

Cavity BCM Digital Receivers Study

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Cav4c Hardware Registers Settings

The screenshot displays the 'DRC BPMs - IPM1H04C - Hardware Registers' interface. It features a grid of registers with their names, current values, and units. A red box highlights the DAC4 register, which is set to 2.5. A blue box highlights the DAC4 register's value and its associated DAC4 input field.

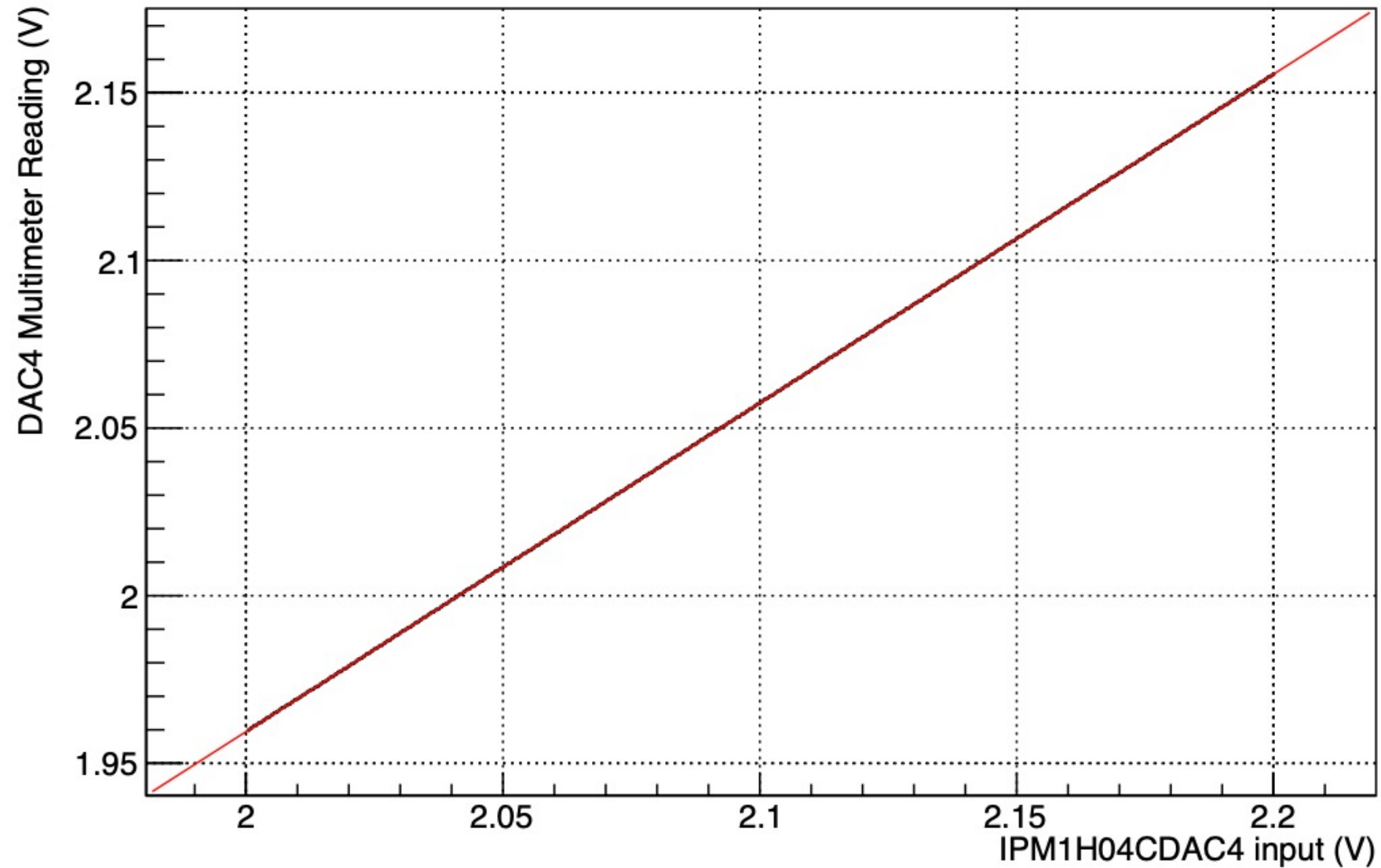
Register Name	Value	Unit
XPOSIS	0	0
YPOSIS	0	0
SWDLY	0x0	0x10
XPM1HZ	0xFFFFDF37	1.000000e+03
XPP1HZ	0x60DCB98	1.341105e-03
XDOS	9.990000e+00	0.0000
XCCTMP	0x21B	6.250000e-02
CICDEC (>=0x2)	3.000000	1.000000e+00
DAC1	3	3.051758e-04
XPOSQS	0	0
YPOSQS	0	0
SWSKP	10	10
XCM1HZ	0x212C	1.000000e+00
XCP1HZ	0xFDE807BA	1.341105e-06
YDOS	9.990000e+00	0.0000
YCCTMP	0x21B	6.250000e-02
CICGAN	0x1212	0x1212
DAC2	5	3.051758e-04
XCURIS	0	0
YCURIS	0	0
YPM1HZ	0x2648	1.000000e+00
YPP1HZ	0xFDF7EF21	1.341105e-06
XPHD	2.631500e-01	0.0000
XRFTMP	0x273	6.250000e-02
EXPCOL	65535	0.000000e+00
DAC3	2	3.051758e-04
XCURQS	0	0
YCURQS	0	0
AUDIOS	0x0	0x0
YGM1HZ	0x25E3	1.000000e+00
YCP1HZ	0x6151AE3	1.341105e-06
YPHD	2.631500e-01	0.0000
YRFTMP	0x249	6.250000e-02
CWCOL	0	0
DAC4	2.5	3.051758e-04
XVGA	0x0	0x0
OLD X/Y PHS OFF	0.0	-45.7
TSTAMP	0	60
XDPOFF	60	60
XIFTMP	0x2EB	6.250000e-02
YVGA	0x0	0x0
TSTFRQ	60.00000000	0x863
YDPOFF	-140	-140
YIFTMP	0x2CB	6.250000e-02
MPAGE	0x0	0x400
SWCTRL	0x0	0x0
XDP1HZ	-117	-117
TSTCTL	0x80	0x80
INTTMR (0xF)	0.250	1.668887e+01
YDP1HZ	37	37
CTRL	0x2	0x2
INTRPT	0x7F00	0x3C00
OFFSET	X 0.000	8.000
SCALE	lx 0.000	5.500
CIRCOL	0	0
TUNAVE	100	100
CIRPNT	491519	491519
TUNTRG	63	0.000000e+00
DACSL1	0x1	0x101
CIRAVL	0	0
DACSL2	0x0	0x0

Vary DAC4 input and measure the digital receiver's output with a multimeter

Info from John Musson:
The DAC is 18-bits, which fully represents the signal data. But, the "DAC Set" operation is only 16 bits (utilizing the top 16 bits of the 18 bit output). Hence, we can only manually step the output by 305 uV, not the expected 76 uV.

