Arc BLM activity before/after seed laser swap

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During the FY20 physics run, regions in the higher arcs have been activated in a manner never before seen. Chopper viewer images suggested a tail on the C beam was a cause of the difficulty. Accordingly, on March 19 while Hall C was down to switch experiments from a1n to d2n, the laser seeds for B and C were swapped. The B beam is defined by a narrow chopper slit and is low current so it it less likely than C beam, which passes through an open slit, to contain a tail. Response of selected BLMs in arcs 1 and 2 as a function of A and C current were compared for three six hour periods:

A. March 10 1400-2000 with both high current halls, before the laser seed swap
B. March 20 0700-1300 with Hall A the only high current hall
C. March 23 0100-0700 with both high current halls, after the laser seed swap

Arc 1 BLMs 04, 09, 16, 22, 29, 33 and 37 were downloaded for the six hour periods. Arc 2 BLMs 4, 10, 16, 23, 29, 32 and 36 were also downloaded. The less correlated BLMs are shown first and ignored thereafter.

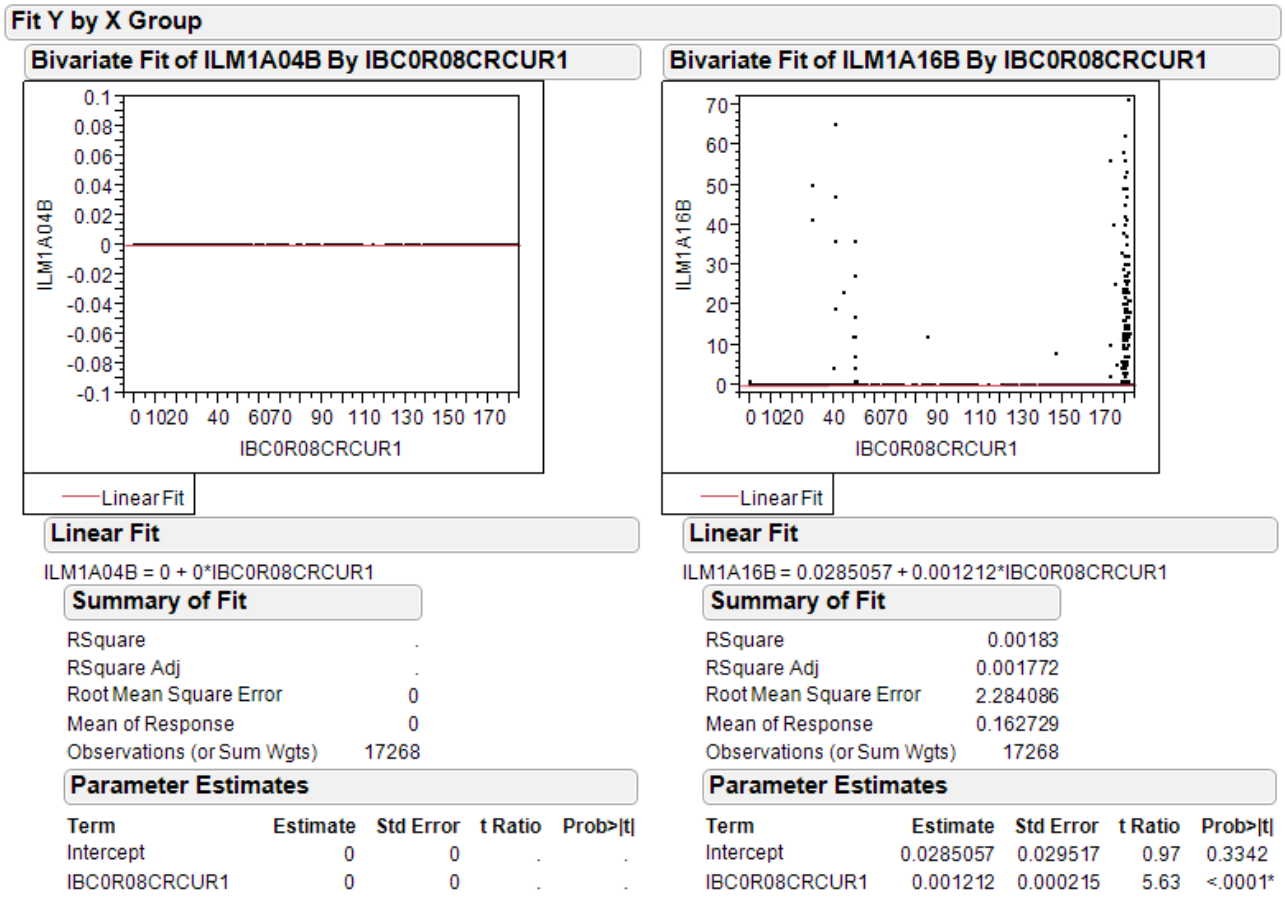


Figure 1. Arc 1 BLMs with no correlation to total current in arc. Period A, before seed change.

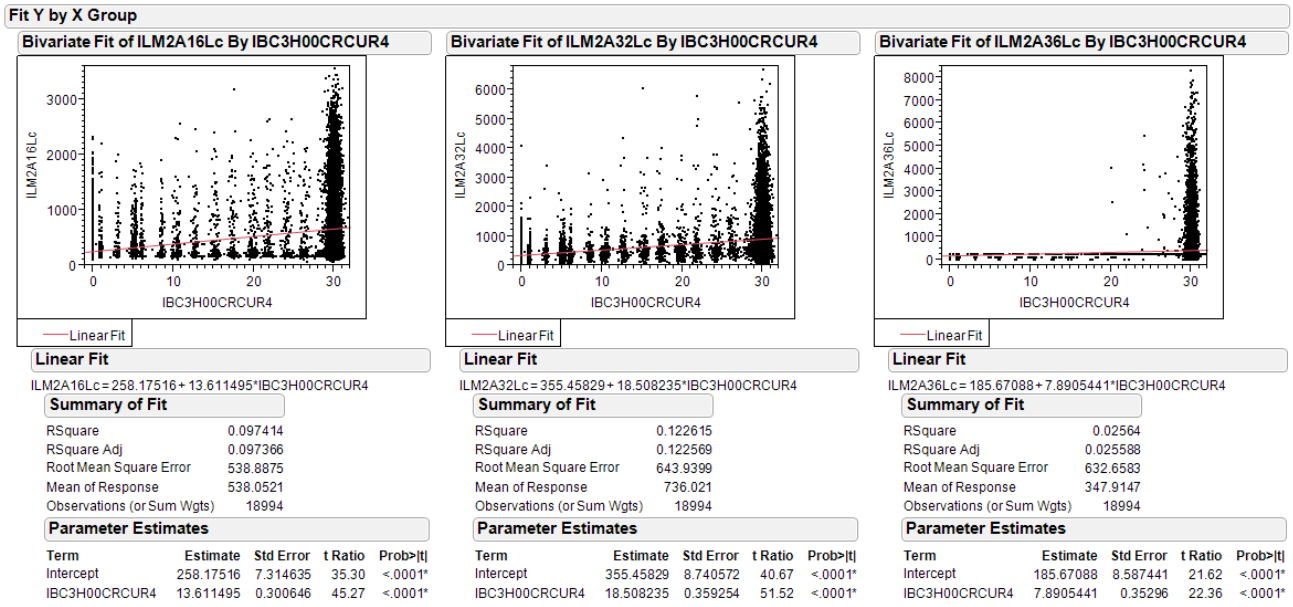


Figure 2. Arc 2 BLMs with little or no correlation to Hall C current. Period A, before seed change.

