bcm offset

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For each bcm calibration we get two values:

d3
gain = 0.0001071 +/- 4.481e-7
offset = 0.2659 +/- 0.1027
d10
gain = 3.74e-5+/-3.847e-7
offset = 0.007297 +/-0.1378
Bcm calibration numbers
dnew
gain = 0.0003264+/-1.406e-6
offset = 0.1055 +/- 0.09974
Bcm calibration numbers
unew
gain = 0.0003954+/-1.727e-6
offset = 0.1375 +/- 0.1005

With the calibrations we can calculate the current and the charge:

$$I = gain_{bcm} \cdot bcm_{rate} + offset$$

$$Q = gain_{bcm} \cdot bcm_{counts} + offset \cdot (beam - on - time)$$

BCM current ranges

See log entry https://logbooks.jlab.org/entry/3492651

On October 27/17, using the run numbers 90206, 90207, 412 and 413, the range of the bcm were measured.
To get the data we followed the next steps:
*A function generator was used to simulate the nominal cavity output power, were -40dBm corresponds to 1uA.
*The function was connected to the splitter at the cavity output, which goes to the analog and digital receivers.
*The attenuation in the heliax cable between the signal generator and the splitter is -0.65dB.
*To get the equivalent of 1 muA of output power at the splitter, we set the signal generator a little higher -40dBm+0.65dBm = -39.35dBm.
*Using the definition P(dBm)=10log(I^2 Reff/0.001Watt), and the above power level at 1 muA, then the current at any other power level is given in muA by I = 10**(P/20)*92.7897

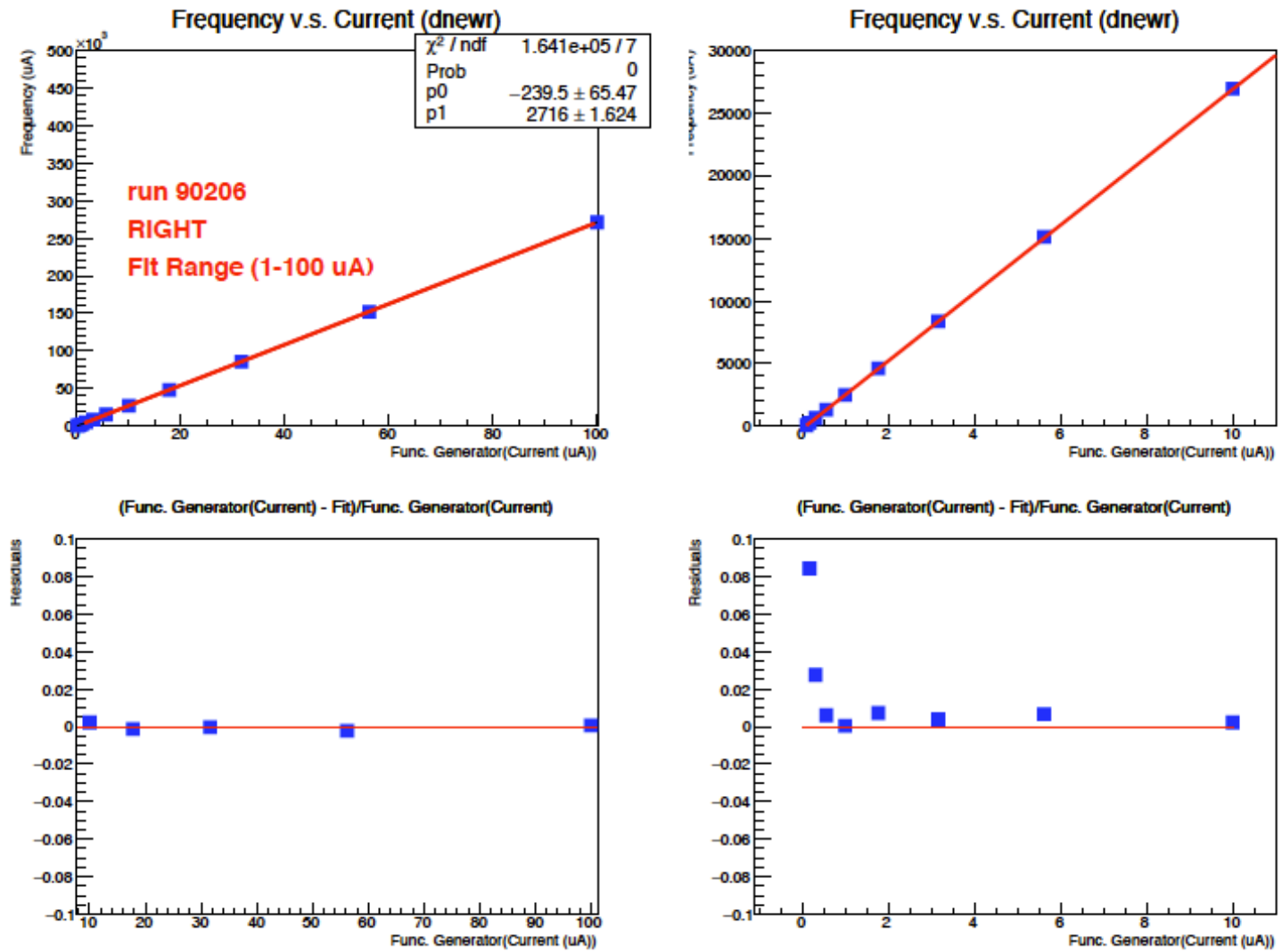
After the data analysis, we determined that the bcm ranges are:

