Cavity BCM Digital Receivers Study

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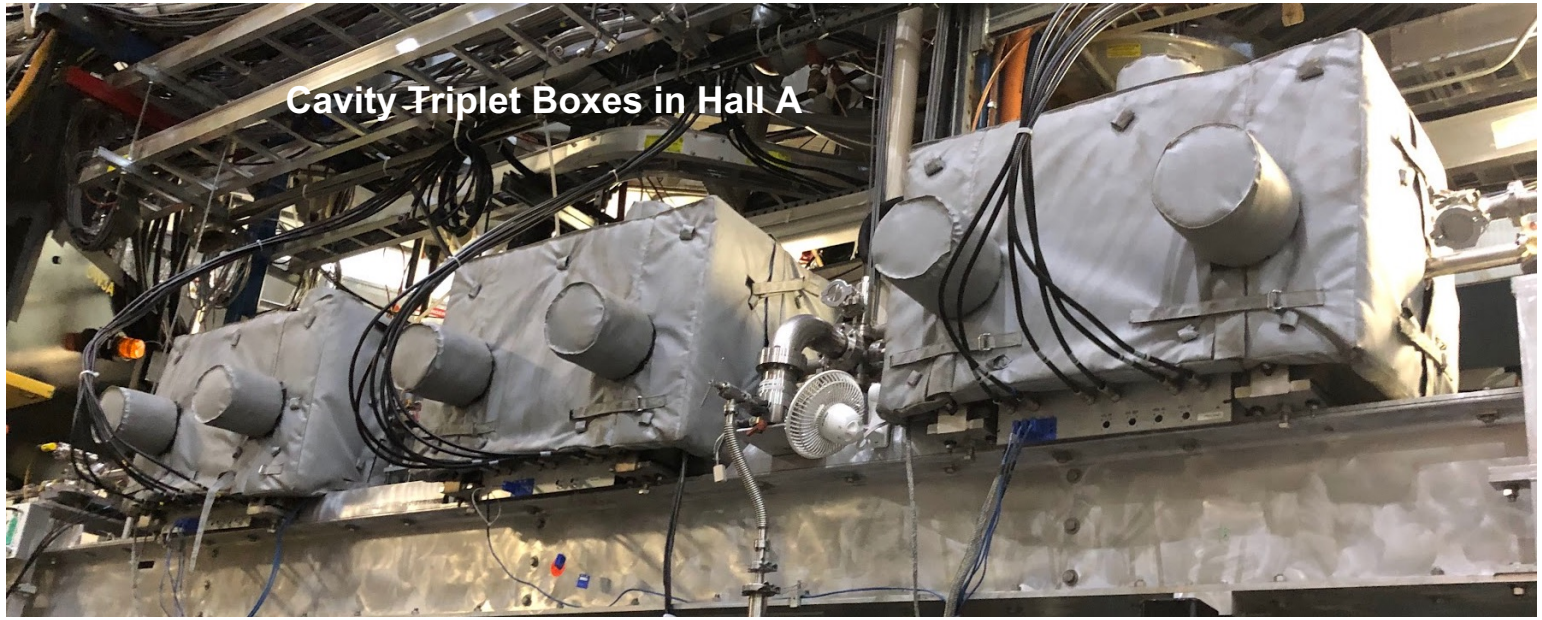
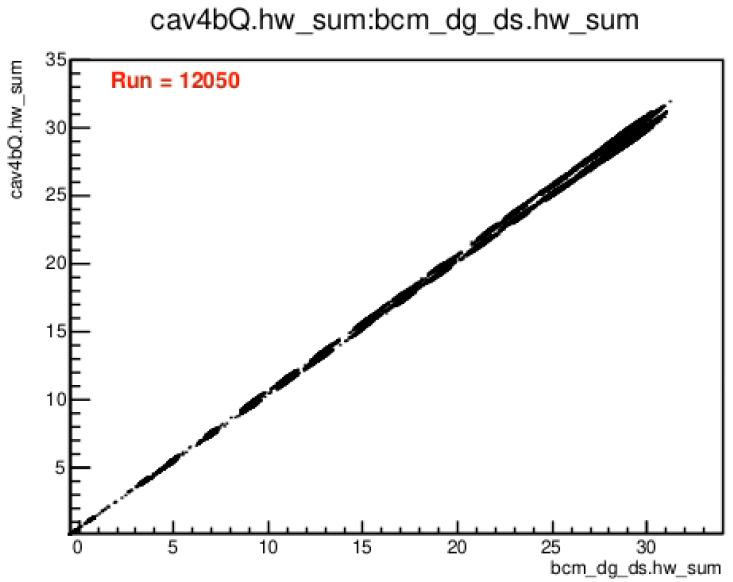
Hall A Cavity BCM Digital Receivers Study with RF Signal Source

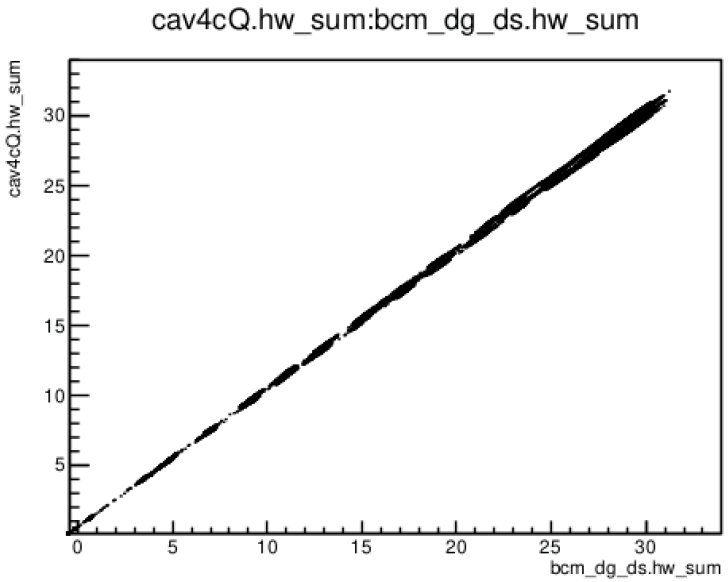
- RF signal source was connected to the digital receiver's input; six copies from a single RF source were connected to the X and Y input of the three receivers.
- John Musson adjusted the receivers' configuration for high current running.
  - ➢ The saturation problem from last week (see backup slides) was resolved.
- Took a run while changing RF level; ~ 1minutes of data for each RF level.

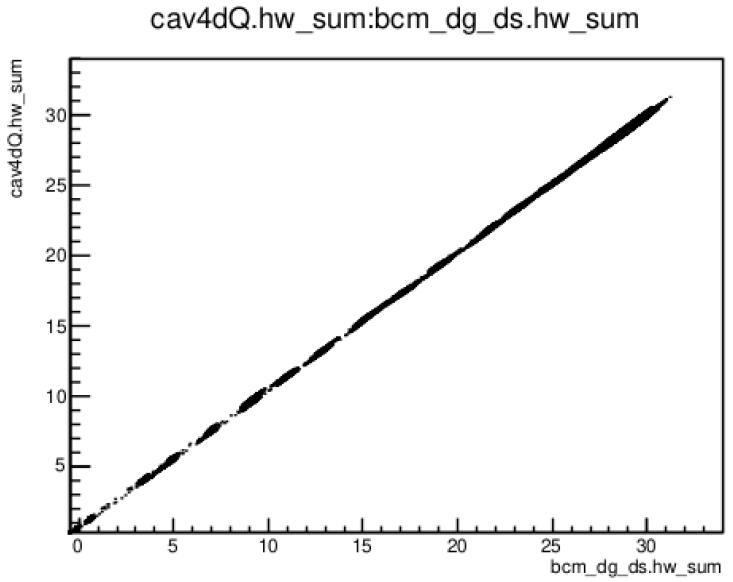


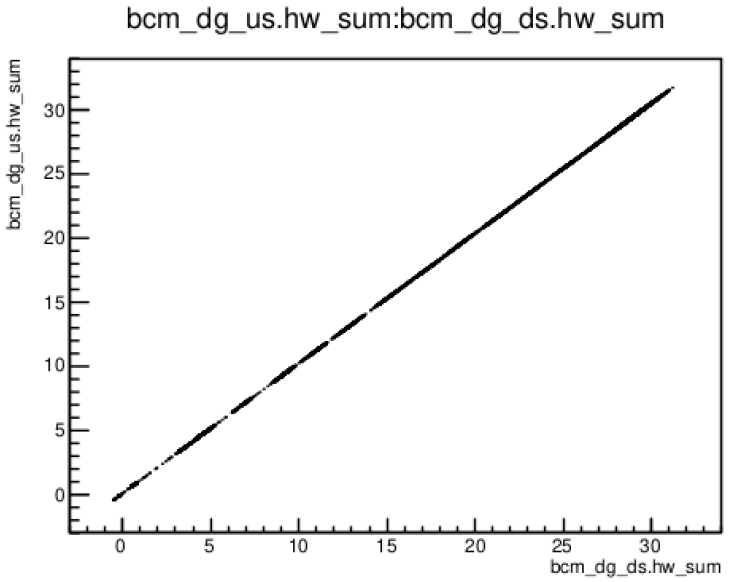
BCM Yield Signals Correlations (Run 12050)

- This data was taken after John Musson adjusted gains for the digital receivers.
- All three cavity triplets are showing a double band correlation with the standard BCM while the two standard BCMs are exhibiting an excellent correlation with each other.



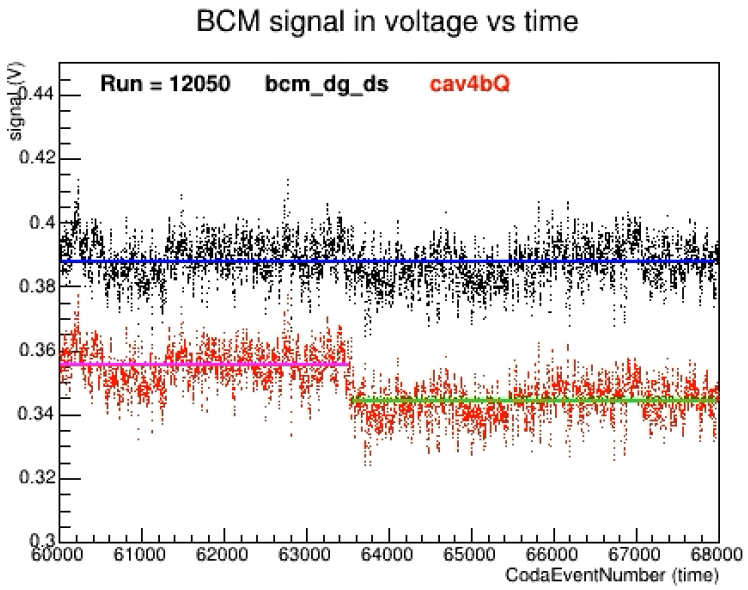


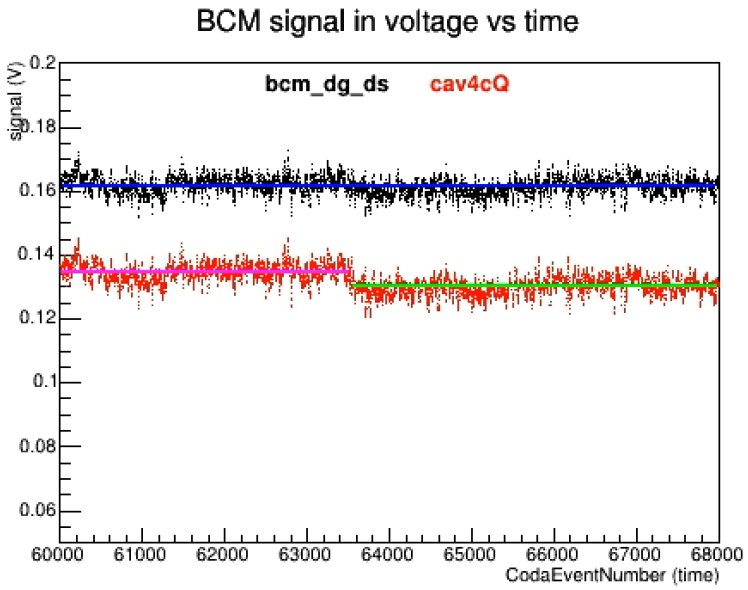


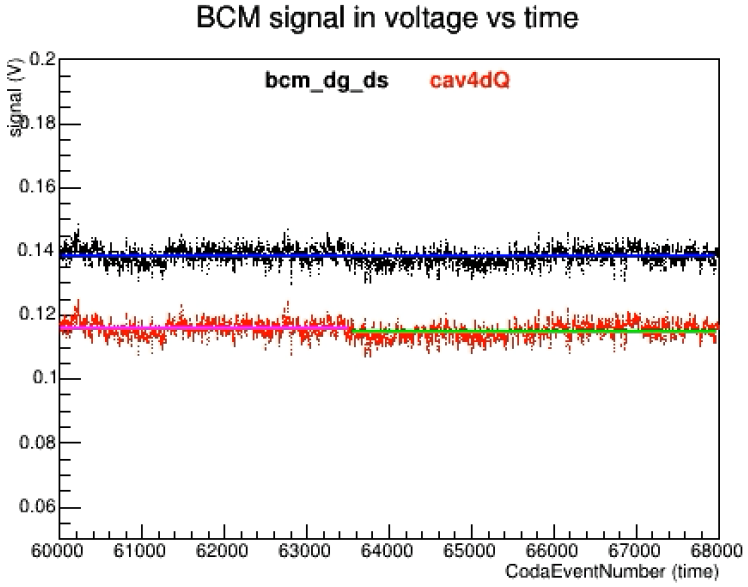


BCM Yield Signals over Time for Selected Events at 30 µA beam current (Run 12050)

- This data was taken after John Musson adjusted gains for the digital receivers.
- All three cavity triplets are showing a double band correlation with the standard BCM while the two standard BCMs are exhibiting an excellent correlation with each other.
- The double band is due to a sudden drift in cavity triplet signals. This drift was not seen during RF signal study.