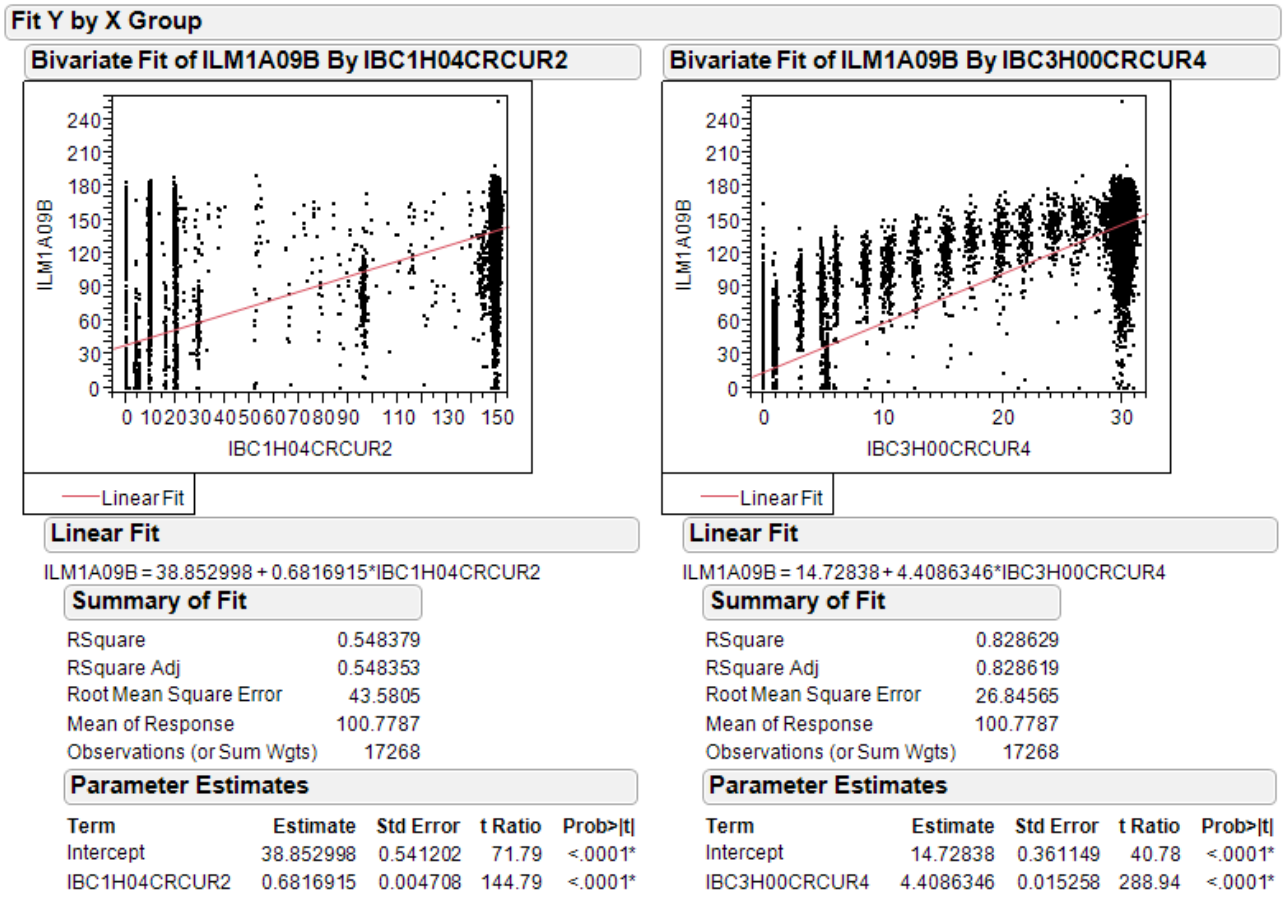


Figure 3. ILM1A09 vs Hall A and Hall C currents with both in the machine, before seed change. Correlation with Hall C (3H00) current is better than with Hall A, even though Hall A has five times the current for most of the period.

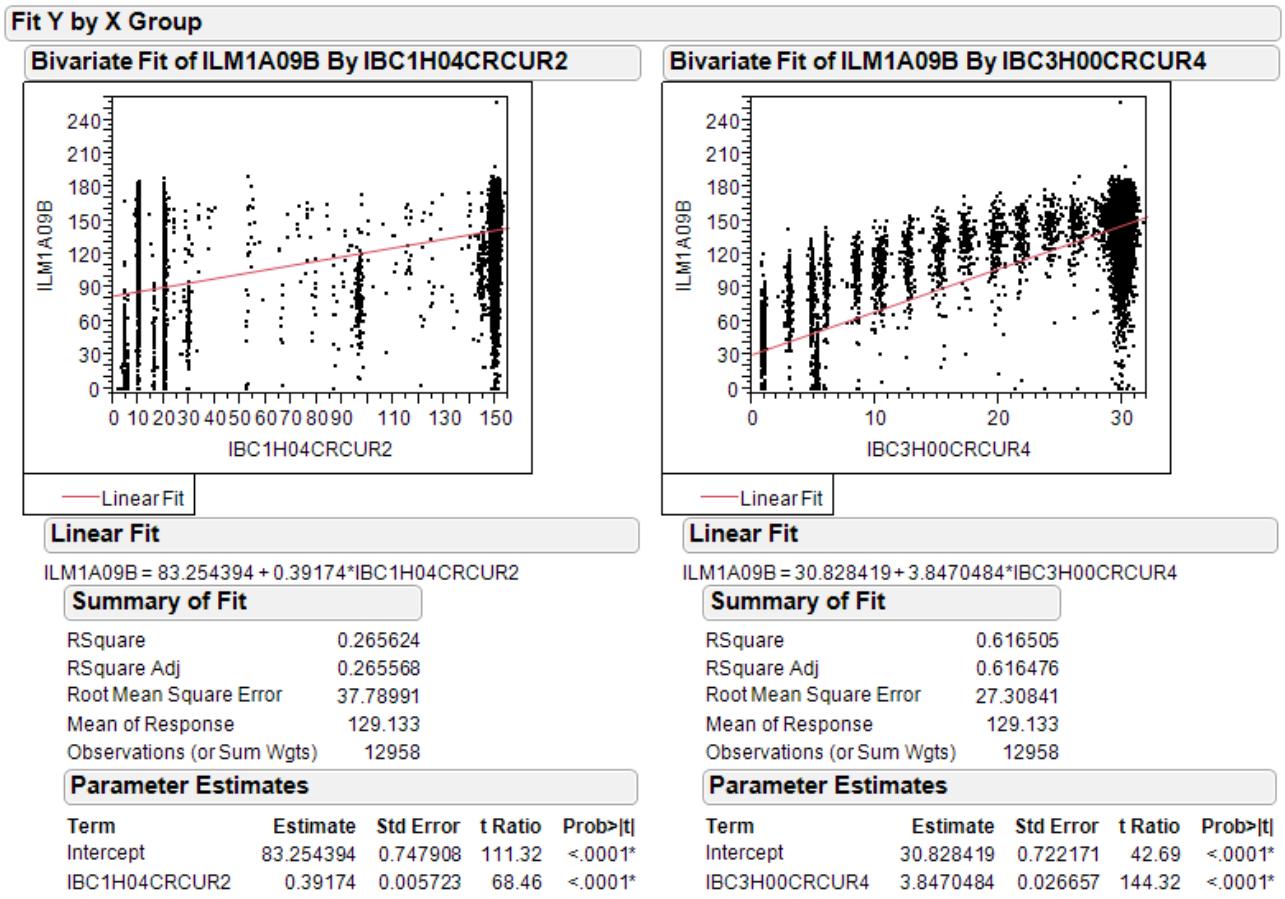


Figure 4. Same as figure 3 except points with both A and C currents under 1 μA are removed. Cutting out the near-zero currents reduced R^2 for Hall A current by just over half while it reduced R^2 for Hall C current by only a fourth. This suggests that Hall C beam was responsible for the majority of the BLM activity even in arc 1 where Hall A current is five times as great.

I will now proceed to waste space by showing similar plots for the other four arc 1 BLMs whose data for period A I have on hand.