u1->30-100uA
d1->30-100uA
d3->5-60 uA
d10->3-25uA
unew->2-100uA
dnew->1-100uA

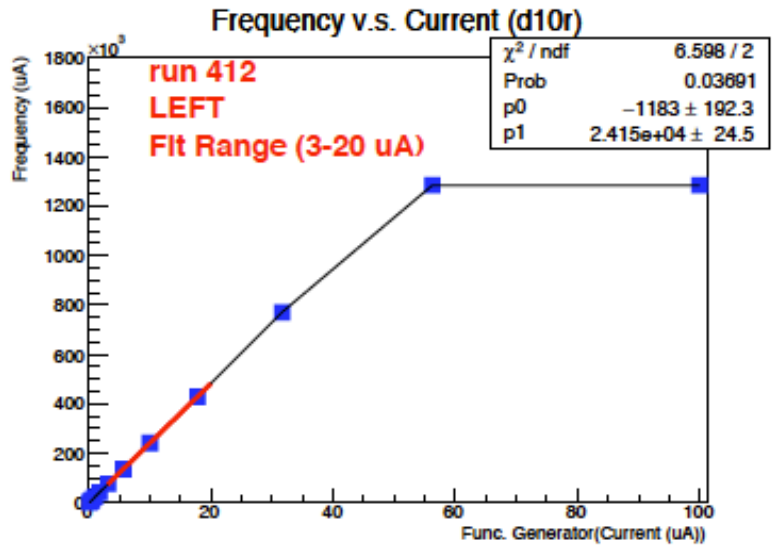
Therefore for the Tritium run we can use d3, d10, unew or dnew.

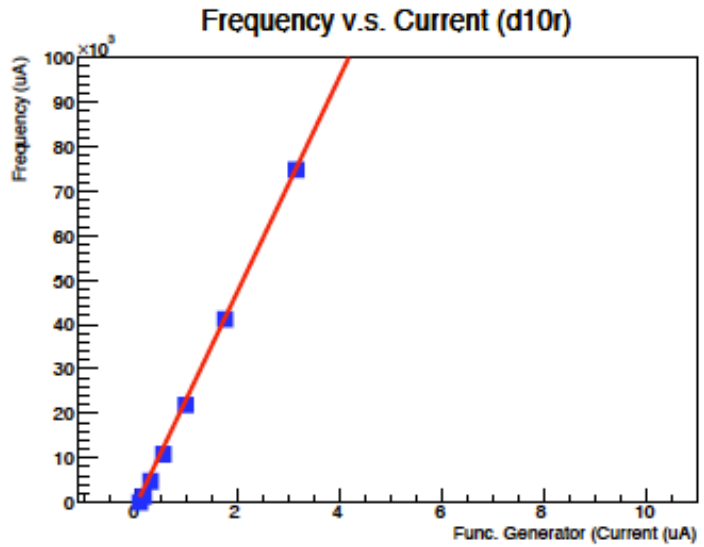
How the bcm start to read?