Cav4c Digital Receiver's DAC4 Output vs Input (Shown in December)

DAC4 Multimeter Reading vs IPM1H04CDAC4 input

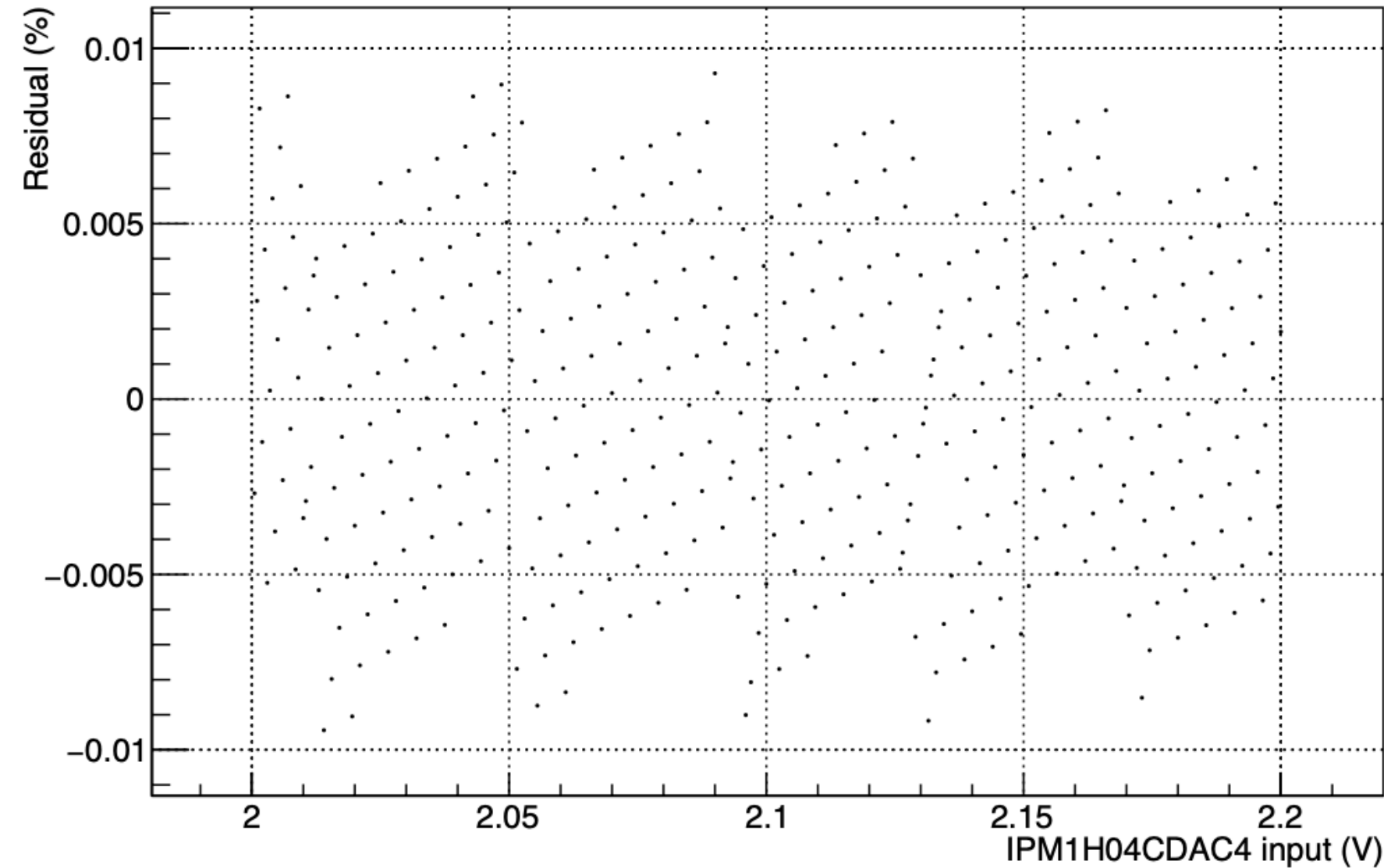


Part of data just to show the pattern

IPM1H04CDAQ4	DAC4 Multimeter Reading	A_1-A_0
2.0000	1.9596	
2.0005	1.9599	0.0003
2.0010	1.9605	0.0006
2.0015	1.9611	0.0006
2.0020	1.9614	0.0003
2.0025	1.9620	0.0006
2.0030	1.9623	0.0003
2.0035	1.9629	0.0006
2.0040	1.9635	0.0006
2.0045	1.9638	0.0003
2.0050	1.9644	0.0006
2.0055	1.9650	0.0006
2.0060	1.9653	0.0003
2.0065	1.9659	0.0006
2.0070	1.9665	0.0006
2.0075	1.9668	0.0003
2.0080	1.9674	0.0006
2.0085	1.9677	0.0003
2.0090	1.9683	0.0006
2.0095	1.9689	0.0006
2.0100	1.9692	0.0003
2.0105	1.9697	0.0005
2.0110	1.9703	0.0006
2.0115	1.9707	0.0004
2.0120	1.9713	0.0006
2.0125	1.9718	0.0005

Cav4c Digital Receiver's DAC4 Output Residual vs Input (Shown in December)

