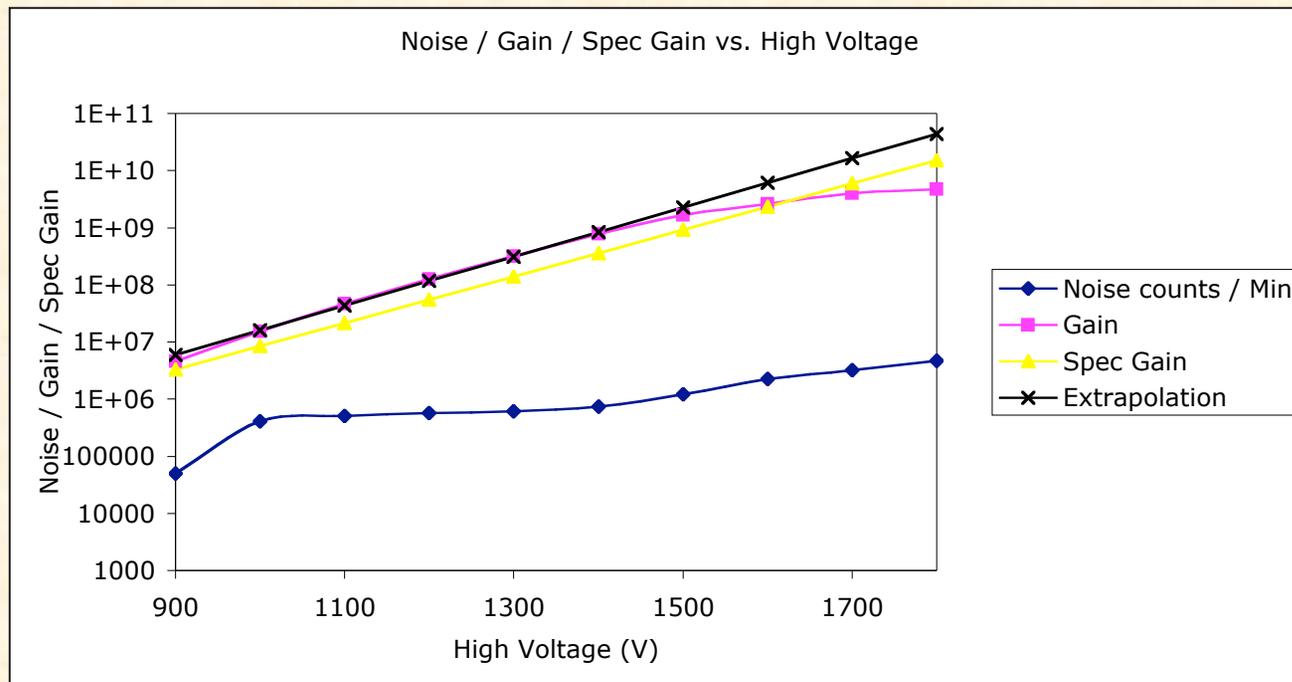
Comparing the experimental gain vs. the specification gain from the company

Approximately 1 PE should be hitting the PMT for these tests. This plot ensured that.



Noise counts / min and Extrapolation

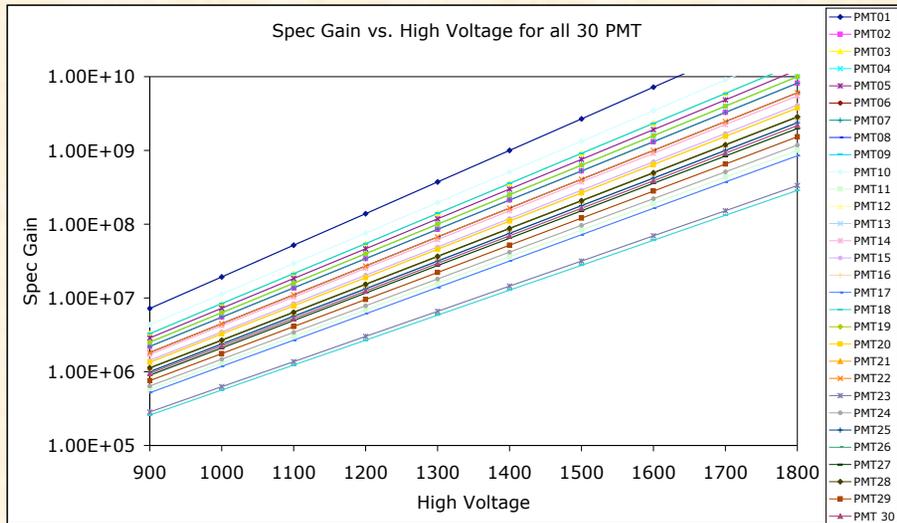
- We then added the noise counts / min to find the stable region of each PMT
- We also extrapolated the data to find the high voltage that would give us a gain of $5E7$