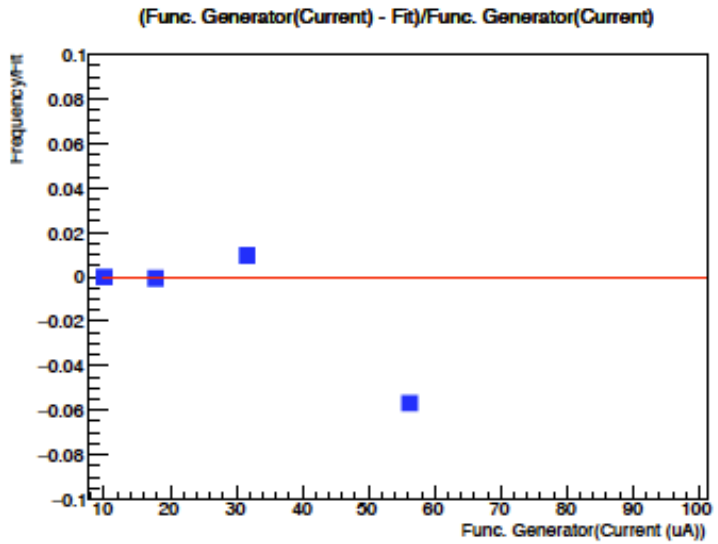
dnew

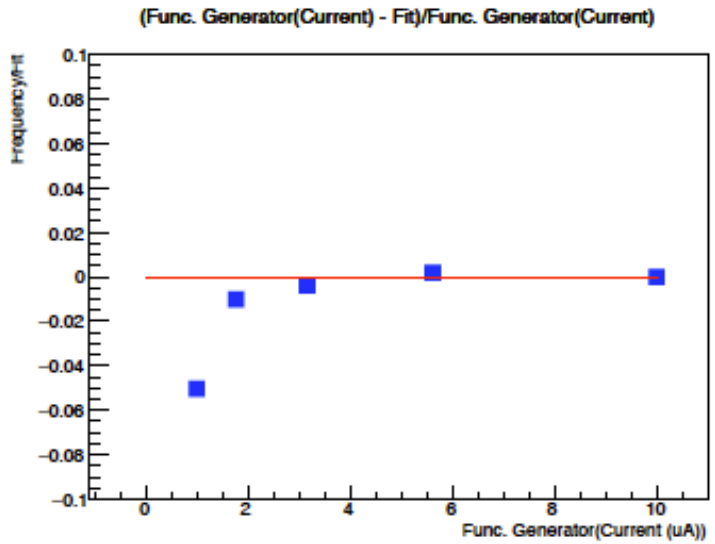


d10


Frequency v.s. Current (d10r)
run 412
LEFT
Fit Range (3-20 uA)
χ² / ndf 6.598 / 2
Prob 0.03691
p0 −1183 ± 192.3
p1 2.415e+04 ± 24.5
Frequency (uA)
Func. Generator(Current (uA))


Frequency v.s. Current (d10r)
Frequency (uA)
Func. Generator (Current (uA)

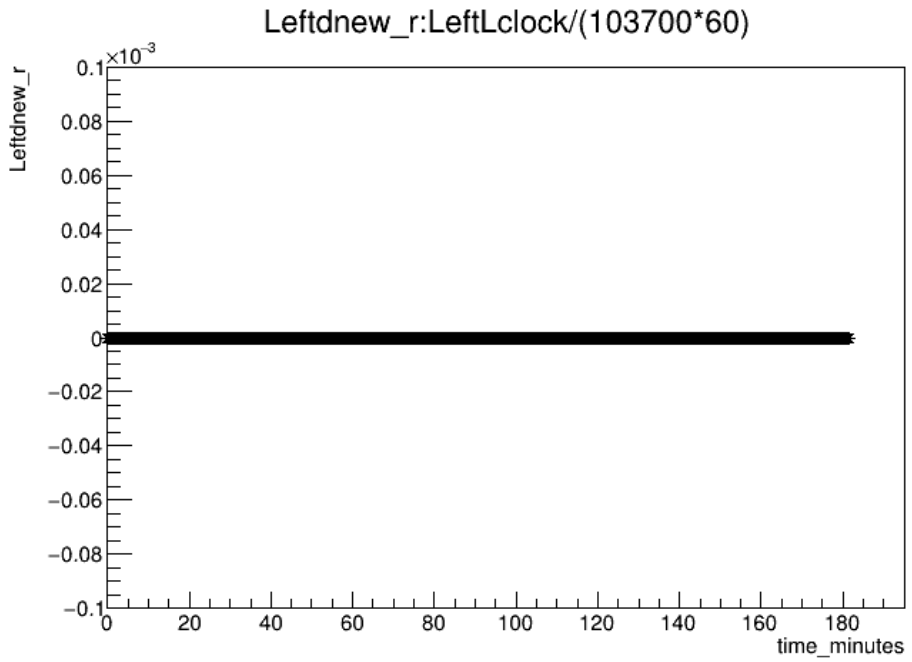

(Func. Generator(Current) - Fit)/Func. Generator(Current)
Func. Generator(Current (uA))


(Func. Generator(Current) - Fit)/Func. Generator(Current)
Func. Generator(Current (uA))

The offset will correspond to the value of the bcm (such as pedestal) when there in not beam, = 0 uA.
If we look at a cosmic run (no beam):