DAC4 Multimeter Reading Residual vs IPM1H04CDAC4 input



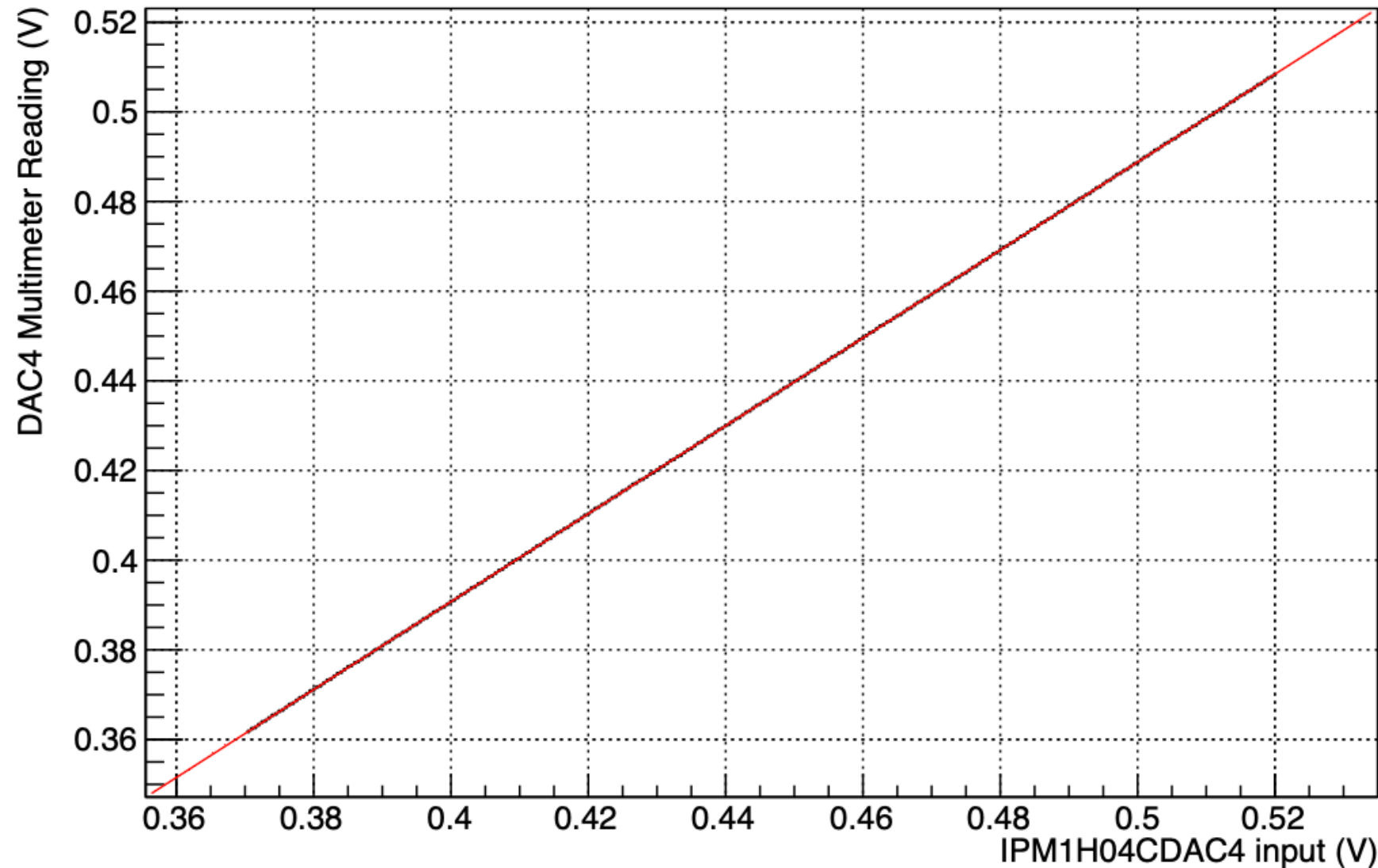
- Residual = data – linear fit
- Two observations:
 - A specific pattern is seen
 - Periodic peaks are seen up to ± 0.01 %.

Recommendations from December Meeting

1. Conduct a scan of the digital receiver's output with the multimeter at a lower voltage level, approximately 0.5 V. It's important to note that the previous scan was performed at around 2 V, while the parity runs were taken at the 0.5 V level.
2. Adjust the digital receiver's gain and take parity data at a higher voltage level, say 5 or 6V.

Cav4c Digital Receiver's DAC4 Output vs Input (Shown in December)

