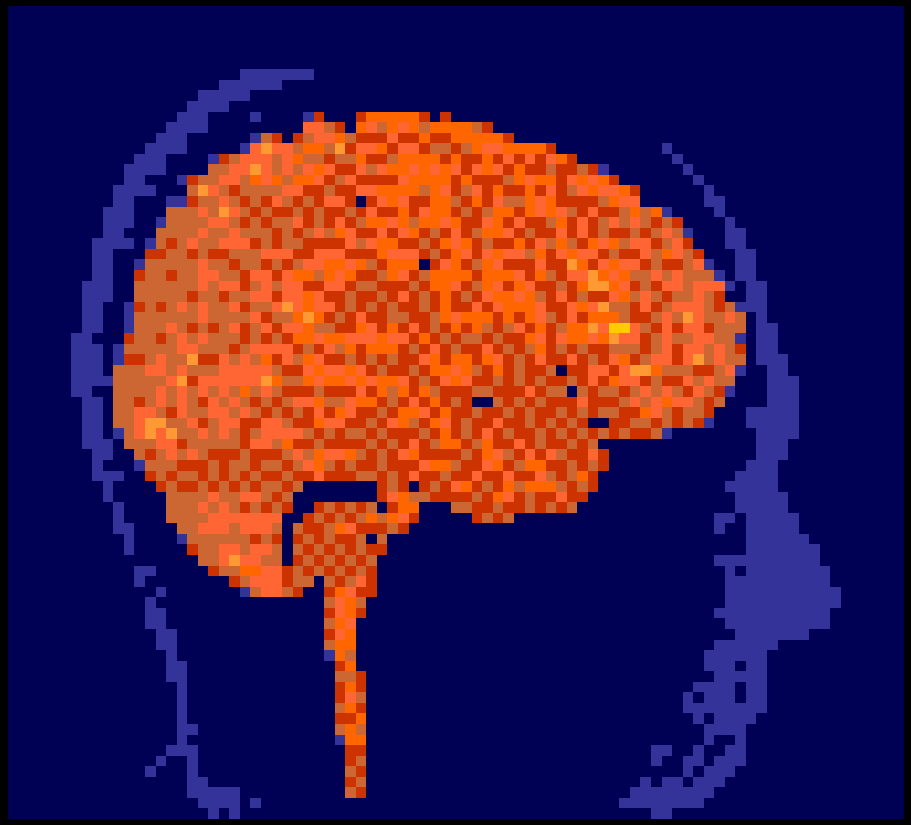
Remote Cognosensors : Developing an NIR Imaging Model to Map Brain Function



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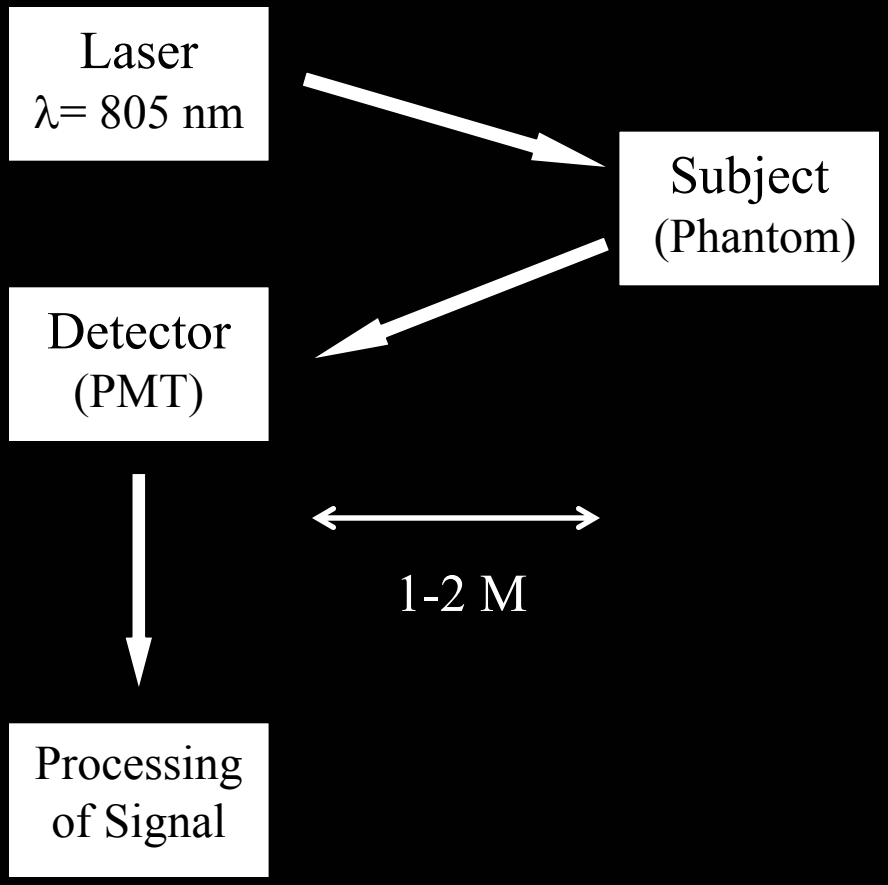
Introduction