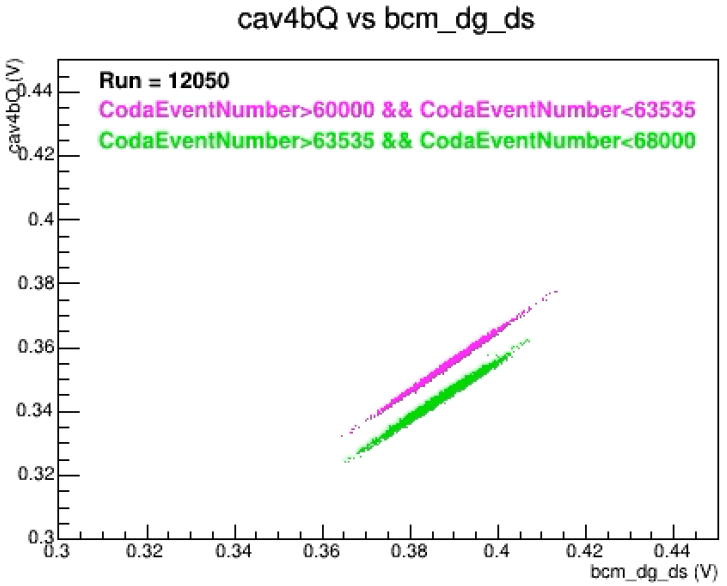


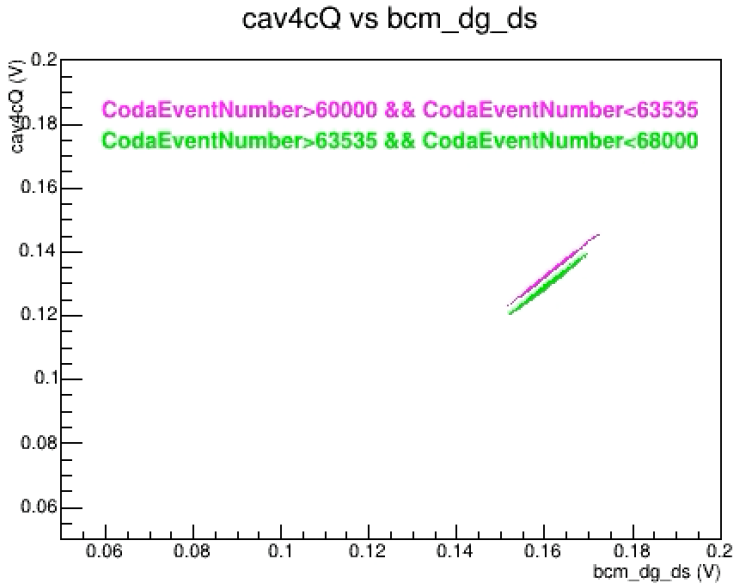
Each cavity BCM's signal drifted (jumped down) after CodaEventNumber = 63535. This is prominent in cav4bQ and least visible in cav4dQ.

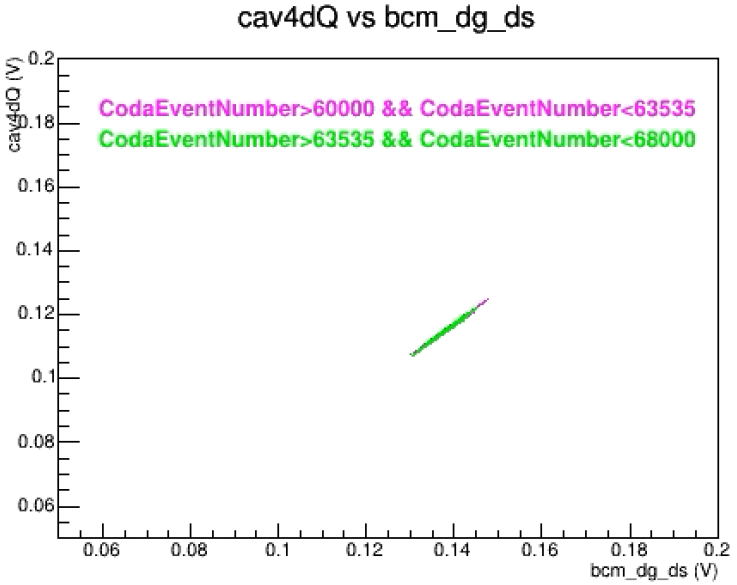
bcm_dg_ds signal is scaled down to match the signal scale of individual cavity BCM.

BCM Yield Signal Correlations for Selected Events at 30 µA Beam Current (Run 12050)

- This data was taken after John Musson adjusted gains for the digital receivers.
- All three cavity triplets are showing a double band correlation with the standard BCM while the two standard BCMs are exhibiting an excellent correlation with each other.
- The double band is due to a sudden drift in cavity triplet's signals. This drift was not seen during RF signal study.





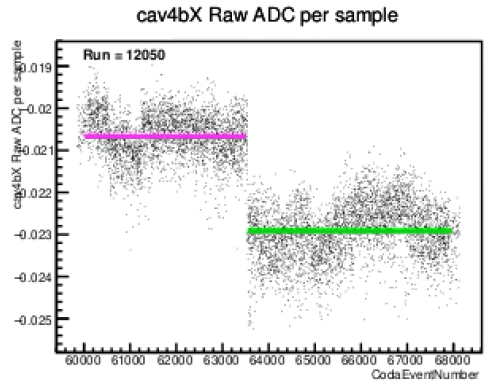


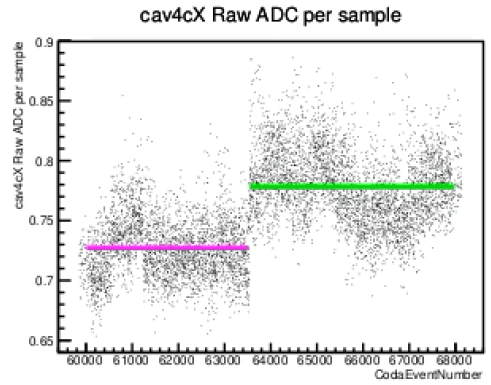
Observed double bands are due to drift in cavity BCM's signals. This is prominent in cav4bQ and least visible in cav4dQ.

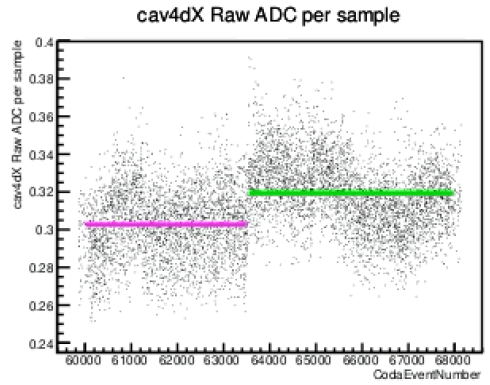
bcm_dg_ds signal is scaled down to match the signal scale of individual cavity BCM.

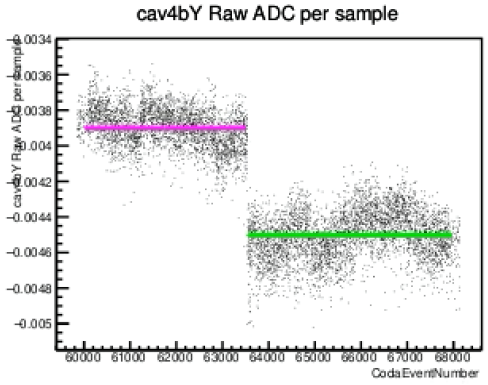
BPM Yield Signals over Time for Selected Events at 30 µA beam current (Run 12050)

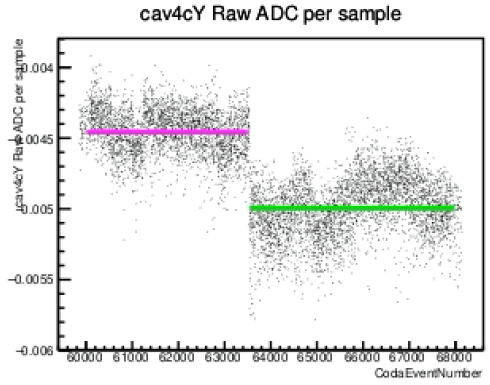
- This data was taken after John Musson adjusted gains for the digital receivers.
- All three cavity triplets are showing a double band correlation with the standard BCM while the two standard BCMs are exhibiting an excellent correlation with each other.
- The double band is due to a sudden drift in cavity triplet signals.
- At the same time the cavity BPMs also saw sudden drifts. This drift was not seen during RF signal study.