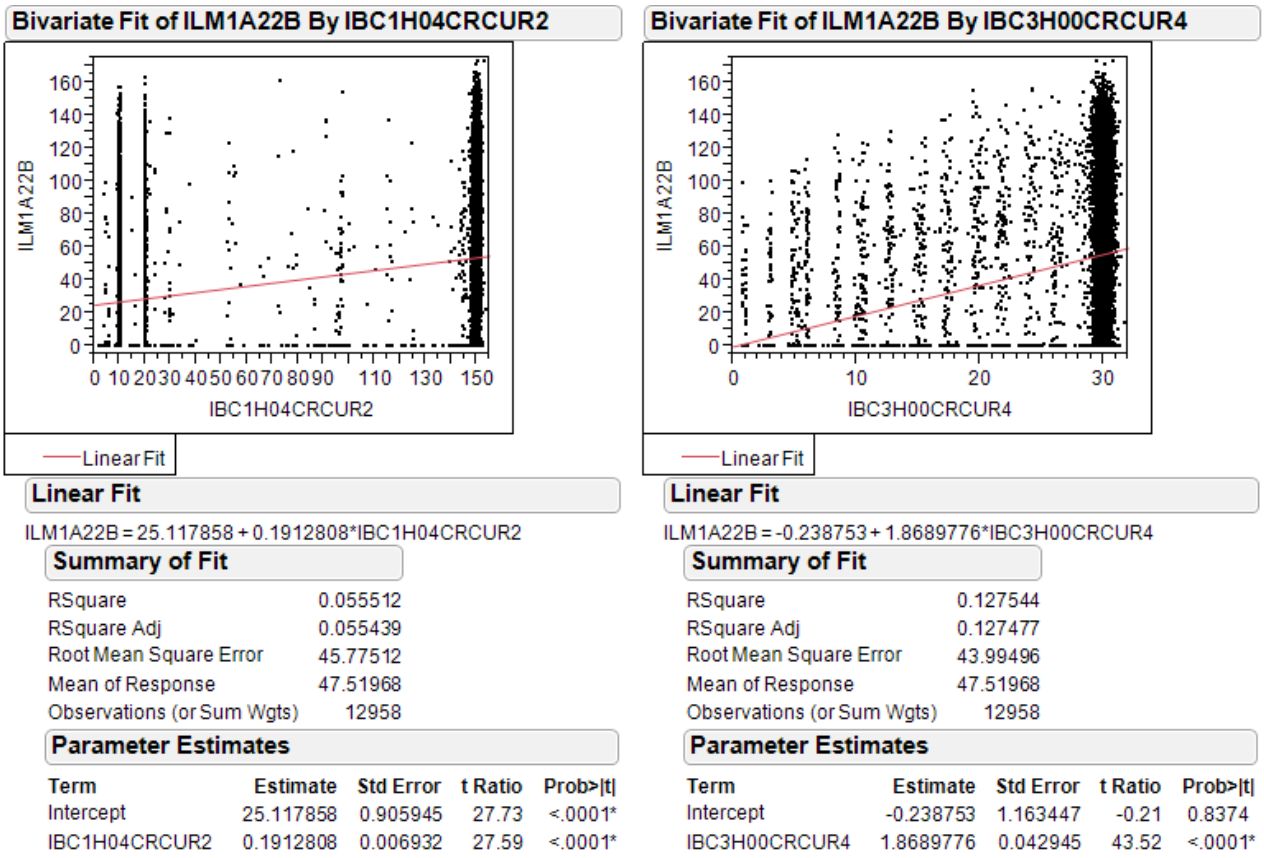


Figure 5. ILM1A22 is almost useless, so I won't show it again.