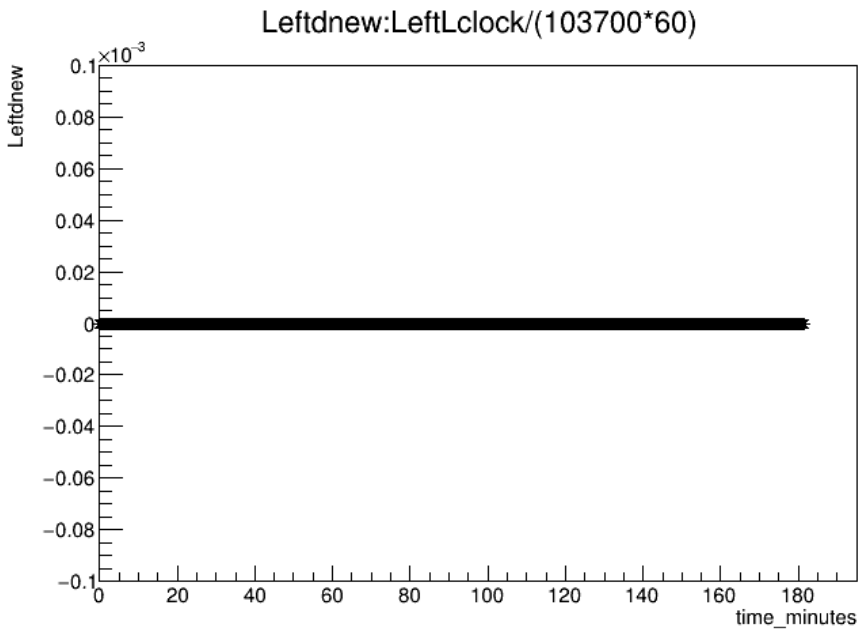
Run 1057 on January 10/2018 with a duration of 181.351 mins. We get:

rate



dnew

counts



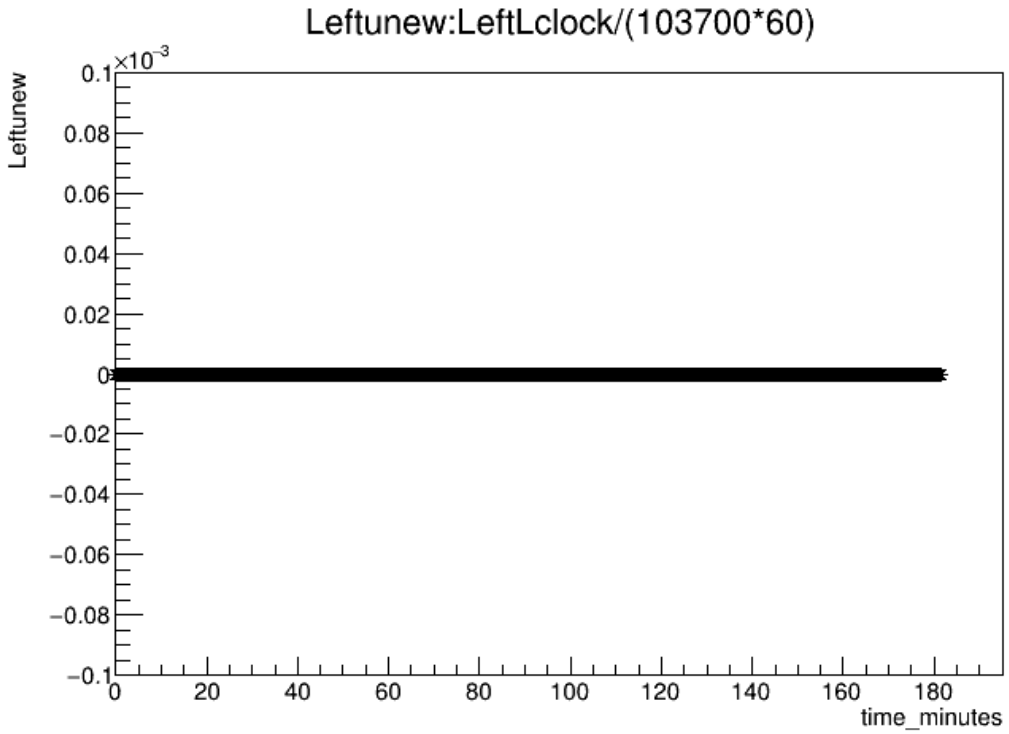
0 rate

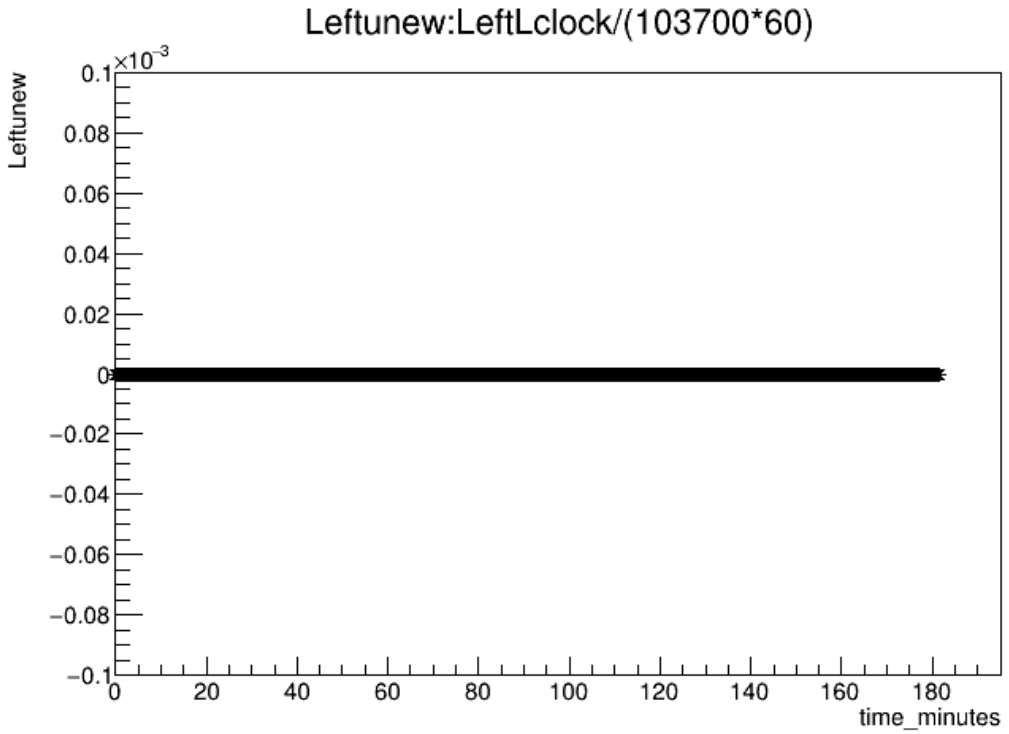
0 counts

rate

unew

counts





0 rate

0 counts

Why the digital receivers read 0 when there is no current in the beam?

There are always noise counts in the background but there is a threshold in the data.In the hall, the analog outputs from the receiver are used, which is then re-digitized by the DAC.

The receivers are designed to give a digital signal that could be plugged directly in the daq system, however, we decided to convert the digital signal to analog, then take that signal to the counting house, use the v/f converter and then send that to the DAQ.

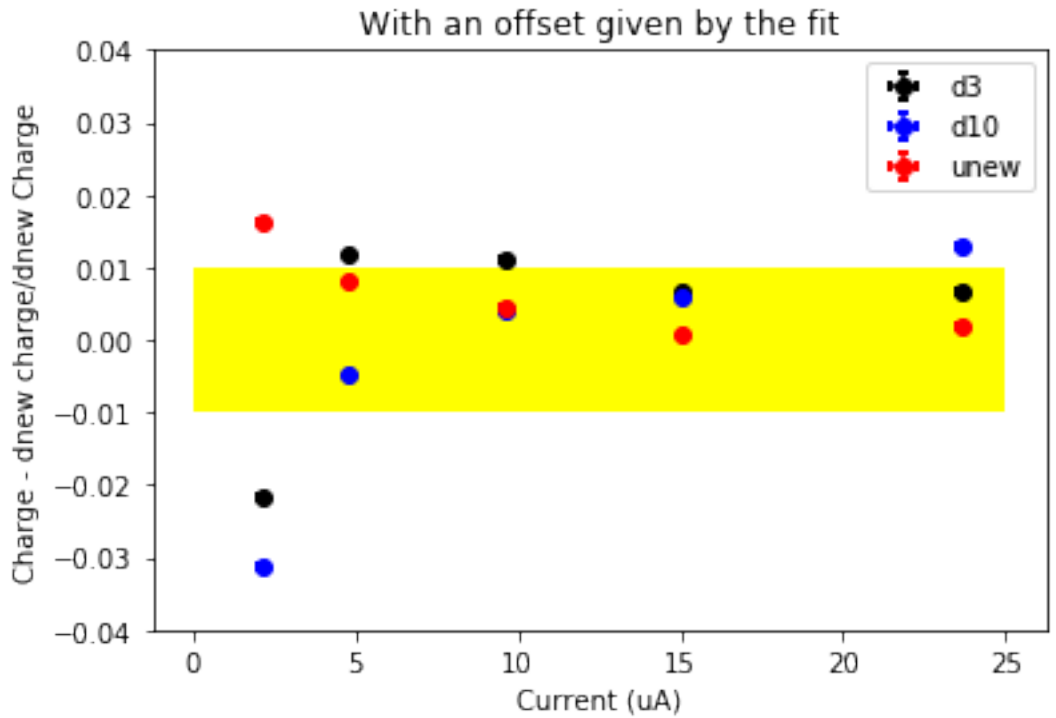
In the process of converting the signal from digital to analog insude the receiver is where I understand the threshold is applied. The digital signal that the receiver can send is of 28 bit, but since we decided to convert that to analog, we can use just 18. Therefore, the receiver itself makes the decision of what to put in those 18 bits. Which means any output less than Full-Scale/2^18 (10V/262144 = 38 uV) is not visible.