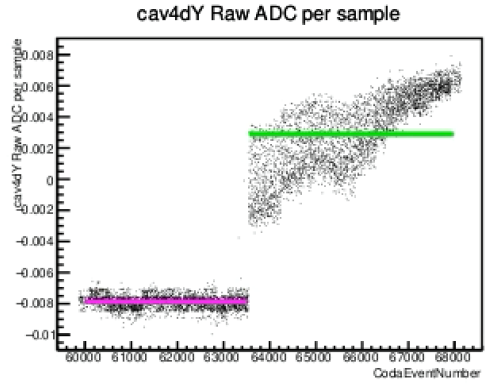


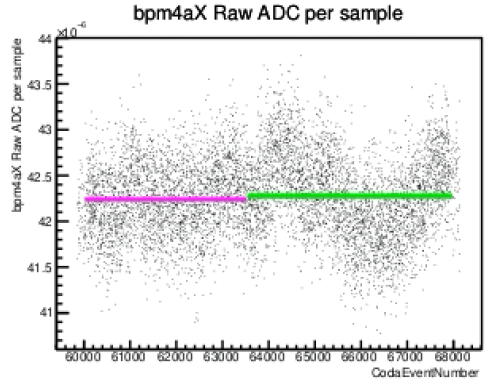


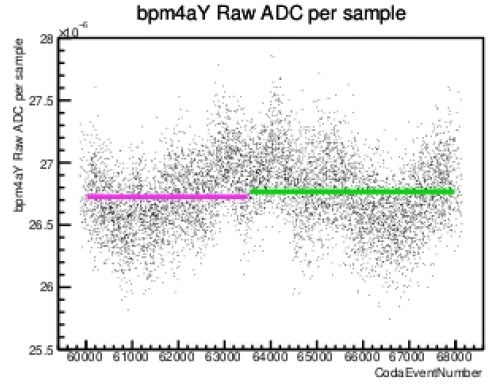






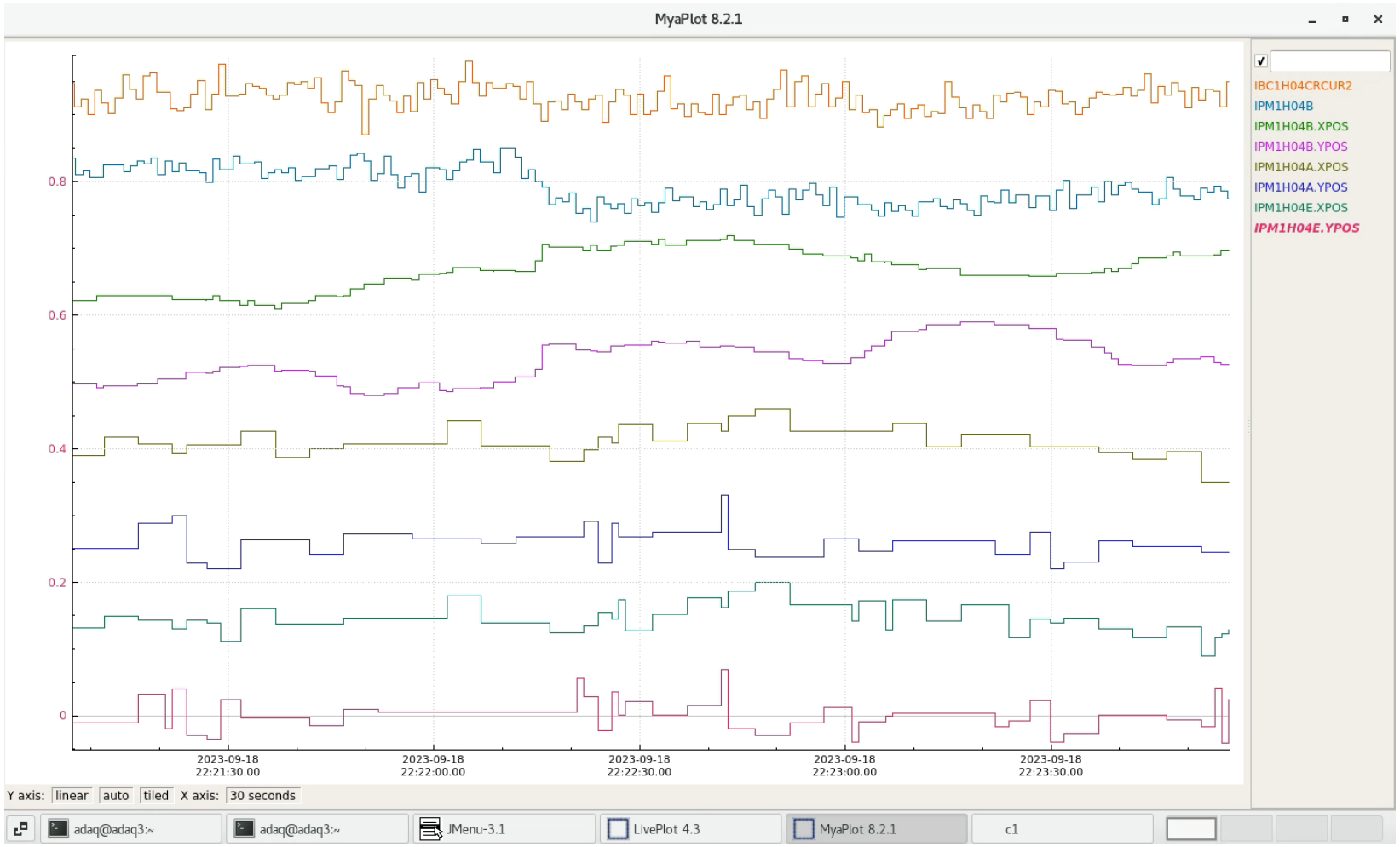






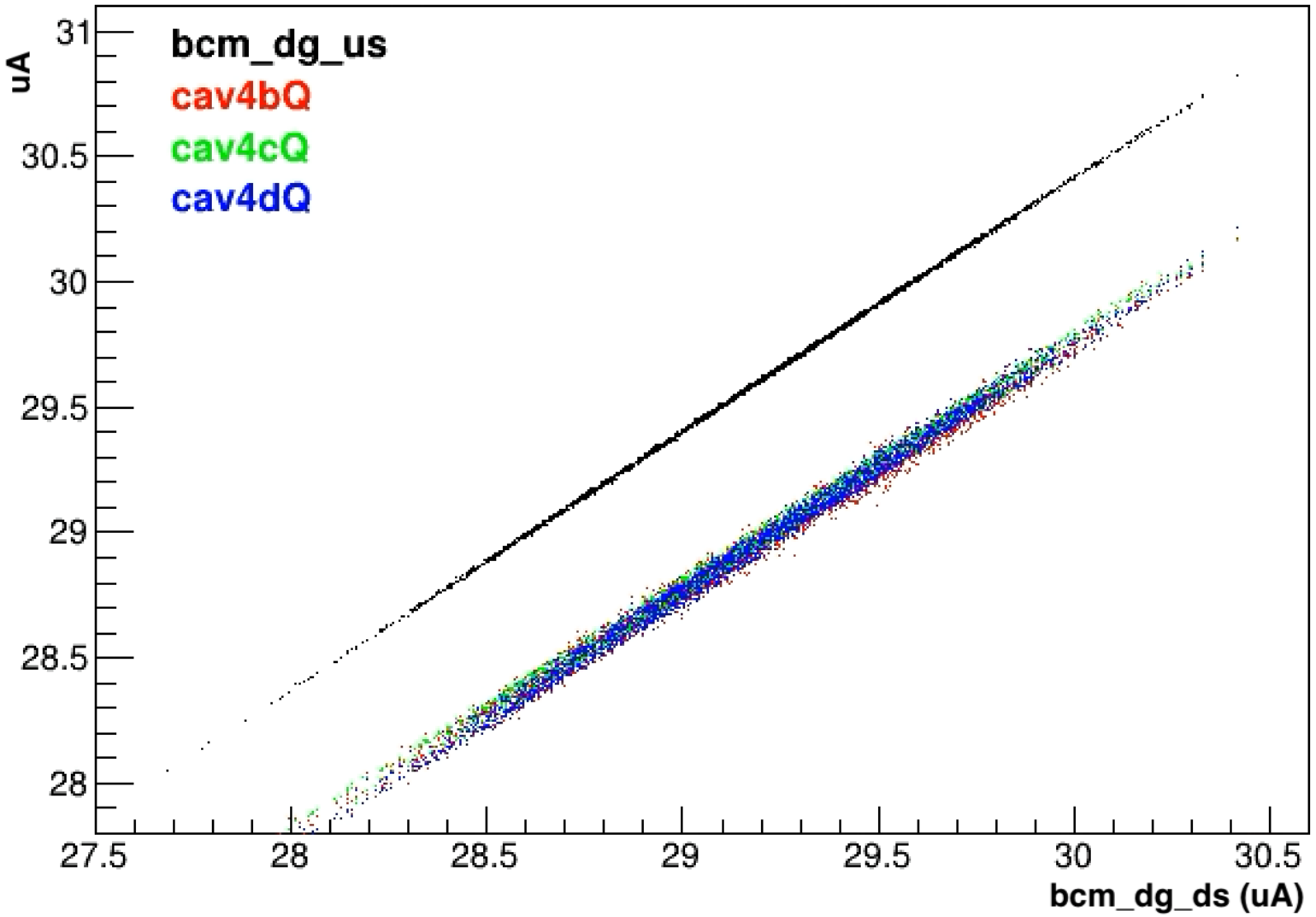
BPM Yield Signals over Time for Selected Events at 30 µA beam current (Run 12050)

- This data was taken after John Musson adjusted gains for the digital receivers.
- All three cavity triplets are showing a double band correlation with the standard BCM while the two standard BCMs are exhibiting an excellent correlation with each other.
- The double band is due to a sudden drift in cavity triplet signals.
- At the same time the cavity BPMs also saw sudden drifts. This drift was not seen during RF signal study.
- There doesn't seem to be any beam position change when there is signal jump in cavity BPMs (BCMs).



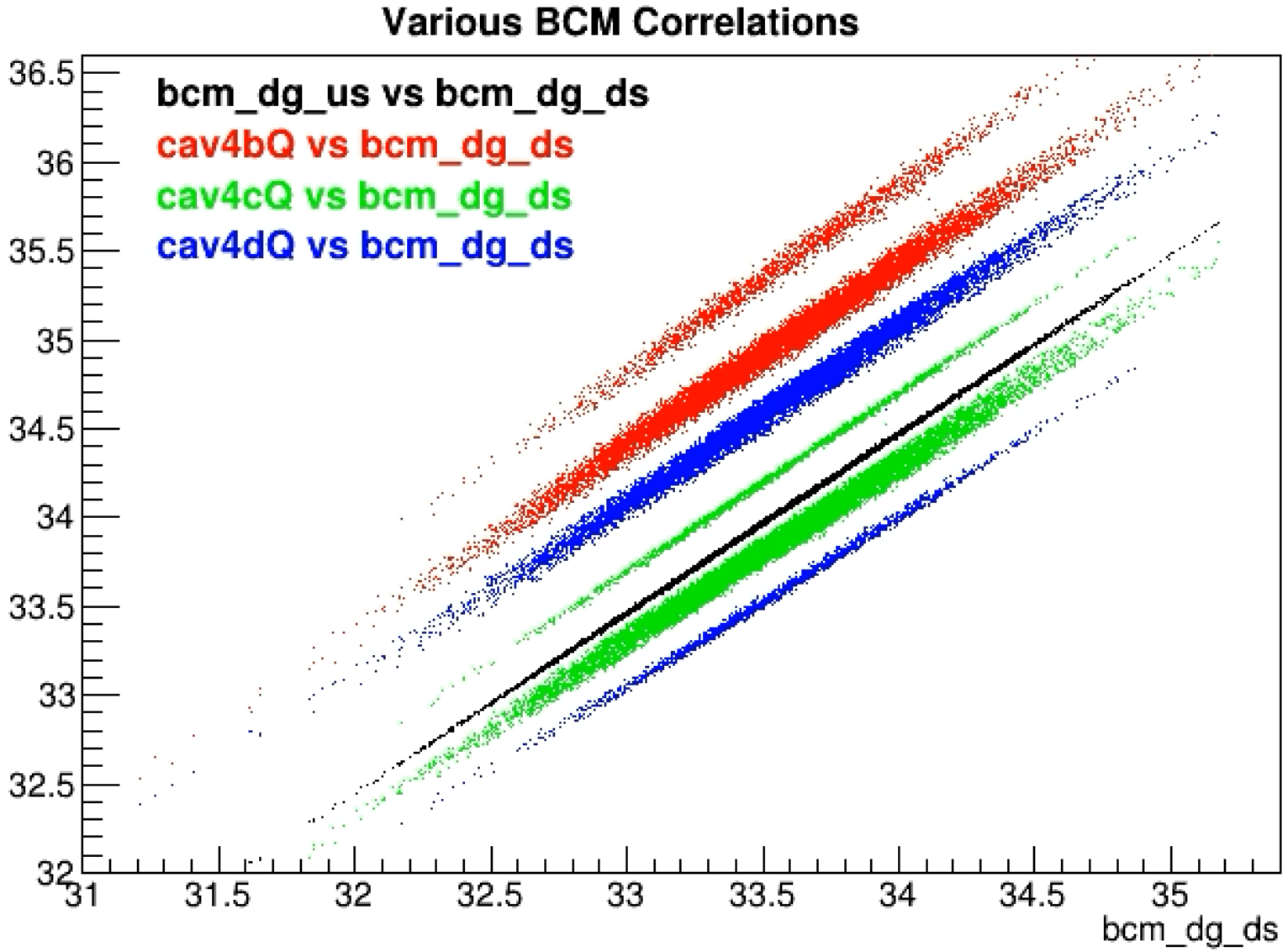
BCM Yield Signals Correlations for Data with No Drift (Run 12050)

- This data was taken after John Musson adjusted gains for the digital receivers.
- All three cavity triplets are showing a double band correlation with the standard BCM while the two standard BCMs are exhibiting an excellent correlation with each other.
- The double band is due to a sudden drift in cavity triplet signals.
- At the same time the cavity BPMs also saw sudden drifts. This drift was not seen during RF signal study.
- The cavity triplet signals have significantly larger spread as compared to the standard BCMs.



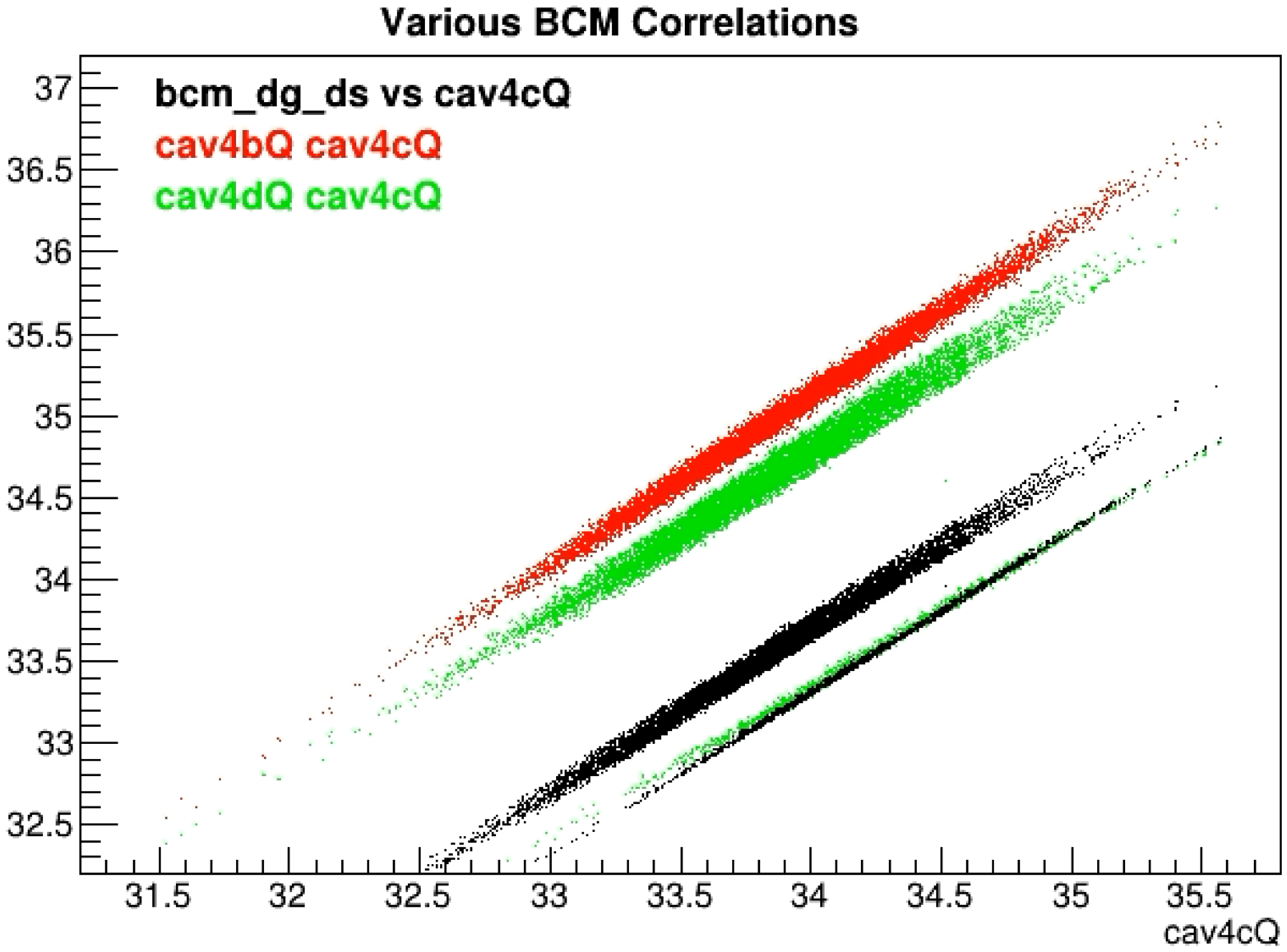
BCM Yield Signals Correlations (Run 12330) More Recent Run From 10/01/2023

- The cavity triplet signals are noisier as compared to the standard BCMs signals.

