Tagger Microscope Update

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GlueX Collaboration Meeting
May 11-13, 2015

Outline

- Status from the fall
- Bias studies
- Replacement fibers
- Remaining work

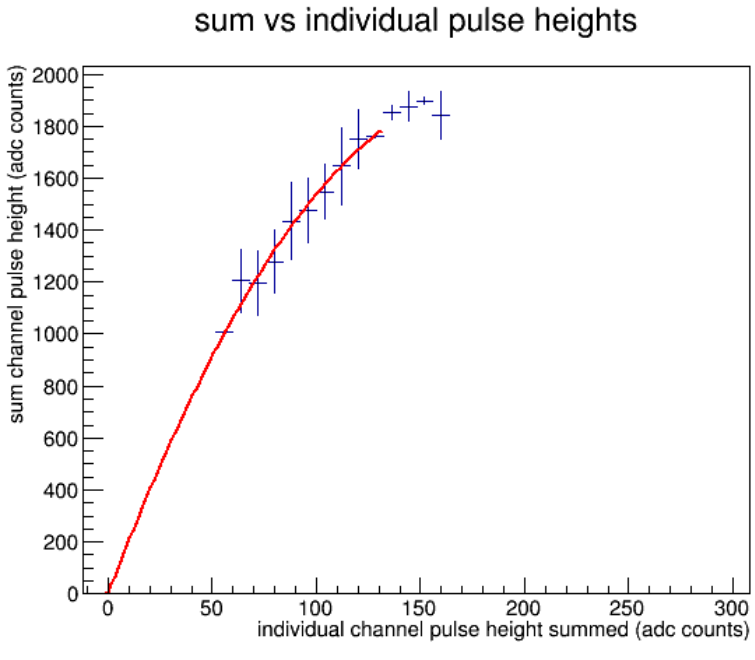
TAGM status after fall run

The photon yield of the microscope was measured per channel

Average yield smaller than anticipated

Only 7 channels met our requirements

high-gain matching (Fall)

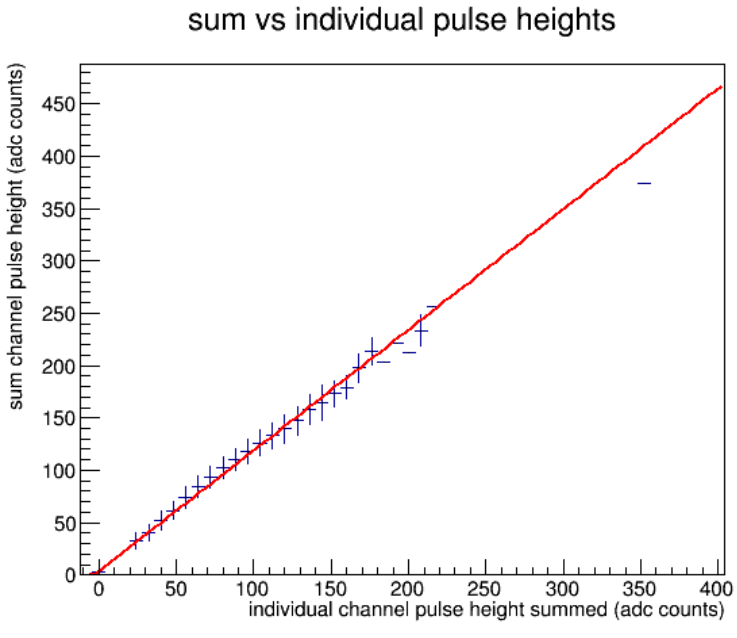


fit to second order polynomial (run 1898)

Chi2	= 0.970233
NDf	= 7
p0	= 2.50371 +/- 2.49999
p1	**= 21.1211 +/- 1.79436**
p2	= -0.057479 +/- 0.0140699

- Readout from high gain, summed output on y-axis
- Summed readout from low gain, individual outputs on x-axis
- Preamplifier saturates at ~1800adc counts, removed those points from fit

low gain matching (Fall)

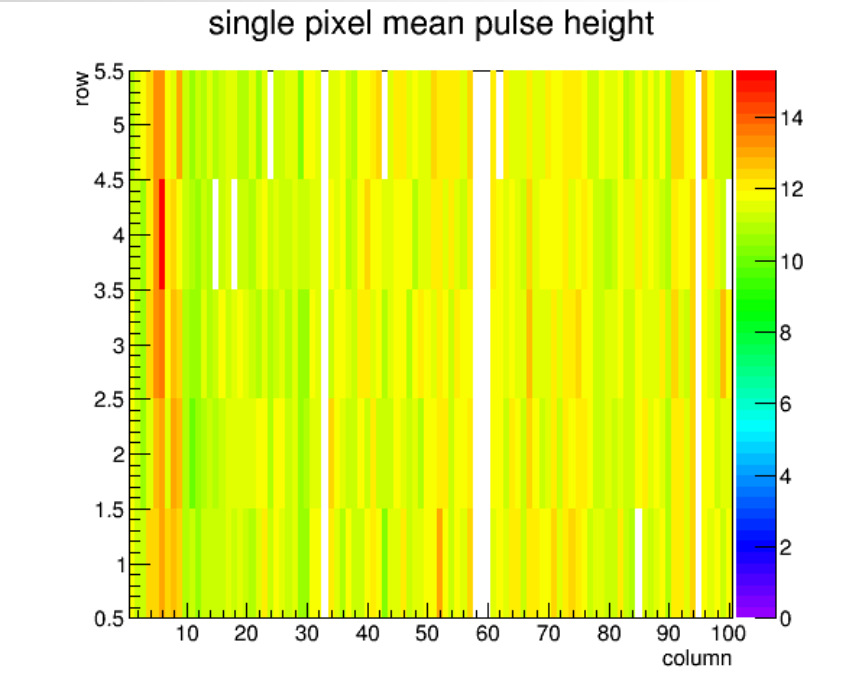


fit to first order polynomial (run 1807)

Chi2	= 4.26315
NDf	= 20
p0	= 3.9017 +/- 2.2148
p1	**= 1.15253 +/- 0.0305288**

- Readout from low gain, summed output on y-axis
- Summed readout from low gain, individual outputs on x-axis
- Use ratio of linear term coefficients divided by the number of pixels per high gain summed output to get the conversion between low gain summed output to pixels

Single pixels in high gain (Fall)



- Used row-by-row runs to measure single pixel pulse height for each SiPM
- Average single pixel pulse height is ~12 adc counts in high gain

ADC counts to pixels

- Use the ratio of the linear terms to get the high gain amplification

  ~17x amplification (high gain summed)/(low gain summed)

- 200 pixel specification

  The decay time of the green scintillator is 2.7 ns.