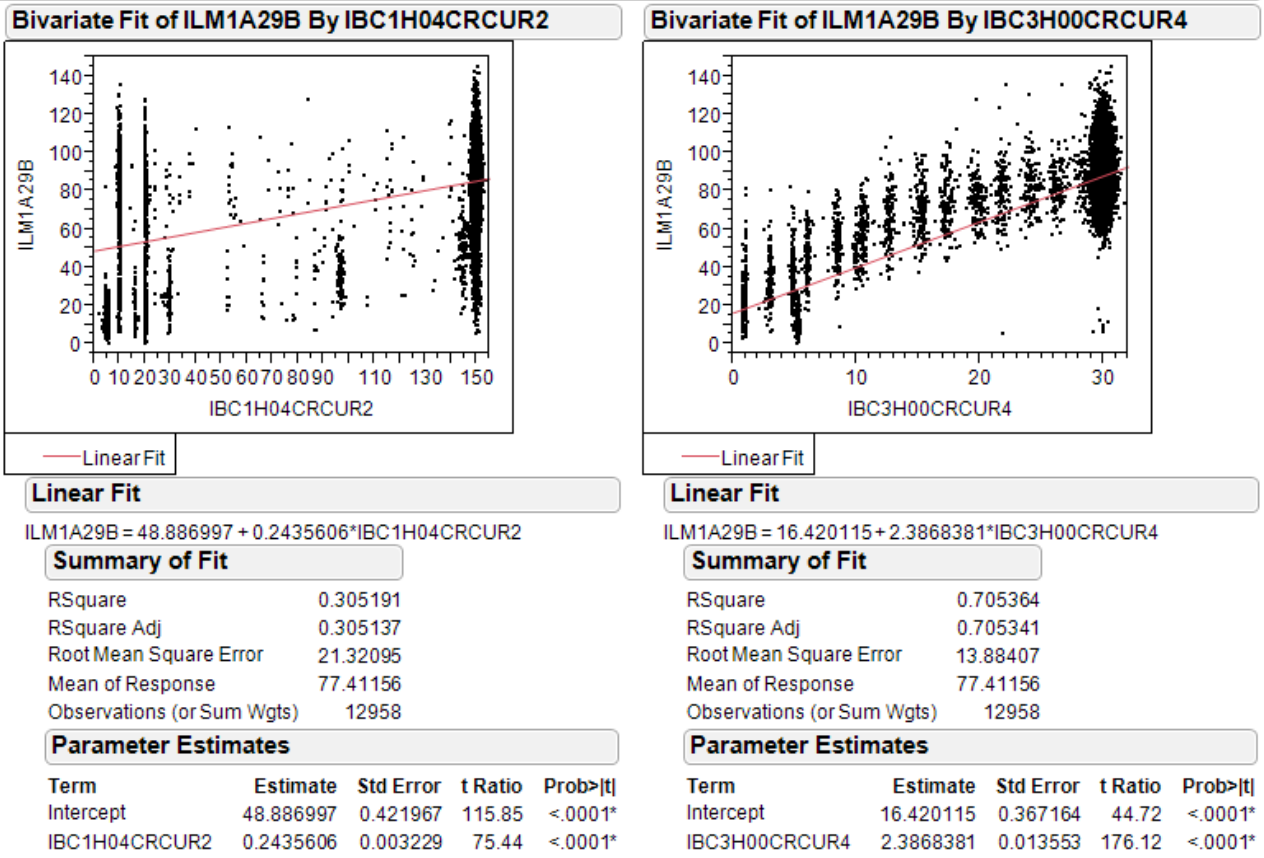


Figure 6. ILM1A29 has much better correlation with current

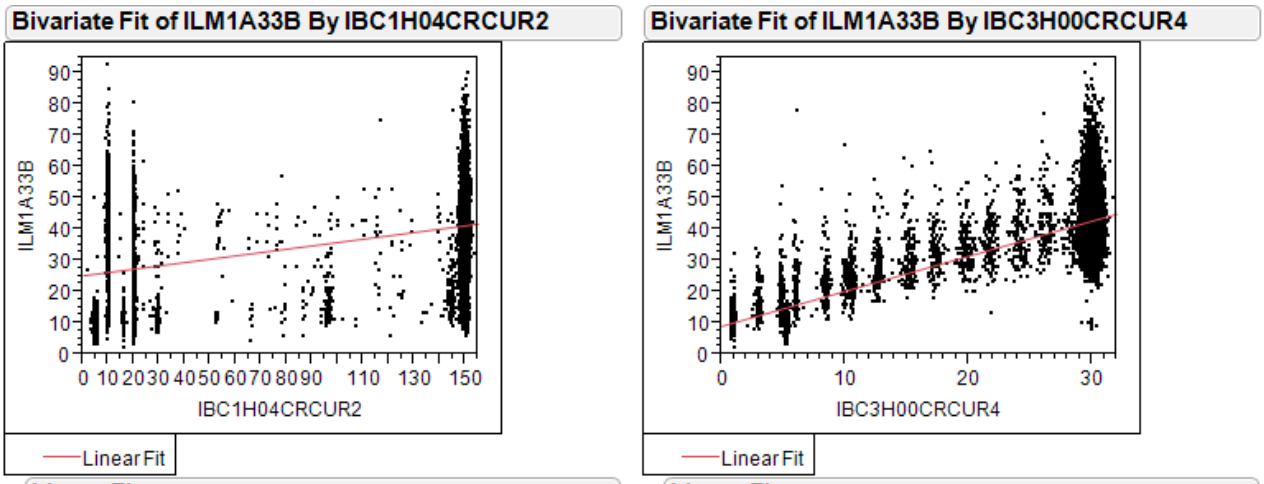


Figure 7. ILM1A33 vs currents

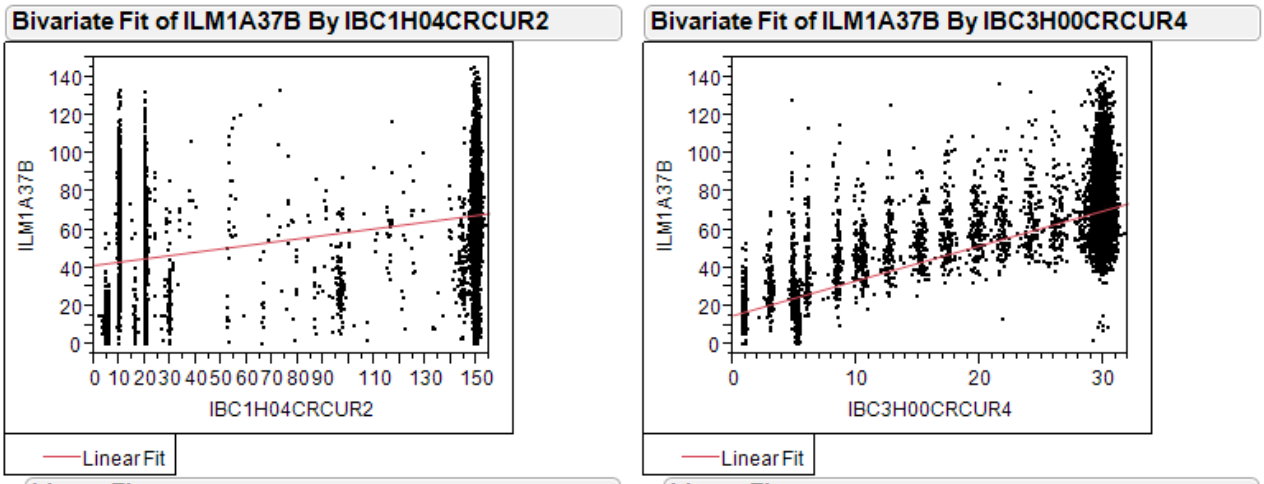


Figure 8. ILM1A29 vs currents

I conclude that before the laser seed swap that the Hall C beam was the cause of perhaps two-thirds the arc 1 BLM activity. I will now examine period B when Hall C was off for ILMs 9, 29, 33 and 37.

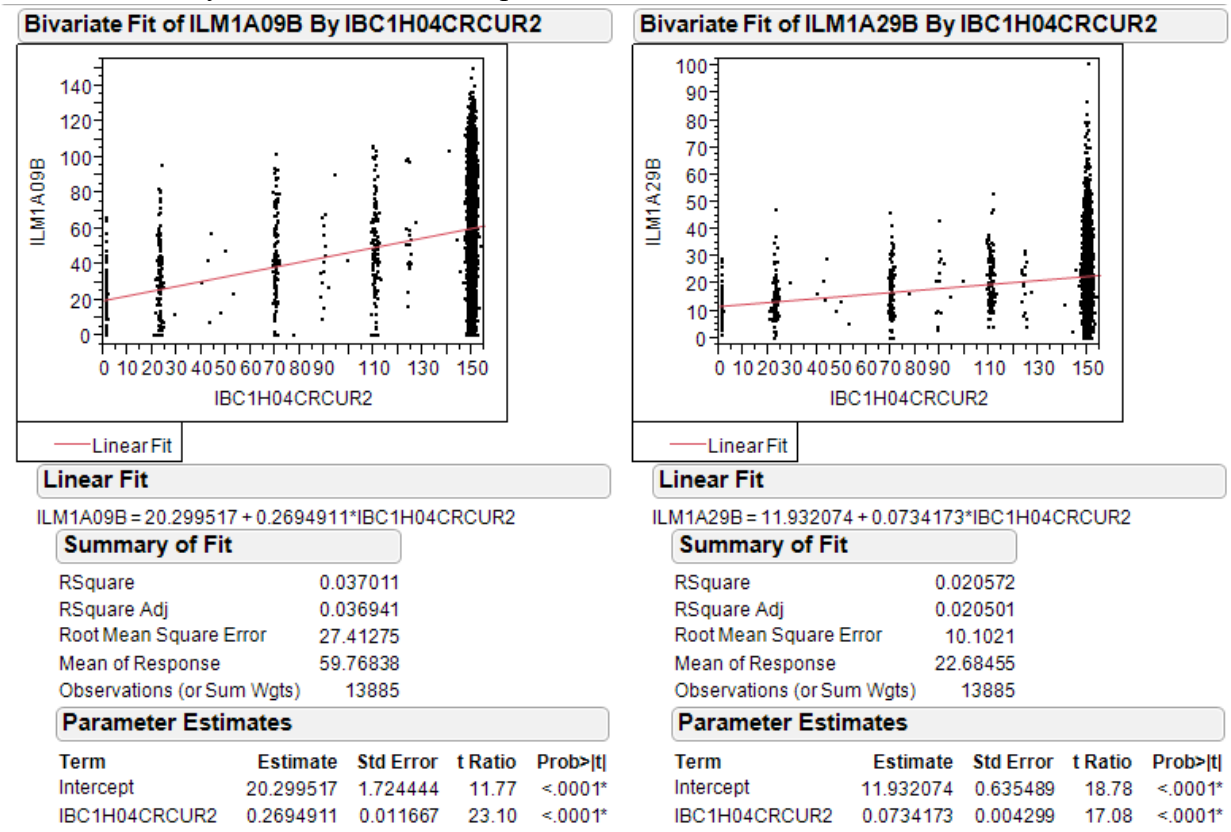


Figure 9: BLMs 9 and 29 with only Hall A, B and D beam in the machine.

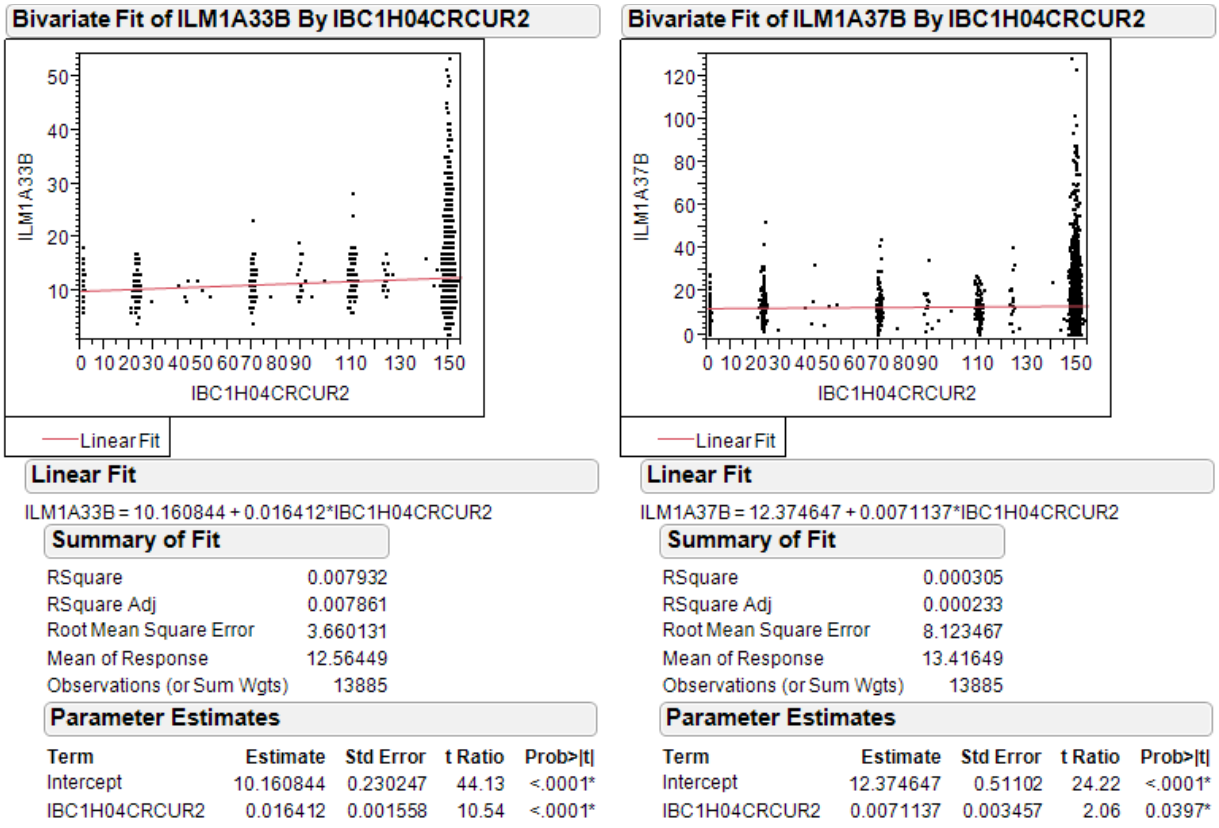
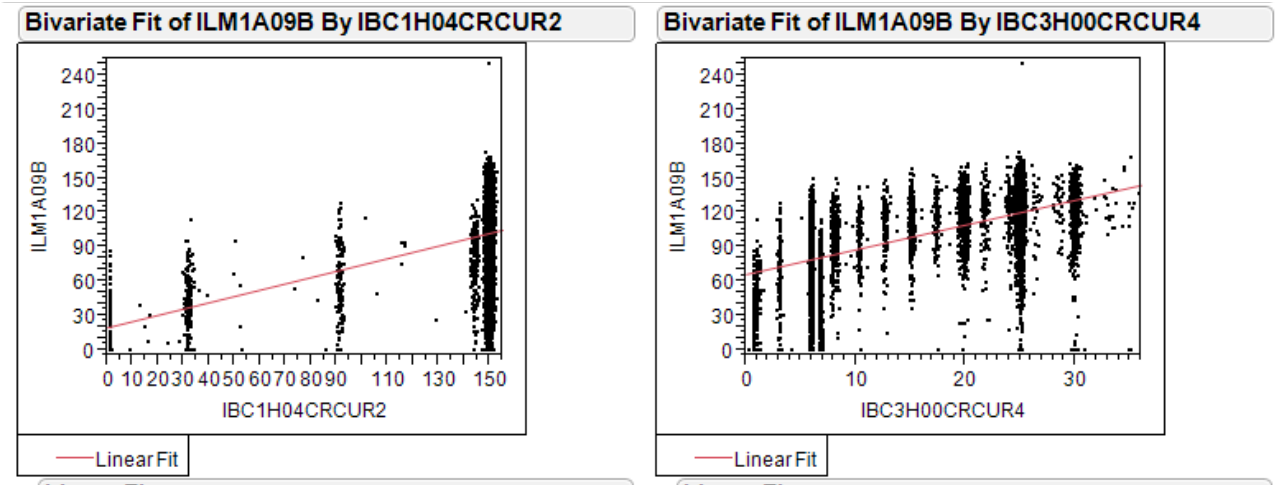