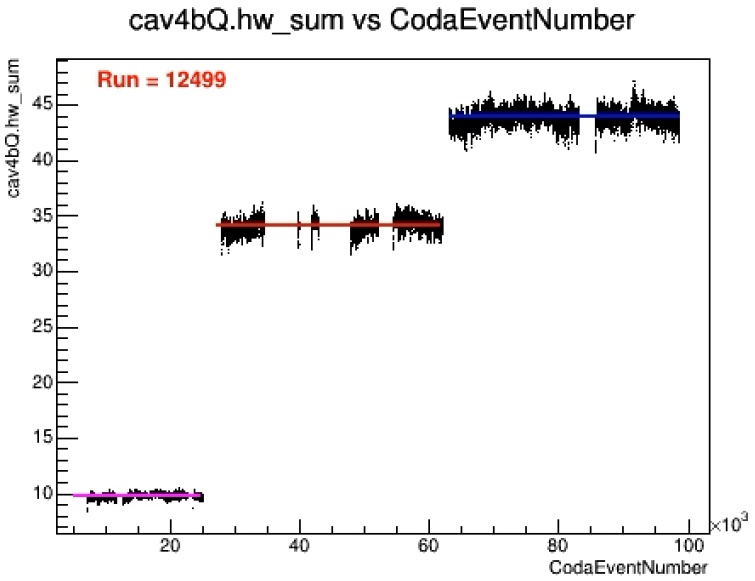


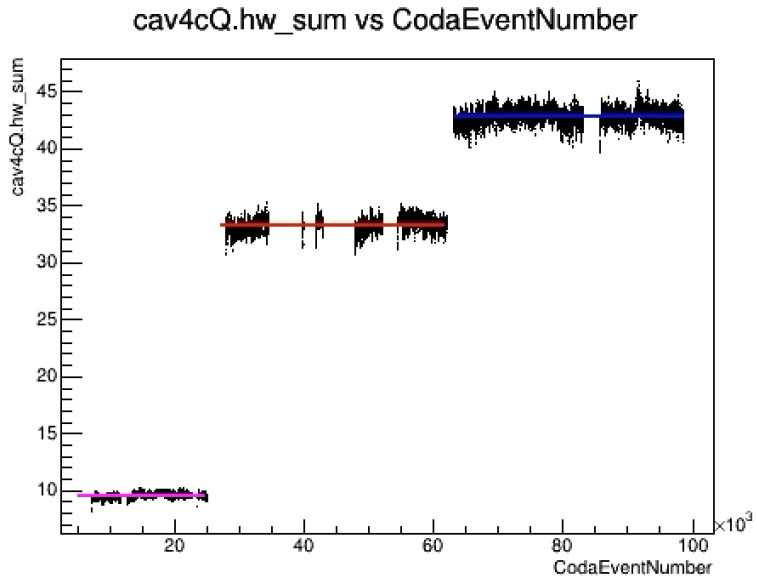
BCM Yield Signals Correlations (Run 12330) More Recent Run From 10/01/2023

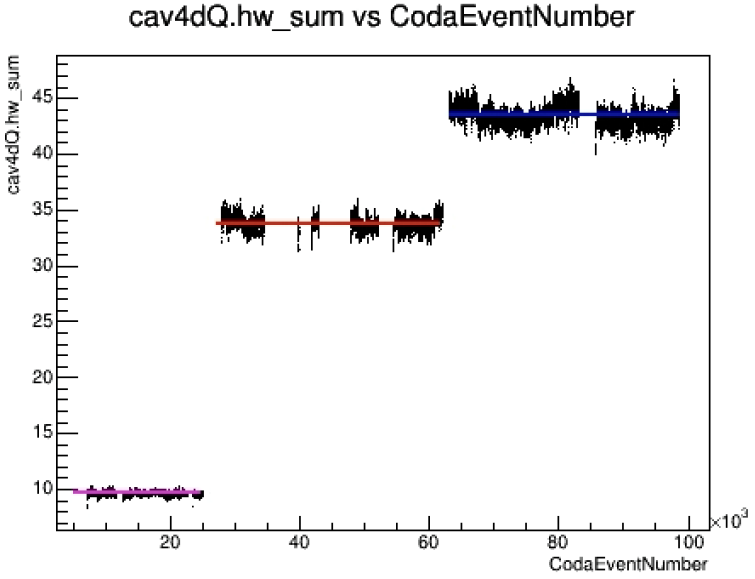
- The noise do not seem to be correlated between the different cavity BCMs.

