Bo Update 02/14/12

Ben Jones

Contents

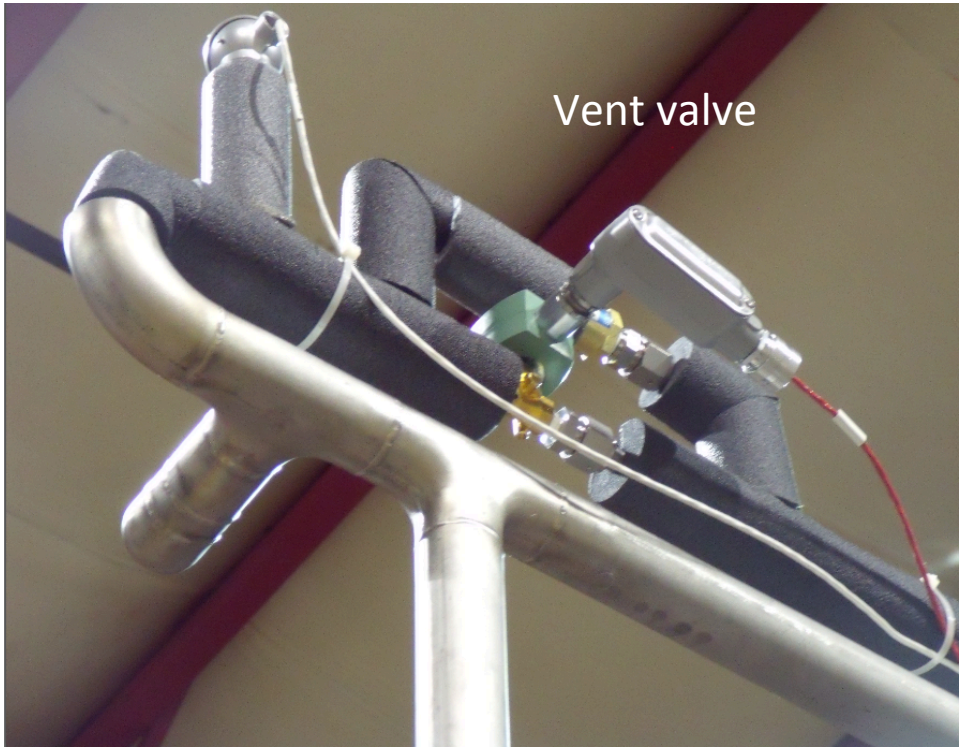
- 1) Condenser Status
- 2) O2 Monitor, N2 Monitor, Filter line
- 3) New Feedthrough
- 4) Plate Status
- 5) Quantum Efficiency Calculations

There are also new developments in N2 analysis, but are saved for another meeting.

LN2 Condenser valve replacements

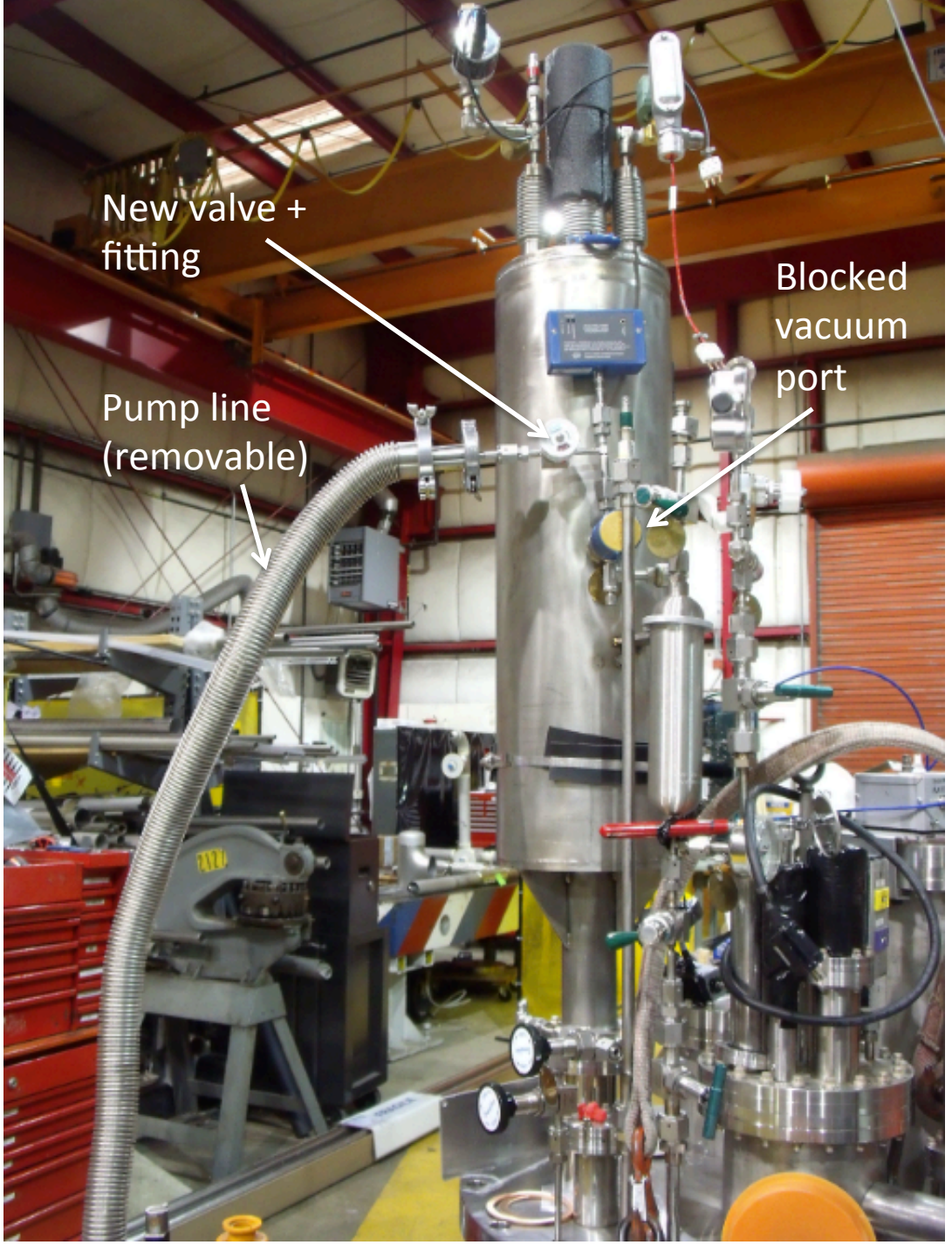
Previous valves had problems with croygenic temperatures, and would stick or stop responding

New valves installed on LN2 fill and vent lines whilst Bo warm



LN2 vacuum Jacket

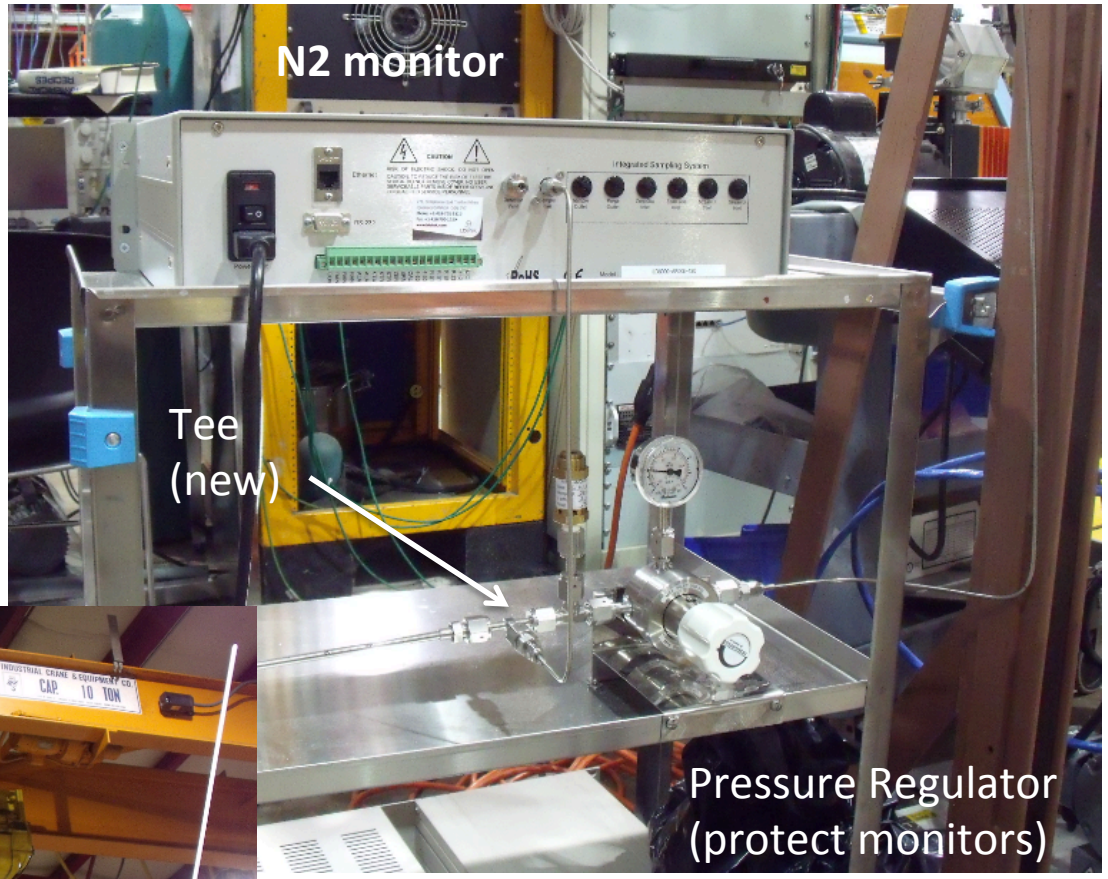
- Vacuum jacket vacuum line was previously blocked by level monitor
- Now we are open, temporarily remove level probe to add additional vacuum fitting
- Now we can pump down condenser jacket.
- This will reduce rate of N2 consumption and improve temperature stability of Bo

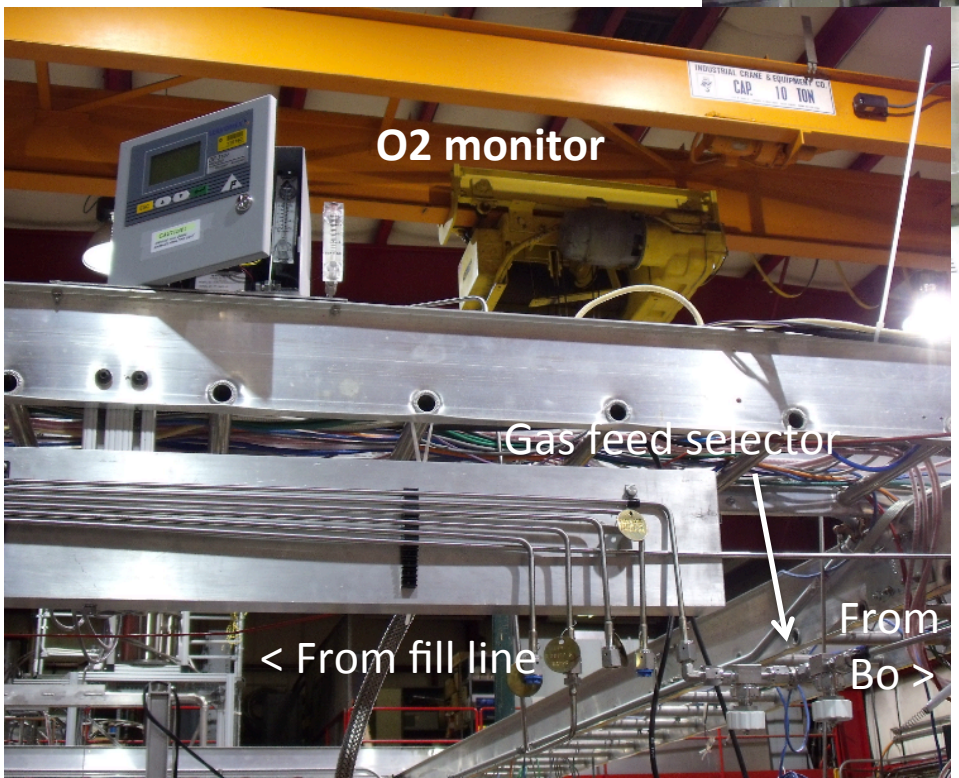


Monitors and Filters

- With Stephens help we negotiated the N2 monitor out to mid March. We may be able to borrow for short periods again, up to the Fall.
- Line to existing O2 monitor is being installed now, will be ready for next week – eliminates one possible systematic from our measurements
- Filter regeneration failed due to electrical fault last week. This has now been fixed and filters are regenerating for a fill on Friday.