  We want 200ps timing resolution

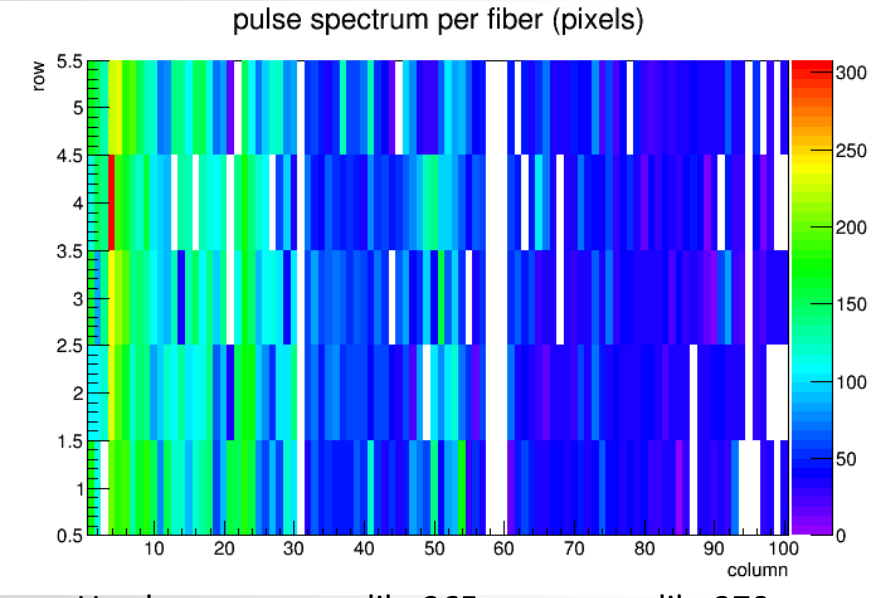
  2700ps / 200ps = $\sqrt{N}$

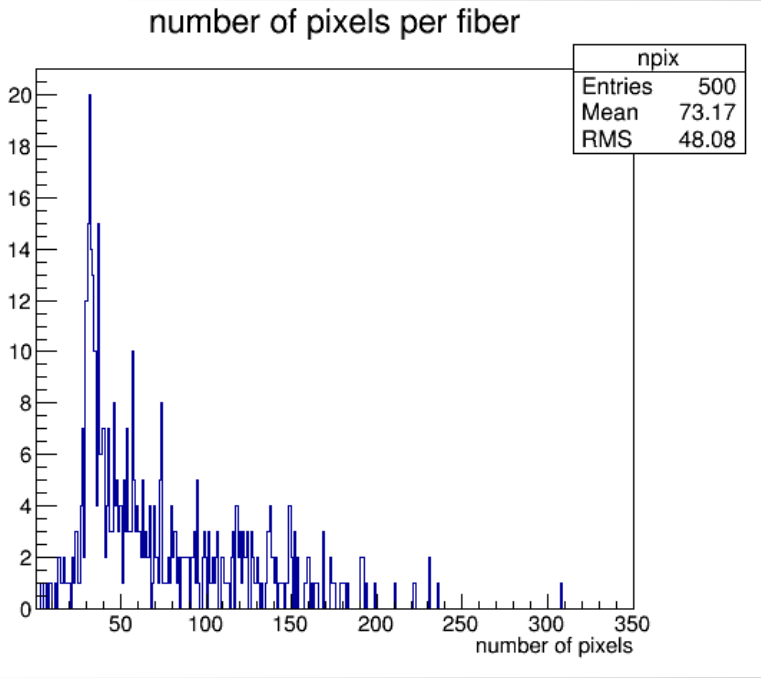
  N ~ 200 photons = 200 pixels

- Divide by the single pixel pulse height to get number of pixels

  The single pixel pulse height is measured in high gain. This provides a conversion factor from low gain summed outputs to the number of pixels per pulse.

Average pixels per pulse (Fall)





Used runs tagm_calib_265 to tagm_calib_270

Require npix to be at least 200 pixels, only 7 meet this spec

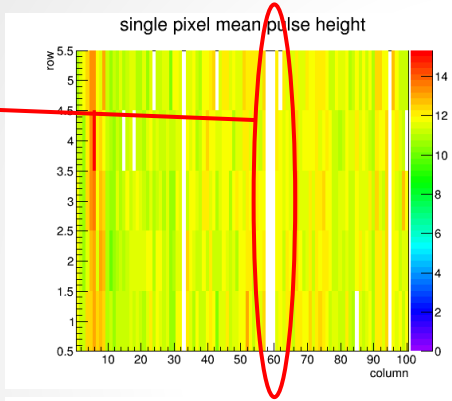
Find new bias voltages

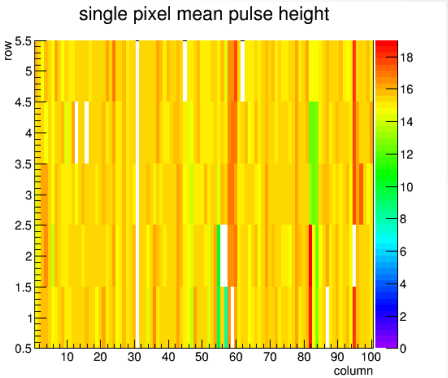
- Take dark rate data with original bias settings
- Take dark rate data with +1V bias voltages
- Find new single pixel height for +1V scan
- Fit these points to a line to provide a bias voltage as a function of single pixel pulse height
- Decided to try 15, 20, and 25 adc pixel heights corresponding to voltage increases of roughly 0.25V, 0.6V, and 1.1V
- This was done for every channel