DAC4 Multimeter Reading vs IPM1H04CDAC4 input

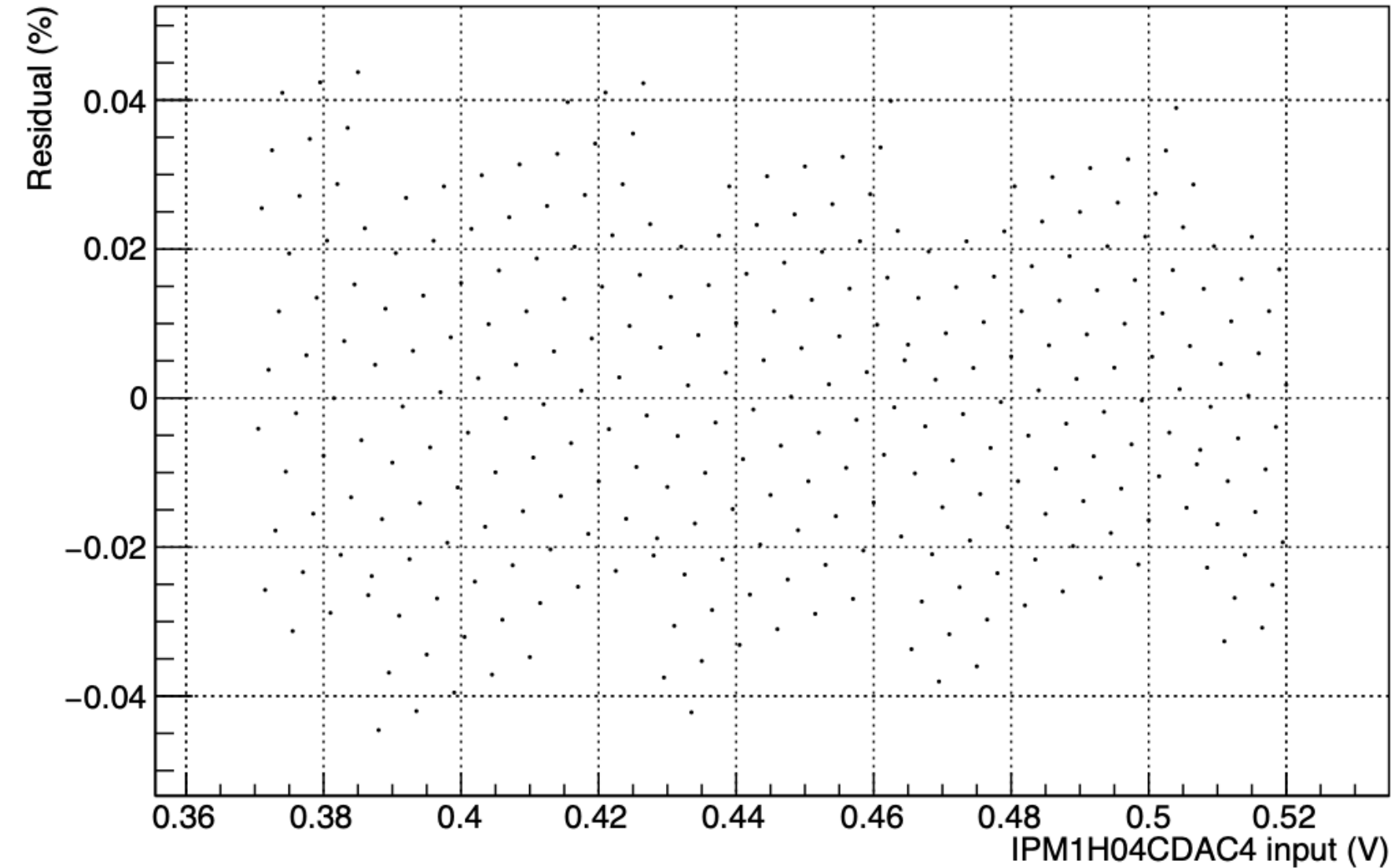


Part of data just to show the pattern

IPM1H04CDAQ4	DAC4 Multimeter Reading	A_1-A_0
0.3700	0.3612	
0.3705	0.3618	0.0006
0.3710	0.3624	0.0006
0.3715	0.3627	0.0003
0.3720	0.3633	0.0006
0.3725	0.3639	0.0006
0.3730	0.3642	0.0003
0.3735	0.3648	0.0006
0.3740	0.3654	0.0006
0.3745	0.3657	0.0003
0.3750	0.3663	0.0006
0.3755	0.3666	0.0003
0.3760	0.3672	0.0006
0.3765	0.3678	0.0006
0.3770	0.3681	0.0003
0.3775	0.3687	0.0006
0.3780	0.3693	0.0006
0.3785	0.3696	0.0003
0.3790	0.3702	0.0006
0.3795	0.3708	0.0006
0.3800	0.3711	0.0003
0.3805	0.3717	0.0006
0.3810	0.3720	0.0003
0.3815	0.3726	0.0006
0.3820	0.3732	0.0006
0.3825	0.3735	0.0003

Cav4c Digital Receiver's DAC4 Output Residual vs Input (Shown in December)

DAC4 Multimeter Reading Residual vs IPM1H04CDAC4 input



- Residual = data – linear fit
- Observations:
 - The pattern remains the same as in higher (2 V) output case
 - Periodic peaks are larger ± 0.04 % (a factor of four).

What Next?

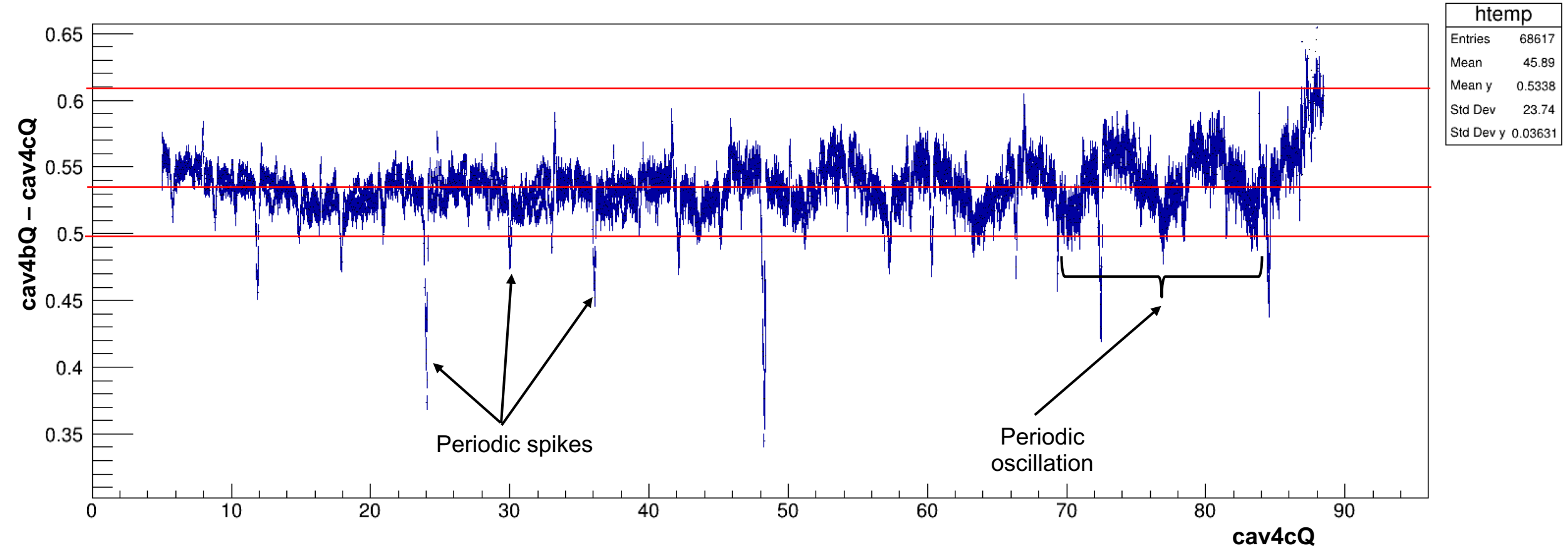
1. Adjust the digital receiver's gain and take parity data at a higher voltage level, say 5 or 6V, using RF source.