Monitor plumbing





Feedthrough

Installed in Bo and connected directly to PMT base with solder connection

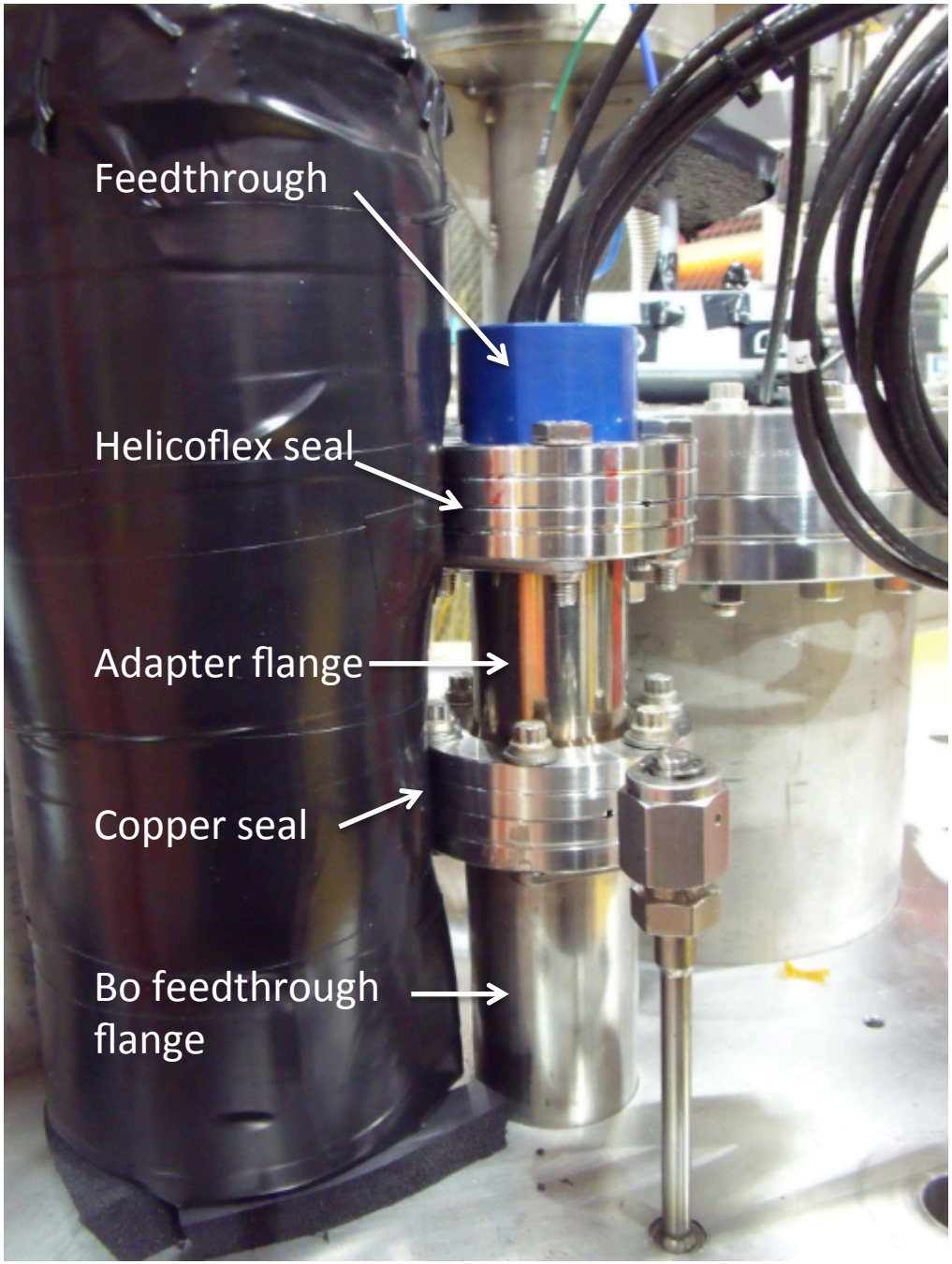
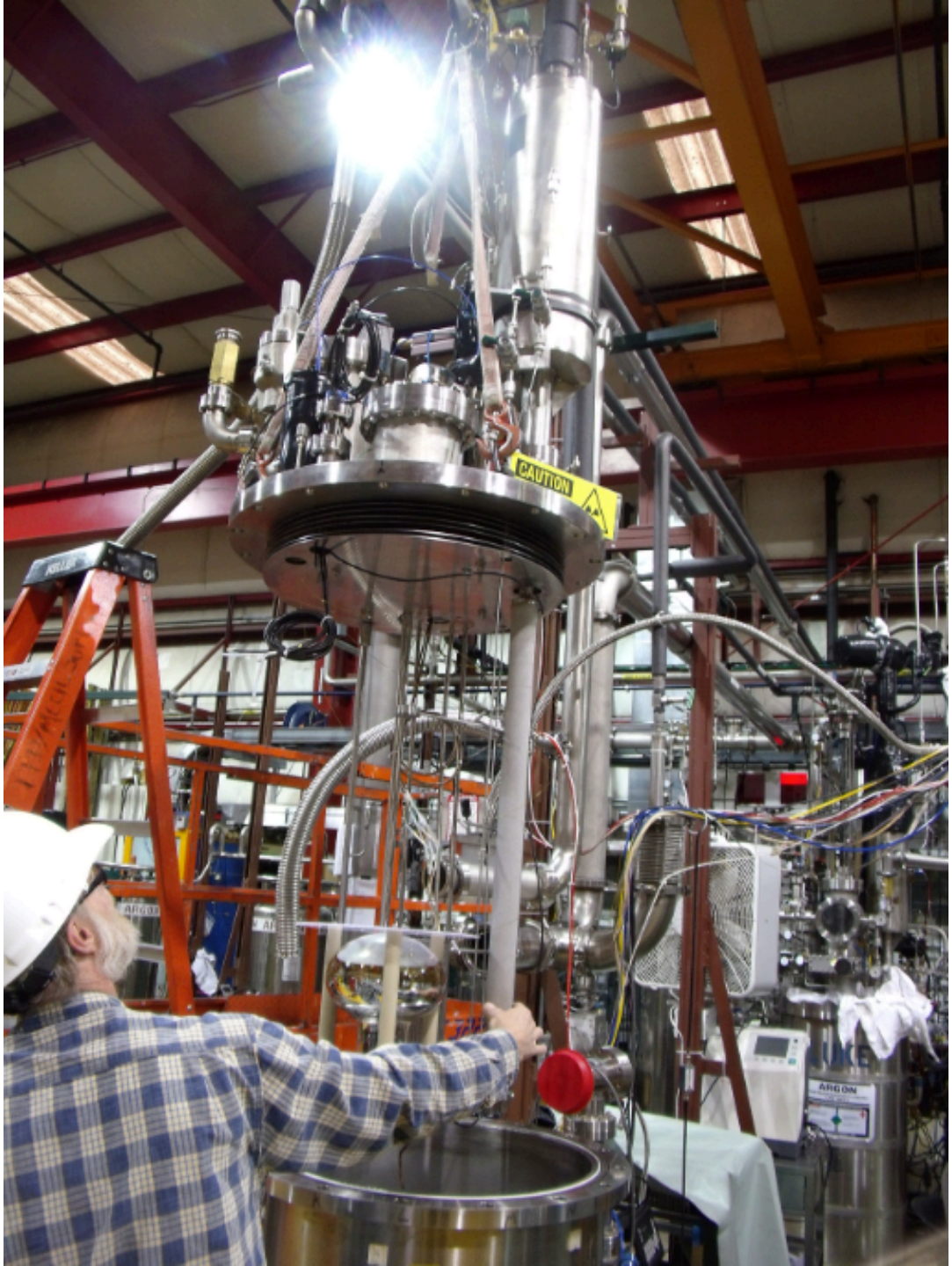


Plate Status

- Fresh plate made for Bo according to Christina + Christies recipe
- ~1 hour of lab light exposure during preparation
- Then immediately moved to dark cupboard wrapped in black foil
- Installation into Bo from foil cover immediately before closing



Bo now closed

Electrical connections checked, and are good

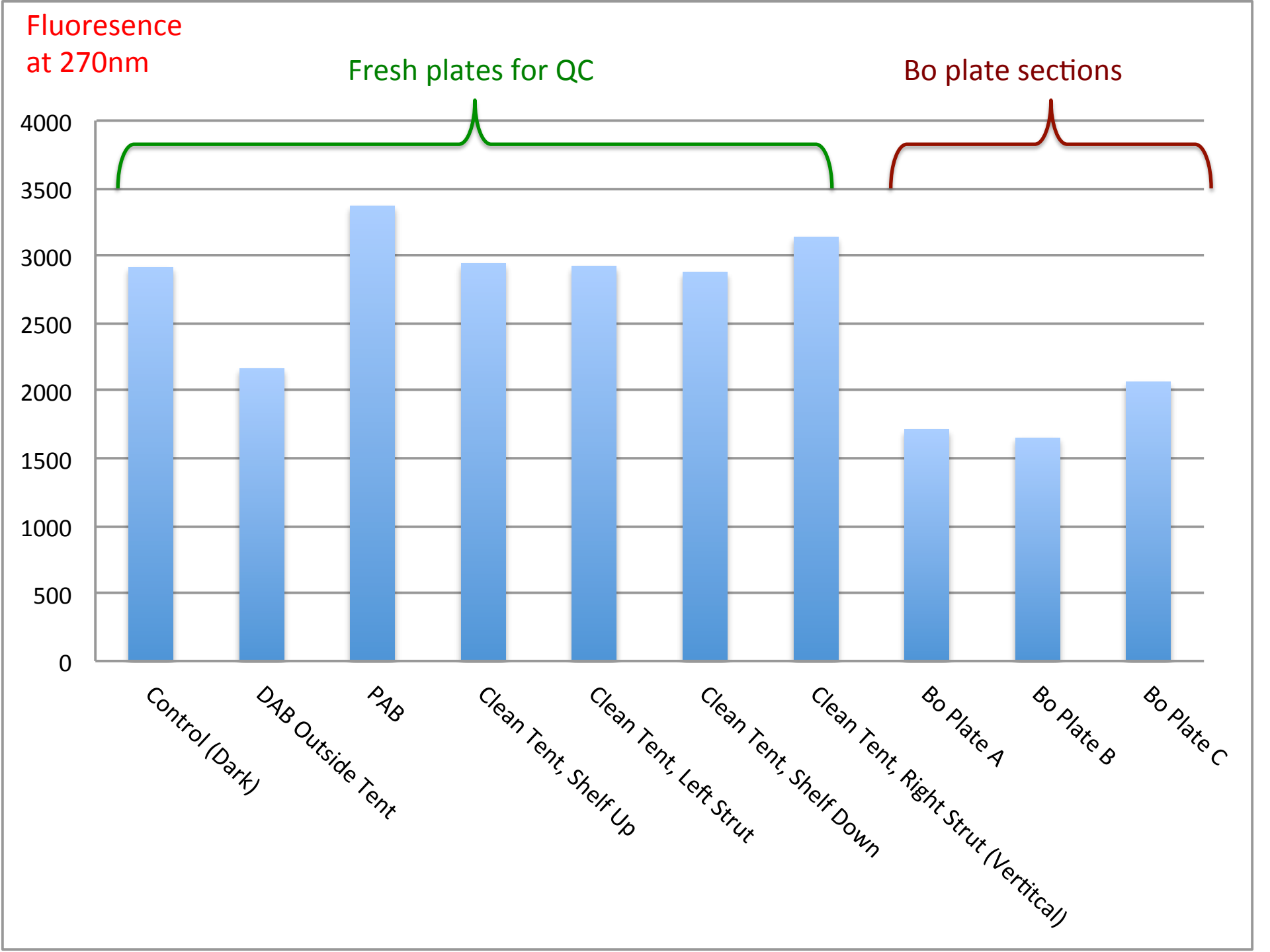
Vacuum pumping in progress.