Single pixel results

Missing channels

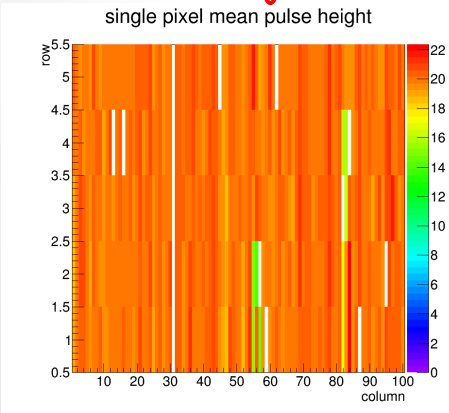
12 adc

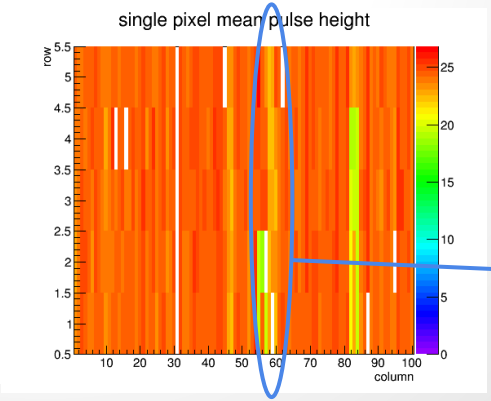




15 adc

20 adc

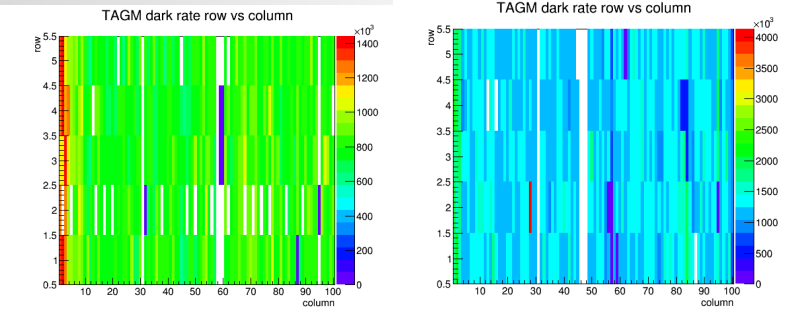


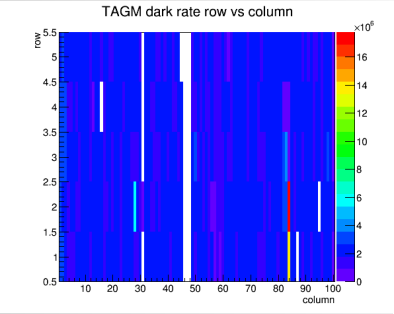


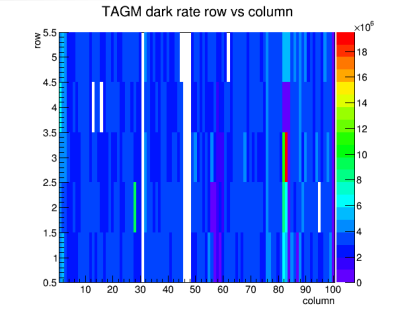
25 adc

Channels recovered

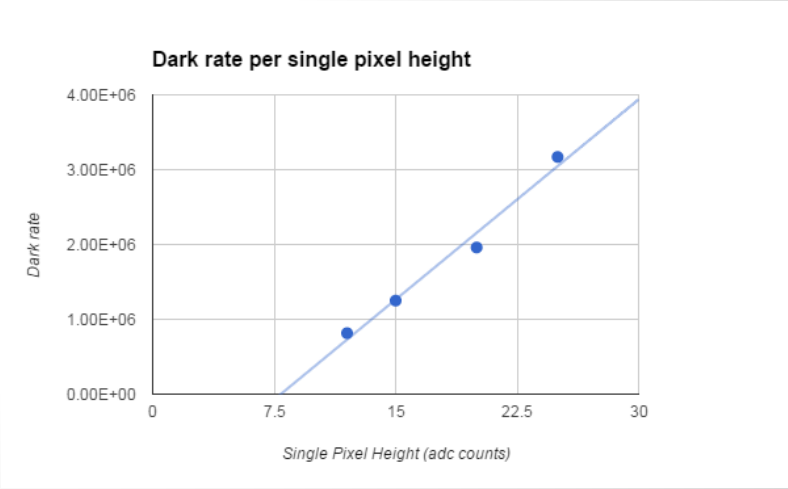
Dark rate before beam



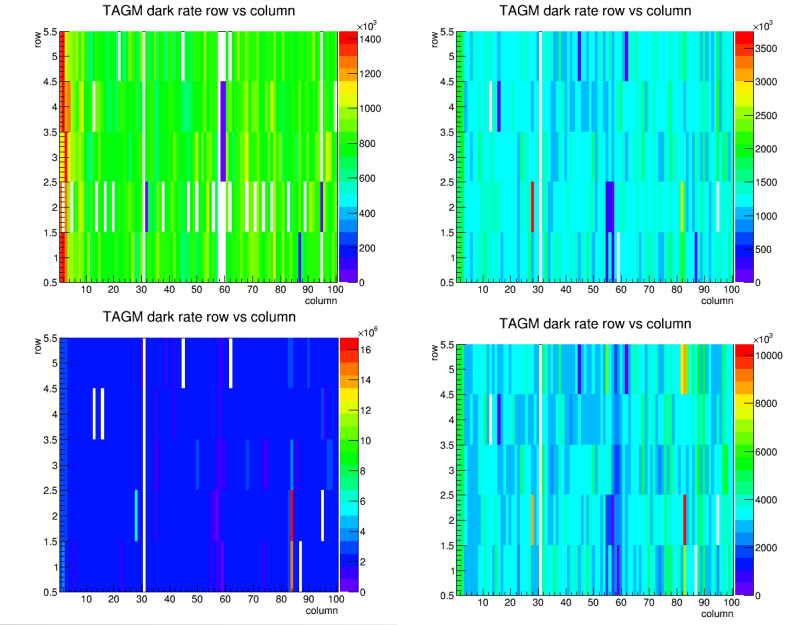




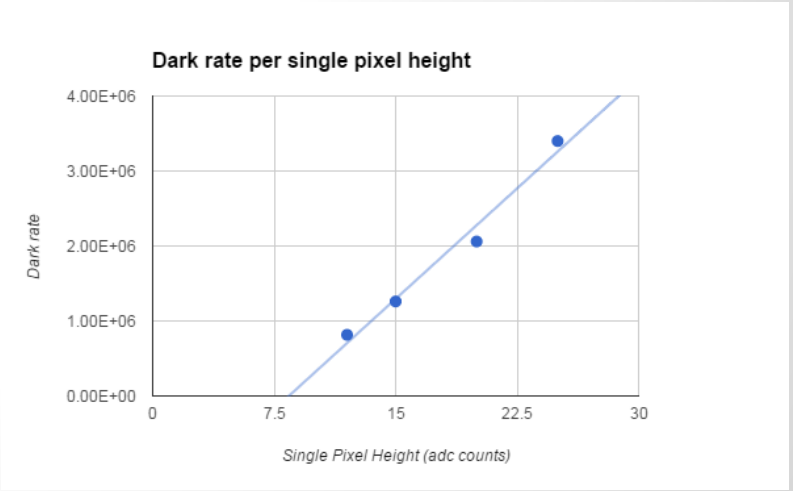
12 adc	15 adc	20 adc	25 adc
8.15×10^5	1.25×10^6	1.96×10^6	3.17×10^6