Our gain of $5E7$ is right in the stable region of the PMT

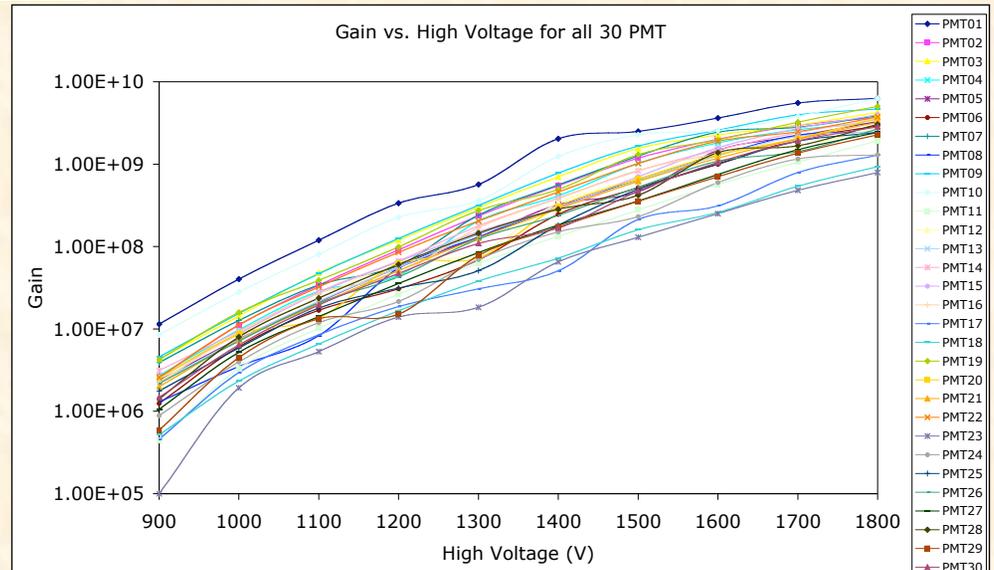
All 30 PMT

- Spec gain vs. high voltage and gain vs. high voltage for all 30 PMT



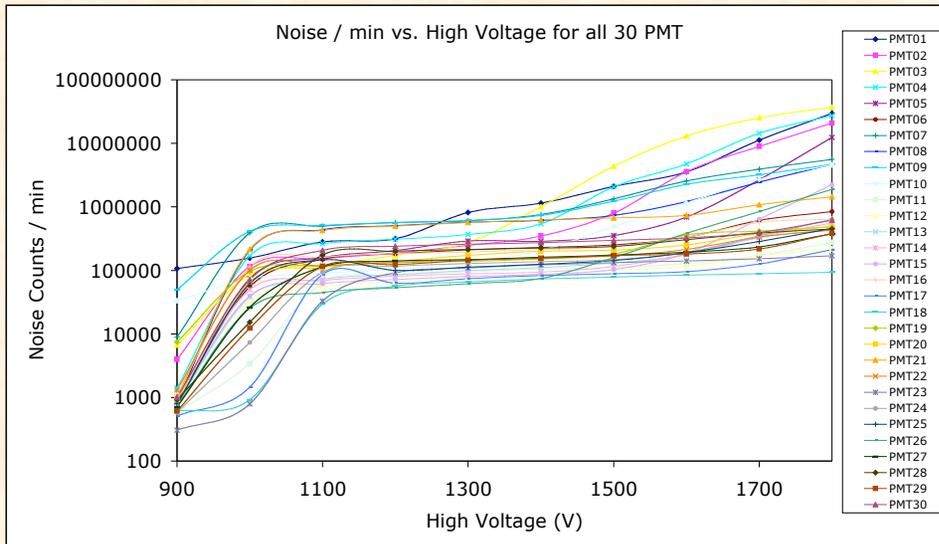
Our measured gain closely reflects the spec gain given to us by the company