Feedthrough is holding vacuum to 10^{-6} Torr – this is standard for pumping Bo down

Data expected Friday, with further N2 injection next week.

Old plate test

- Cut into “standard” 5x5cm test squares using bandsaw
- Each tested in four orientations in fluorimeter (calibrated with standard test samples)
- Plate performance is the average of these four measurements
- Compared to same procedure for a set of brand new, 3 coat microboone style plates prepared for installation QC test
- Coating-to-coating variation is always large for 3 coats, but on average the Bo plates are 62% as good as the fresh plates.
- So clearly some degradation from PAB exposure


Fluoresence
at 270nm
Fresh plates for QC
Bo plate sections
4000
3500
3000
2500
2000
1500
1000
500
0
Control (Dark)
DAB Outside Tent
PAB
Clean Tent, Shelf Up
Clean Tent, Left Strut
Clean Tent, Shelf Down
Clean Tent, Right Strut (Vertitcal)
Bo Plate A
Bo Plate B
Bo Plate C

Scrubbing off degraded layer

- Janet requested we try to “scrub off” the degraded layer.
- Not sure how hard we should scrub, so tried three different tactics.
- Points on the universal scrubbage scale: “very hard scrub”, “polish”, “gentle brush”
- In all cases, significant performance loss rather than gain.

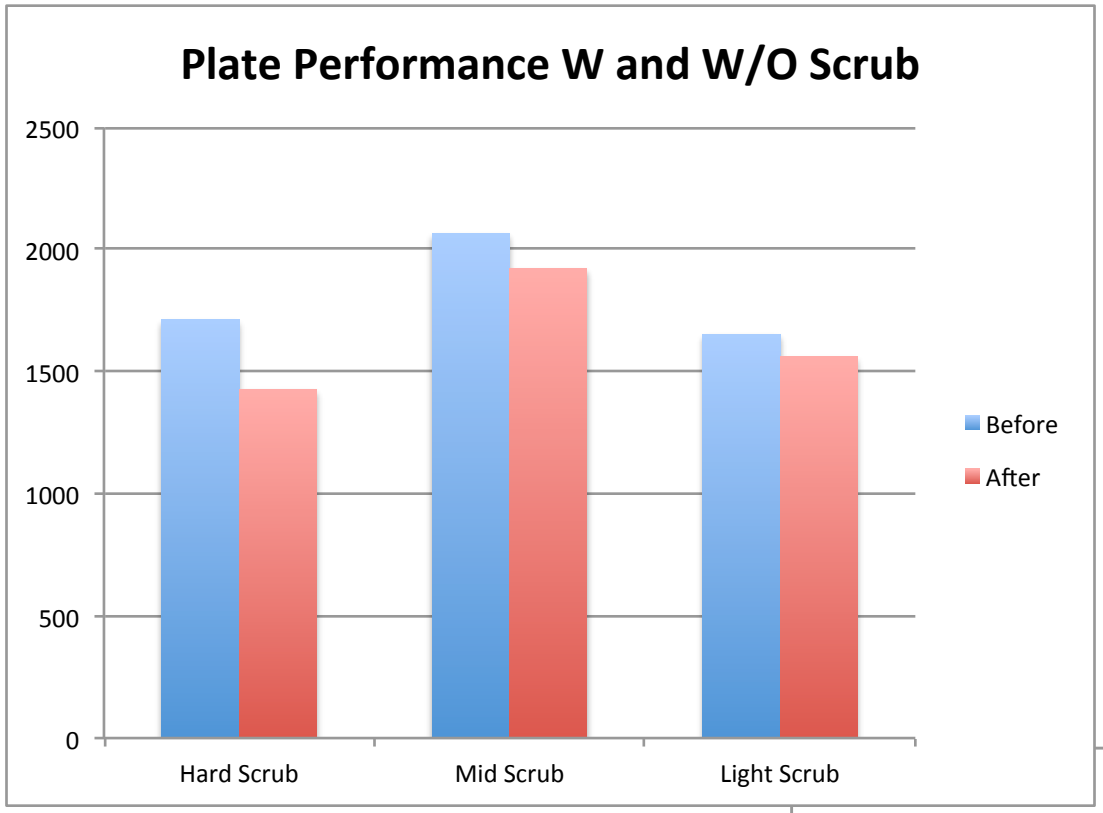
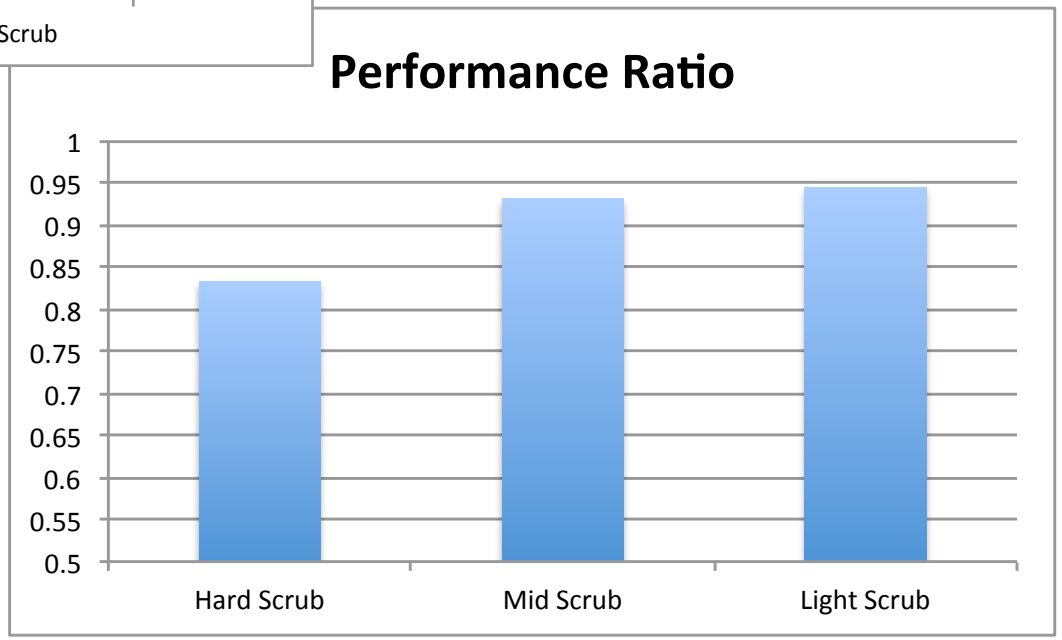


Plate Performance W and W/O Scrub
2500
2000
1500
1000
500
0
Hard Scrub
Mid Scrub
Light Scrub
Before
After


Performance Ratio
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
Hard Scrub
Mid Scrub
Light Scrub

Real QE Calculations

- Since measured QE lower than expected, back-of-envelope scribbles for solid angle effects etc have come under scrutiny
- To address this, have now made a more serious effort using ray tracing to extract expected PE distribution for a given QE

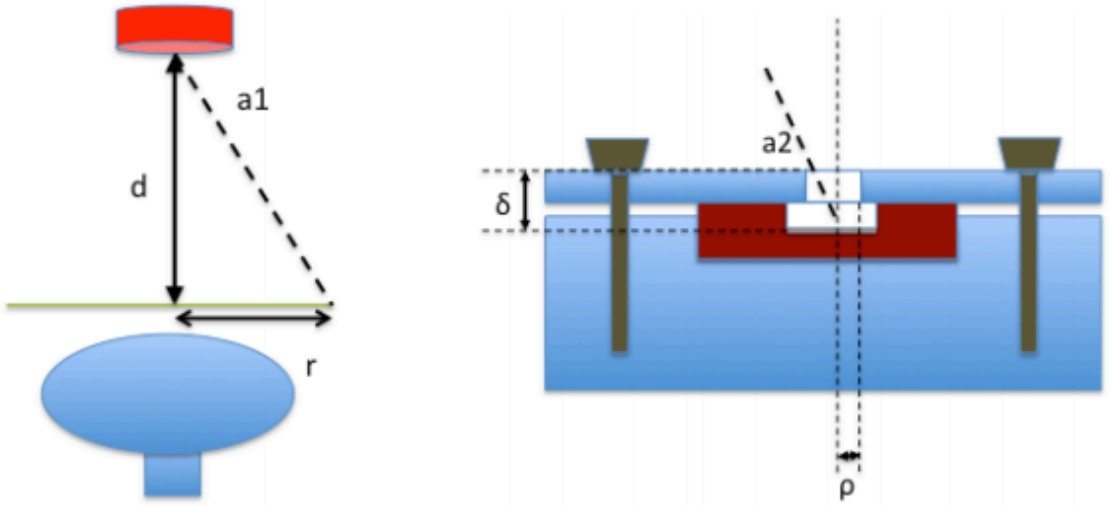
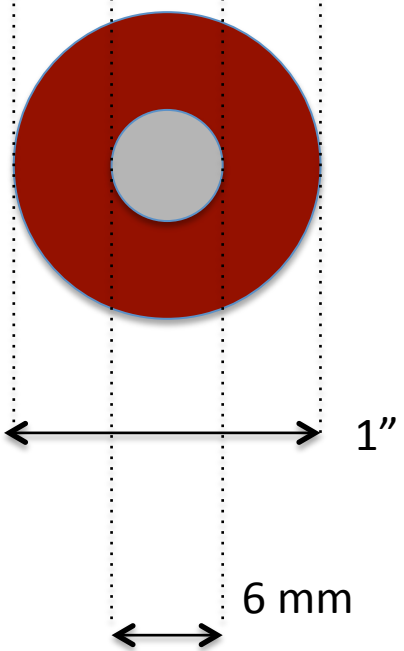