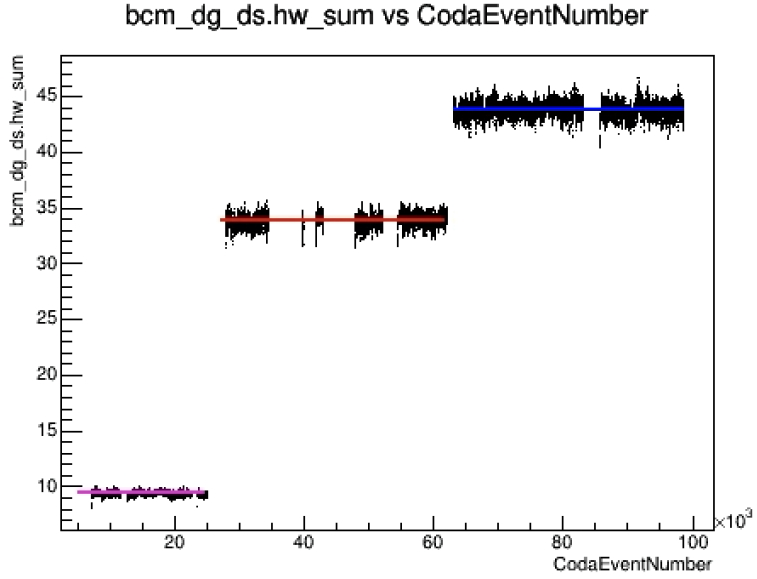


Yields (Run 12499) More Recent Run From 10/08/2023

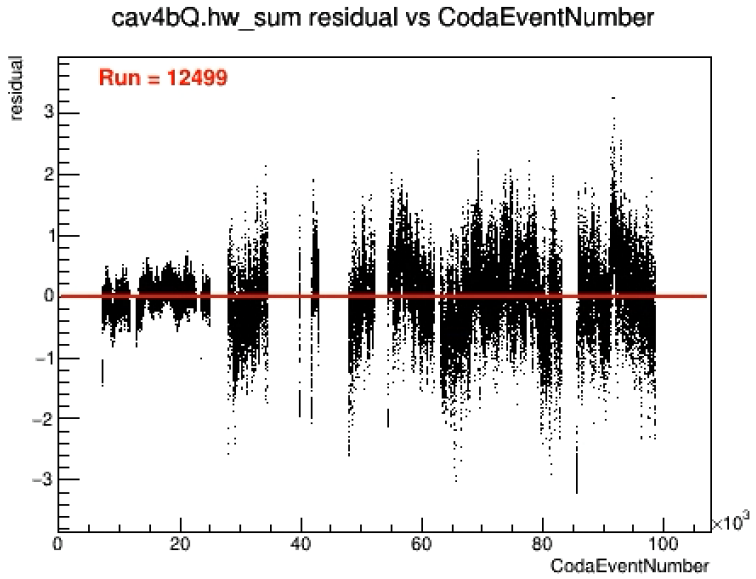


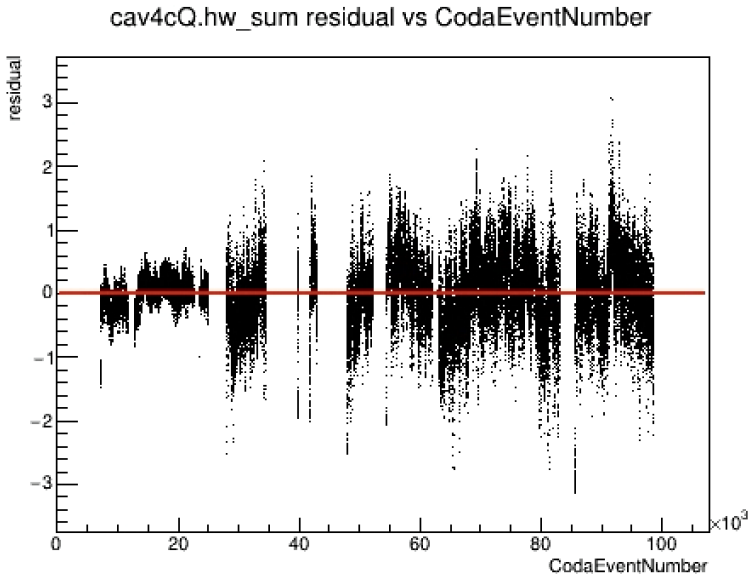


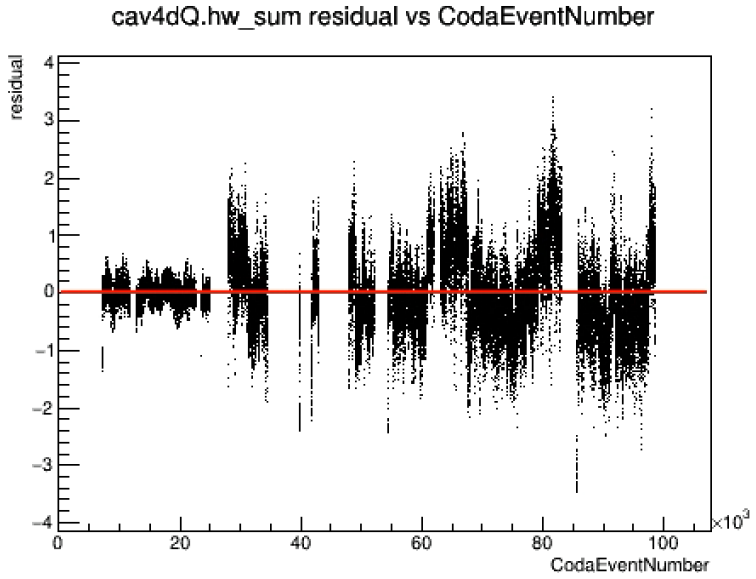


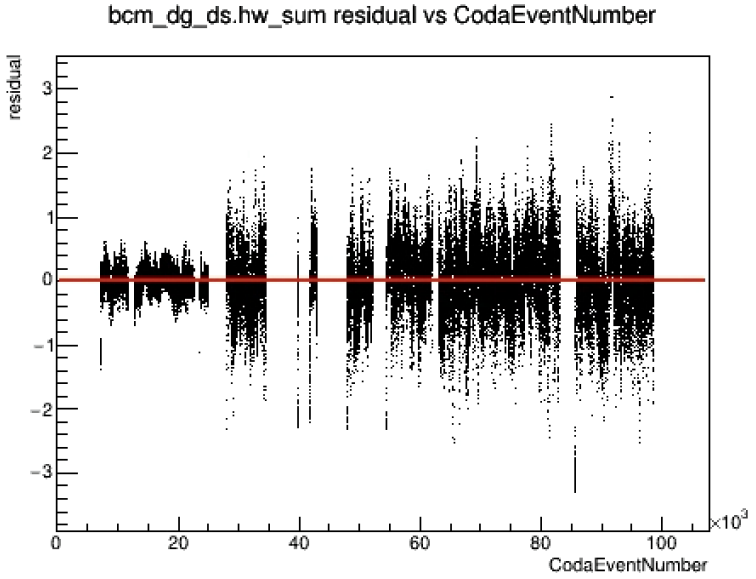


Yield Residuals (Run 12499) More Recent Run From 10/08/2023

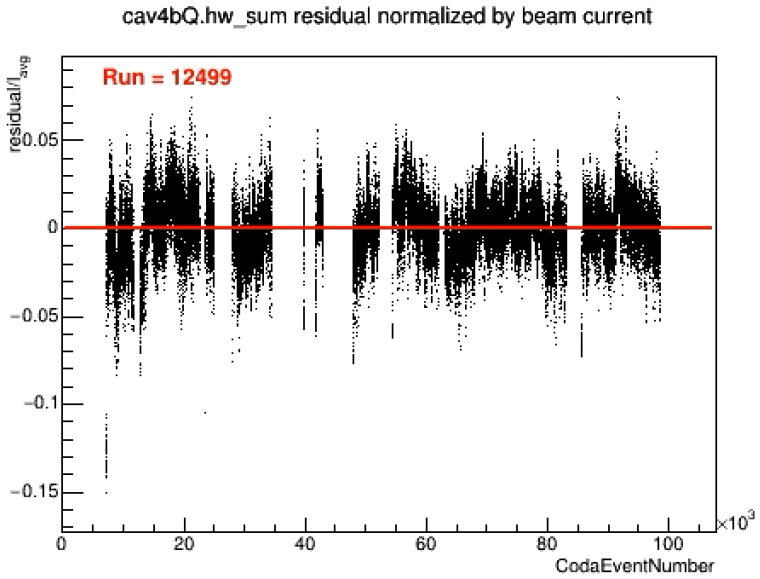


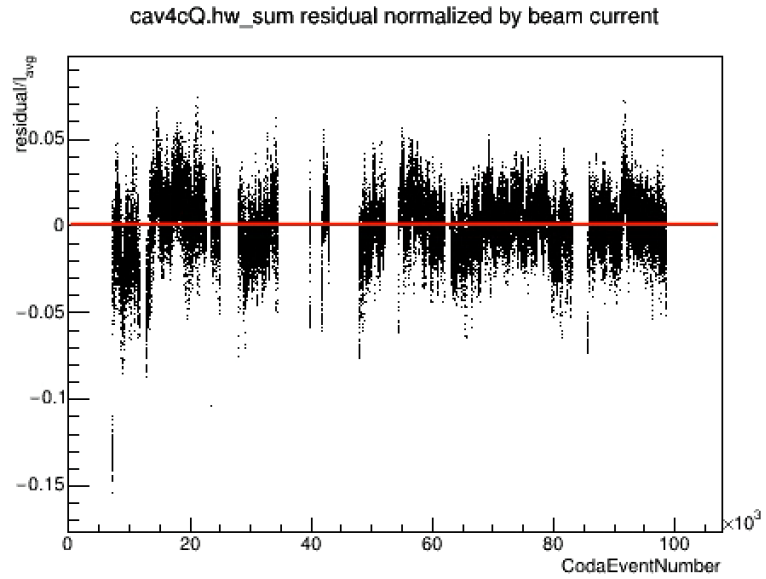


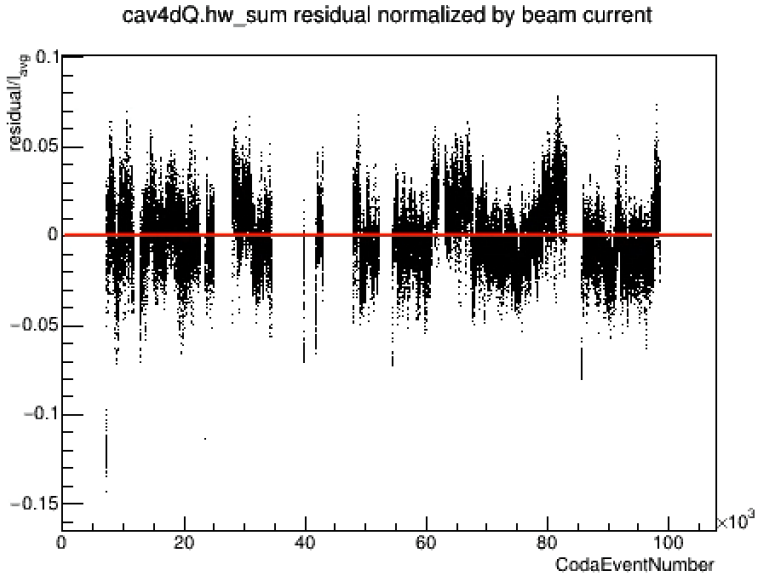


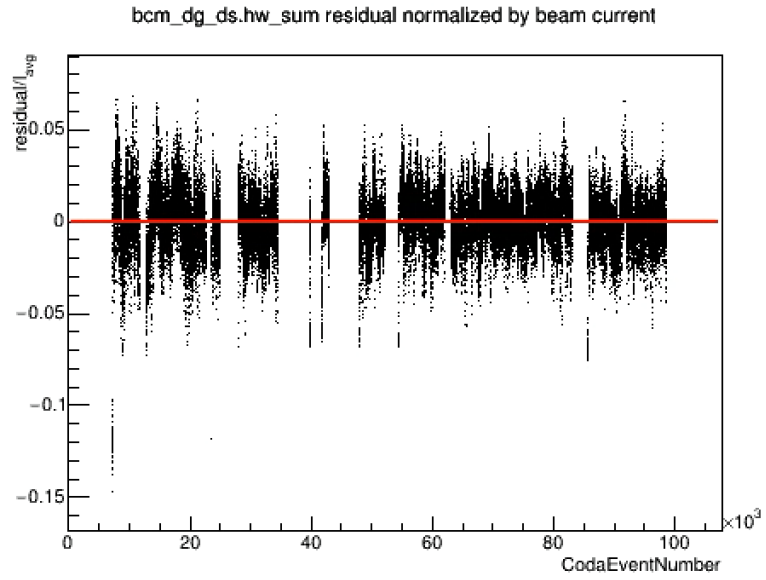


Yield Residuals Normalized by I_{avg} (Run 12499) More Recent Run From 10/08/2023