Gain plot starts to break down when PMTs start to become saturated



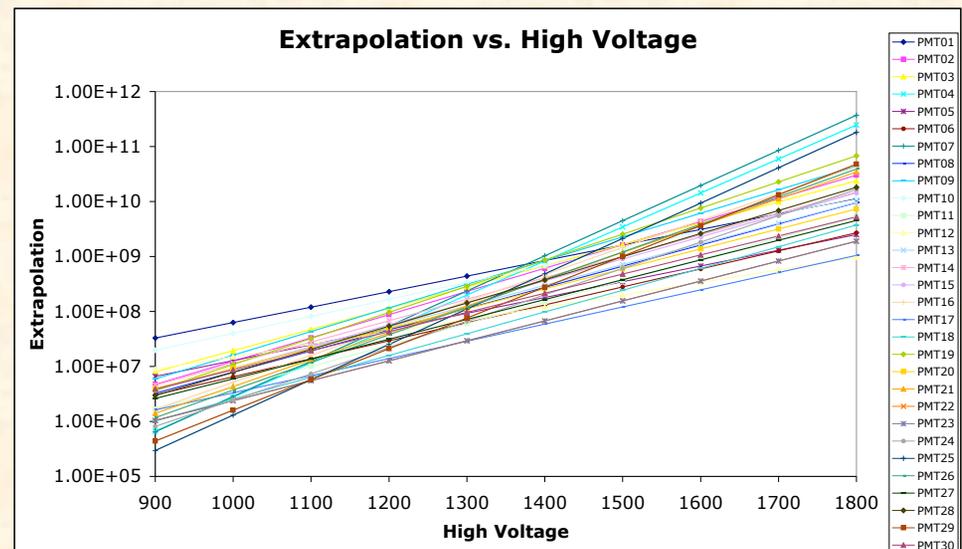
All 30 PMT

- Noise vs. high voltage and the extrapolation for all 30 PMT



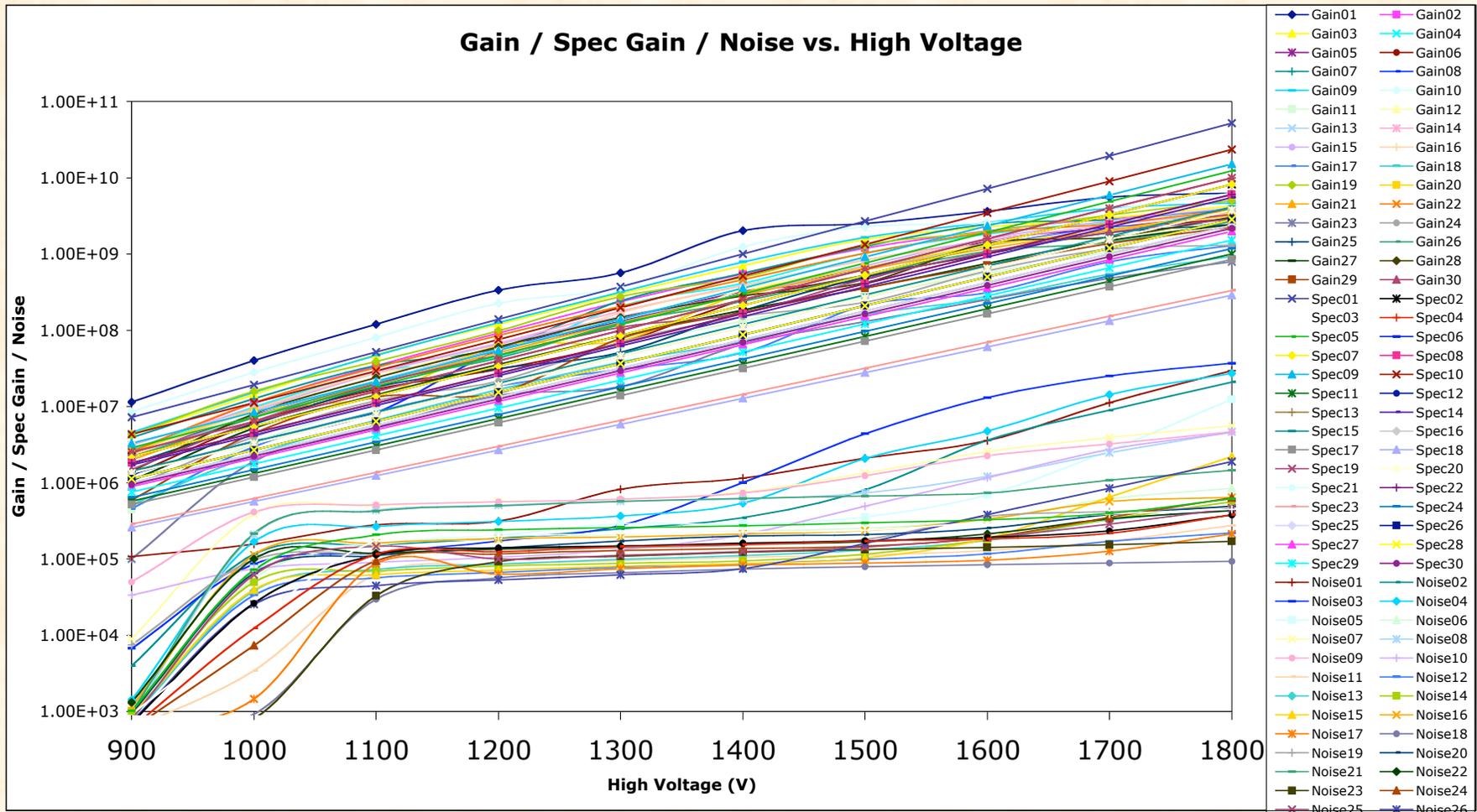
We have some very nice PMTs!!