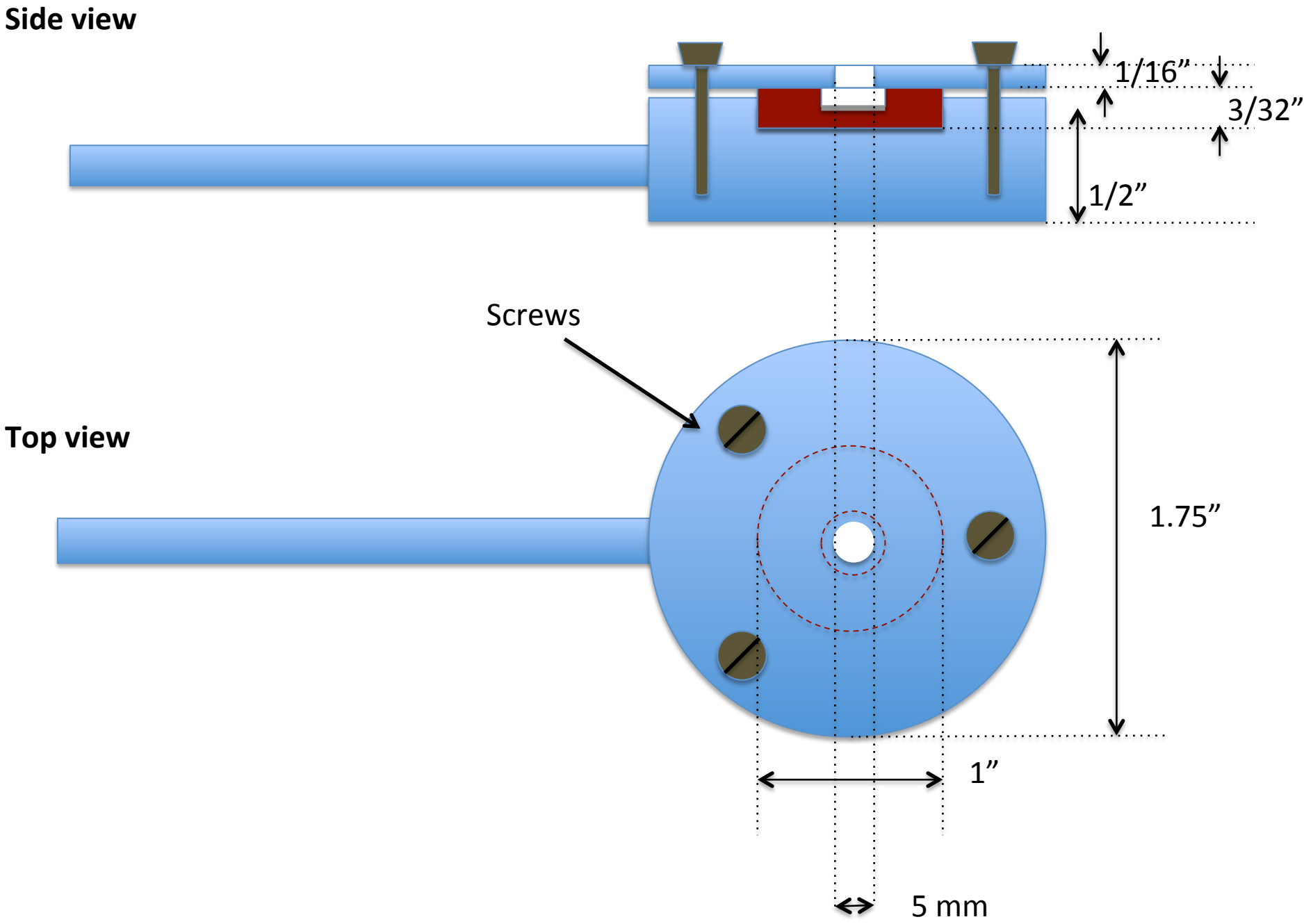
Figure 1: Figure showing alpha source position

Important Dimensions

Side view

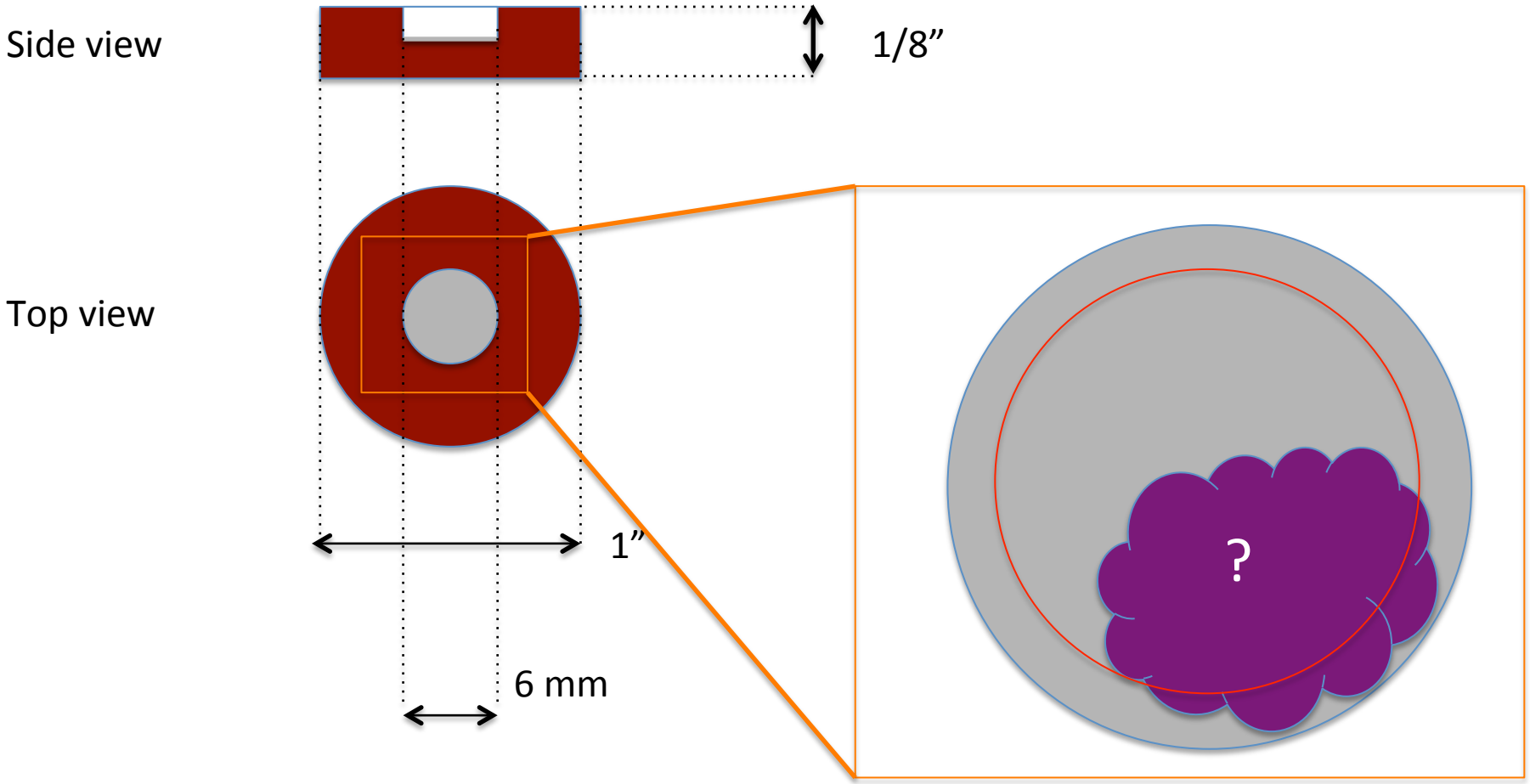
Top view




Side view
1/16”
3/32”
1/2”
Screws
Top view
1.75”
1”
5 mm

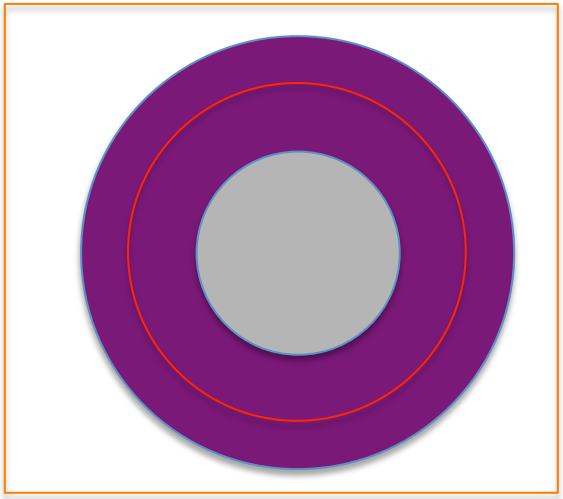
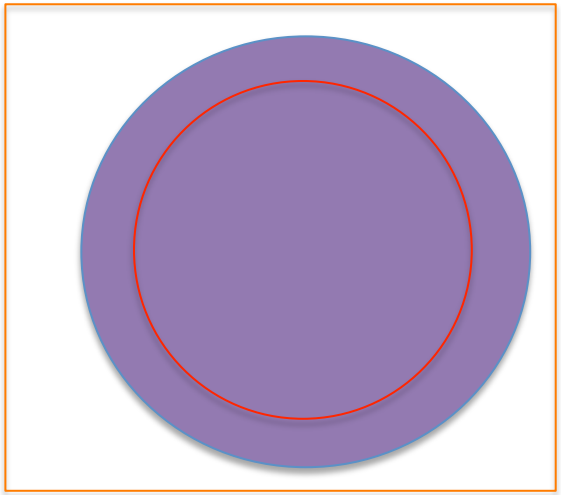
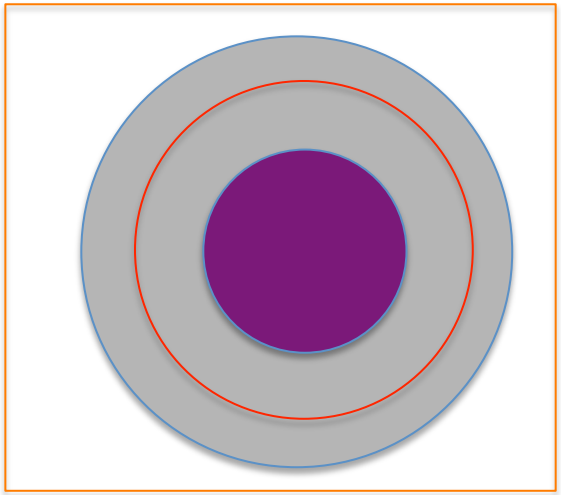
Important Dimensions

Janets concern about source distribution:



System has cylindrical symmetry, so distribution in phi does not matter.

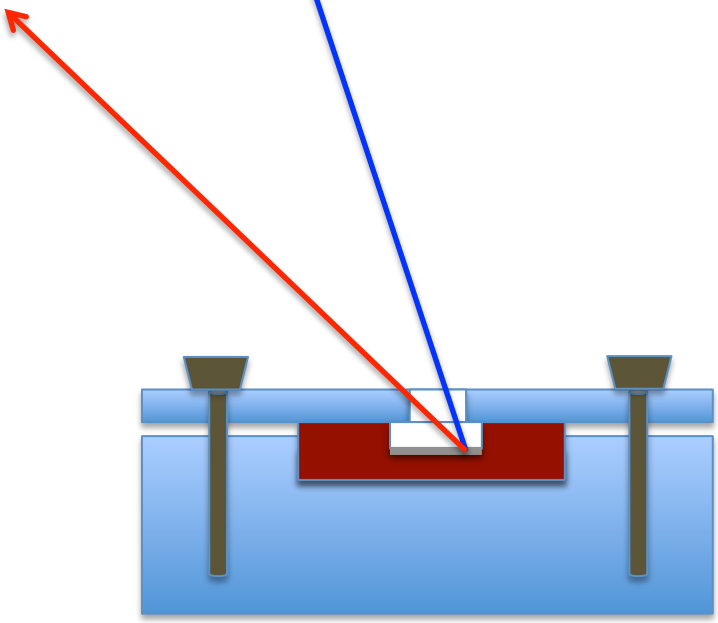
Do all calculations with 3 “extreme” radial source distributions:

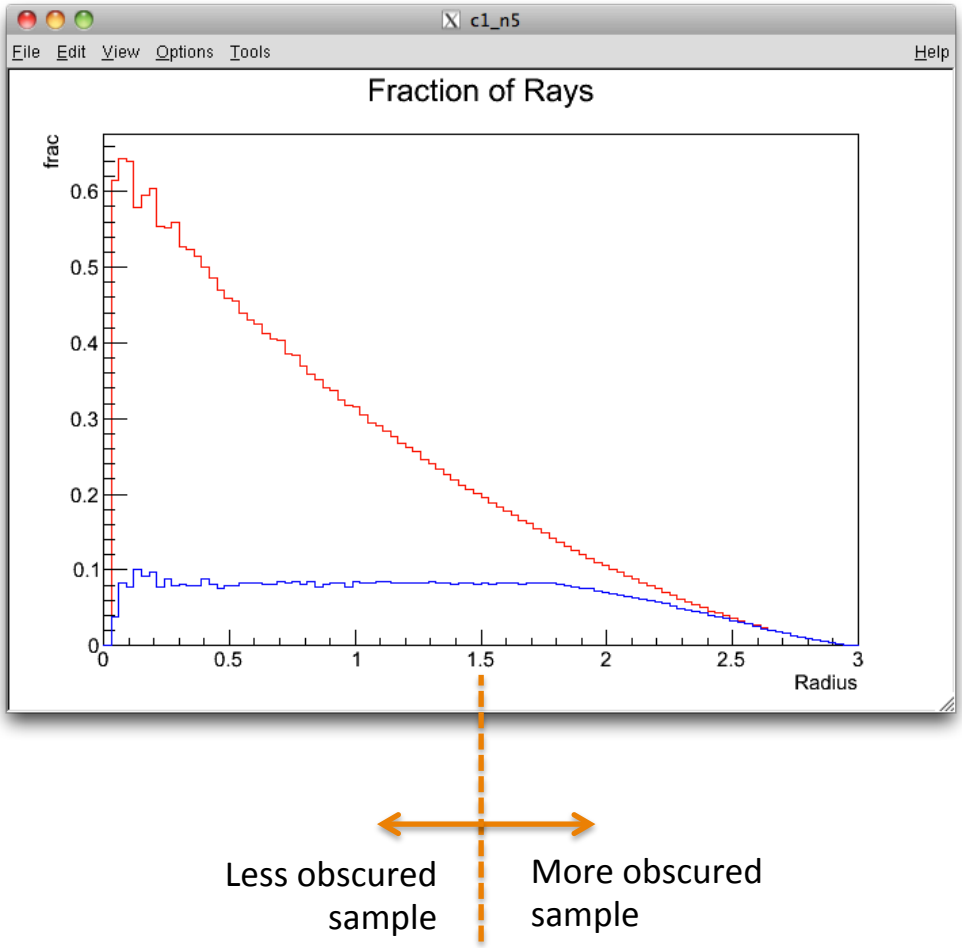
More Obscured	Baseline	Less Obscured
		
0 < r < 1.5mm : Empty 1.5 < r < 3mm : Uniform source	0 < r < 3mm : Uniform Source	0 < r < 1.5mm : Uniform source 1.5 < r < 3mm : Empty
¾ of plate area covered	*Full plate area covered*	*¼ of plate area covered*

Plate

Red = rays escaping hole

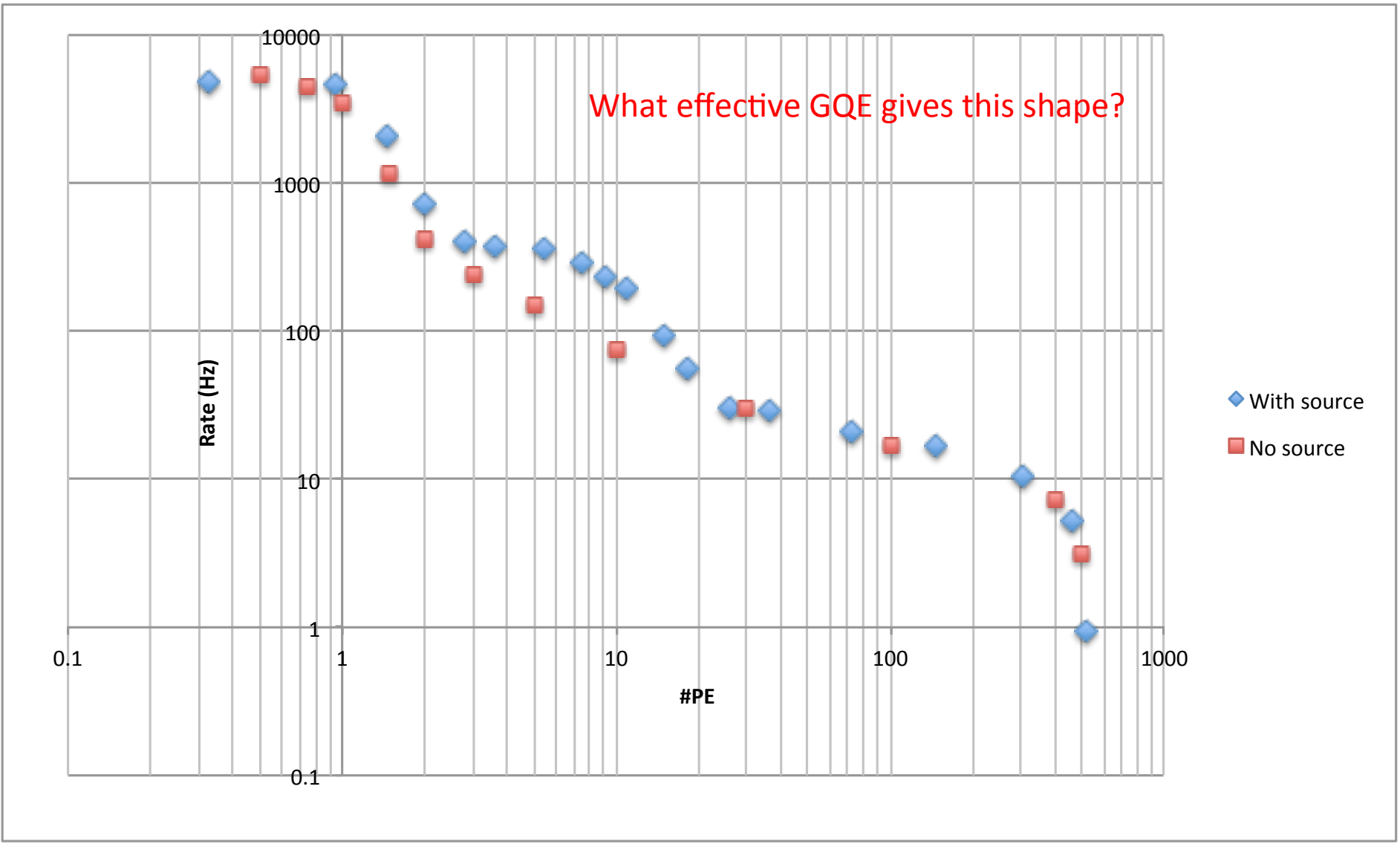
Blue = rays hitting plate

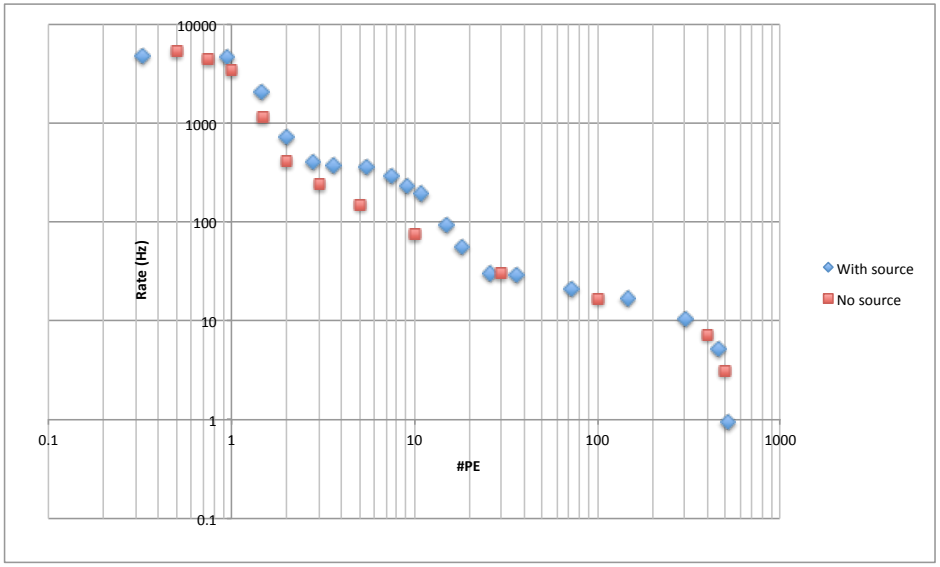




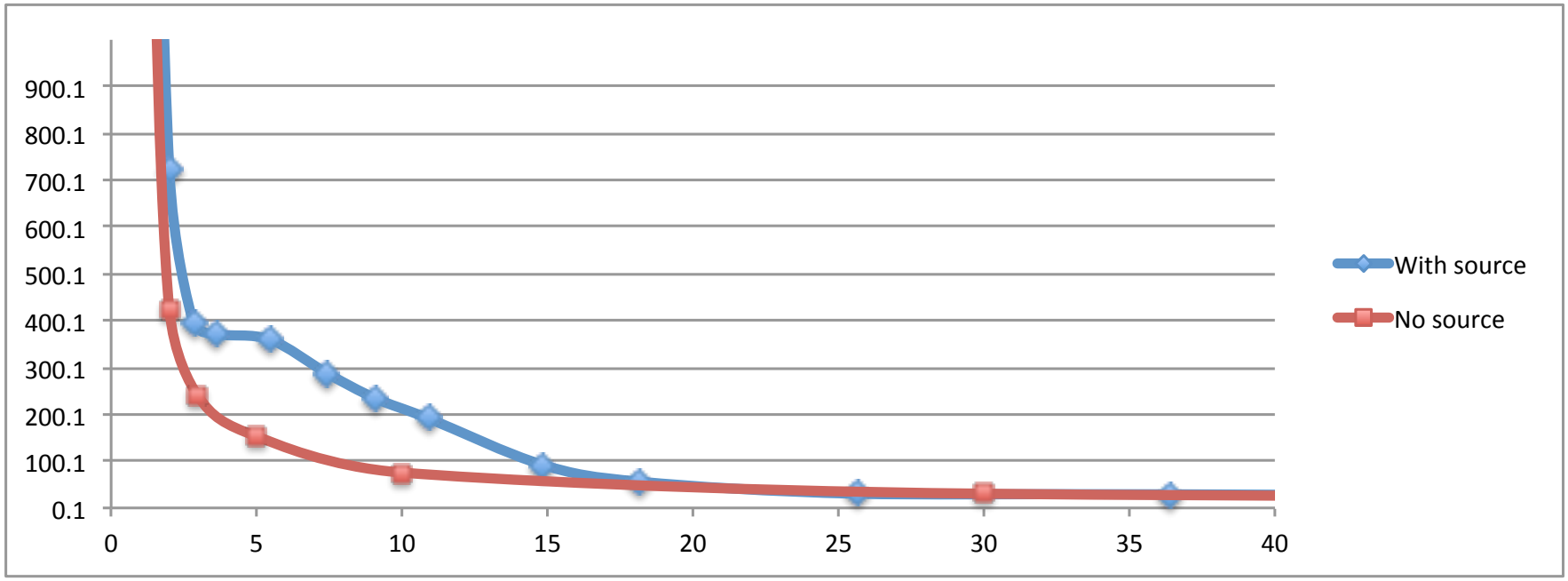
Less obscured sample

More obscured sample


What effective GQE gives this shape?
10000
1000
100
10
1
0.1
Rate (Hz)
0.1
1
10
100
1000
#PE
With source
No source



- Invert cumulative distribution to pdf
- Put on linear-linear scale
- Restrict to alpha rich region only