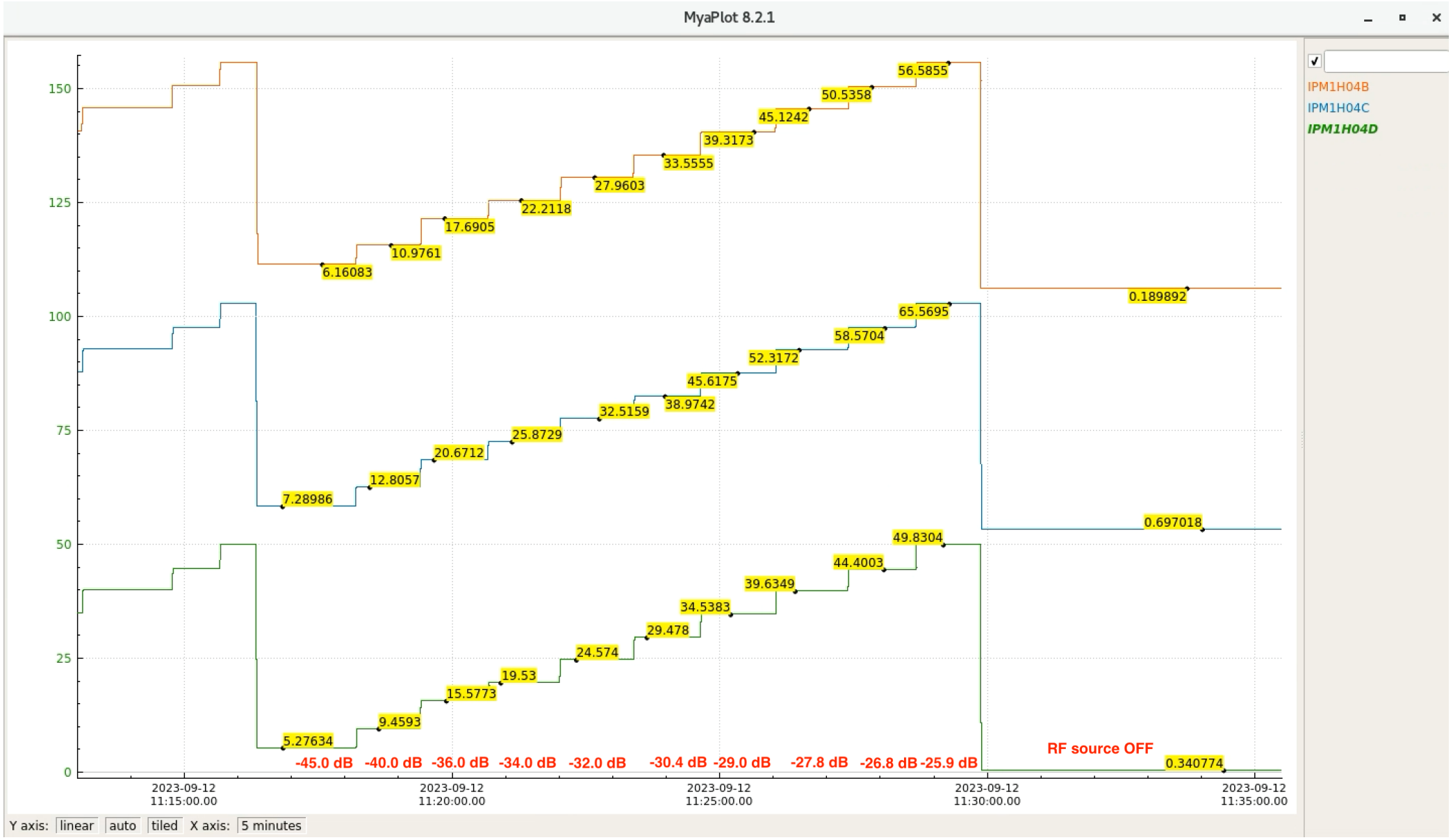




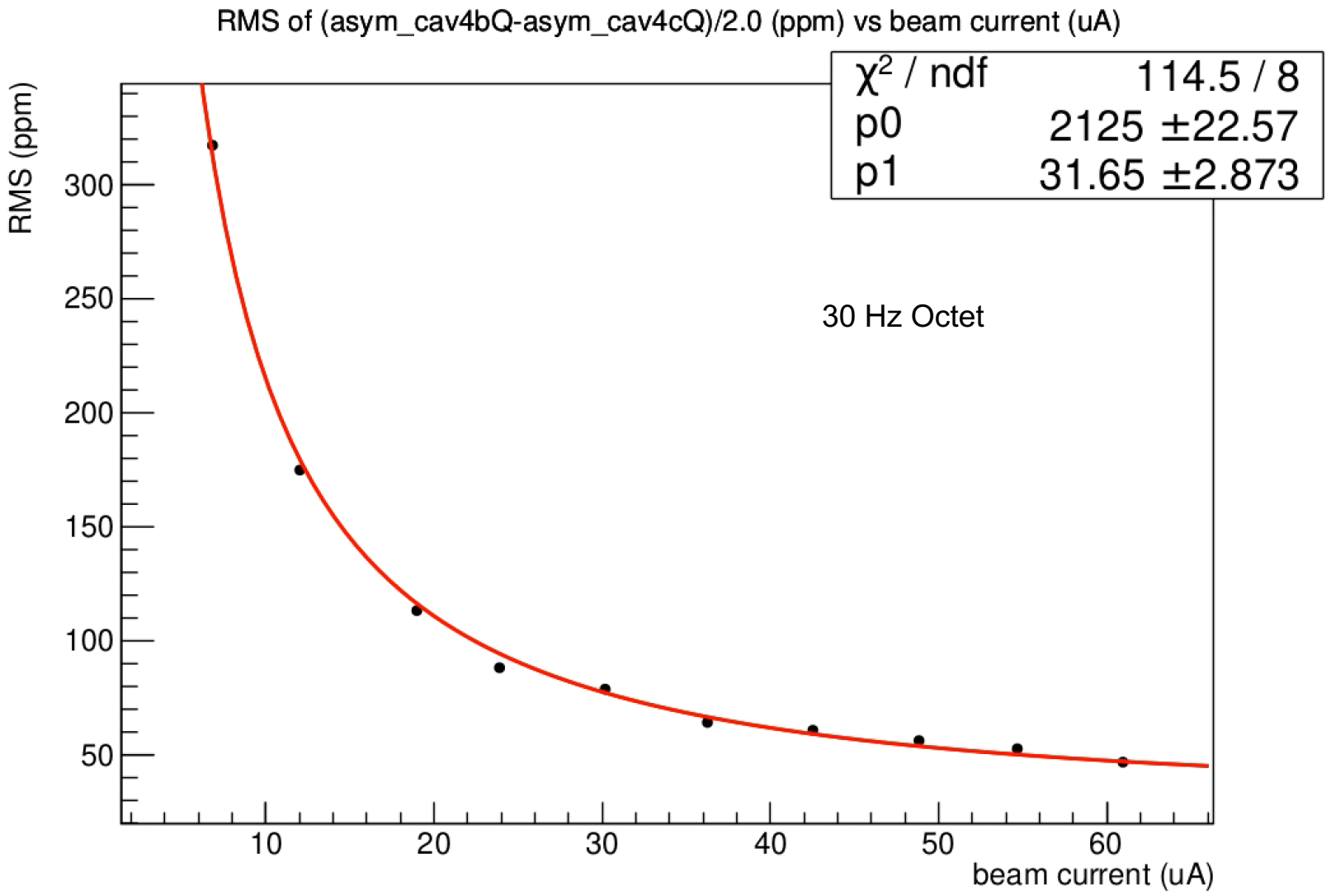


Thank You

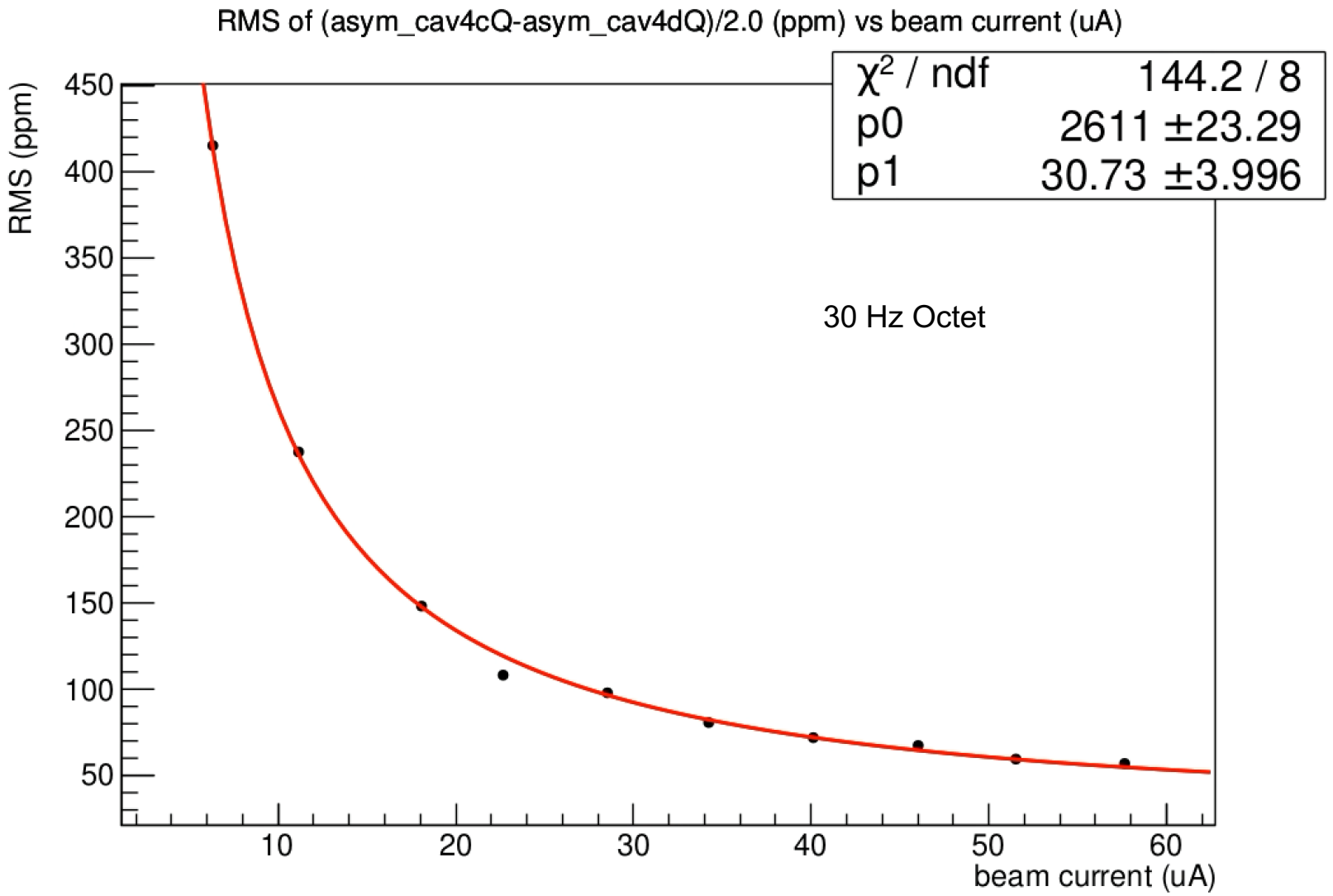
RF Level Scan (Strip Charts during Run 11904)



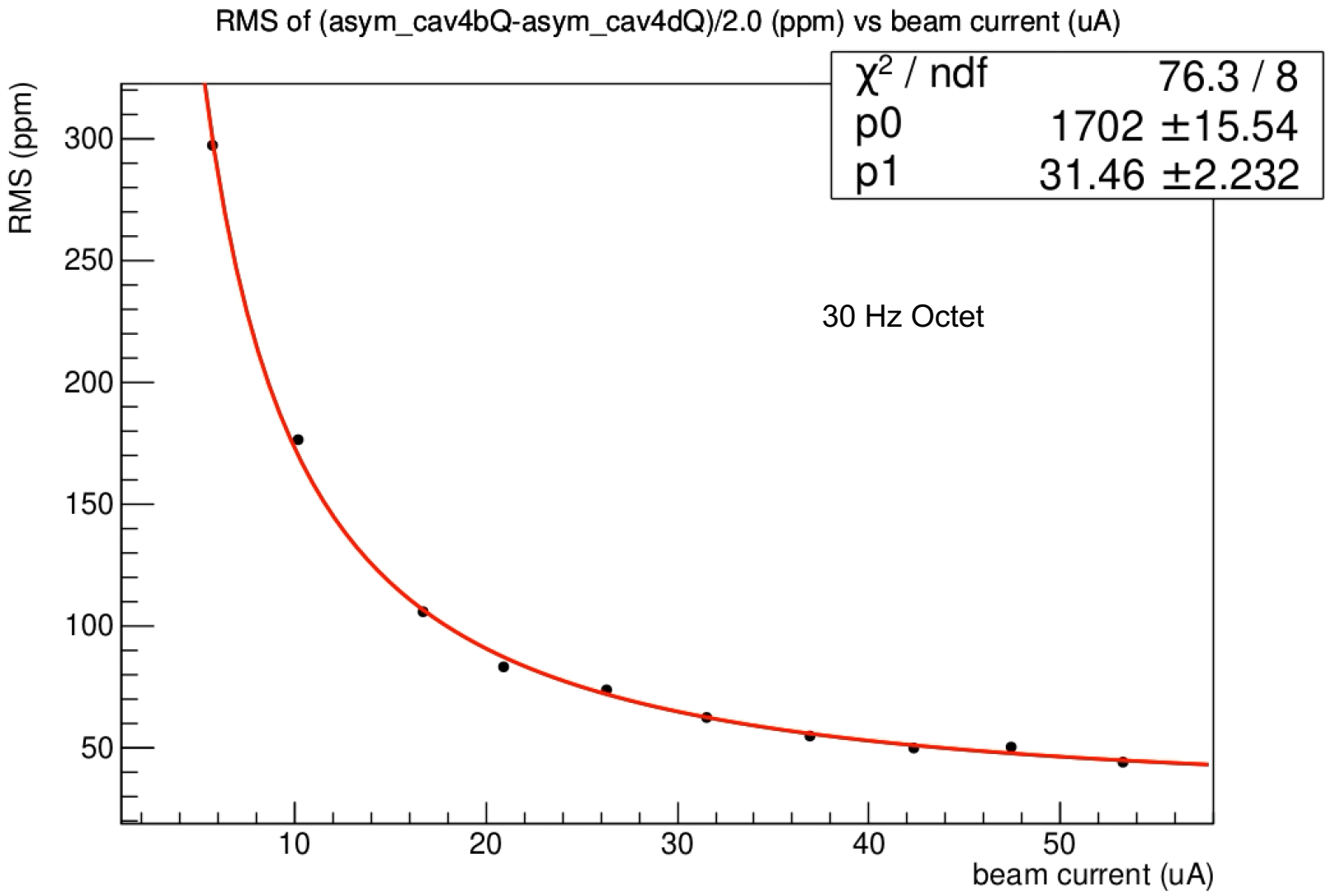
Noise Floor from Cav4bQ and Cav4cQ Double Difference (Run 11904)



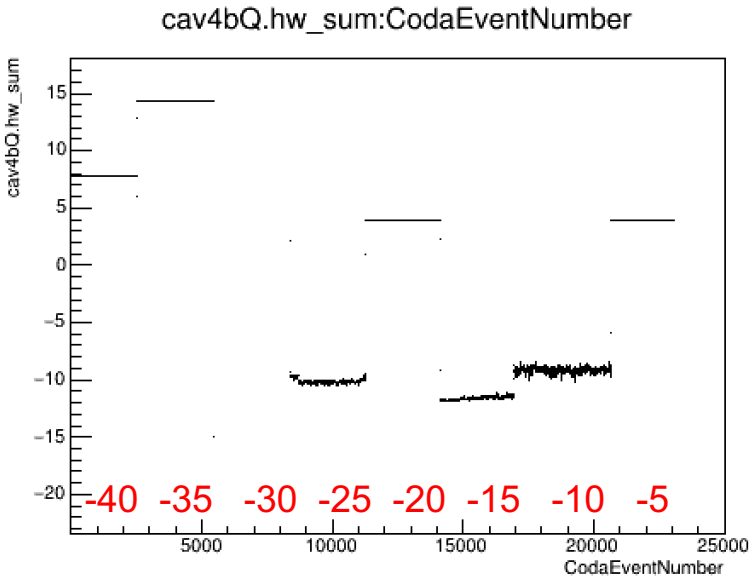
Noise Floor from Cav4cQ and Cav4dQ Double Difference (Run 11904)

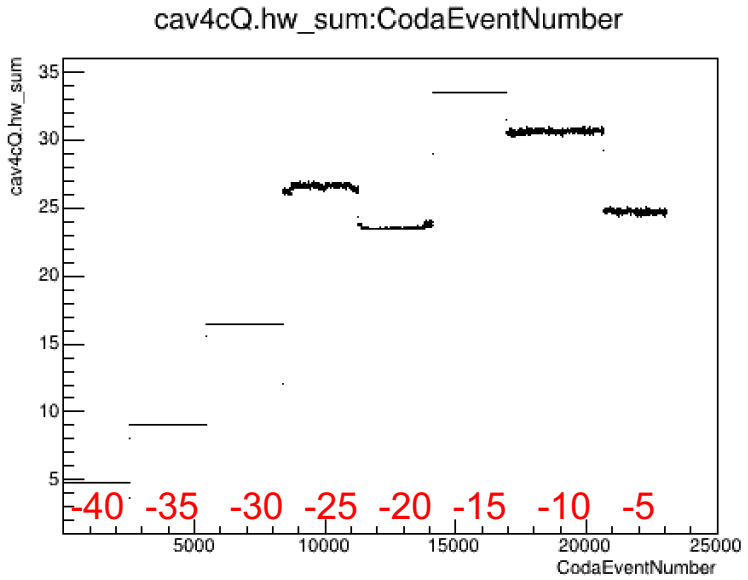


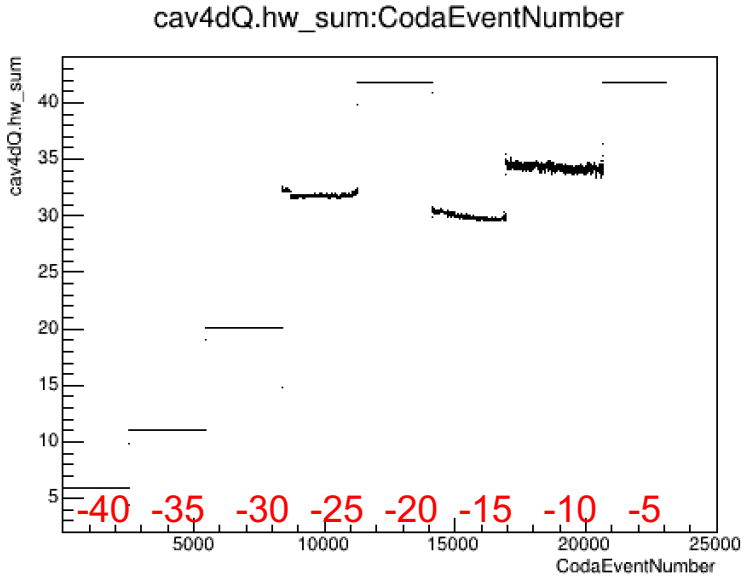
Noise Floor from Cav4bQ and Cav4dQ Double Difference (Run 11904)