Goal: Develop an untethered system for detection of oxygenation and blood volume levels in the pre-frontal cortex.

- Use oxygenation and blood volume information to tell us about subject behavior
- Why untethered? Eliminates nervousness and misleading signals

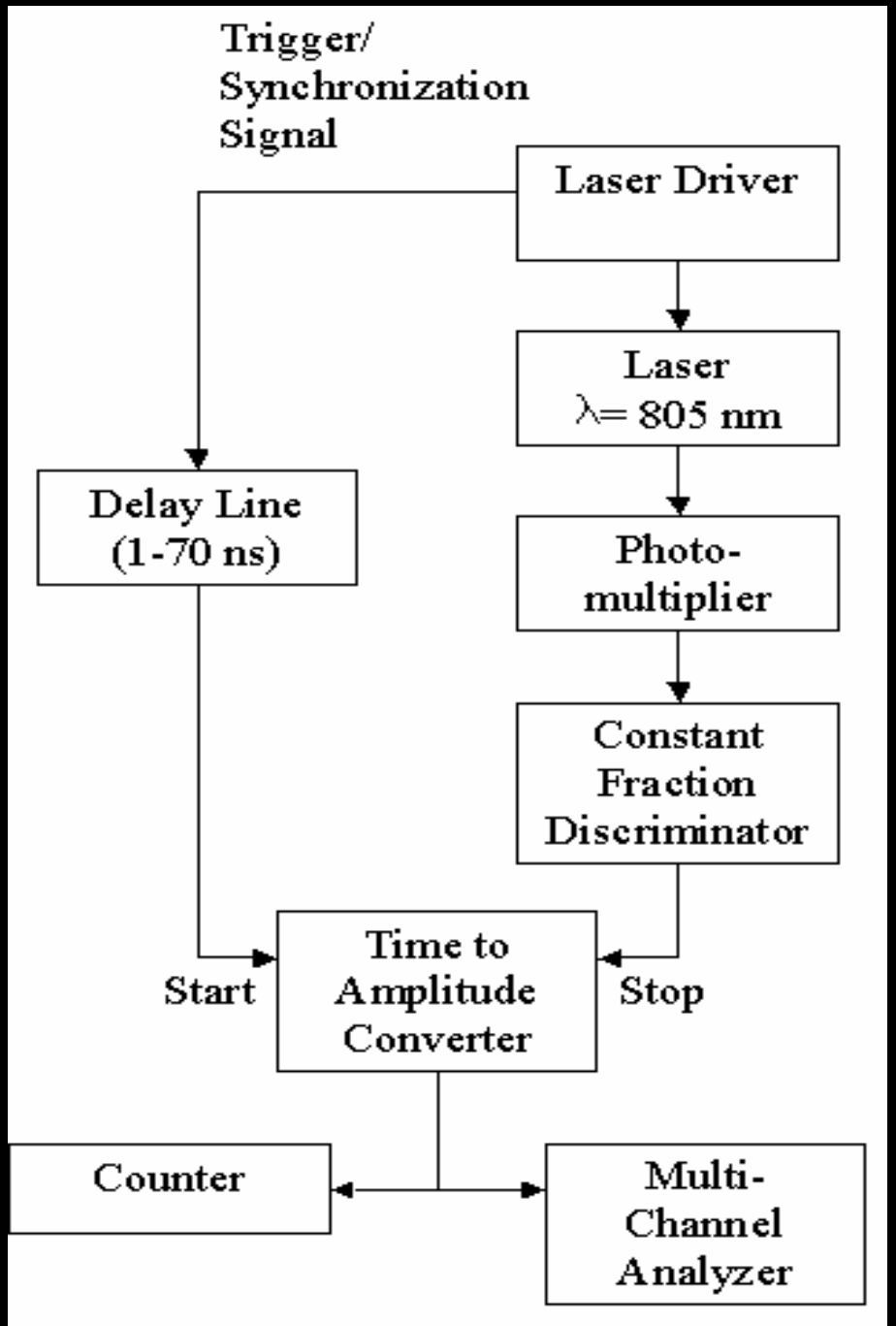