For example as, when there is not beam, the receiver is showing ~10 counts of noise, which is 3-4 bits, and still 6 bits lower than the DAC can see.

Scalers with not beam

How the calibration look like with of the bcm look like with respect to dnew:
Using the dummy runs files=('875' '876' '877' '878' '881')
With current (uA) = ('24' '15' '10' '5' '5' '2.5')

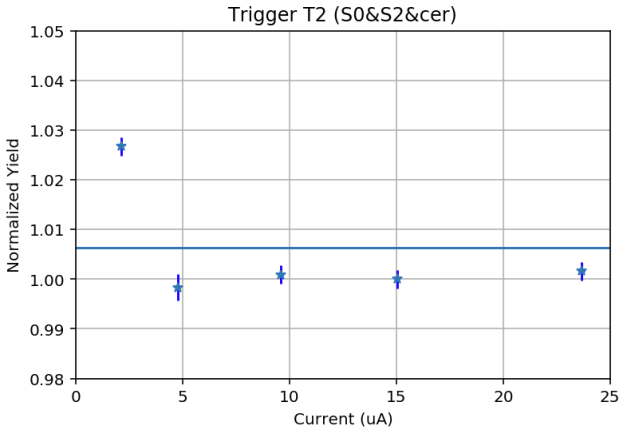
Using a cut of currents >1uA



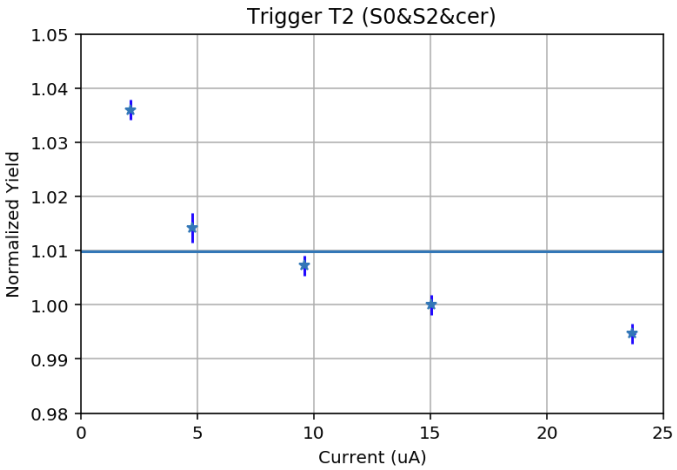
The yellow represents 1% band from the dnew calibration

What “boiling” do we get with those calibrations for the dummy?