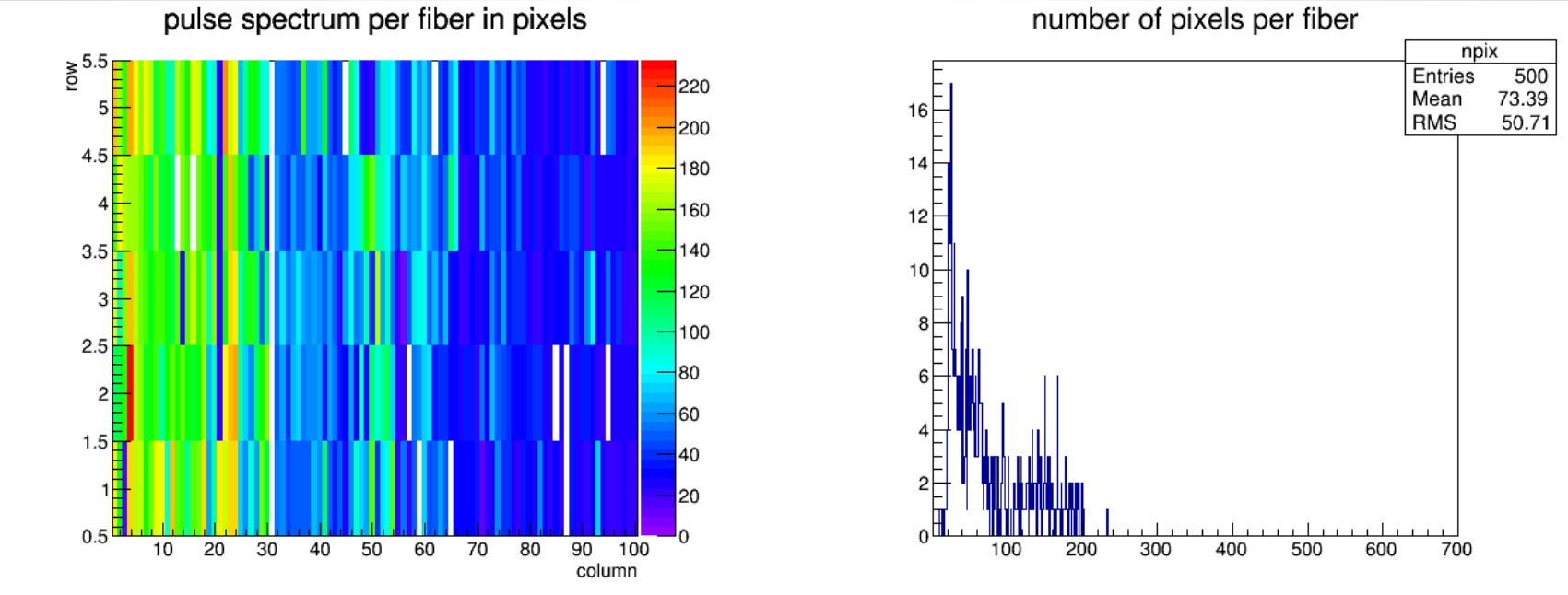
Dark rate post beam



12 adc	15 adc	20 adc	25 adc
8.15×10^5	1.26×10^6	2.06×10^6	3.40×10^6

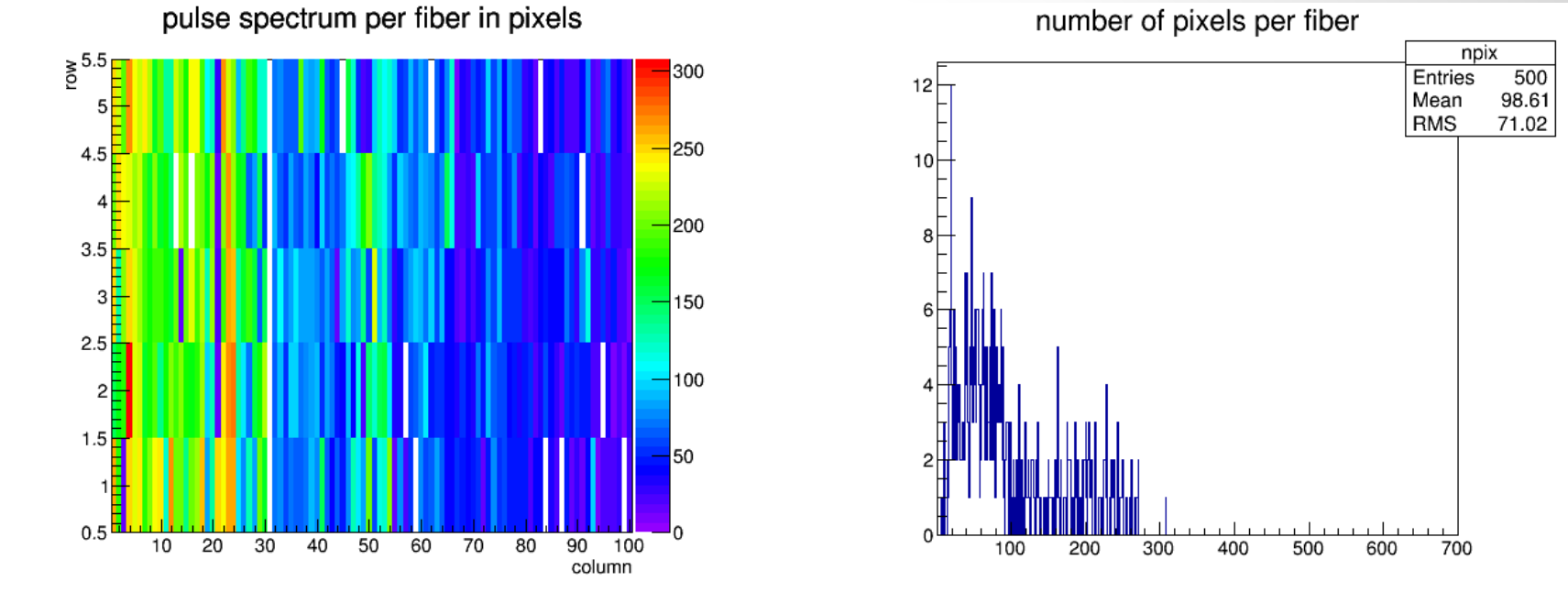


Average pixels per pulse 15 adc



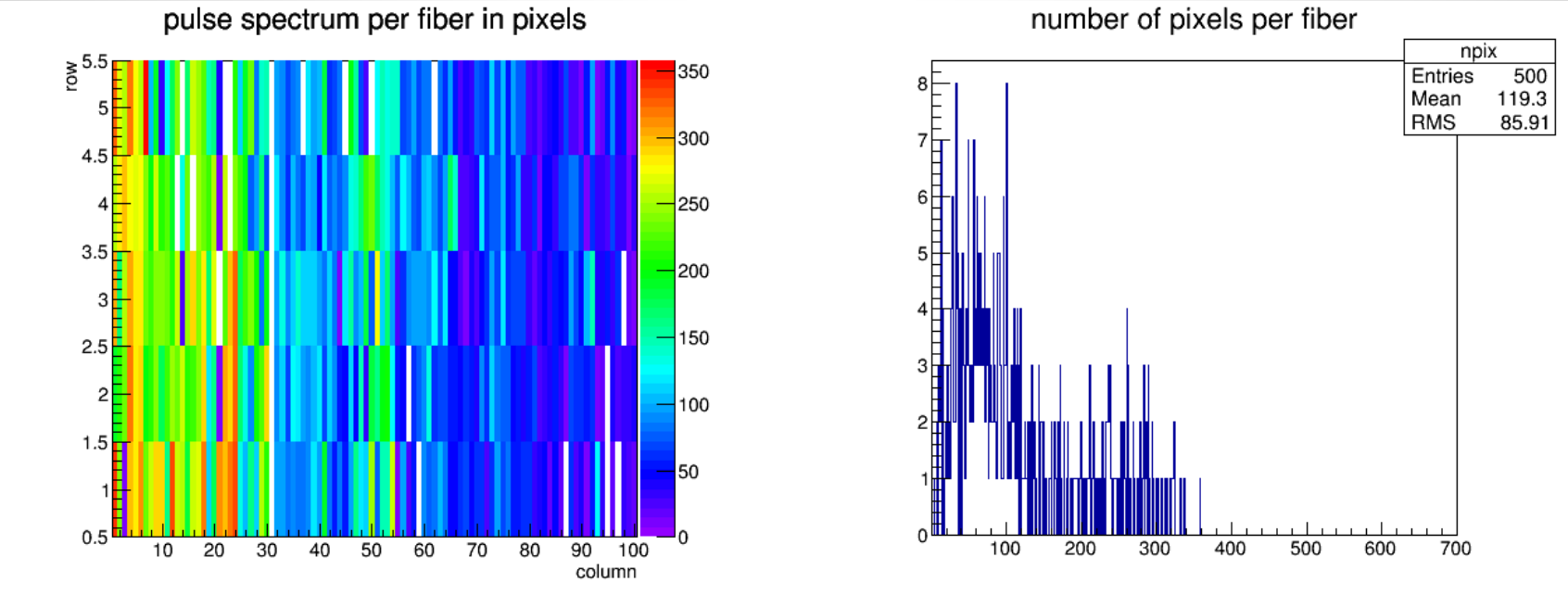
~2 channels above 200 pixels

Average pixels per pulse 20 adc



~70 channels above 200 pixels

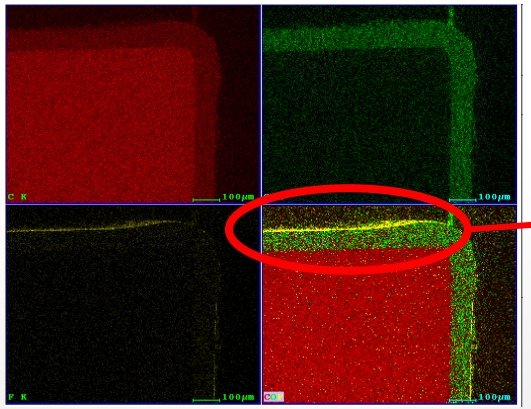
Average pixels per pulse 25 adc



~100 channels above 200 pixels

Bias study conclusion

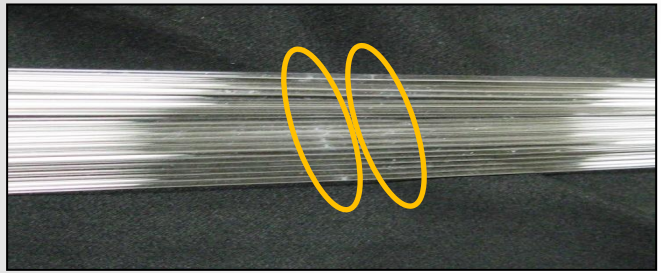
- The 25 adc bias voltage setting is now our operating setting
- Pushing the biases further will run the risk of overbiasing
- We are still below spec in many columns
- UConn will construct 12 new bundles with double-clad fibers