Experimental Setup



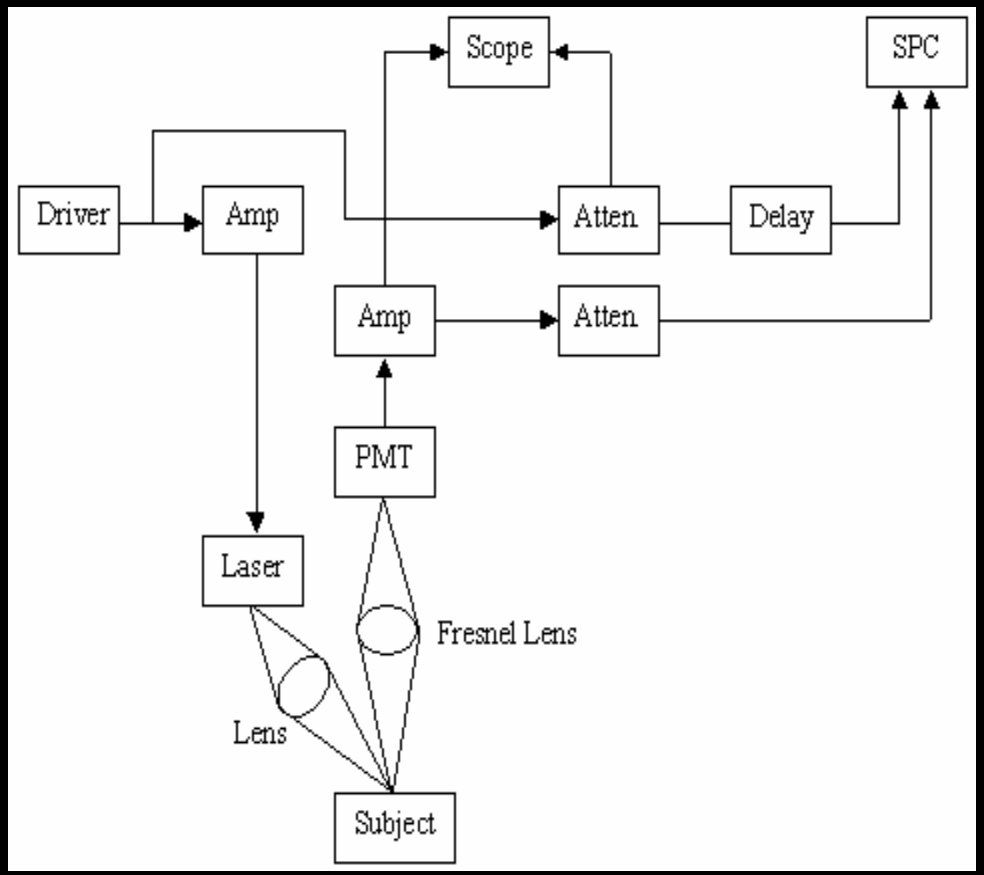
- Basic Principle- Convert photons from laser into an electrical signal
- Processing of signal is based on TCSPC (Time Correlated Single Photon Counting)
- Develop processing system- determine absorption coefficient (μ_a)