RF Level Scan (Run 11875) from Last Week



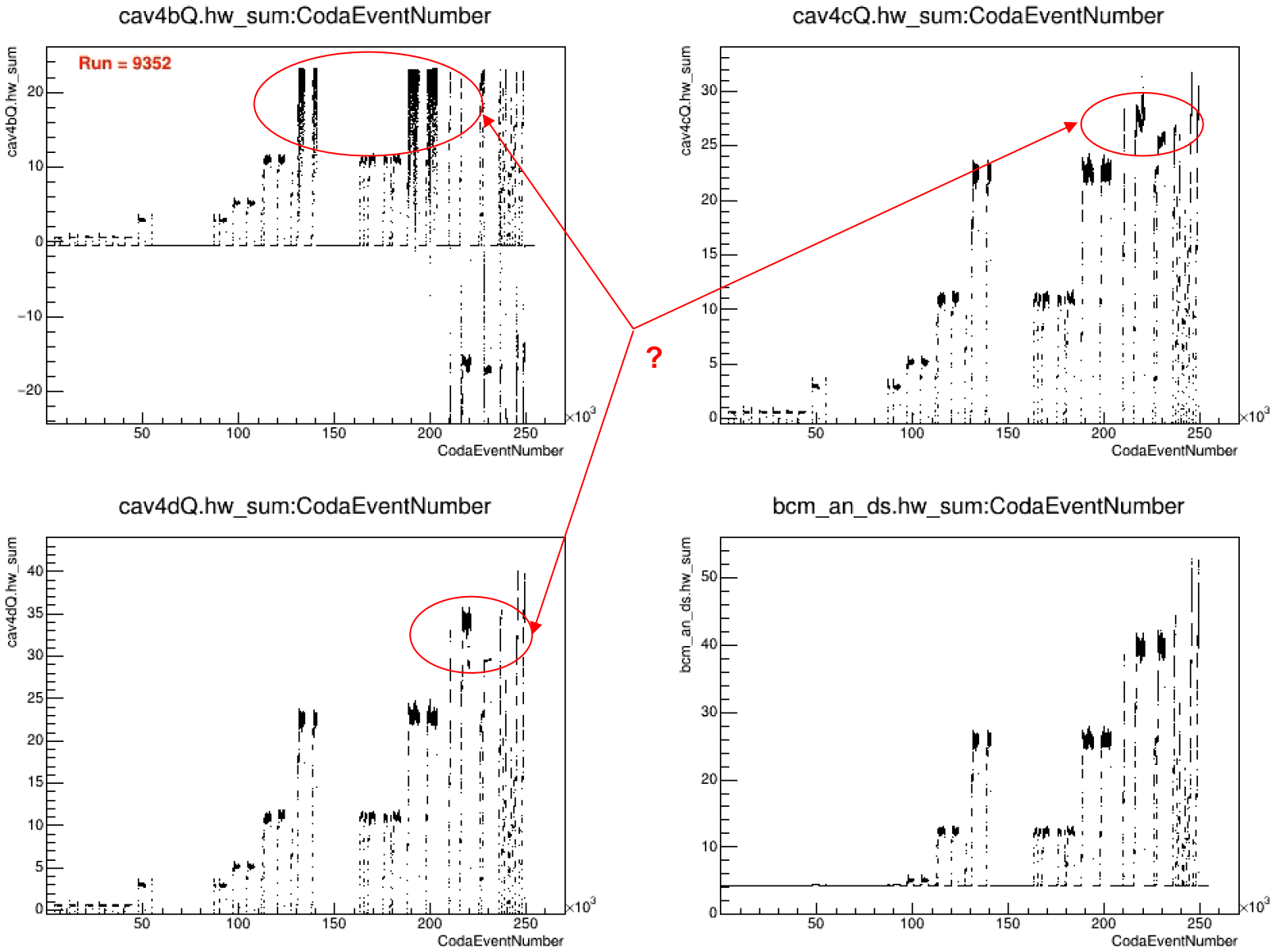




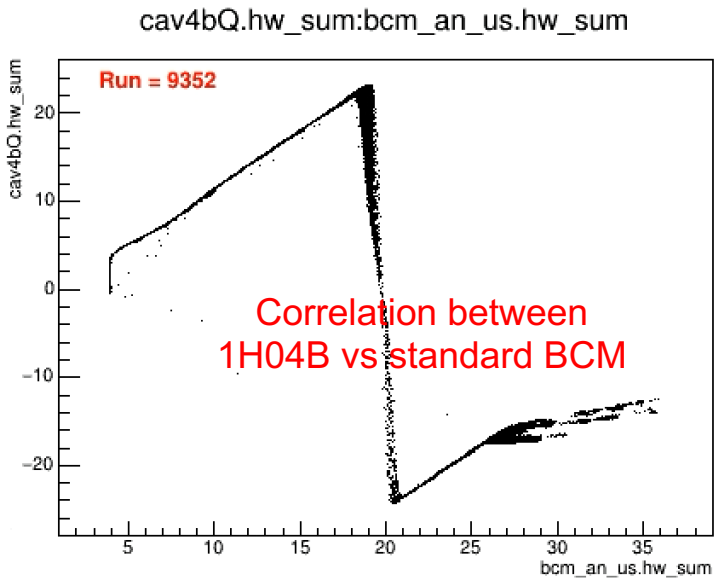
Multimeter readings of the DAC3 output voltage for each receiver at different RF levels.

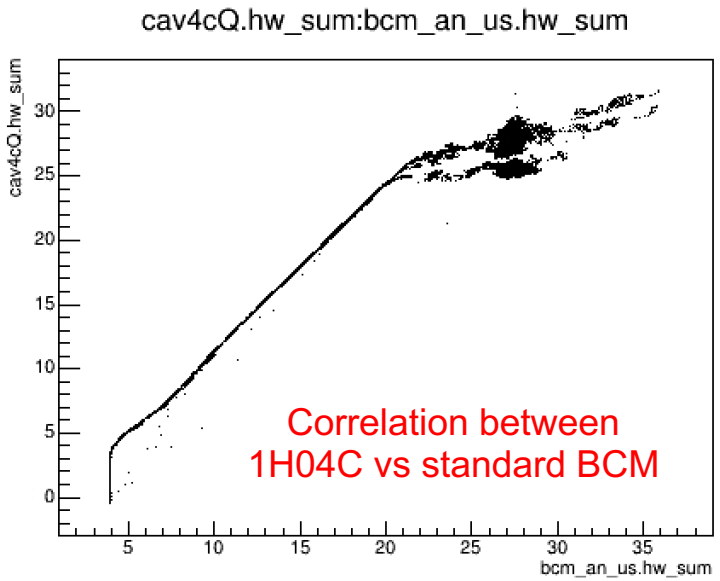
					Multimeter readings fluctuate at these settings			
RF level	-40	-35	-30	-25	-20	-15	-10	-5
1H04B	3.26	5.86	-9.23	-4.46	-1.2	1.5	-3.9	0.4
1H04C	1.10	1.99	3.52	6.31	6.2	7.1	7.1	5.1
1H04D	1.07	1.93	3.43	5.07	6.8	6.8	5.1	7.1

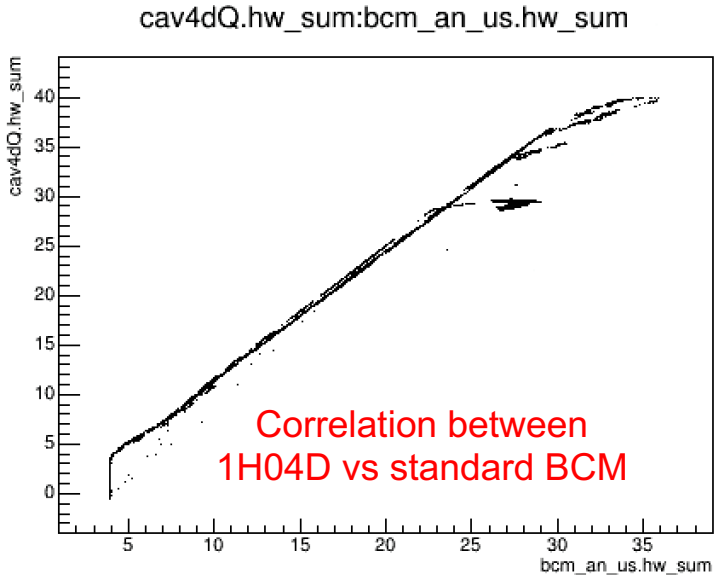
Beam Current Over Time (Run 9352, SBS Run)

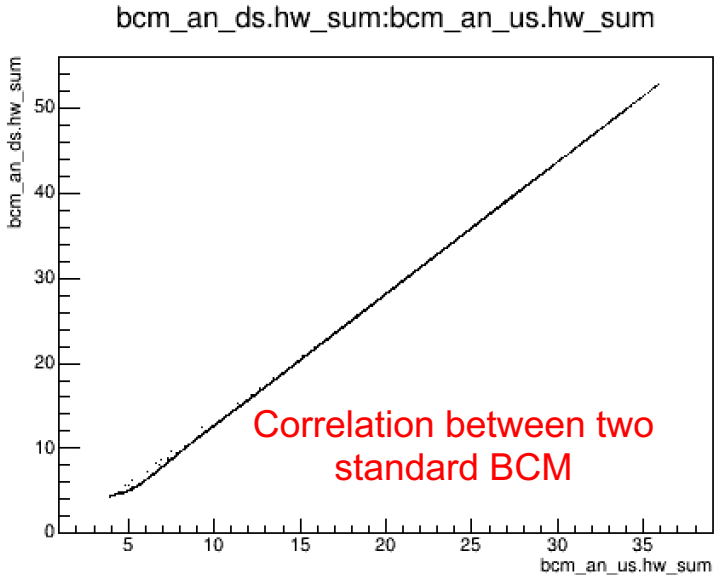


Cavity Triplets vs Hall A Standard BCM (Run 9352, SBS Run)

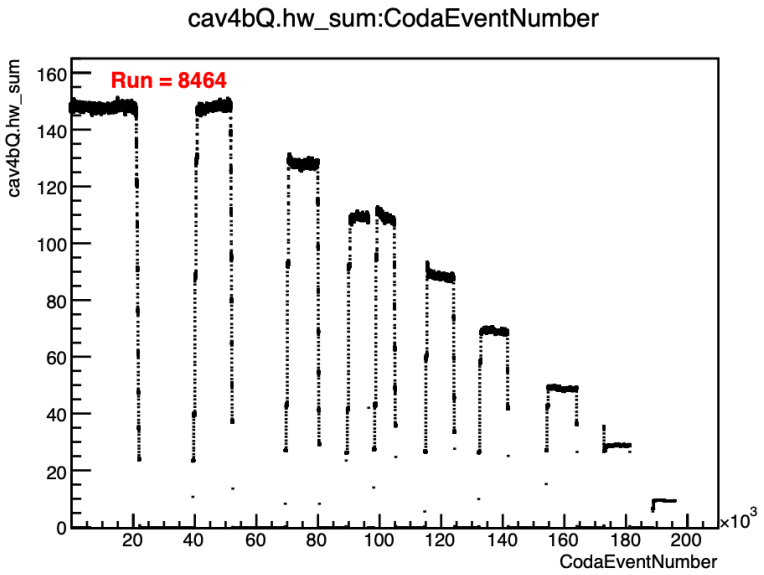


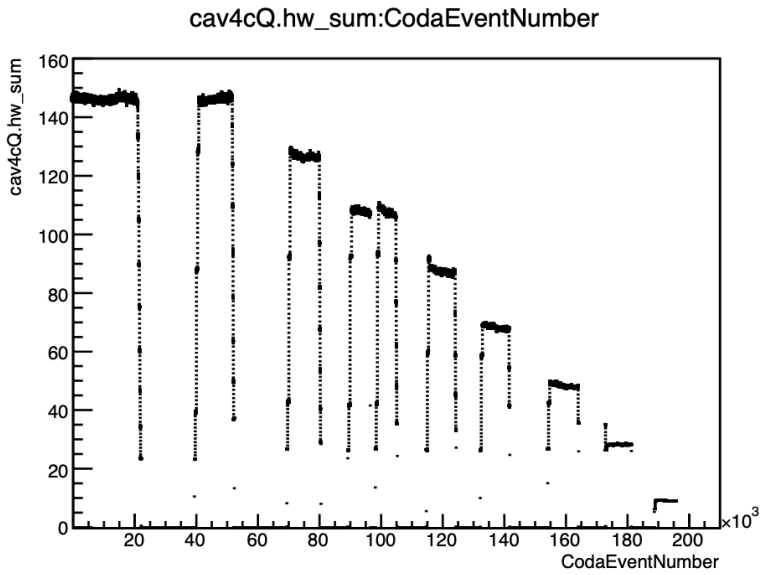


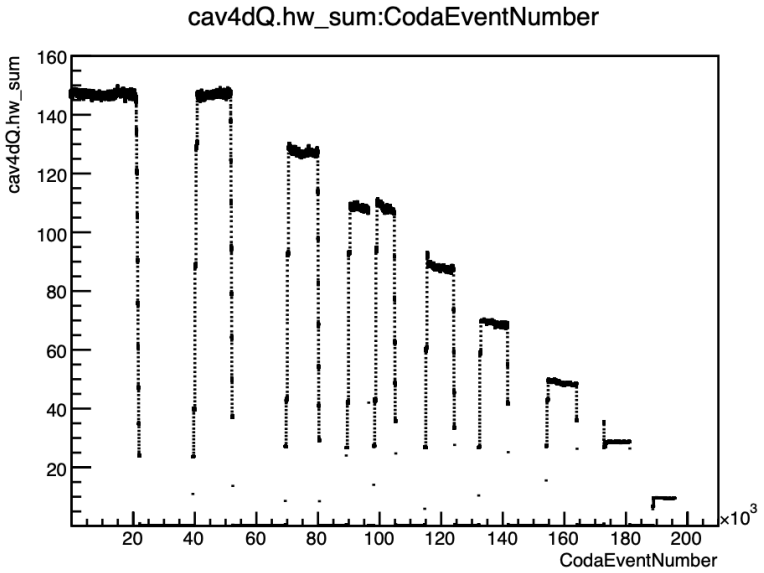


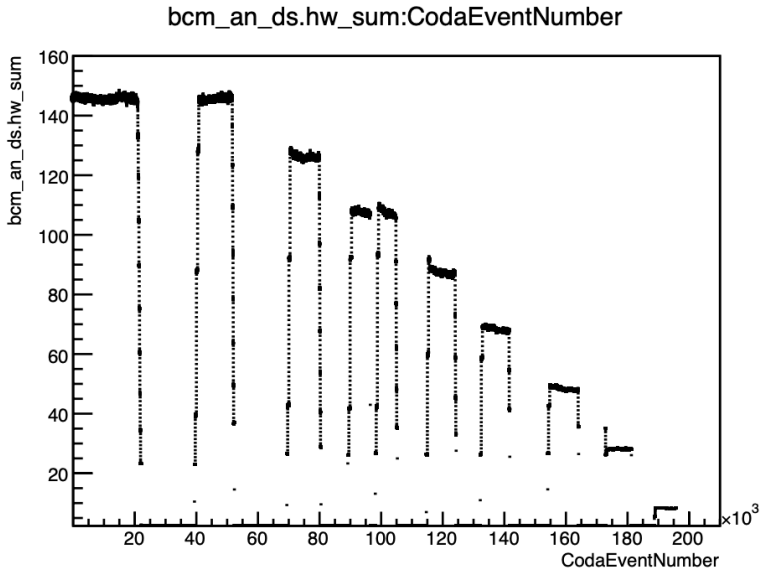


Beam Current Over Time (Run 8464, CREX Run)