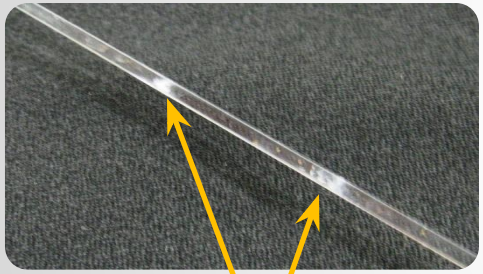


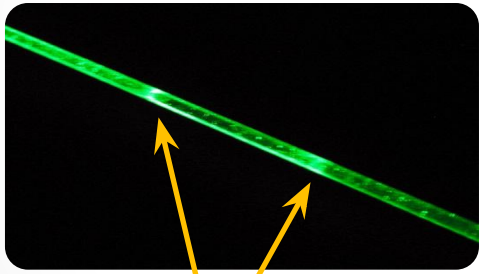
Proof of second layer of cladding

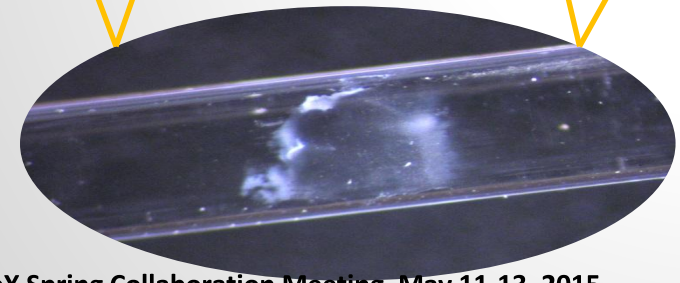
Replacement Fiber Bundle Status

Hard Water Deposits







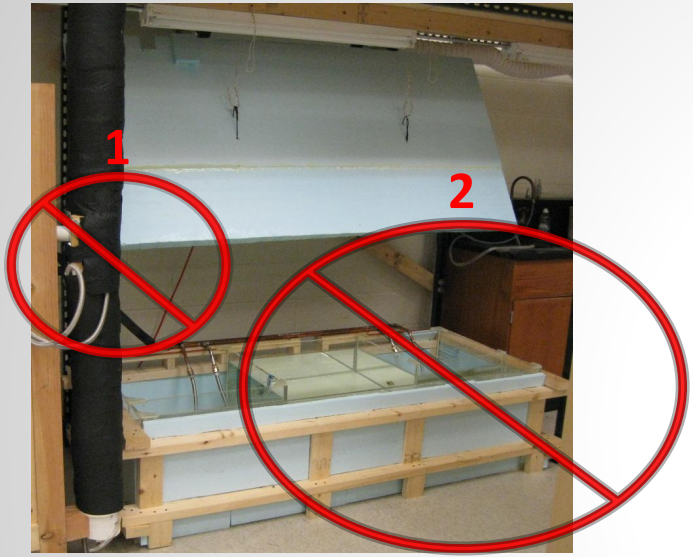


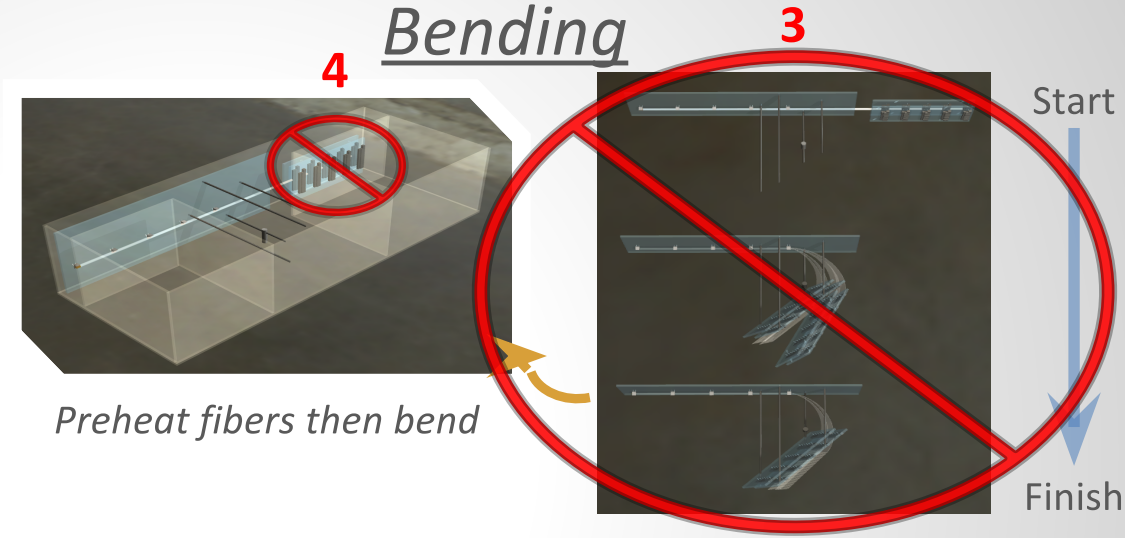
Kink in Fibers

Occasional Problems Encountered

- Minor kinks during fiber bending
- Hard water deposits & cladding separation
  - ✓ Resulting in light loss

Replacement Fiber Bundle Status

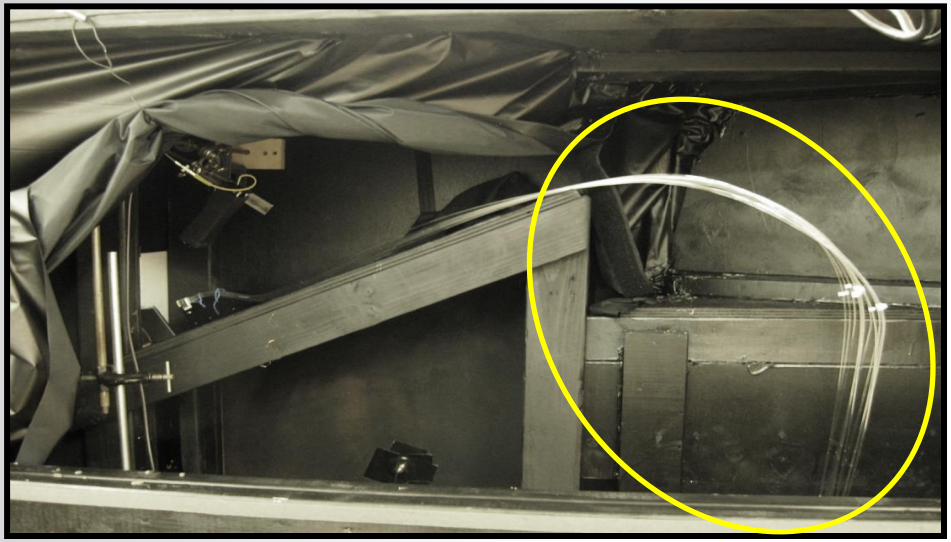




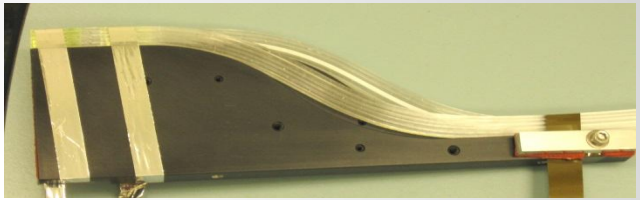
Bundle Manufacturing Changes

- ***No more***:
  1) Straightening fibers
  2) Using a hot water bending tank
  3) Putting large bend in fibers
  4) Straight section prior to chimneys (i.e. preamp boards)
- Minimalist approach taken when processing fibers, to help increase fiber light yield

Replacement Fiber Bundle Status



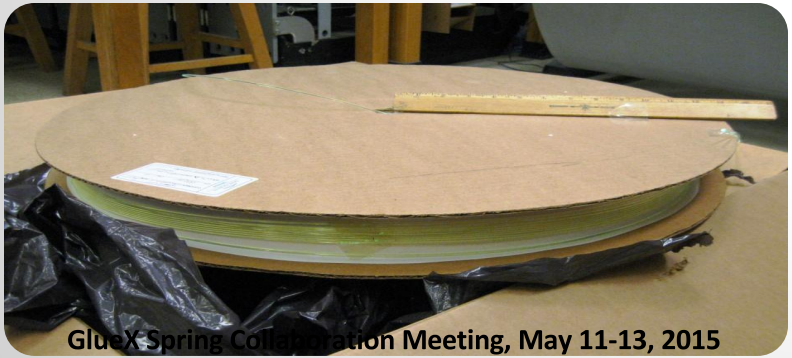
S-bend



Bundle Manufacturing Changes

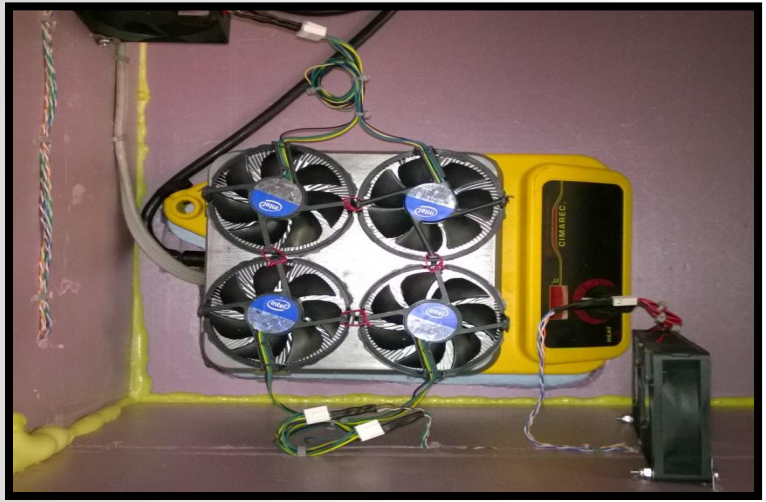
- "S-bend" fiber processing only
  - ✓ Needed to avoid TAGH
- Use fiber curvature from storage spool
  - ✓ Less fiber processing = better light yield