Standard Single Photon Counting System

- One source / One detector model at the moment
- Solved problem of trigger signal not being accepted by SPC board
- Some concern with grounding issues with the Hamamatsu R5600U PMT

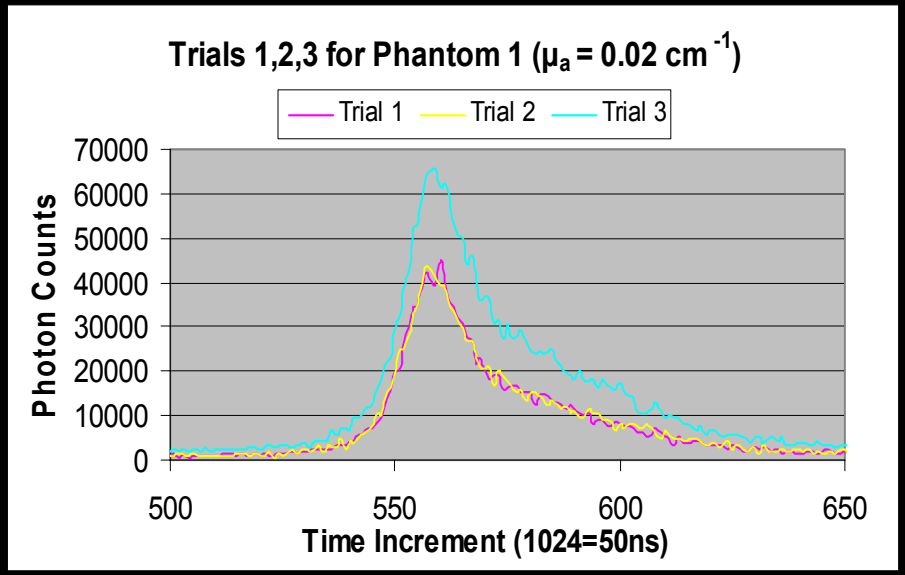


SPC Experimental Setup

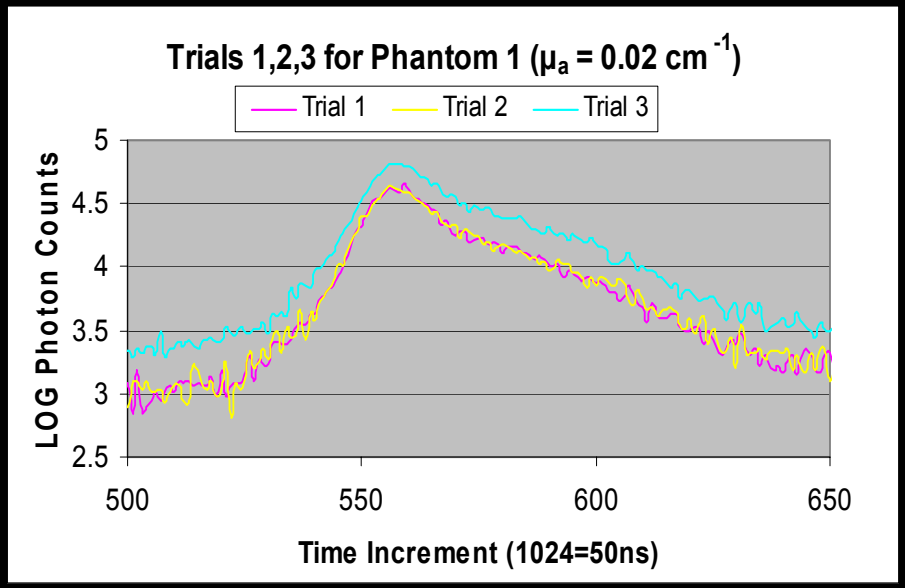


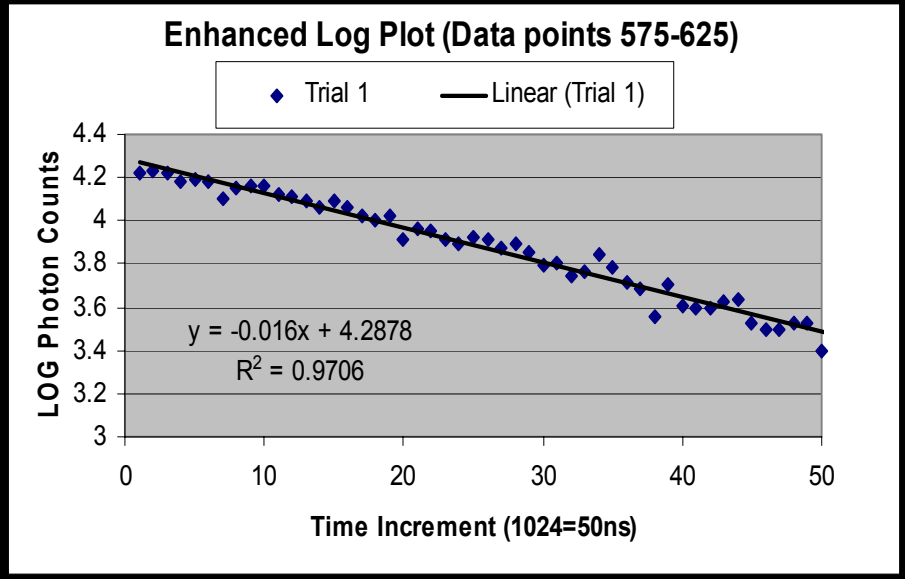