Thank You



Double difference profile plot between cav4bQ and cav4cQ

cav4bQ/1.265-cav4cQ/0.9:cav4cQ {CodaEventNumber>36.28e3&&cav4cQ>5}

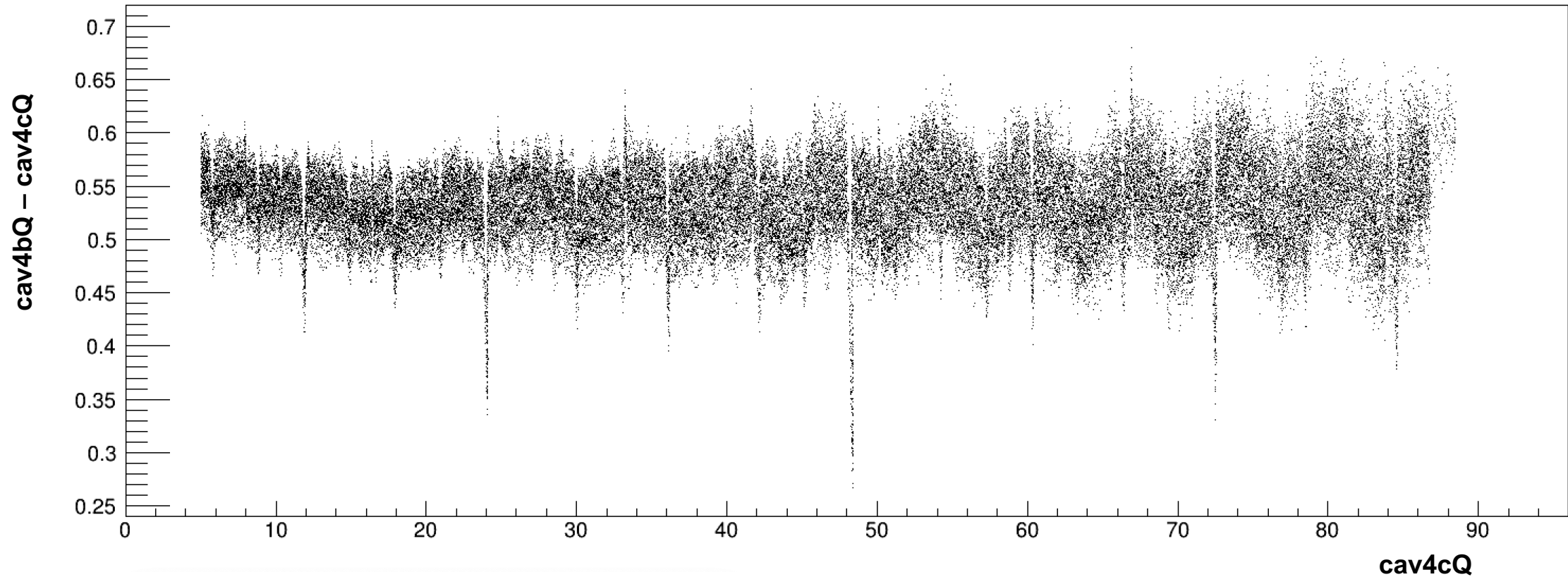


Two important features are observed:

1. Periodic spikes
2. Periodic oscillation, whose amplitude increases as a function of current
3. $\sim 0.1\%$ differential nonlinearity

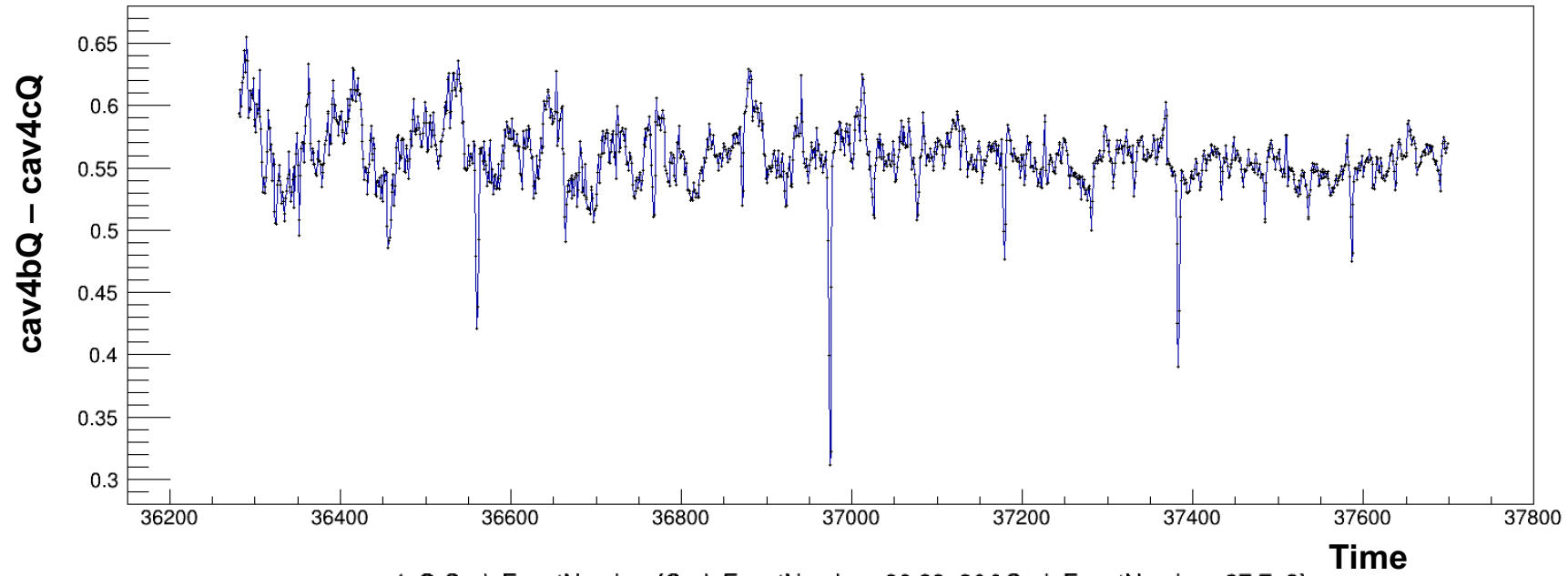
Double difference profile plot between cav4bQ and cav4cQ