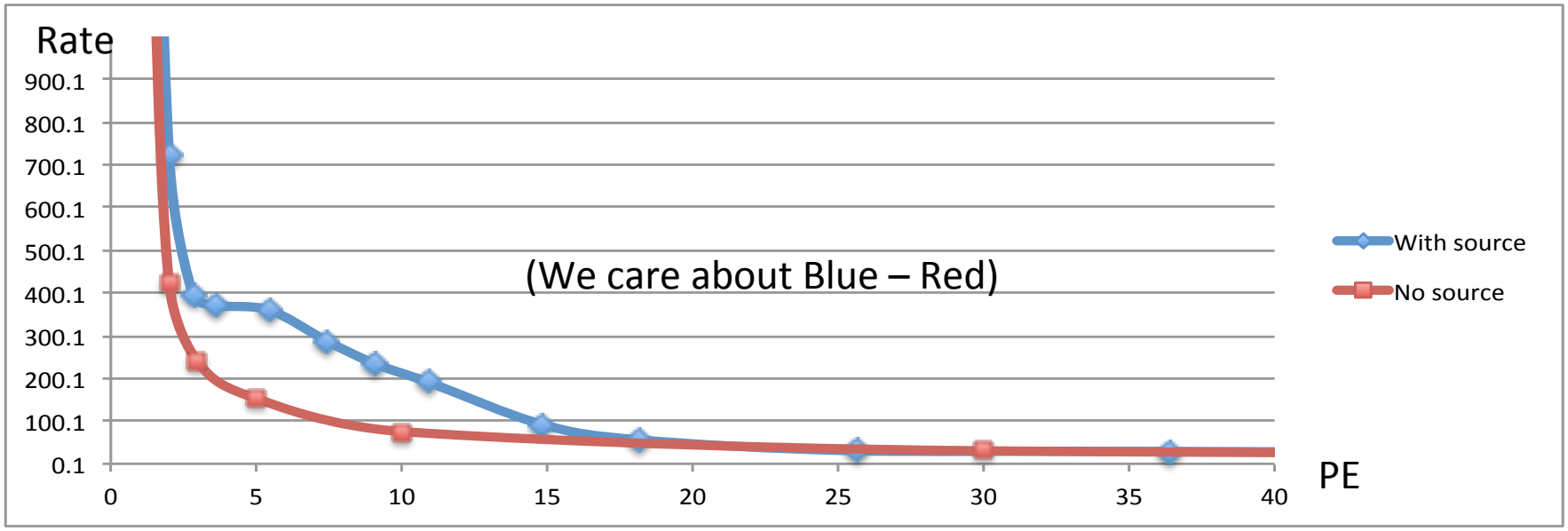


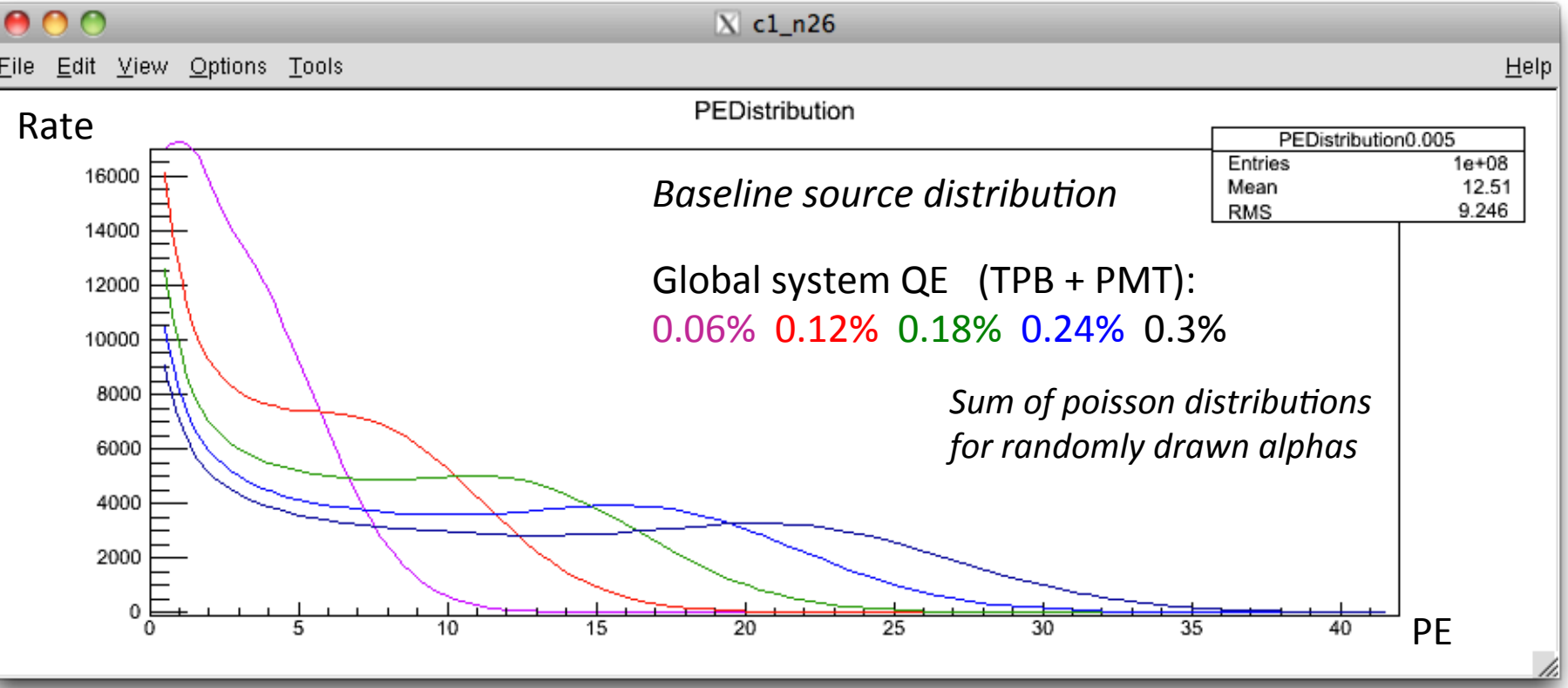
GQE Estimate:

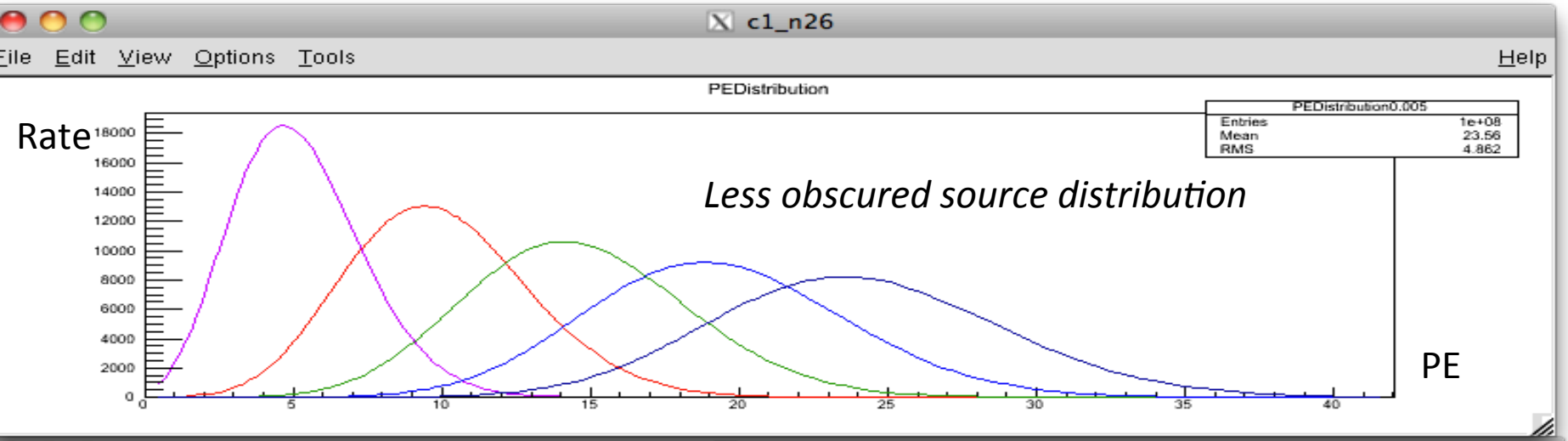
- Before we dig into extracting GQE, remember what we expect
- Basic back-of-envelope estimate:
  - 50% isotropic TPB emission x 0.2 TPB conversion efficiency x 0.26 PMT QE
  - Expected 3% GQE
- Known extra factors:
  - 62% plate degradation (measured with this plate)
  - Extra factor (not worse than 50%) for real isotropic emission effect
  - Expected ~ 1% GQE

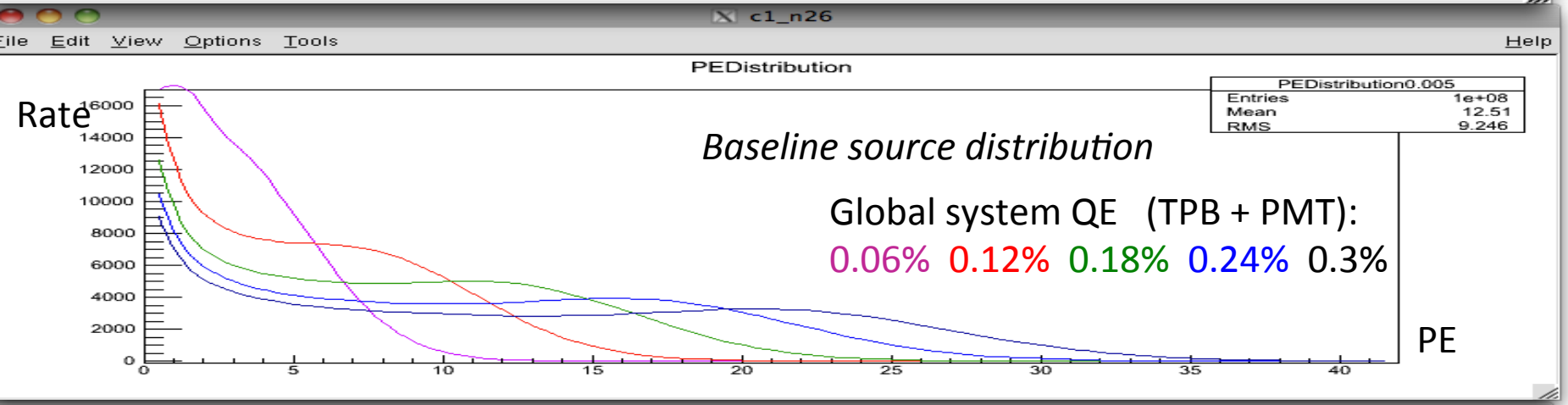
- Strategy:
  - Assume a GQE, randomly choose alphas, poisson distribute light yield from each according to assumed GQE, solid angle fraction and known light yield
  - Light yield is:

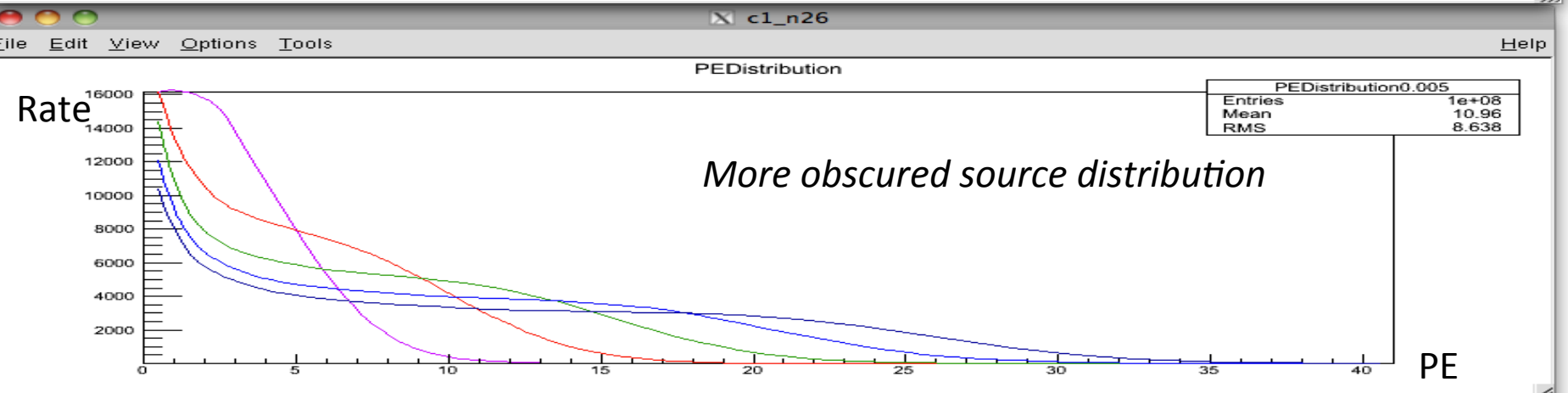
40,000 (ideal) * 5.3 (energy) * 0.77 (alpha quench) * 0.56 (prompt)