- Laser Frequency varied from 15 MHz to 40 MHz
- Attenuators used are identical (anywhere from 1 dB to over 40 dB attenuation
- Amplifiers used not identical

SPC Experimental Results 1

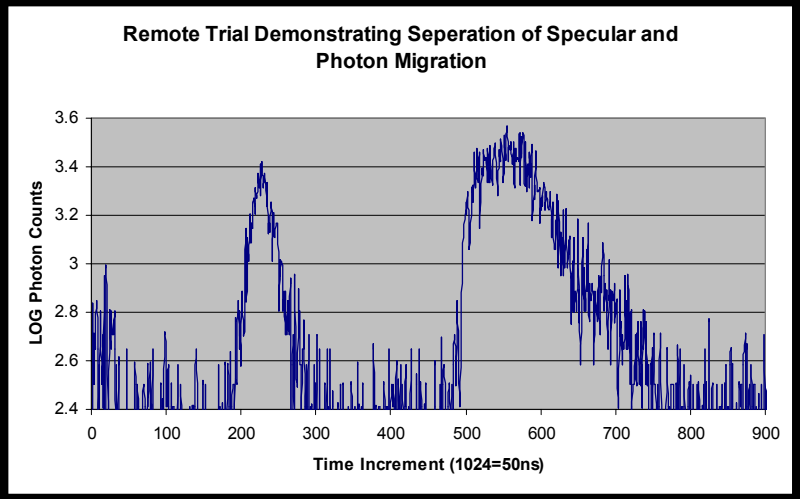


- Trials done with PMT/Subject distance at 60 cm
- Trial 3 done with subject position altered to increase reflection