Storage Spool

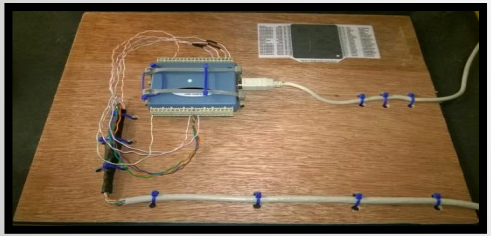


Replacement Fiber Bundle Status

Hot plate with thermally bonded heat sinks/fans

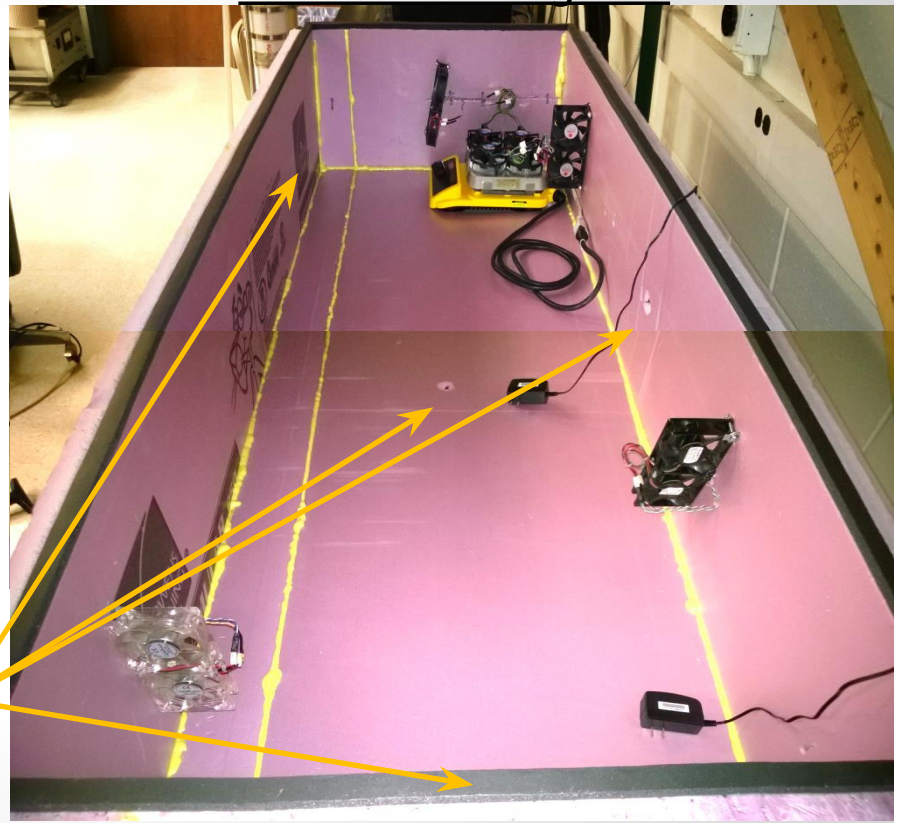


DAQ



Thermistors

Hot Air Bending Box



Replacement Fiber Bundle Status

LG Spool Name:	Received	Worker Initials	Worker Name
A1	Aug 2014	LH	Liana Hotte
A2	Aug 2014	BW	Ben Willis
S1	Sep 2014	AK	Aaron Khan
S2	Sep 2014	AS	Andrew Sampino
S3	Sep 2014	ZG	Zane Grady
S4	Sep 2014	BC	Ben Commeau

SciFi Spool Name:	Received
O1	Oct 2014

Bundle Progress

Completed | In Progress | Projected | Last updated: Apr 17, 2015

Fiber Bundle	Strap Color	LG Rough Cut	LG Measure	LG End Mill	LG Polish	SciFi Cut	SciFi End Mill	SciFi Polish	Fuse	Measure	Bend
41	Red	Nov 03, 2014	Dec 17, 2014	Feb 07, 2015	Feb 23, 2015	Dec 29, 2014	Feb 07, 2015	Feb 10, 2015	Apr 15, 2015		
42	Orange	Nov 13, 2014	Dec 18, 2014	Mar 27, 2015	Feb 24, 2015	Jan 06, 2015	Feb 07, 2015	Feb 10, 2015			
43	Yellow	Dec 04, 2014	Dec 18, 2014	Apr 13, 2015	Feb 25, 2015	Jan 06, 2015	Feb 07, 2015	Feb 10, 2015			
44	Green	Dec 15, 2014	Dec 18, 2014	Apr 14, 2015		Jan 06, 2015	Feb 07, 2015	Feb 20, 2015			
45	Cyan	Dec 15, 2014	Dec 18, 2014	Apr 15, 2015		Jan 06, 2015	Mar 27, 2015	Apr 03, 2015			
46	Blue	Dec 19, 2014	Dec 22, 2014	Apr 16, 2015		Jan 08, 2015	Apr 01, 2015	Apr 04, 2015			
47	Purple	Dec 19, 2014	Dec 23, 2014	Apr 20, 2015	Apr 24, 2015	Jan 08, 2015	Apr 08, 2015	Apr 13, 2015			
48	Pink	Dec 29, 2014	Dec 30, 2014	Apr 20, 2015	Apr 25, 2015	Jan 08, 2015	Apr 09, 2015	Apr 15, 2015			
49	Black	Dec 29, 2014	Dec 30, 2014	Apr 20, 2015		Jan 08, 2015	Apr 10, 2015	May 01, 2015			
50	White	Dec 30, 2014	Jan 06, 2015	Apr 27, 2015	Apr 24, 2015	Jan 08, 2015	Apr 11, 2015				
51	Red x 2	Jan 07, 2015	Jan 07, 2015	Apr 27, 2015		Jan 13, 2015	Apr 12, 2015				
52	Orange x 2	Jan 07, 2015	Jan 08, 2015	Apr 27, 2015		Jan 13, 2015	Apr 20, 2015				