Figure 10. BLMs 33 and 37 with only Hall A, B and D beams in the machine



Linear Fit

ILM1A09B = 19.541228 + 0.5518795*IBC1H04CRCUR2

Summary of Fit

RSquare	0.058153
RSquare Adj	0.058078
Root Mean Square Error	31.4869
Mean of Response	101.1765
Observations (or Sum Wgts)	12586

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	19.541228	2.942113	6.64	<.0001*
IBC1H04CRCUR2	0.5518795	0.019799	27.87	<.0001*

Linear Fit

ILM1A09B = 66.282626 + 2.1709018*IBC3H00CRCUR4

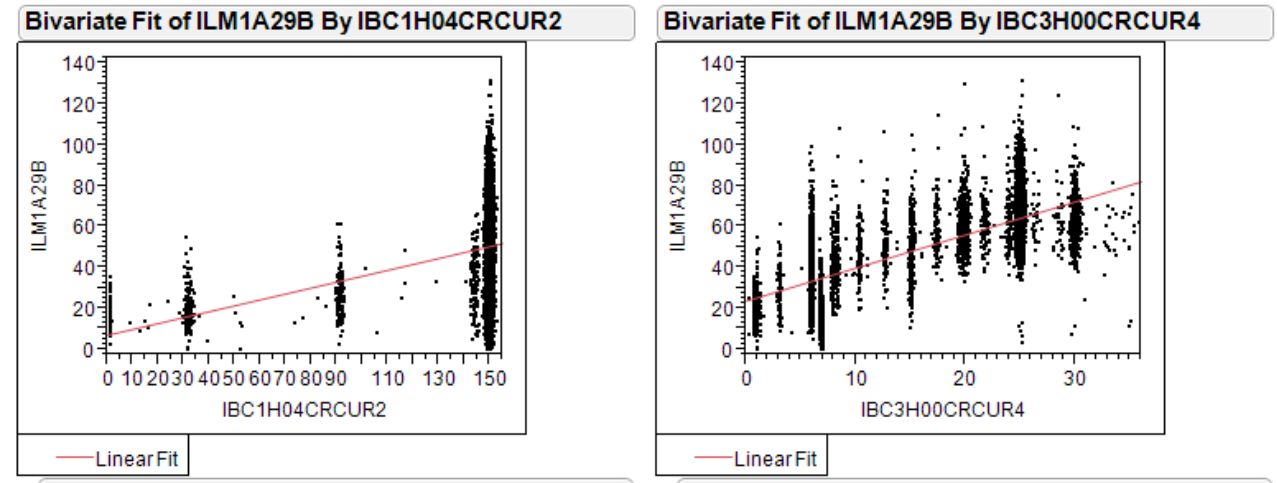
Summary of Fit

RSquare	0.403516
RSquare Adj	0.403469
Root Mean Square Error	25.05756
Mean of Response	101.1765
Observations (or Sum Wgts)	12586

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	66.282626	0.439219	150.91	<.0001*
IBC3H00CRCUR4	2.1709018	0.023529	92.27	<.0001*

Figure 11. BLM after seed swap with four halls operating, period C. Points removed if both A,C<1.



Linear Fit

ILM1A29B = 7.2654265 + 0.2884778*IBC1H04CRCUR2

Summary of Fit

RSquare	0.043657
RSquare Adj	0.043581
Root Mean Square Error	19.14134
Mean of Response	49.93771
Observations (or Sum Wgts)	12586

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	7.2654265	1.788553	4.06	<.0001*
IBC1H04CRCUR2	0.2884778	0.012036	23.97	<.0001*

Linear Fit

ILM1A29B = 23.91669 + 1.6188839*IBC3H00CRCUR4

Summary of Fit

RSquare	0.616539
RSquare Adj	0.616508
Root Mean Square Error	12.12066
Mean of Response	49.93771
Observations (or Sum Wgts)	12586

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	23.91669	0.212456	112.57	<.0001*
IBC3H00CRCUR4	1.6188839	0.011381	142.24	<.0001*

Figure 12. BLM 1A29 after seed swap with four halls operating.

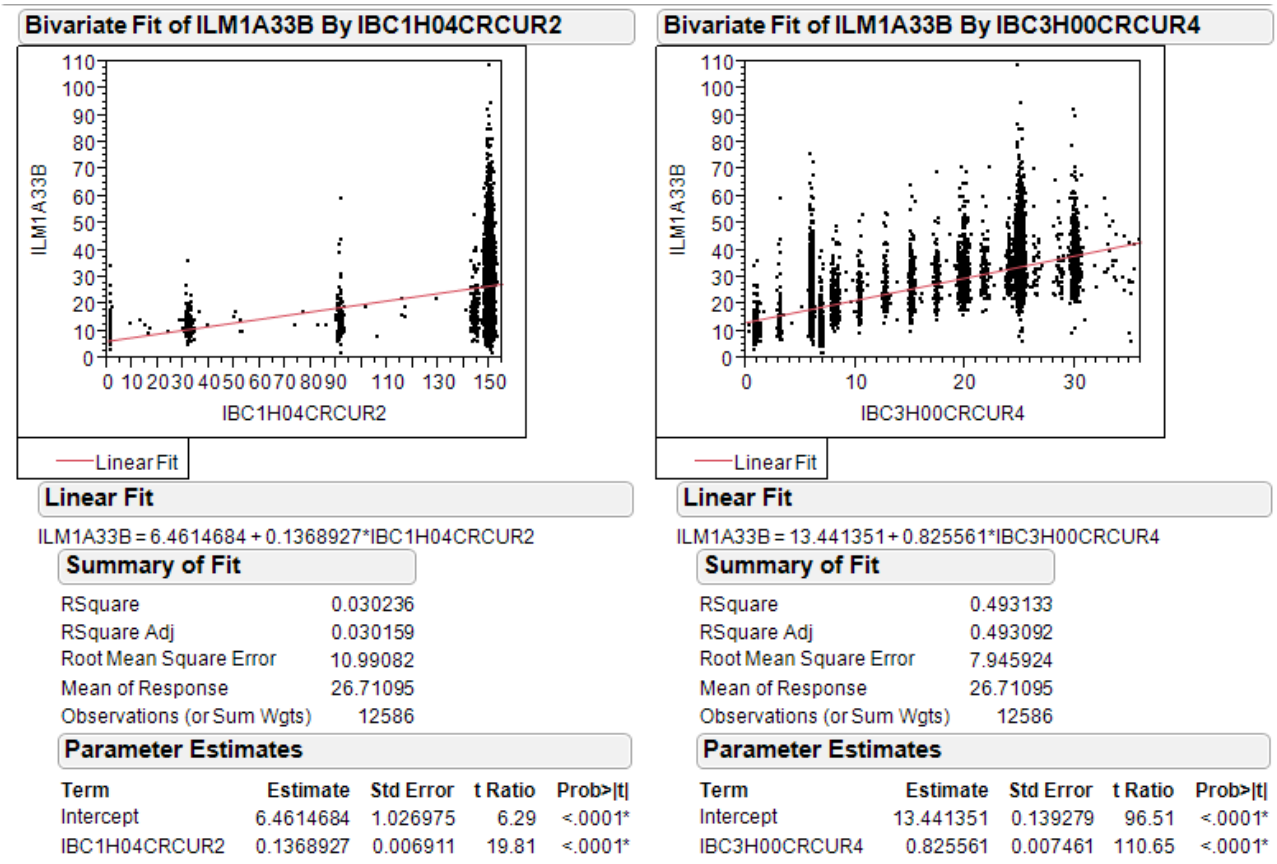


Figure 13. BLM 1A33 after seed swap with four halls operating.