The extrapolation data will allow us to set high voltages to get specific gains



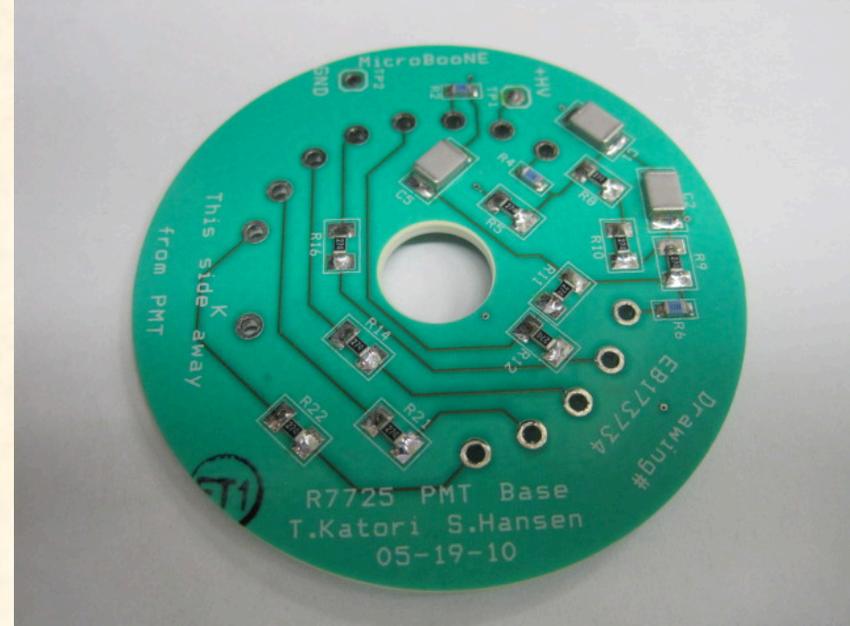
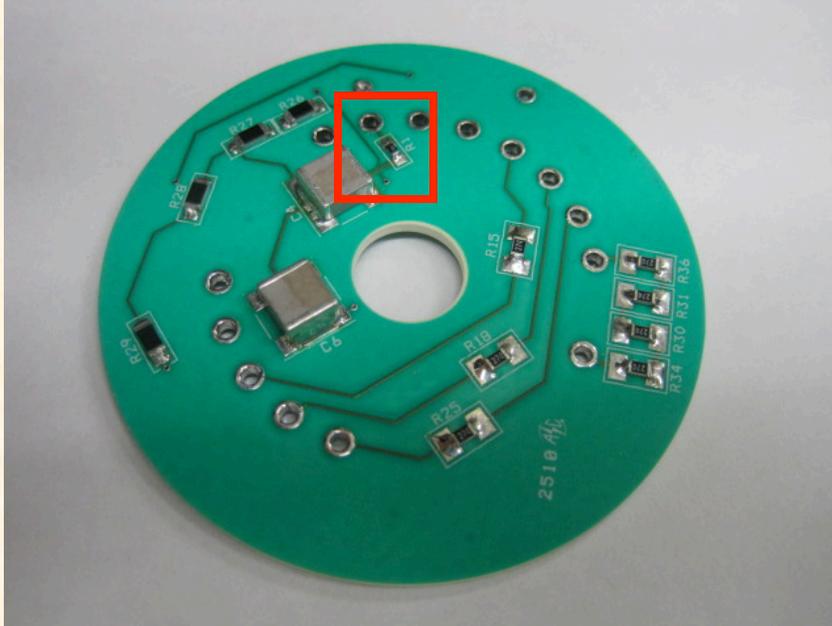
All 30 PMT