		Rough Cut and Measure								Fuse								
										Average Cross Sectional Width				Average Cross Sectional Width				
Fiber Bundle: Fiber Name	Spool Name	Average Width (mm)	Cut Date	Cut Initials	Measure Date	Measure Initials	Light Guide Width 1 (mm)	Light Guide Width 2 (mm)	Average Light Guide Width (mm)	Scintillator Length (cm)	Scintillator Width 1 (mm)	Scintillator Width 2 (mm)	Average SciFi Width (mm)	Fuse Width 1 (mm)	Fuse Width 2 (mm)	Average Fuse Width (mm)	Fuse Notes	Fuse Date	Fuse Initials
41:01	S2	1.98	10/23/2014	BC	11/13/2014	LH	1.96	1.94	1.95	2.077	1.98	1.98	1.98	2.03	2.03	2.03		4/13/2015	LH
41:02	S2	2.03	10/23/2014	BC	11/13/2014	LH	2.03	2.02	2.03	2.038	2.02	2.00	2.01	2.08	2.08	2.08		4/13/2015	LH
41:03	S2	1.99	10/23/2014	BC	12/15/2014	BW	1.96	1.95	1.96	2.027	2.04	2.04	2.04	2.06	2.07	2.065		4/13/2015	LH
41:04	S2	1.93	10/23/2014	BC	12/15/2014	BW	1.93	1.95	1.94	2.091	1.97	1.98	1.975	2.02	2.01	2.015		4/13/2015	LH
41:05	S2	1.97	10/23/2014	BC	12/15/2014	BW	2.21	2.21	2.21	2.068	2.09	2.09	2.09	2.2	2.21	2.205	Cladding flaring	4/13/2015	LH
41:06	A2	1.96	12/29/2014	LH	12/29/2014	LH	1.92	1.93	1.93	2.03	2.09	2.08	2.085	2.14	2.14	2.14		4/13/2015	LH
41:07	S2	1.96	10/23/2014	BC	12/16/2014	BW	1.93	1.94	1.94	2.034	2	2.02	2.01	2.04	2.05	2.045		4/13/2015	LH
41:08	S2	1.99	10/23/2014	BC	12/16/2014	BW	1.99	1.98	1.99	2.077	2.02	2.04	2.03	2.04	2.05	2.045		4/13/2015	LH
41:09	S2	1.92	10/23/2014	BC	12/16/2014	BW	1.91	1.92	1.92	2.027	1.97	1.97	1.97	2	2.01	2.005		4/13/2015	LH
41:10	S2	1.95	10/23/2014	BC	12/16/2014	BW	1.9	1.92	1.91	2.028	1.99	2.01	2	2.04	2.05	2.045		4/13/2015	LH
41:11	A2	1.98	12/29/2014	LH	12/29/2014	LH	1.96	1.96	1.96	1.993	1.97	1.98	1.975	2	2.01	2.005		4/13/2015	LH
41:12	S2	2.01	10/23/2014	BC	12/16/2014	BW	1.98	1.97	1.98	2.177	2	2	2	2.03	2.04	2.035		4/13/2015	LH
41:13	A2	1.98	12/29/2014	LH	12/29/2014	LH	1.94	1.95	1.95	2.089	2.03	2.04	2.035	2.05	2.06	2.055		4/15/2015	LH
41:14	A2	1.99	12/29/2014	LH	12/29/2014	LH	1.99	1.98	1.99	2.033	1.95	1.95	1.95	2	2.01	2.005		4/15/2015	LH
41:15	S2	2.04	10/23/2014	BC	12/16/2014	BW	2.01	2.02	2.02	2.028	1.98	1.99	1.985	2.03	2.04	2.035		4/15/2015	LH
41:18	S2	1.96	10/23/2014	BC	12/16/2014	BW	1.93	1.94	1.94	2.08	1.99	1.99	1.99	2.02	2.03	2.025		4/15/2015	LH
41:19	A2	2.00	12/29/2014	LH	12/29/2014	LH	2	2	2.00	2.036	1.99	1.99	1.99	2.07	2.07	2.07		4/15/2015	LH
41:20	S2	1.97	11/3/2014	BC	12/16/2014	BW	1.96	1.93	1.95	2.039	2.01	2.03	2.02	2.03	2.04	2.035		4/15/2015	LH
41:21	S2	1.98	11/3/2014	BC	12/16/2014	BW	1.97	1.94	1.96	2.04	2.03	2.02	2.025	2.09	2.08	2.085		4/15/2015	LH
41:22	S2	1.92	11/3/2014	BC	12/16/2014	BW	1.94	1.91	1.93	2.032	2.03	2.05	2.04	2.07	2.08	2.075		4/15/2015	LH
41:23	S2	1.94	11/3/2014	BC	12/16/2014	BW	1.96	1.92	1.94	2.037	1.97	1.98	1.975	2.02	2.01	2.015		4/15/2015	LH
41:24	S2	1.96	11/3/2014	BC	12/16/2014	BW	1.98	1.94	1.96	2.034	2.05	2.03	2.04	2.07	2.07	2.07		4/15/2015	LH
41:25	S2	2.03	11/3/2014	BC	12/16/2014	BW	1.99	2.02	2.01	2.089	1.97	1.97	1.97	2.03	2.03	2.03		4/15/2015	LH
41:26	S2	1.99	11/3/2014	BC	12/16/2014	BW	2.02	1.98	2.00	2.048	2.02	2.04	2.03	2.04	2.06	2.05		4/15/2015	LH
41:27	S2	2.02	11/3/2014	BC	12/17/2014	LH	2.03	2.00	2.02	2.175	1.96	1.97	1.97	2.02	2.06	2.04	was broken and re-fused	4/15/2015	LH
41:28	S2	1.99	11/3/2014	BC	12/17/2014	LH	1.99	2.02	2.01	2.029	1.96	1.96	1.96	2.02	2.04	2.03		4/15/2015	LH
41:29	S2	2.00	11/3/2014	BC	12/17/2014	LH	1.98	2.02	2.00	2.027	1.98	1.98	1.98	2.06	2.06	2.06		4/15/2015	LH
41:30	S2	1.99	11/3/2014	BC	12/17/2014	LH	1.94	1.97	1.96	2.023	1.98	1.98	1.98	2	2.01	2.005		4/15/2015	LH
41:31	S2	1.99	11/3/2014	BC	12/17/2014	LH	1.99	2.02	2.01	2.071	1.99	1.98	1.99	2.04	2.05	2.045	was re-fused without breaking	4/15/2015	LH
41:32	S2	1.99	11/3/2014	BC	12/17/2014	LH	2.00	1.97	1.99	2.033	2.02	2.03	2.03	2.06	2.07	2.065		4/15/2015	LH
42:01	S2	1.98	11/3/2014	BC	12/17/2014	BW	1.94	1.96	1.95	2.069	1.99	1.99	1.99	2.01	2.02	2.015		4/15/2015	LH
42:02	S2	1.98	11/3/2014	BC	12/17/2014	BW	1.98	2.01	2.00	2.031	2.02	2.02	2.02	2.05	2.06	2.055		4/15/2015	LH
42:03	S2	2.03	11/3/2014	BC	12/17/2014	BW	2.04	2.01	2.03	2.090	1.98	1.98	1.98	2.05	2.07	2.06		4/15/2015	LH
42:04	S2	1.99	11/3/2014	BC	12/17/2014	BW	1.97	1.95	1.96	2.025	1.98	1.98	1.98	2.03	2.03	2.03		4/15/2015	LH
42:05	S2	1.96	12/29/2014	LH	12/29/2014	LH	1.98	1.98	1.98	2.040	2.01	2.03	2.02	2.05	2.06	2.06		4/15/2015	LH
42:06	S2	2.04	11/3/2014	BC	12/17/2014	BW	2.04	2.07	2.06	2.108	1.94	1.95	1.95	2.07	2.08	2.075		4/15/2015	LH

Replacement Bundles

- 12 bundles being produced
- All fibers cut & end-milled
- ~ ¾ of the fibers are polished
- Almost 2 bundles of fibers fused
- DAQ crate on loan from JLab will be arriving soon for quality assurance testing

Work to be done

- Calibrations
  - Per channel efficiencies
  - Time walk corrections
- Hardware
  - Purchase new Vbias boards
    - Flash the FPGA on the new Vbias boards
    - Calibrate the DAC offsets of the new Vbias boards
  - Investigate and repair missing channels
  - Construct and install new fibers

Questions?