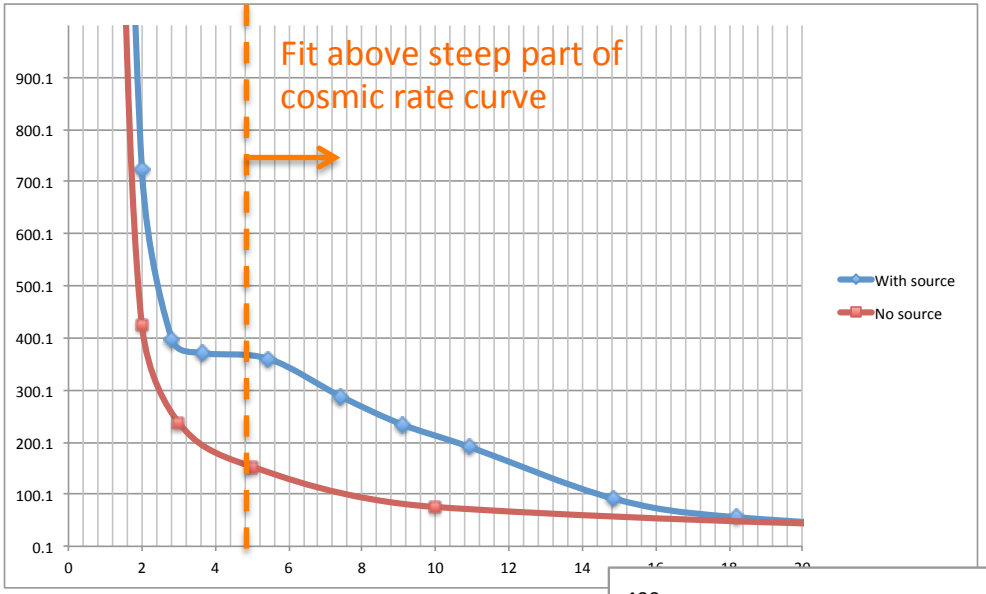

Rate
900.1
800.1
700.1
600.1
500.1
400.1
300.1
200.1
100.1
0.1
0
5
10
15
20
25
30
35
40
PE
With source
No source
(We care about Blue – Red)


c1_n26
File Edit View Options Tools
Help
Rate
PEDistribution
PEDistribution0.005
Entries 1e+08
Mean 12.51
RMS 9.246
Baseline source distribution
Global system QE (TPB + PMT):
0.06% 0.12% 0.18% 0.24% 0.3%
Sum of poisson distributions
for randomly drawn alphas
16000
14000
12000
10000
8000
6000
4000
2000
0
0
5
10
15
20
25
30
35
40
PE


c1_n26
File Edit View Options Tools Help
PEDistribution
PEDistribution0.005
Entries 1e+08
Mean 23.56
RMS 4.862
Rate
Less obscured source distribution
PE

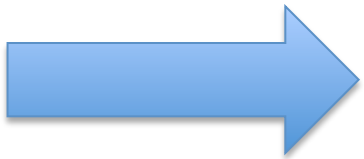

c1_n26
File Edit View Options Tools Help
PEDistribution
PEDistribution0.005
Entries 1e+08
Mean 12.51
RMS 9.246
Rate
Baseline source distribution
Global system QE (TPB + PMT):
0.06% 0.12% 0.18% 0.24% 0.3%
PE

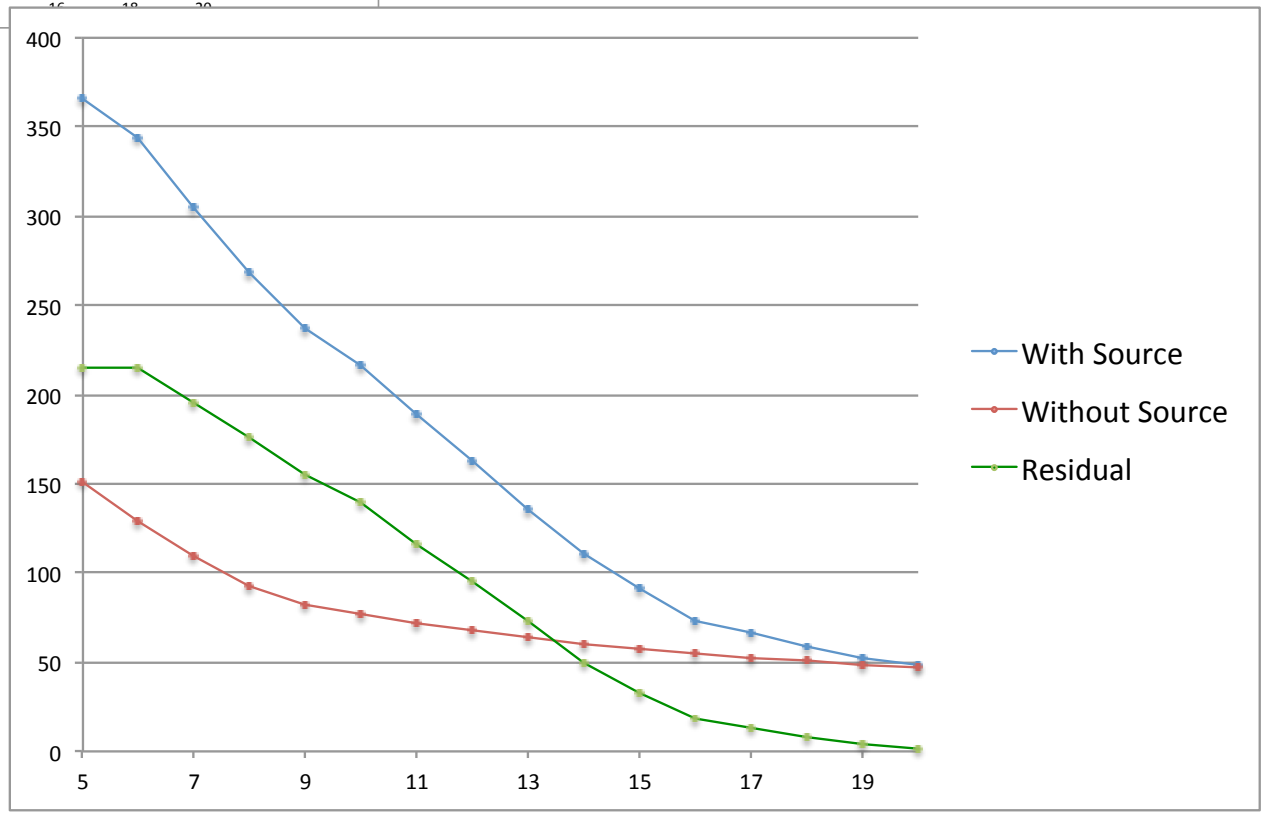

c1_n26
File Edit View Options Tools Help
PEDistribution
PEDistribution0.005
Entries 1e+08
Mean 10.96
RMS 8.638
Rate
More obscured source distribution
PE