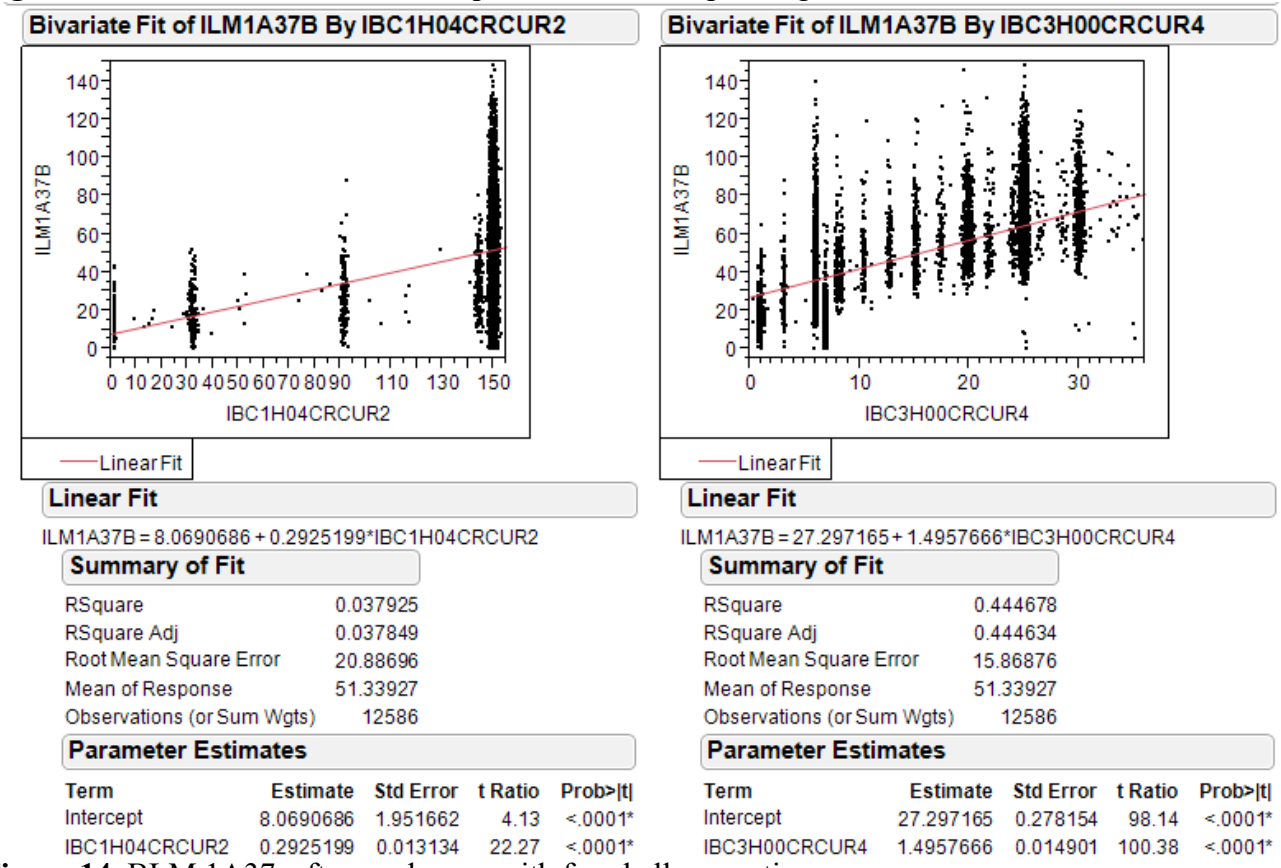


Figure 14. BLM 1A37 after seed swap with four halls operating.

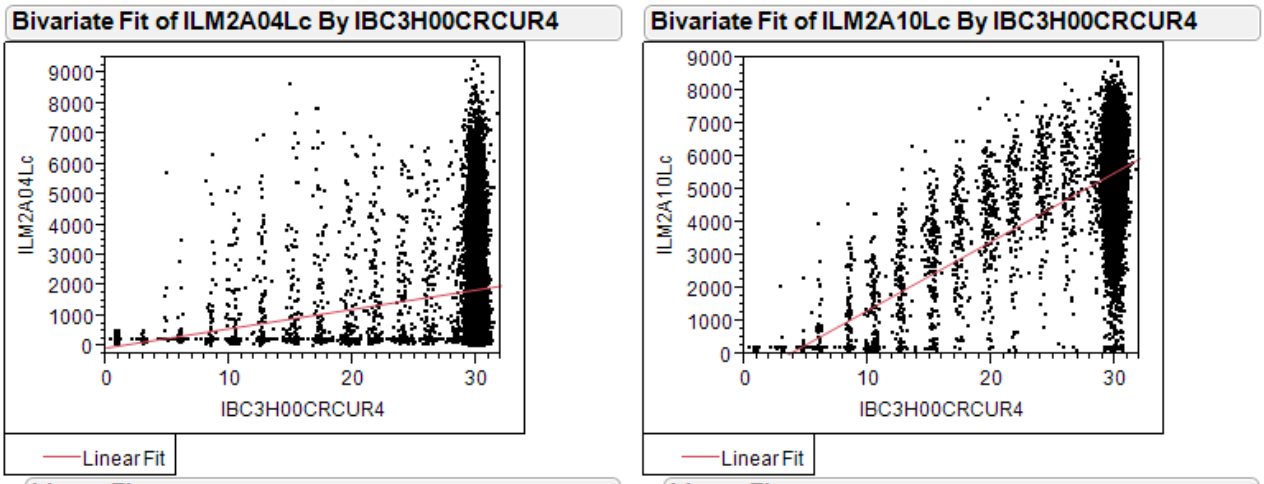


Figure 15. Arc 2 BLMs with Hall C > 1 µA before seed change. Note scale difference vs arc 1.

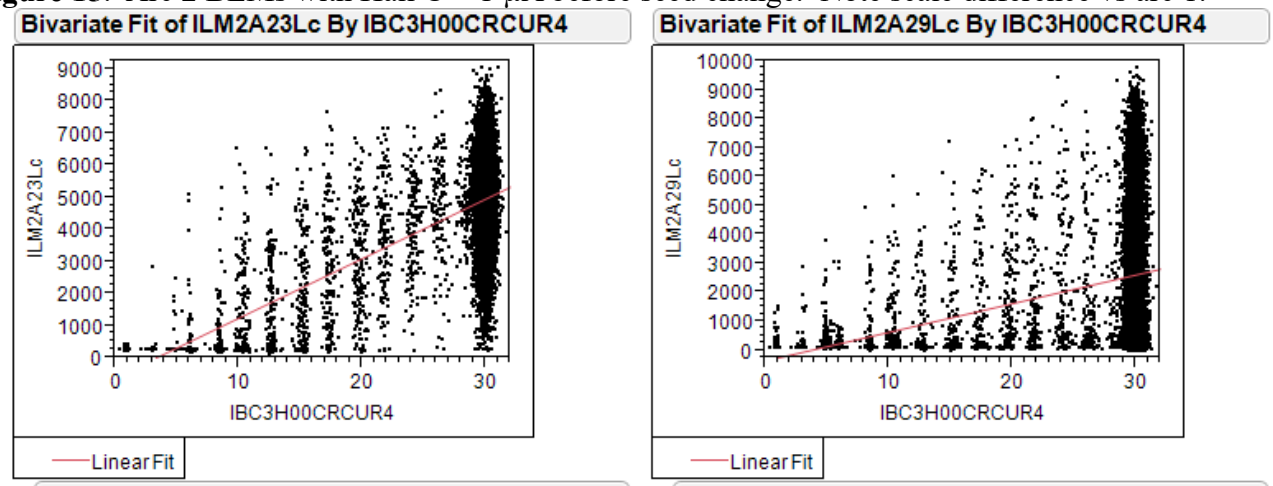


Figure 16. Arc 2 BLMs with Hall C > 1 µA before seed change.