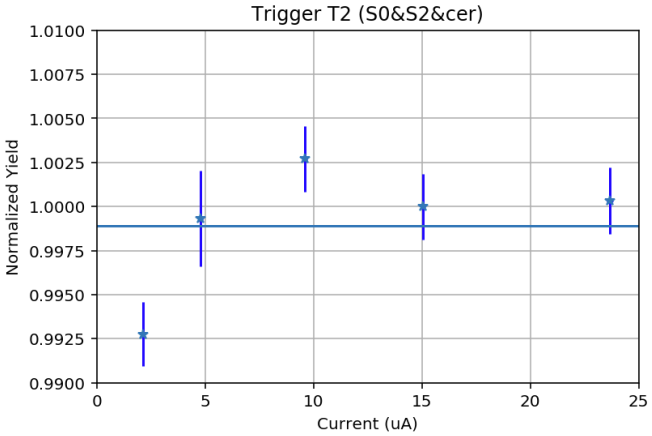
d3



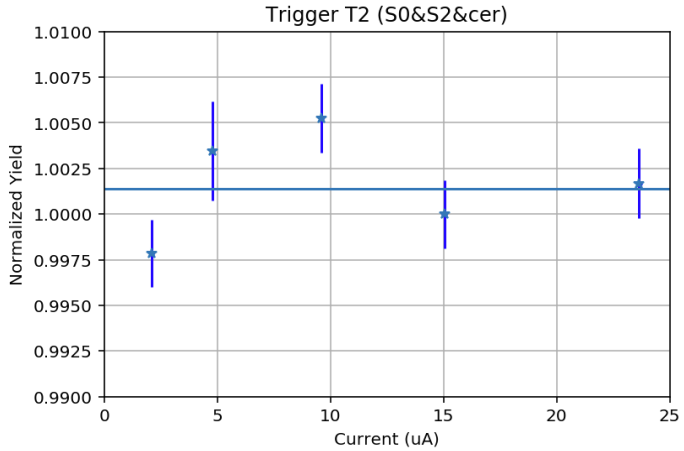
d10



unew

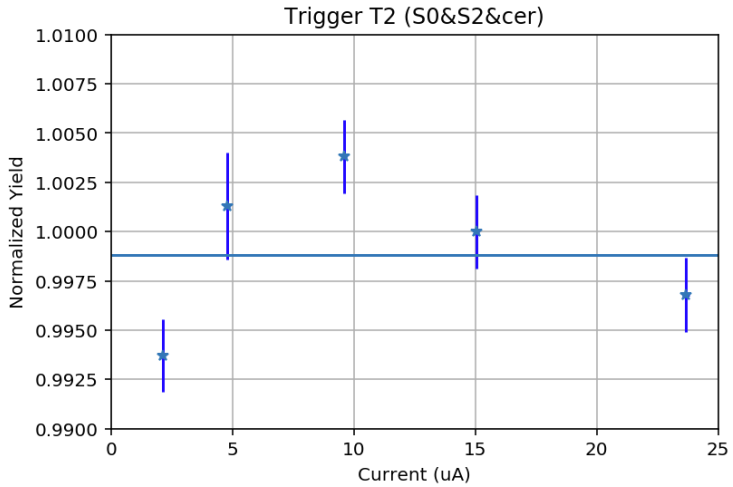


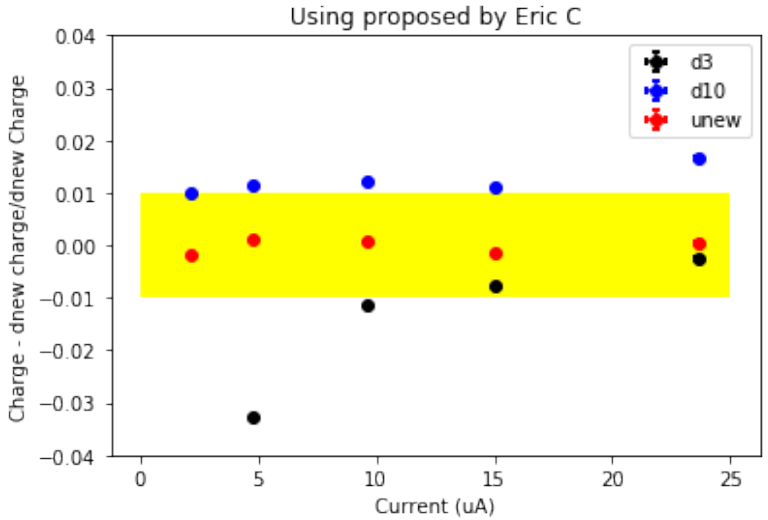
dnew



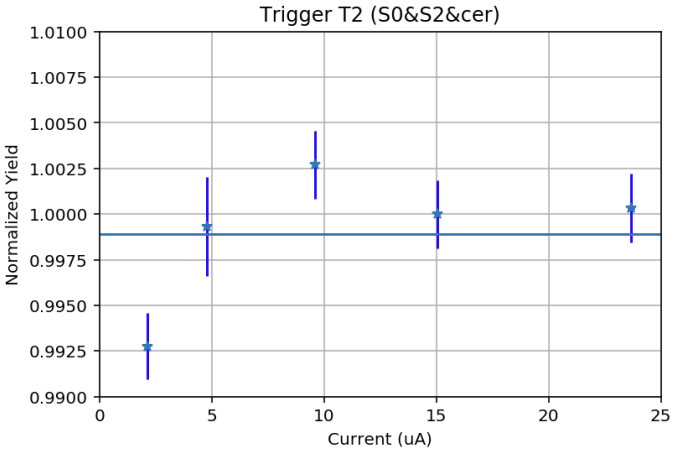
What happen when we force the offset to don’t boil at low currents?