cav4bQ/1.265-cav4cQ/0.9:cav4cQ {CodaEventNumber>36.28e3&&cav4cQ>5}

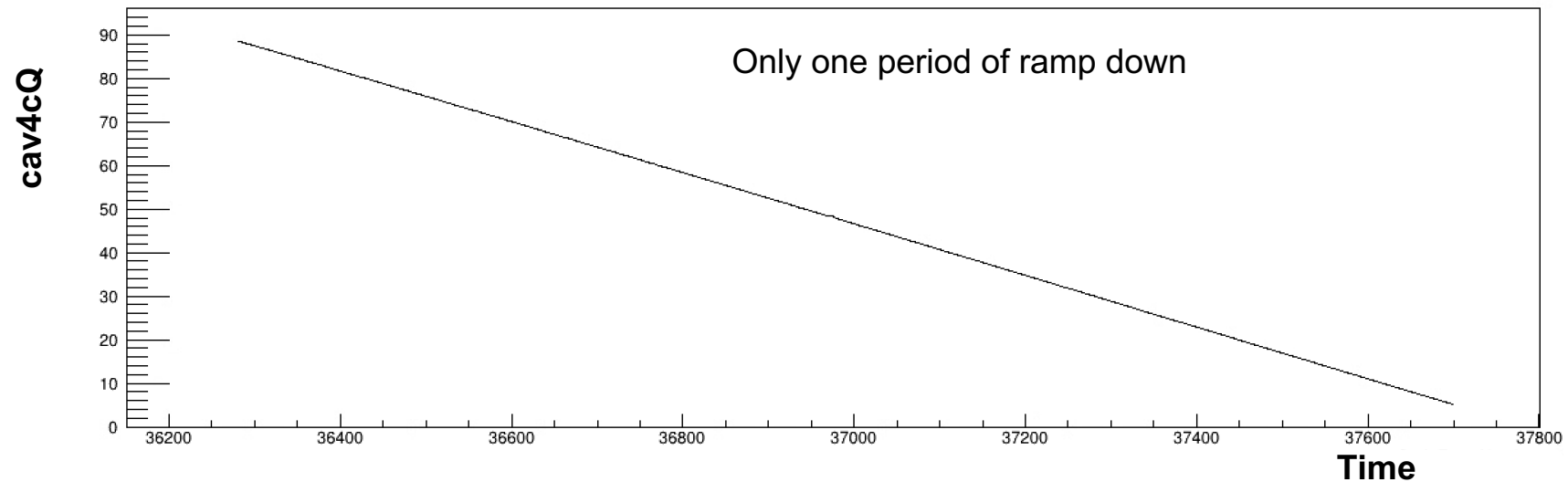


Double difference between cav4bQ and cav4cQ over time

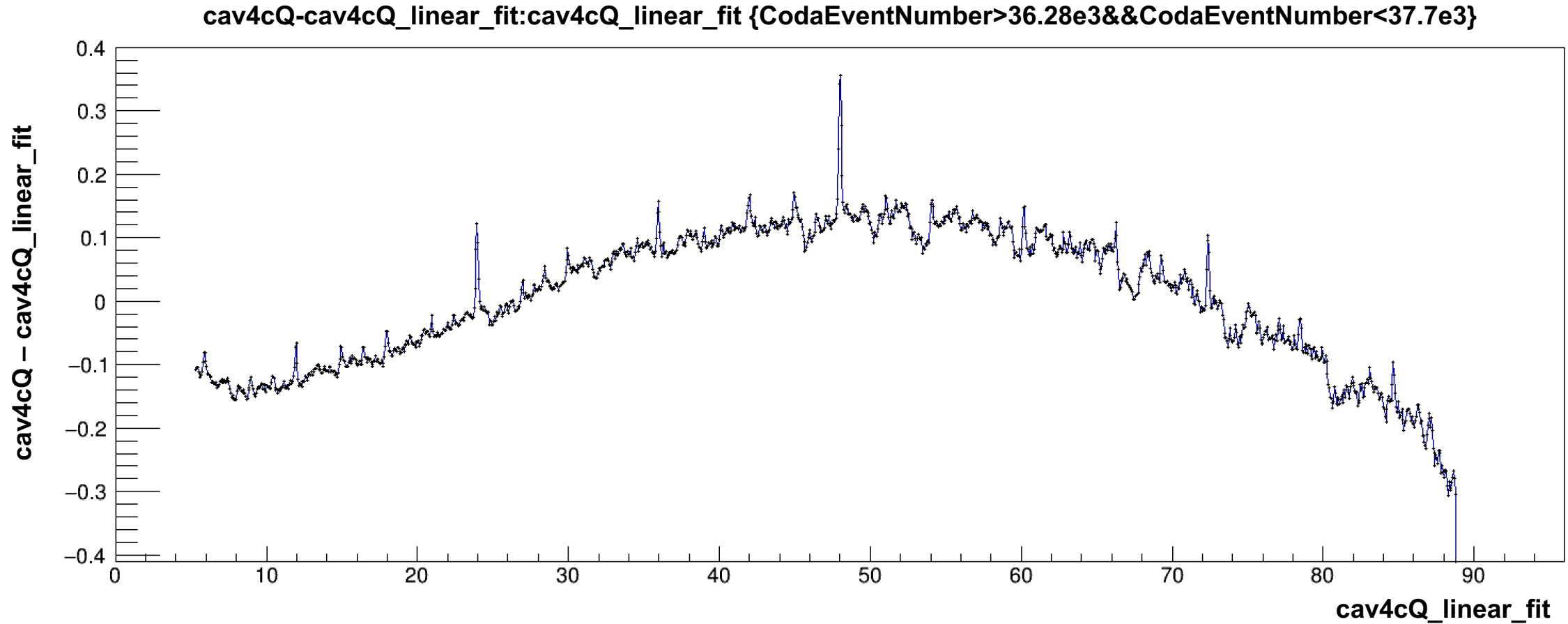
cav4bQ/1.265-cav4cQ/0.9:CodaEventNumber {CodaEventNumber>36.28e3&&CodaEventNumber<37.7e3}