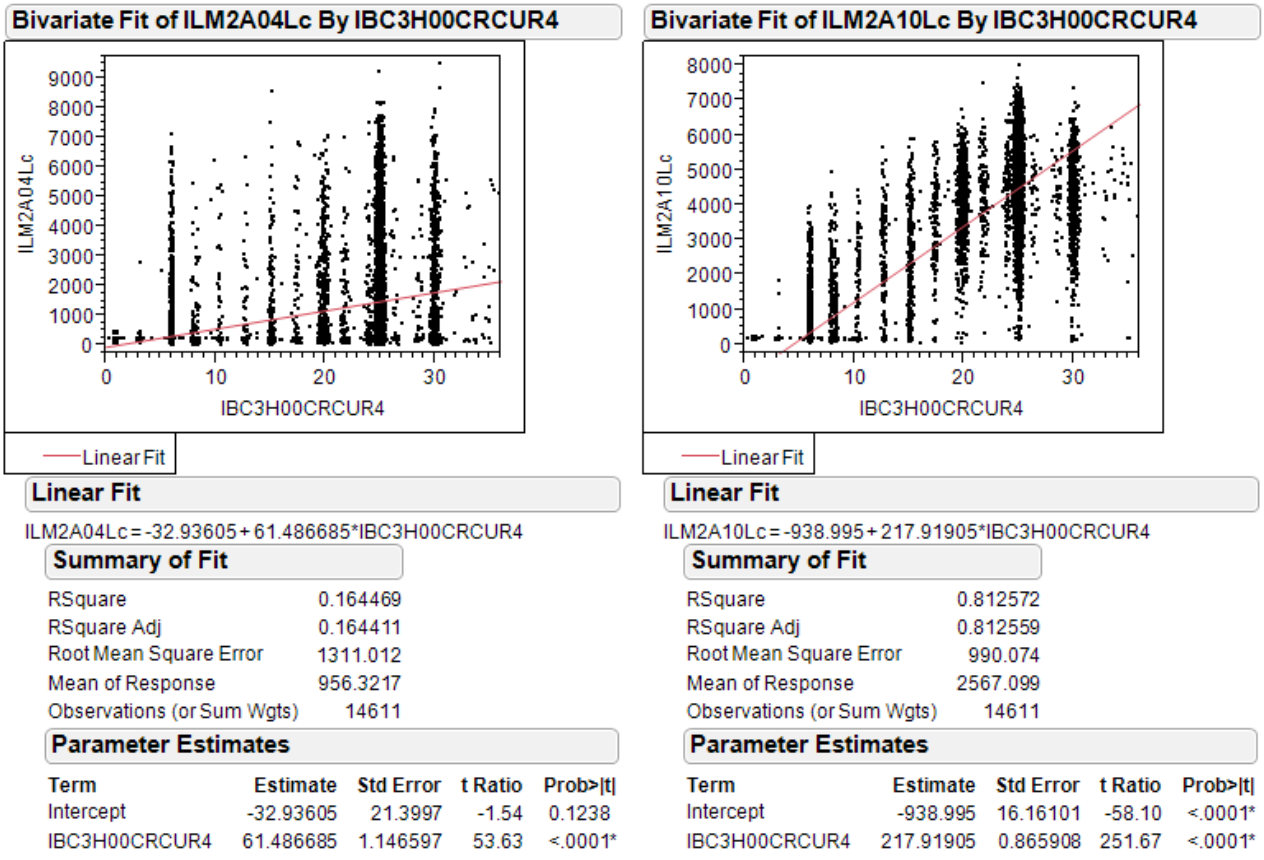


Figure 17. Arc 2 BLMs after seed change with Hall C > 1 μA.

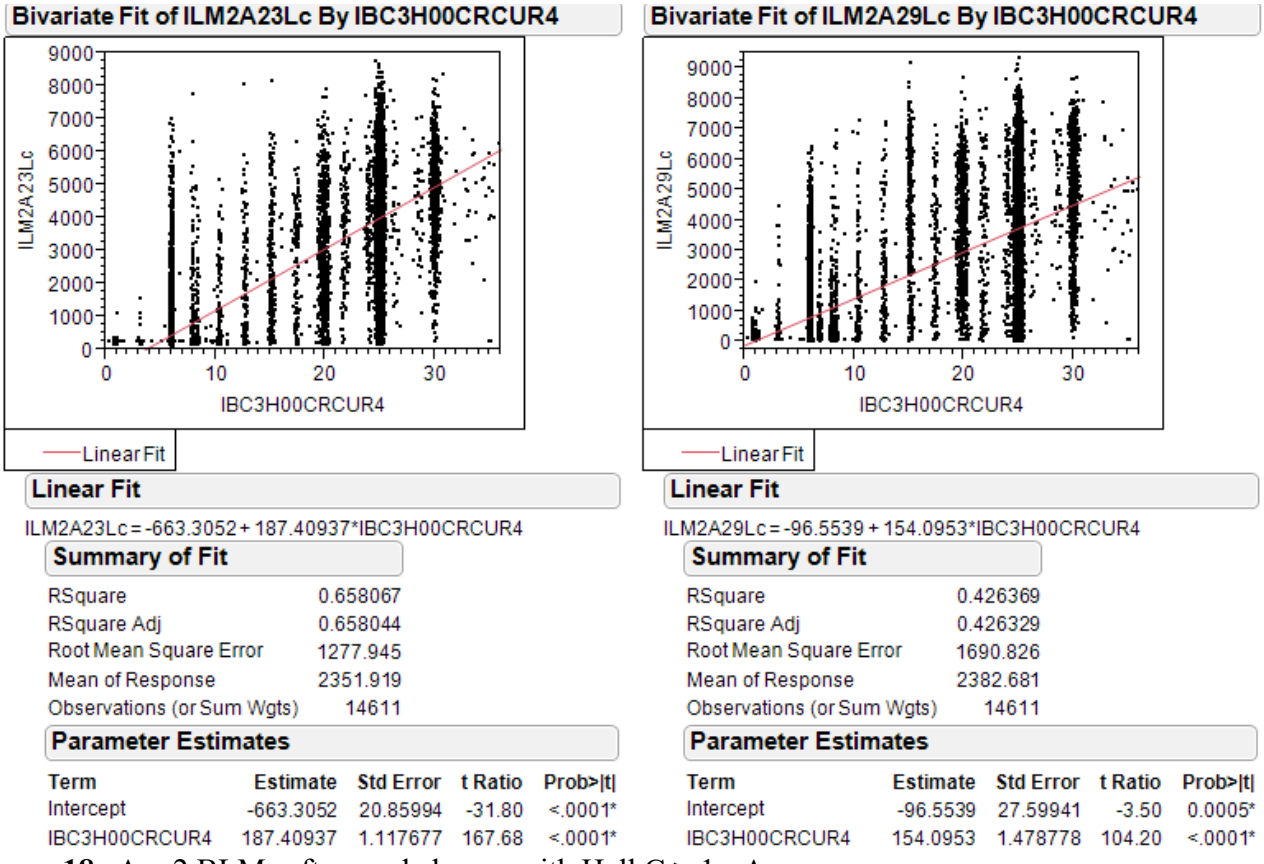


Figure 18. Arc 2 BLMs after seed change with Hall C > 1 μA.

Unfortunately, if I evaluate the linear fits at 30 uA I find that there is modestly less BLM activity attributable to Hall C beam in arc 1 and no significant change in arc 2 except doubling 2A29. Compare the last two columns in the table below. Scale of BLM response is very different in Arc 1 vs Arc 2.

Table 1. Linear fit coefficients and values at 30 uA before and after the laser seed change.