d10

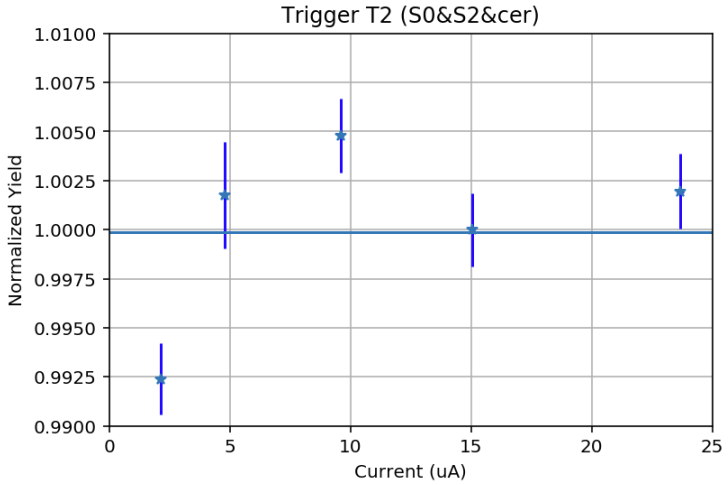




unew

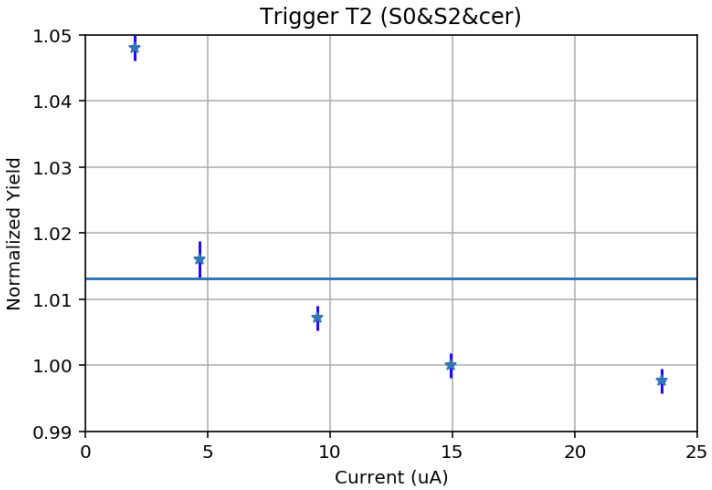


dnew

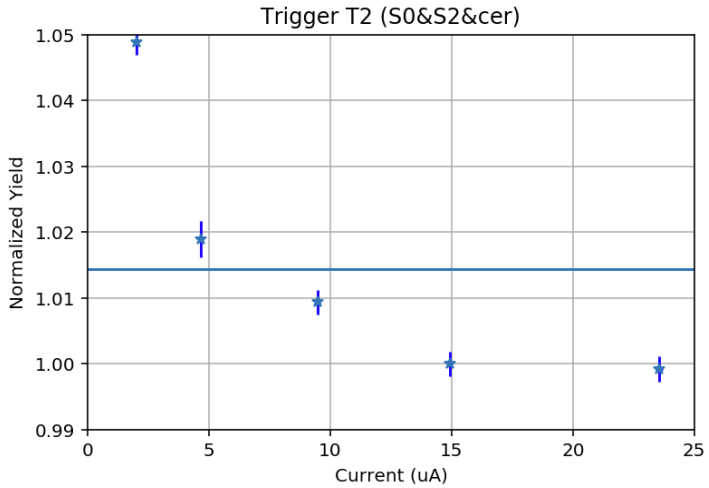


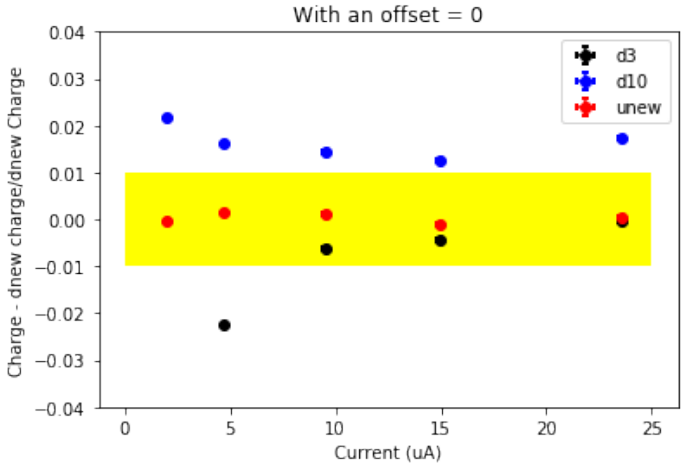
If the offset is 0 for unew and dnew

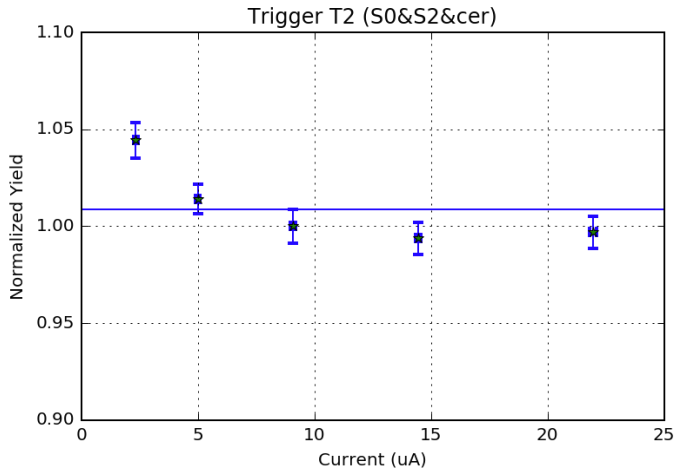
unew



dnew







Empty cell windows

Conclusions

- There is not a linear behavior right away that the bcm start to see beam. That is seen in the big offset errors of the fit calculations.
- We can force the bcm to “not boil” for the dummy, which may introduce a slope in the charge calculation, which propagates for large currents.
- We could use the actual bcm value of the digital receivers when there is not current = 0. And trust the high values of current.