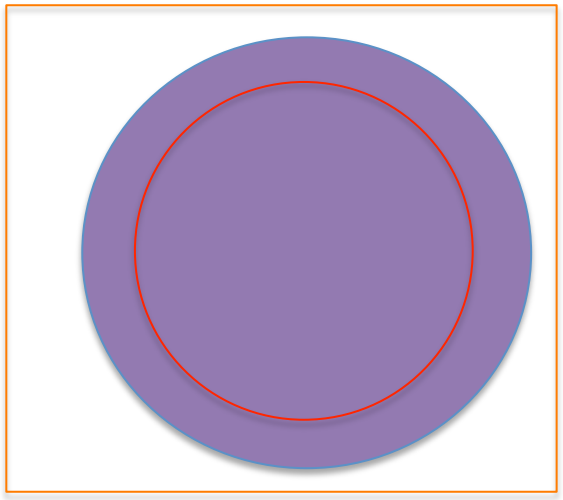
Producing a fit…

Interpolate curves “by hand” to get residual to fit to

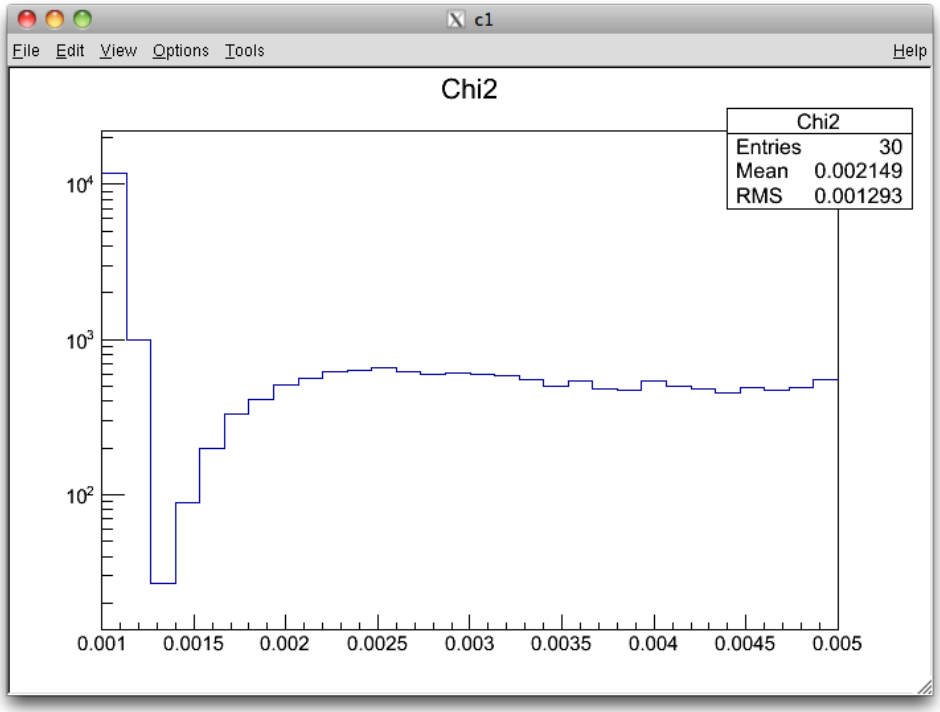


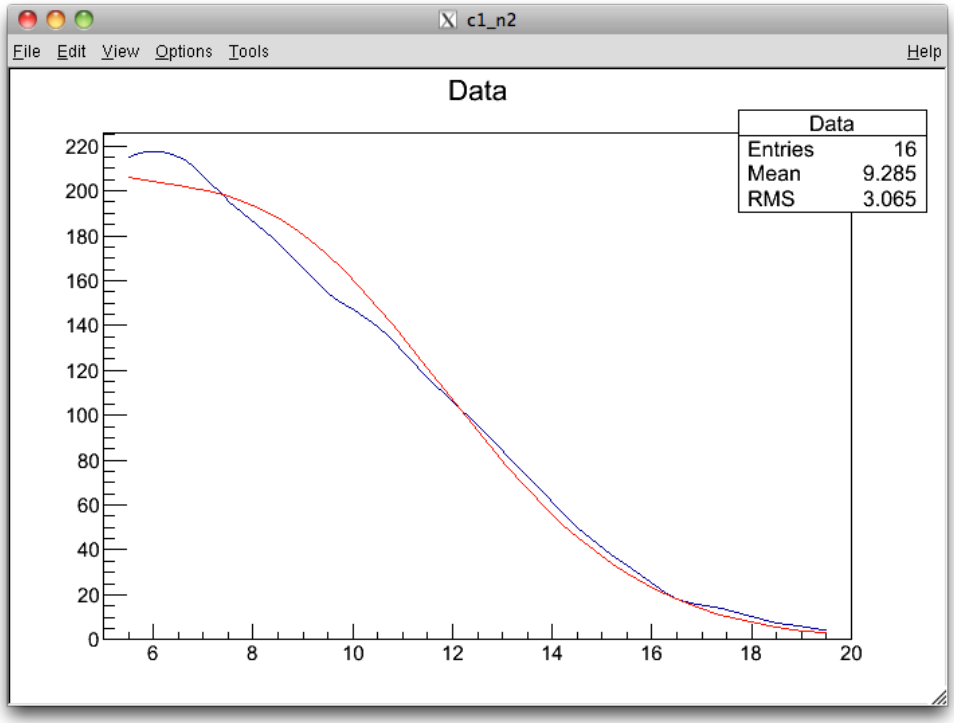


Baseline

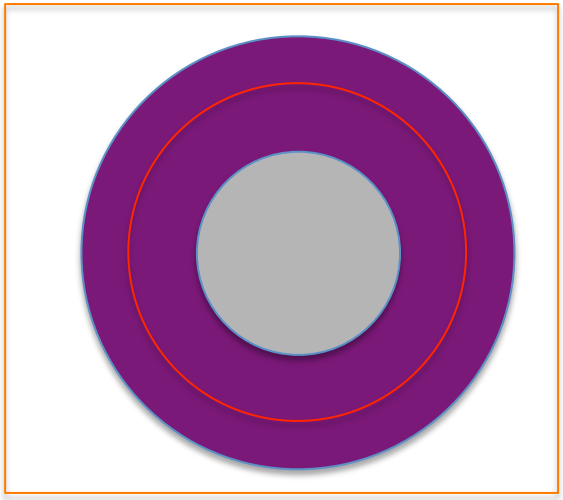


Best Fit GQE = 0.13%

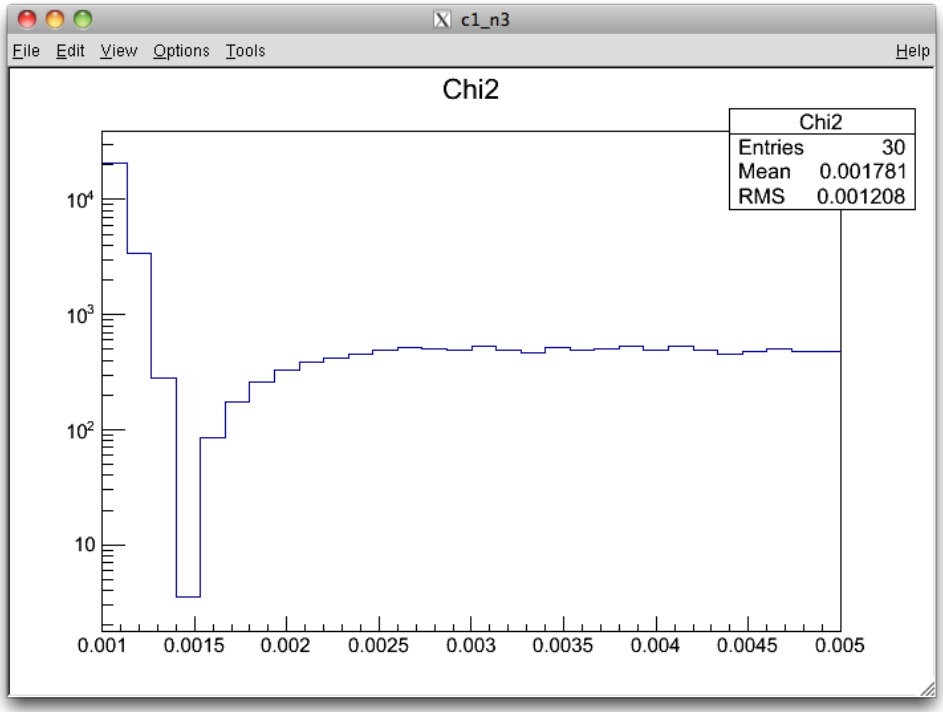


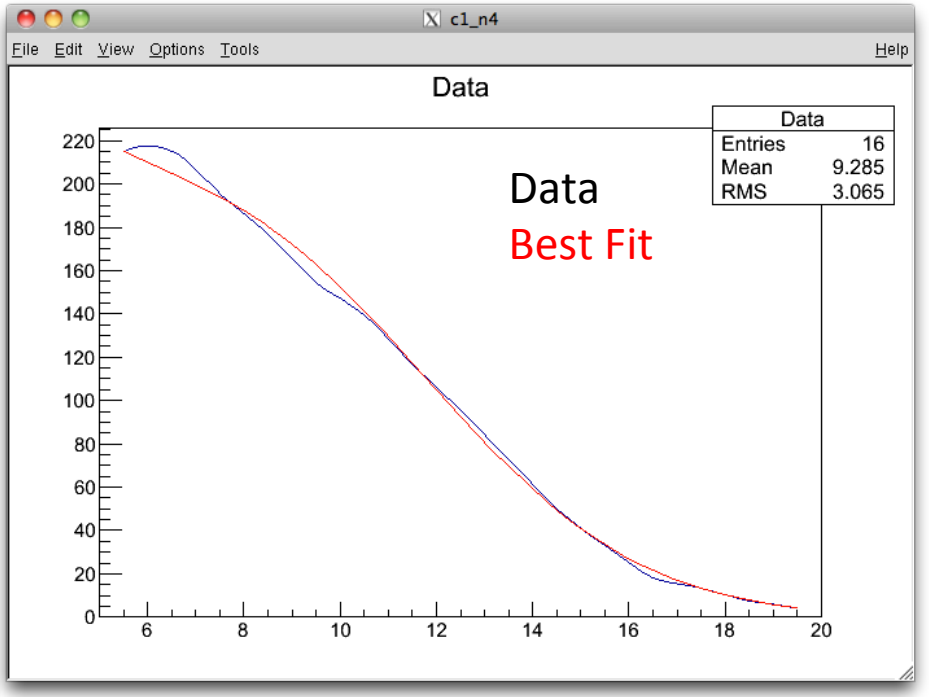


More Obscured

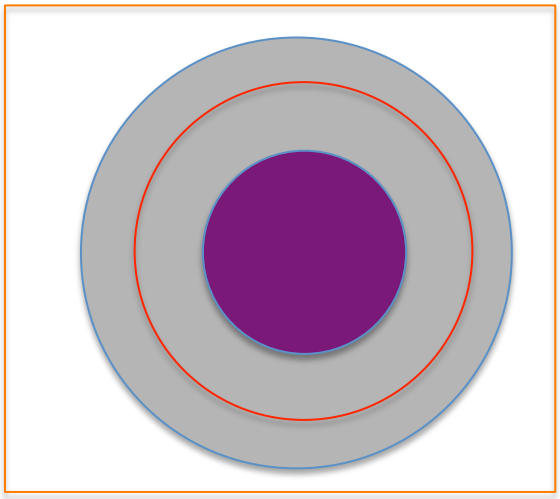


Best Fit GQE = 0.14%

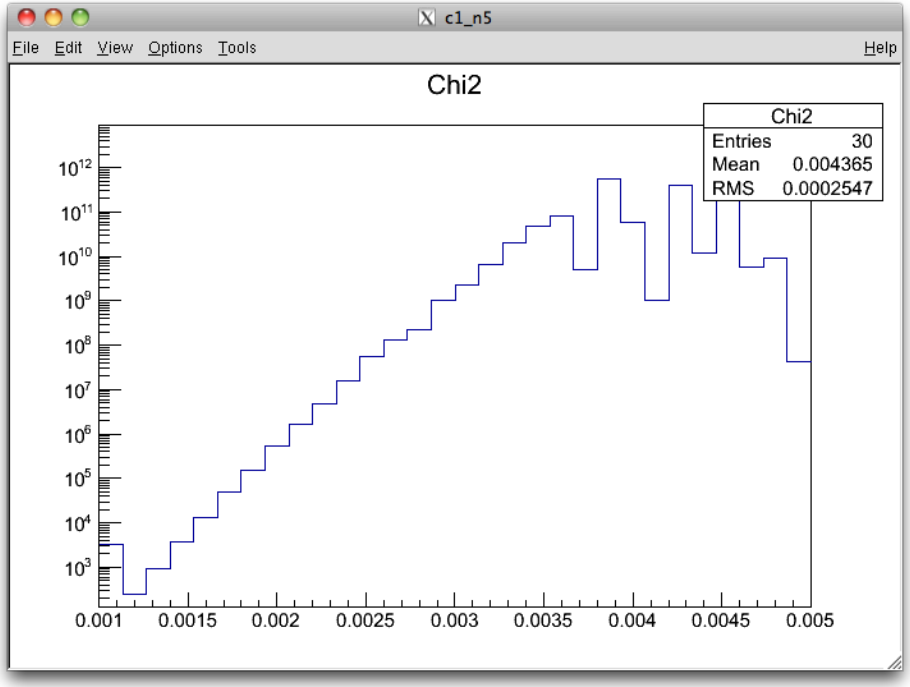


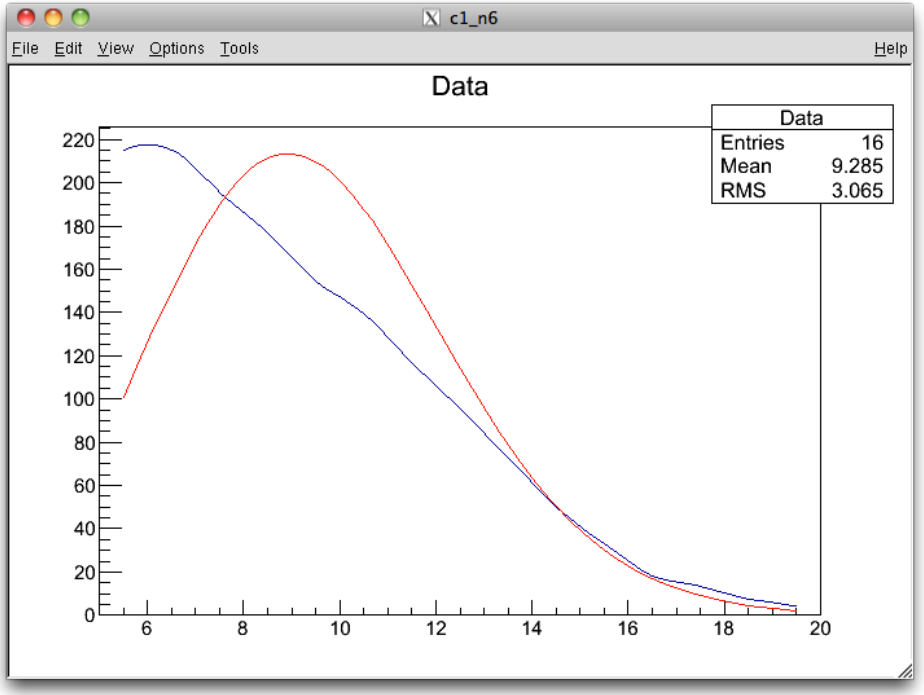


Less Obscured



Best Fit GQE = 0.12%





The End

- That’s all for now!