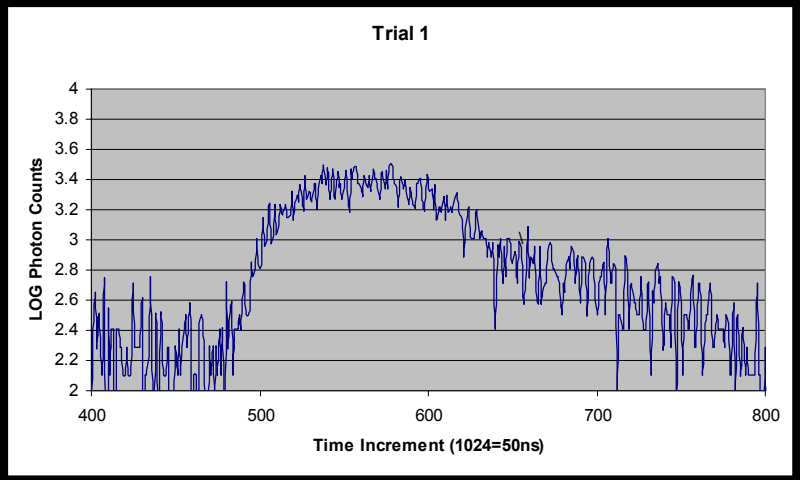




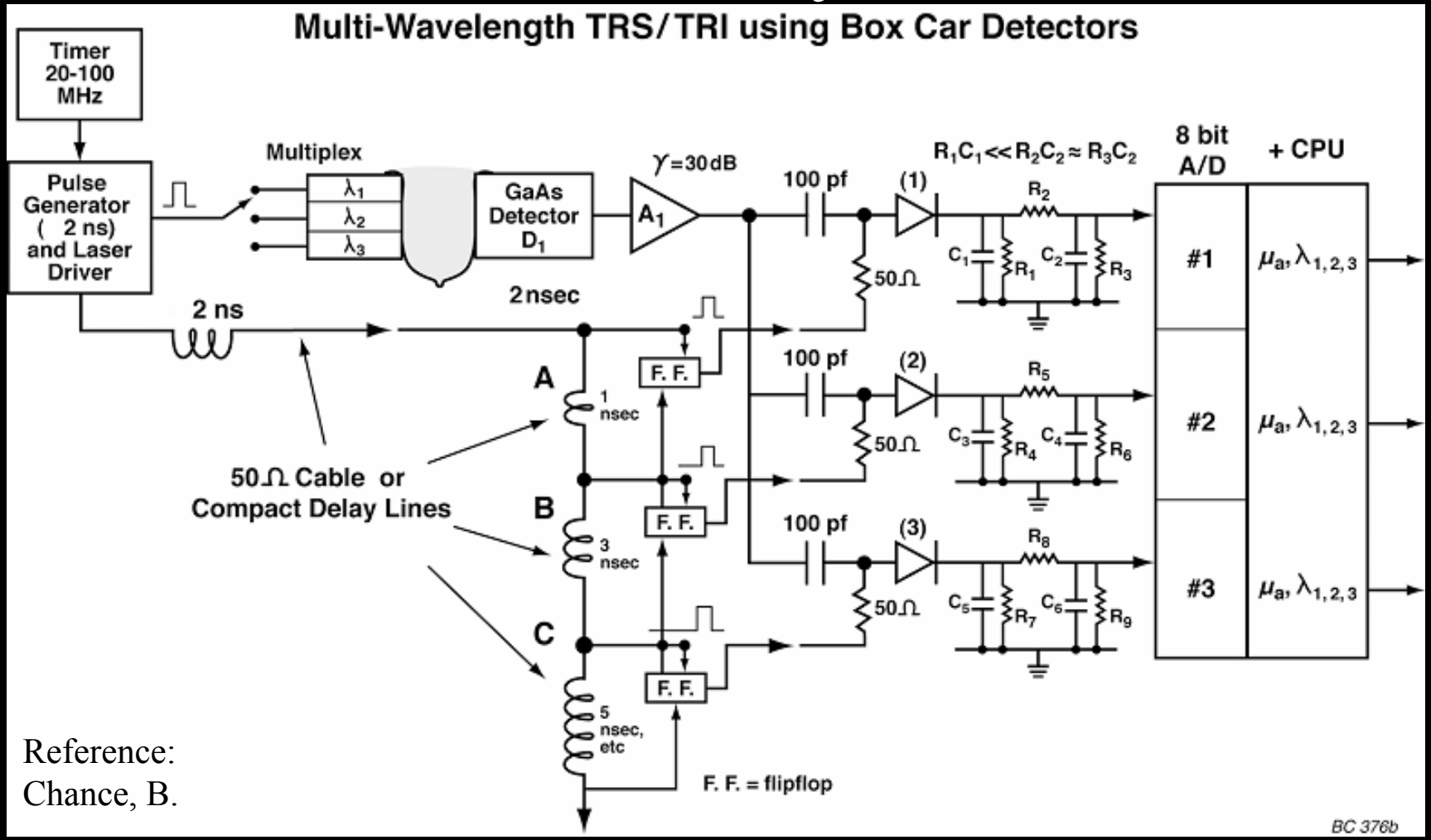
SPC Experimental Results 2



- Possible separation of reflection and diffuse photon signals?
- Possible artifact from PMT.

