NPS Anode current measurements
Status update

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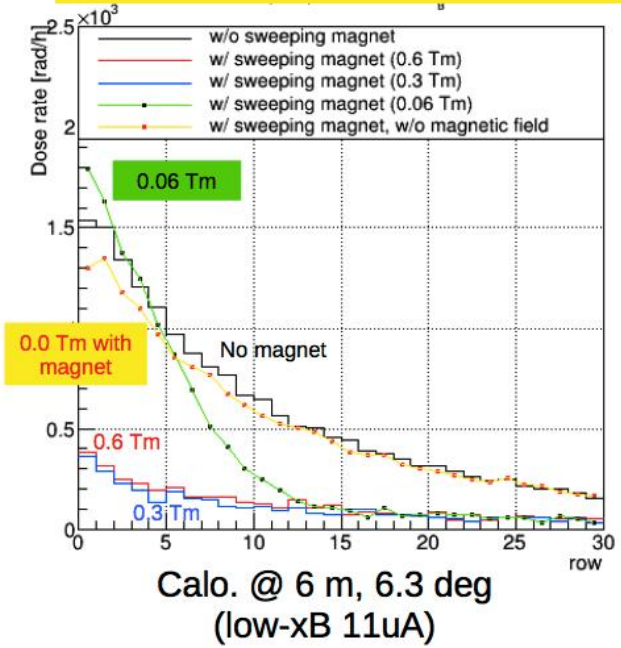
Anode current problem

Ho-San Ko talk at NPS/CPS colab meeting 2020:

Anode current of the background w/o magnetic field shielding



Calo. @ 6 m, 6.3 deg
(low-xB 11uA)

Max dose ~ 400 rad/hr → ~ 0.25 GeV/50ns
→ ~ 4X10^3 p.e./50ns (15p.e./MeV)

PMT gain : 10^6

→ ~ 4X10^9 p.e./50ns → ~ 6X10^-10 C/50ns
→ ~ 13 mA anode current.

High Q^2 setting's max dose (50uA) : ~ 2500 rad/hr
→ ~ 80 mA anode current.

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Steps toward solution:

- Verify background anode current Monte Carlo calculations
- Reproduce NPS experimental conditions at the laboratory test bench
- Measure anode current for original NPS divider
- Modify divider in order to reduce anode current to 0.5-1 uA by combination of gain adjustments like shortening last dynonds and tuning of applied HV
- Measure characteristics of modified divider

Anode current measurements with LED; setup

1) NPS environment background:

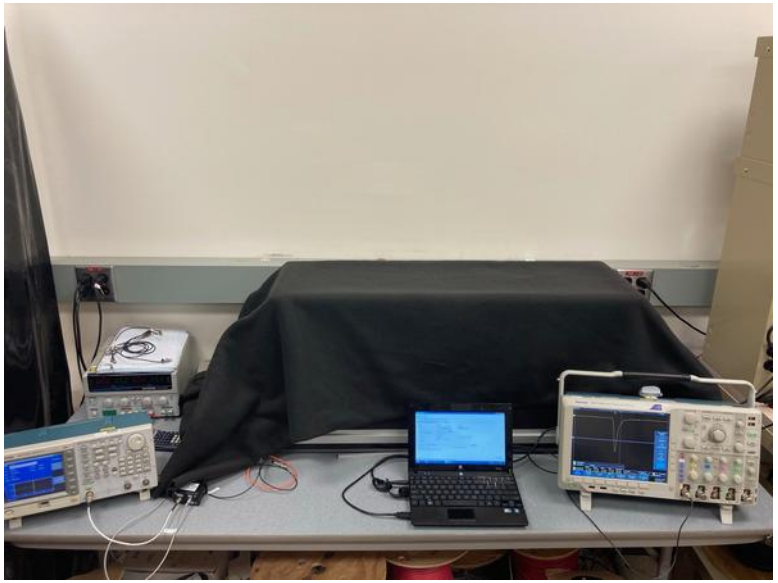
dE/dx ~**250MeV** (correspond to ~ **597 pC** charge) in **50**ns time window

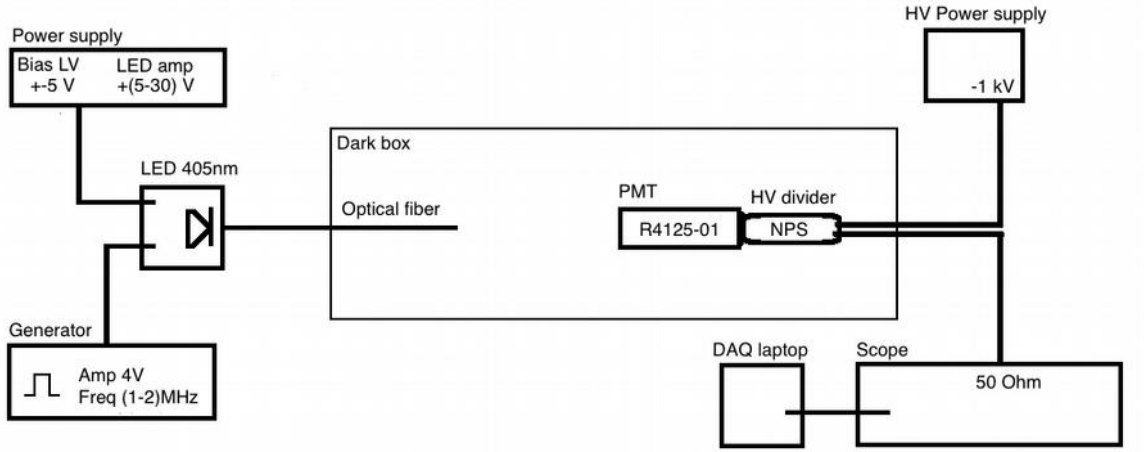
Calculated background anode current:

Lab experiment	**11.935 ± 0.034**	mA
G4 calculations	**~13.0**	mA

2) Test bench background anode current measurements:

- LED setup for anode current measurements mounted
- DAQ configured in automatic mode, waveform from scope readout by laptop for each trigger and saved into separate ASCII files at the hard drive
- Analysis software developed, first step data acquired





Status and action items

- Experimentally measured the charge (**44.74±0.13 pC**) with standard NPS electronics 1kV PMT supply voltage and original divider. The charge value corresponded to dE/dx (~20MeV) of cosmic muon perpendicularly crossed SICCAS PWO

- NPS experimental environment:
  Result from measurement with cosmics scaled to NPS conditions (250MeV/50ns)
  Anode current **Ia = 11.935 ± 0.034 mA** close to Monte Carlo predictions **~13 mA**

- Experimental anode current is big (**>100 uA**), can potentially damage the PMT

- Anode current measurements method with the scope and LED established

- Maximum measured current with current LED setup (**290 uA**) factor of **~40 lower** than predicted NPS experimental conditions. Conditions: NPS original divider at 1kV HV supply, LED Frequency 1Mhz, Pulse ampl to LED = +25.5 V

- LED saturated at ~1Mhz, increasing of frequency or voltage dramatically changed the pulse shape

- **Action item:** Measure gain reduction factor step 1) reducing supplied HV step 2) shortened 1, 2, 3 and etc. dynods at NPS original HV base. Can be done with current LED configuration

- **Action item:** LED setup need to be modified or laser setup needed in order to simulate the experimental conditions