BLM	before_intercept	before_slope	after_intercept	after_slope	before@30uA	after@30uA
1A09	30.83	3.85	66.28	2.17	146	131
1A29	16.42	2.39	23.92	1.62	88	72
1A33	9.10	1.12	13.44	0.83	43	38
1A37	15.49	1.83	27.30	1.50	70	72
2A04	-29.83	63.77	-32.94	61.49	1883	1812
2A10	-731.49	208.94	-939.00	217.92	5537	5599
2A23	-611.52	185.66	-663.31	187.41	4958	4959
2A29	-349.11	99.01	-96.55	154.10	2621	4526

Conclusion: none

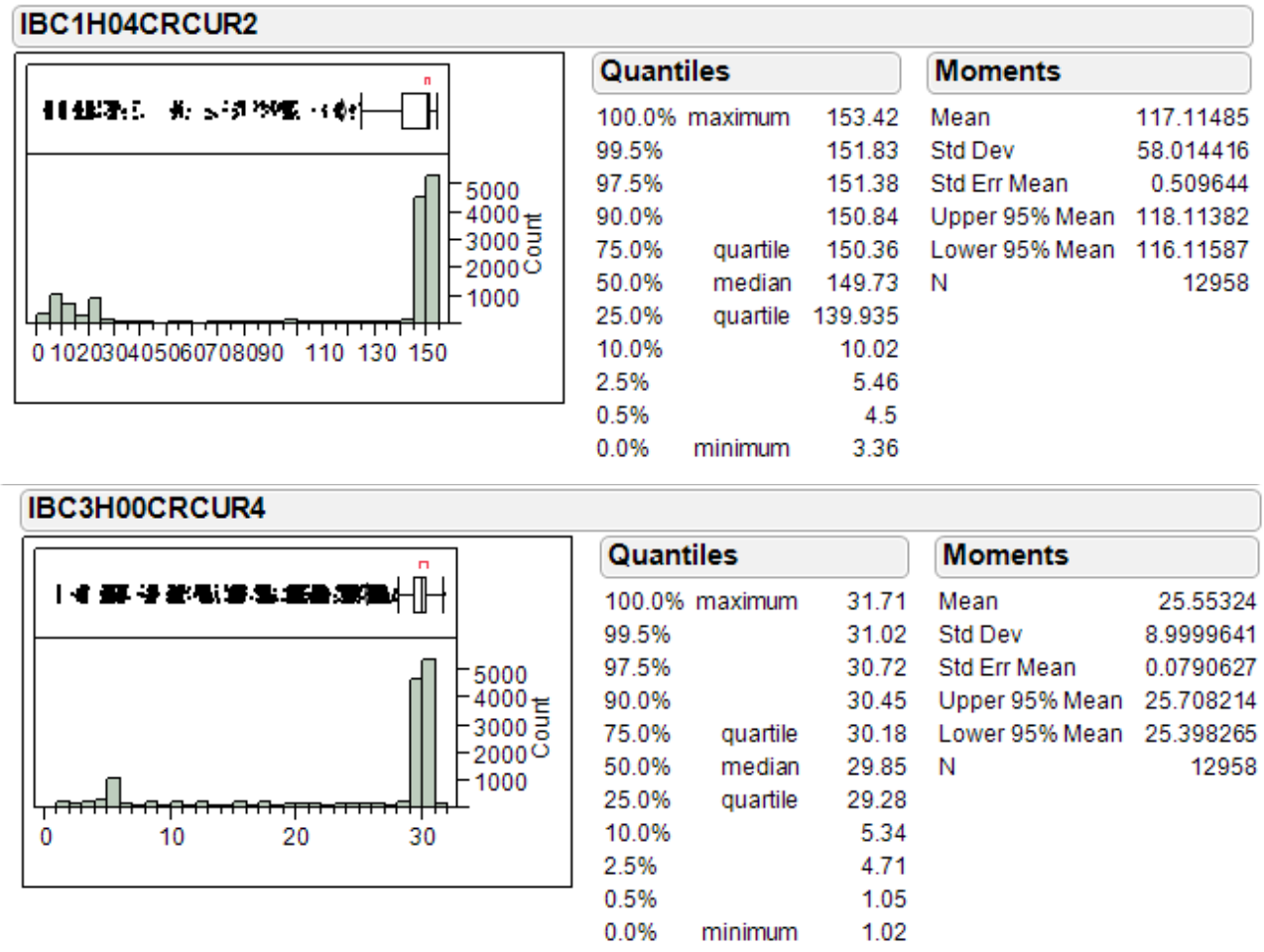


Figure 19. Distributions of currents in period A, the "before" sample

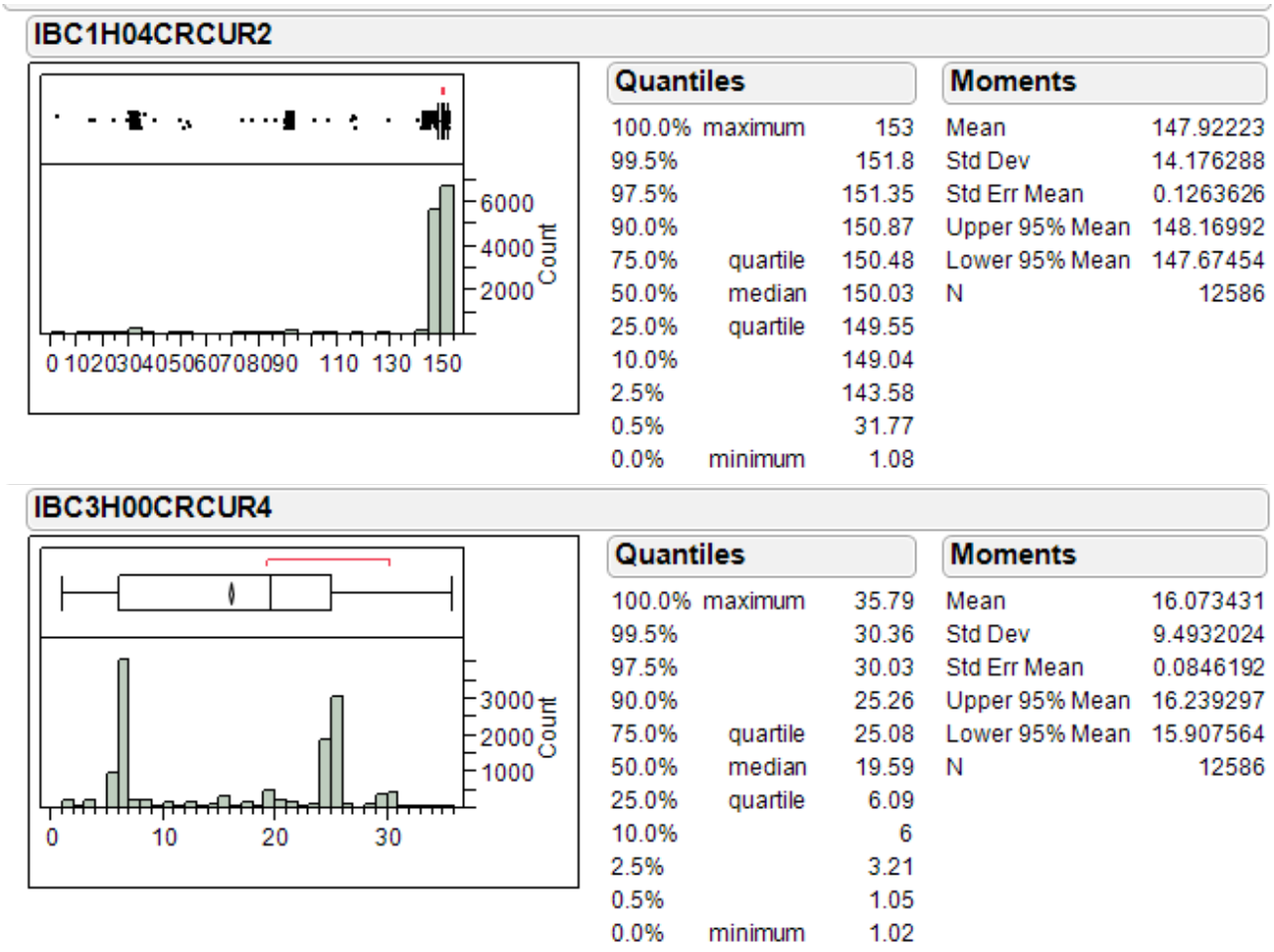


Figure 20. Distribution of currents in period C, the "after" sample.

This data is provided the readers so they may decide whether to ask the author to make additional cuts on the data. Recall that these sets have both A and C currents ≥ 1 μA. Still no conclusion.