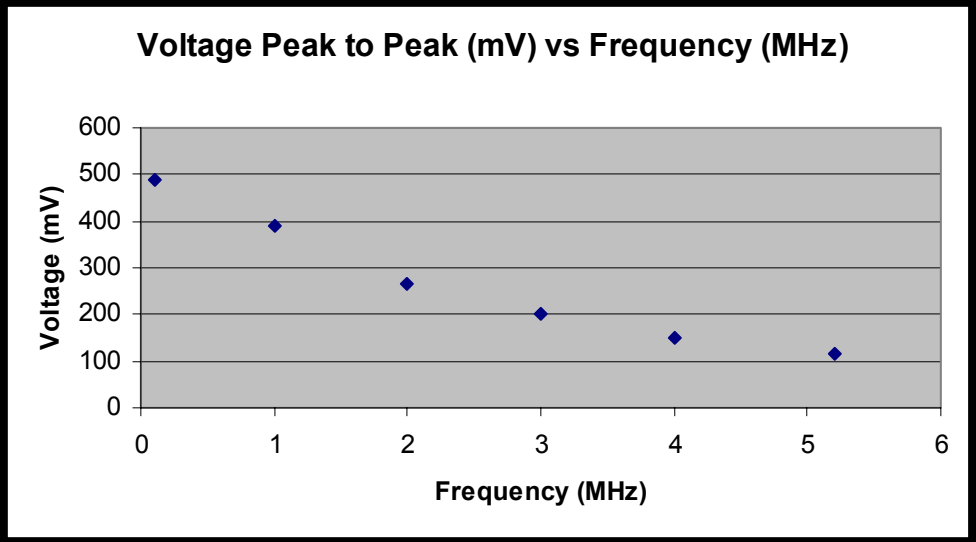


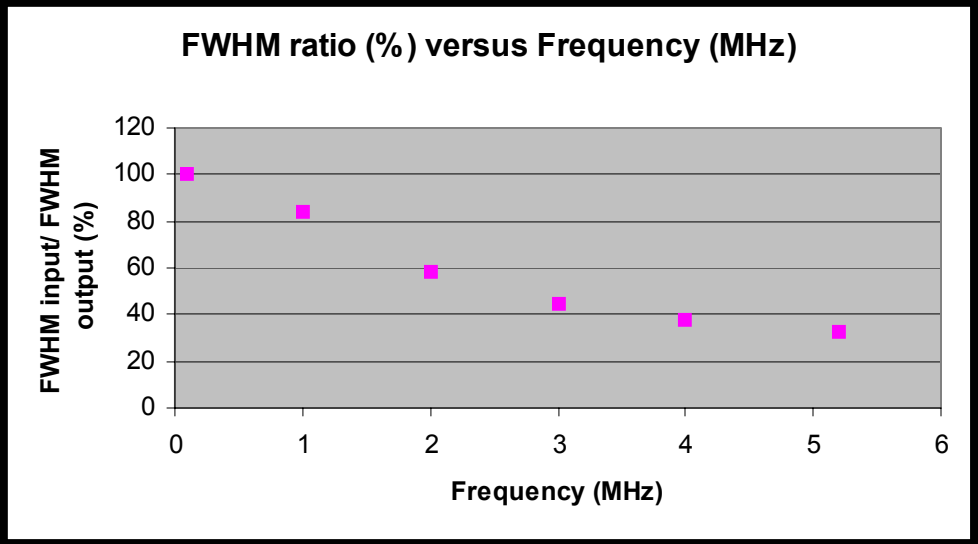
Box Car System



Reference:
Chance, B.

Initial Box Car Results





- Response from 1-gated integrator and pulse generator.
- Voltage decreased as frequency of input increased.
- Pulse stretching increased as frequency of input increased.

What's Next?

- Continue development of Box Car system – make sure data can be acquired
- Continue testing at longer distances to collect more data for SPC method
- Move system to new laser source/detector location to verify results

Conclusions

- Important that subject is completely untethered
- Use μ_a to give information about subject behavior (via oxygenation and blood volume)
- Eventually want to develop multi-channel source/detector system