- Gain / Spec gain / Noise layered



Further testing

- We found that some of the PMT bases were broken and needed to be repaired
- In particular, R1 seemed to be the problem on most



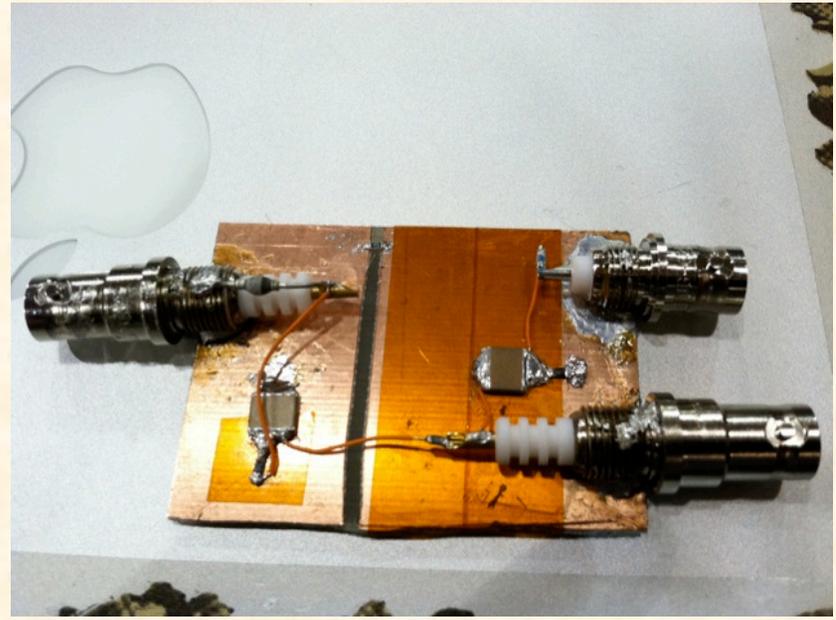
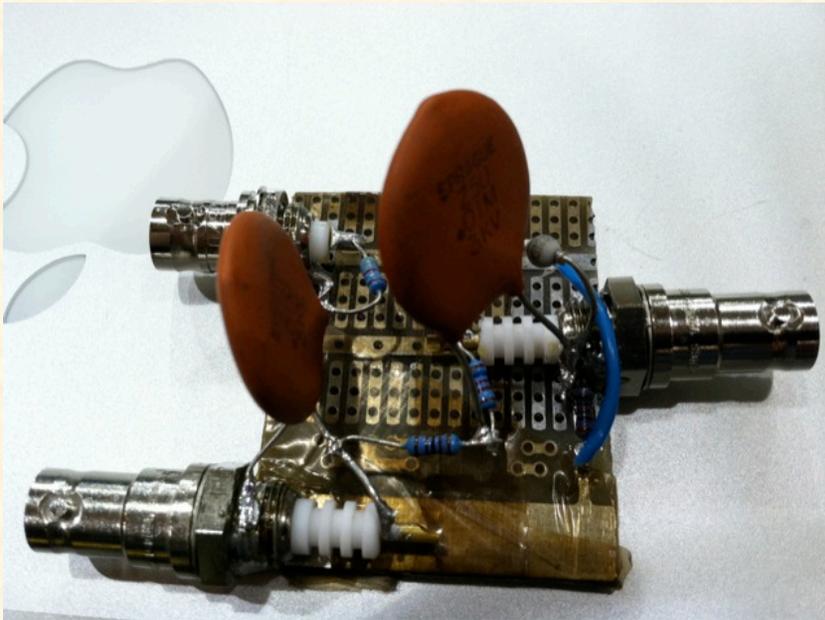
Further Testing

- After fixing the bases we needed to make sure the PMT bases could withstand the LAr we would be using them in



Further Testing

- We also needed to make some splitters so we could connect the PMTs to a high voltage source and an oscilloscope to take measurements



Needless to say, I got a little bit more efficient!

Further Testing

- We ran one test in liquid nitrogen
- Everything held up and we got a nice signal
- Testing in liquid nitrogen or LAr will be ready soon