cav4cQ:CodaEventNumber {CodaEventNumber>36.28e3&&CodaEventNumber<37.7e3}

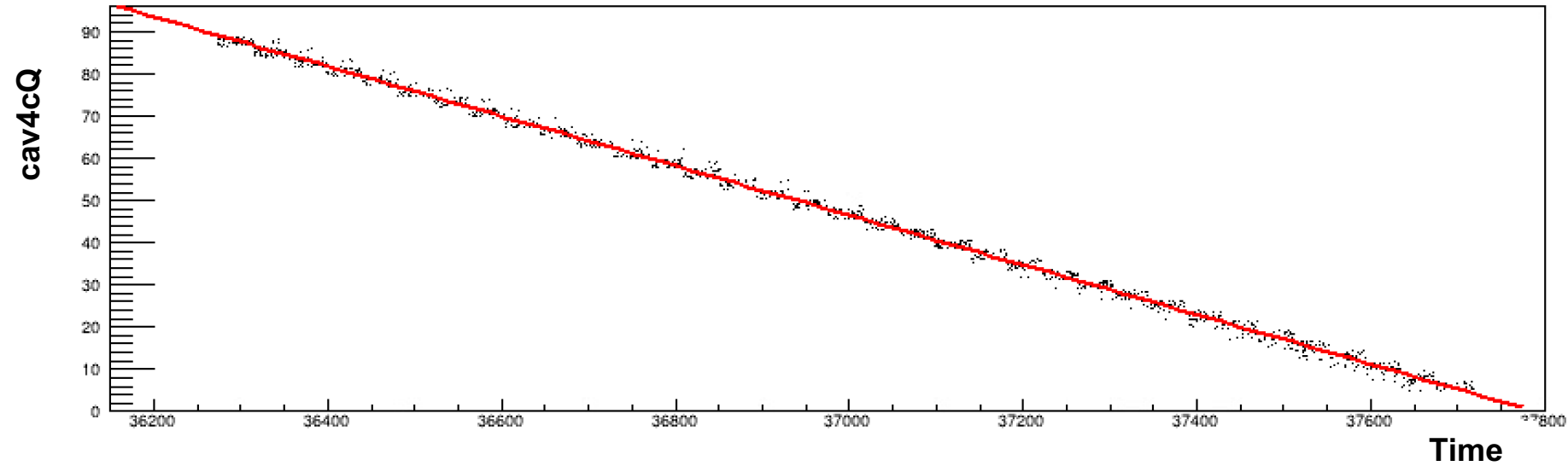


Residual plot for cav4cQ

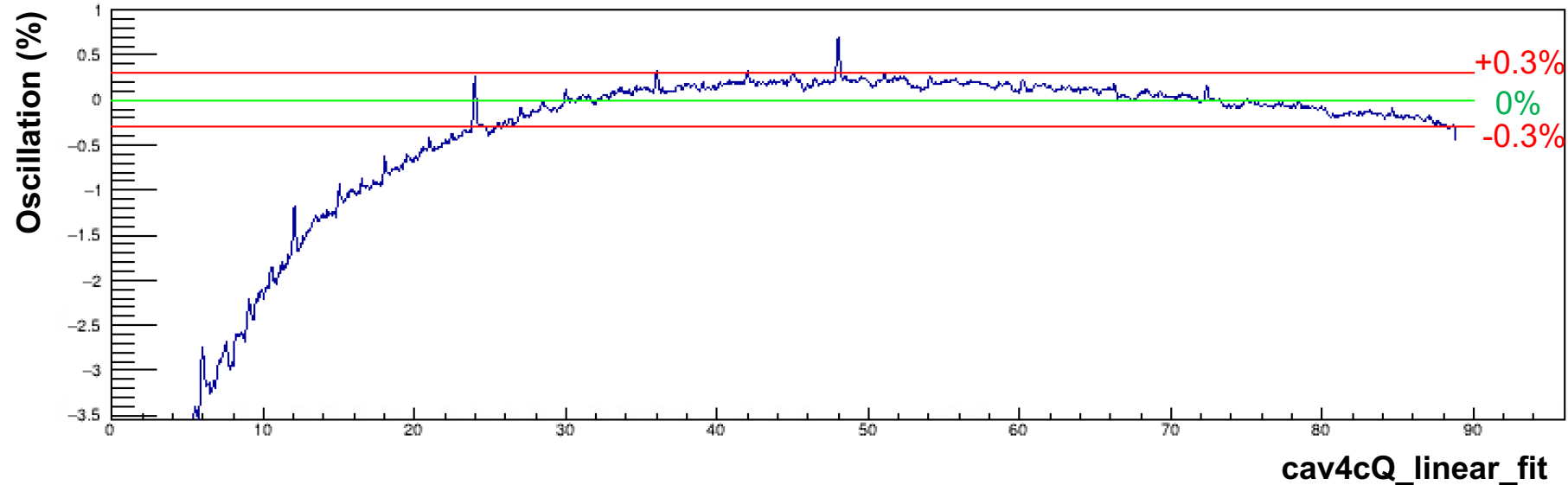


cav4cQ sees up to 0.3 % level of amplitude oscillation for 25 μ A – 90 μ A

cav4cQ:CodaEventNumber {CodaEventNumber>36.28e3&&CodaEventNumber<37.7e3}

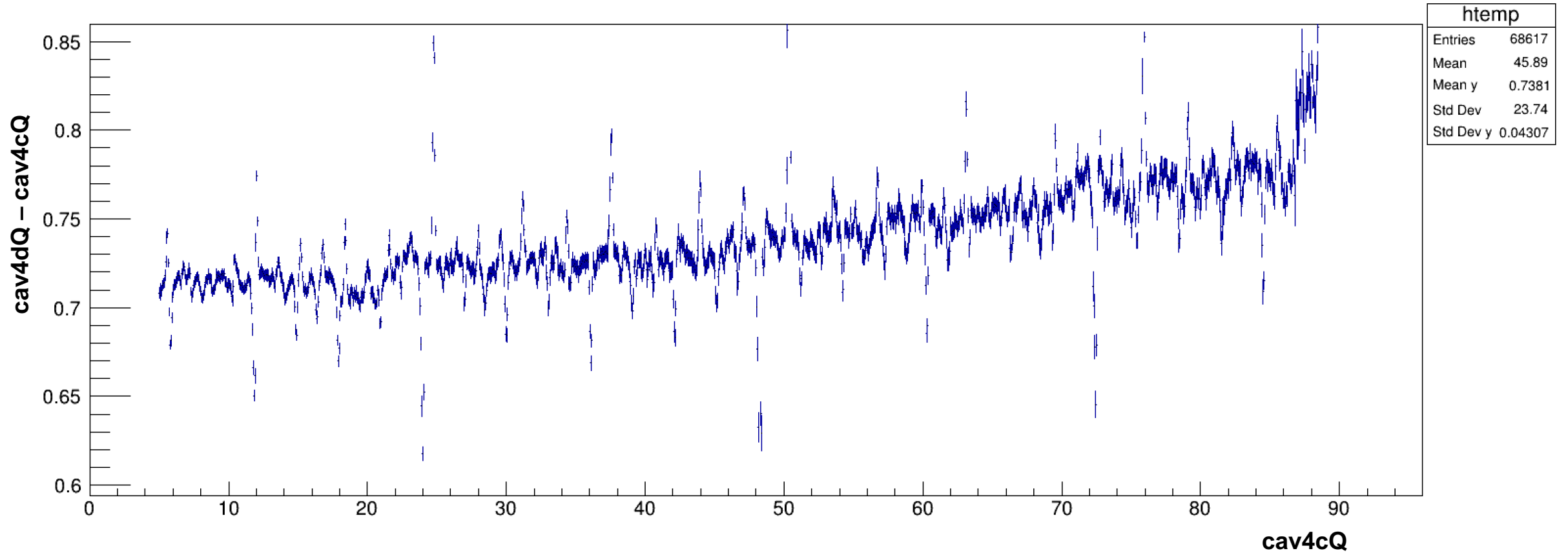


$(\text{cav4cQ} - \text{cav4cQ_linear_fit}) / \text{cav4cQ_linear_fit} * 100 : \text{cav4cQ_linear_fit}$



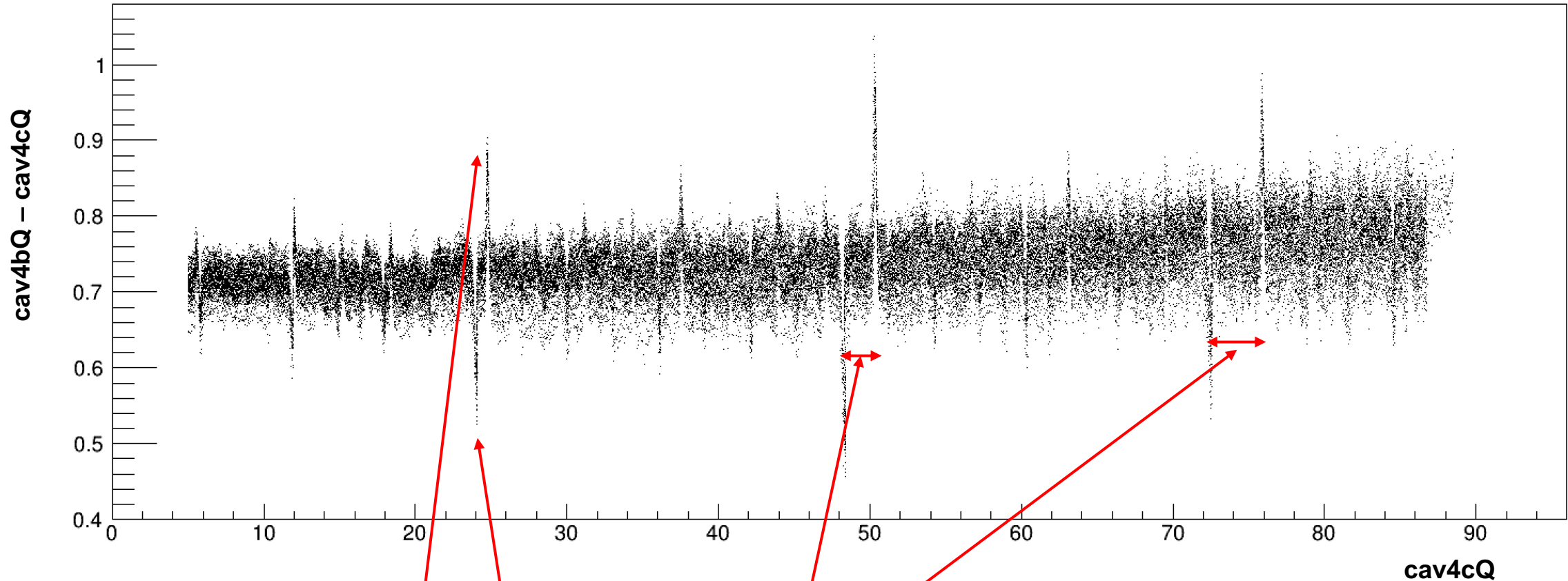
Double difference profile plot between cav4dQ and cav4cQ

cav4dQ/1.096-cav4cQ/0.9:cav4cQ {CodaEventNumber>36.28e3&&cav4cQ>5}



Double difference scatter plot between cav4dQ and cav4cQ

cav4dQ/1.096-cav4cQ/0.9:cav4cQ {CodaEventNumber>36.28e3&&cav4cQ>5}



- Periodic spikes up and down; possibly the two receivers spike at different times
- The gap between the up and down spikes gets larger as the current increase
- A larger spike appears after a few smaller spikes (periodically)