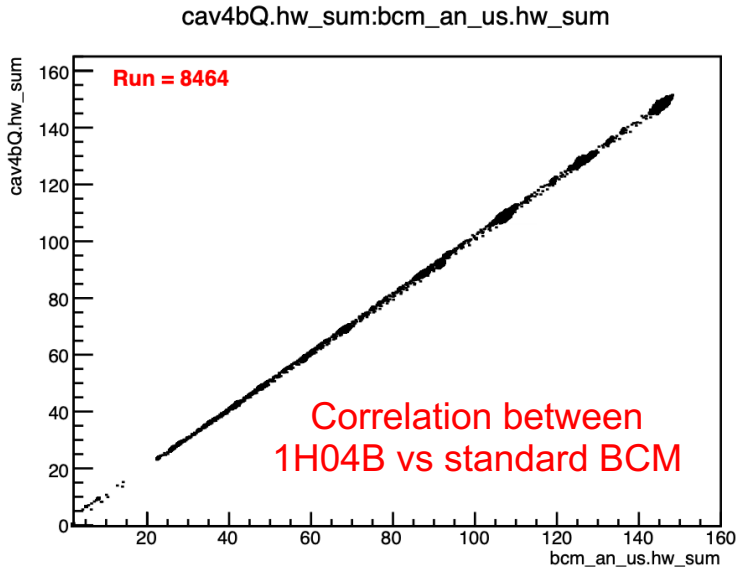


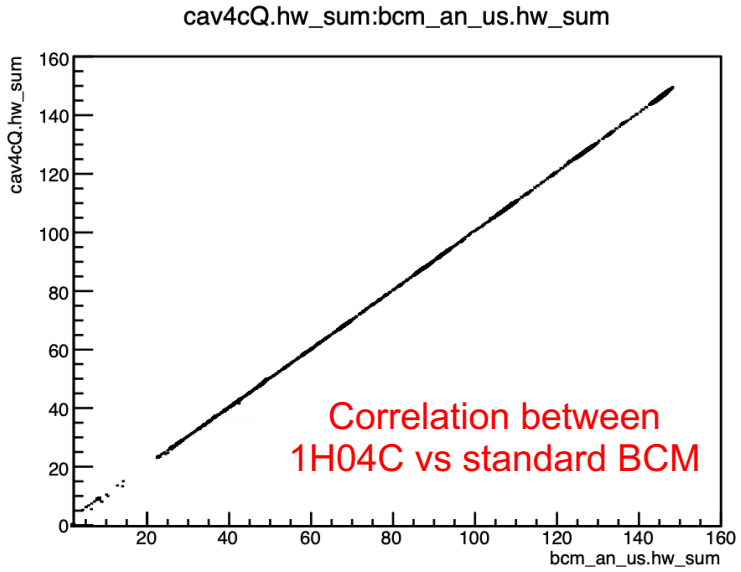


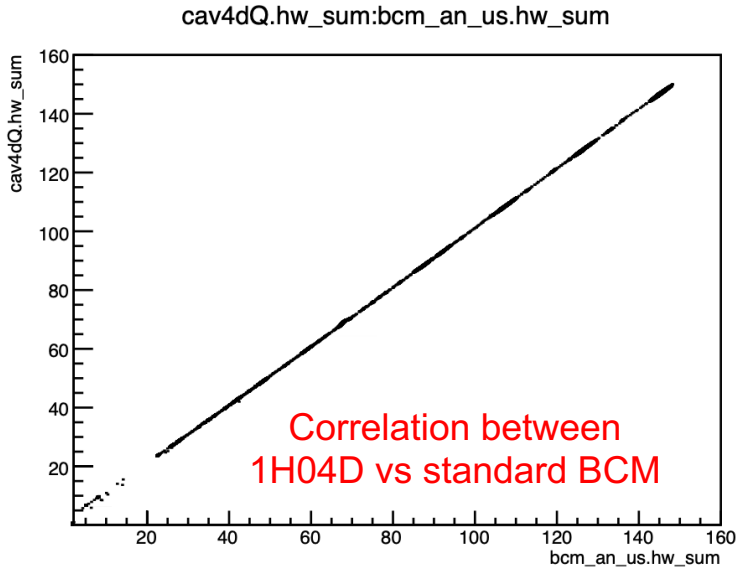


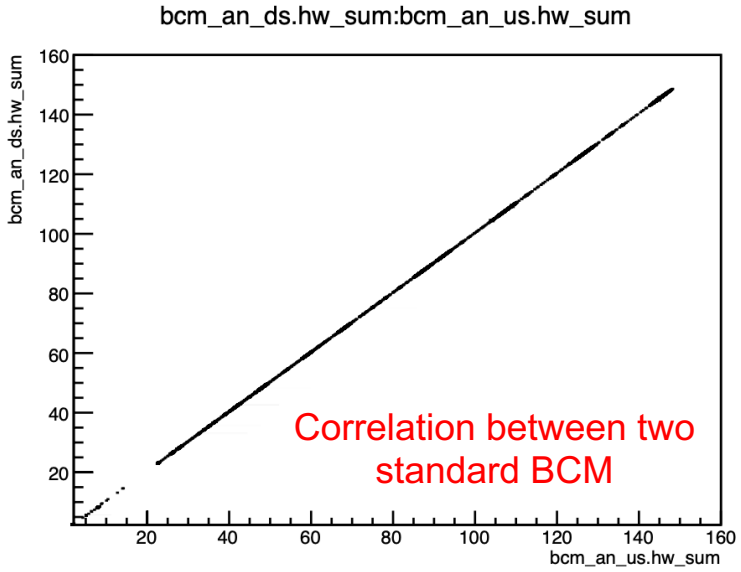


Cavity Triplets vs Hall A Standard BCM (Run 8464, CREX Run)





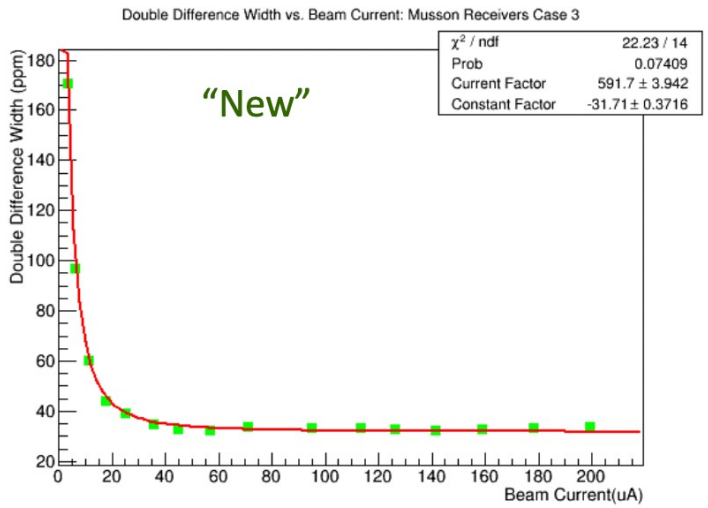


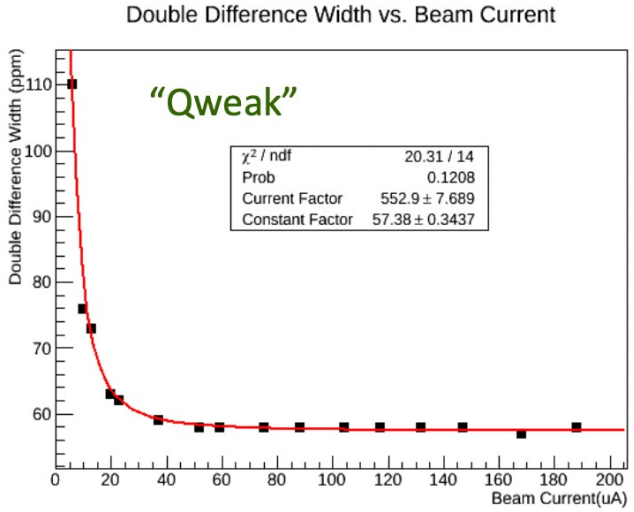


- All cavity triplets show linear relation with the standard BCMs

BCM Digital Receiver Noise Floor – "New" vs. "Qweak"

- rf source signals going into separate digital receivers (separate local oscillators)
- Data-taking done at 960 Hz



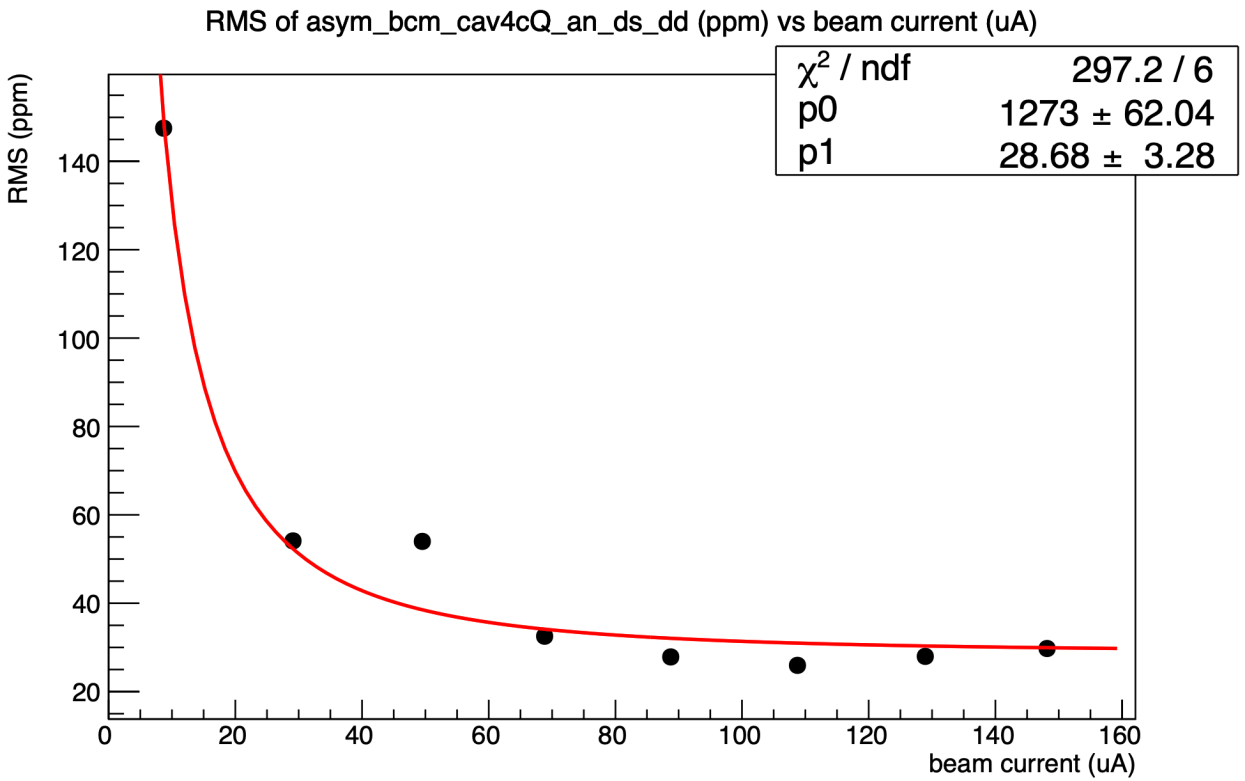


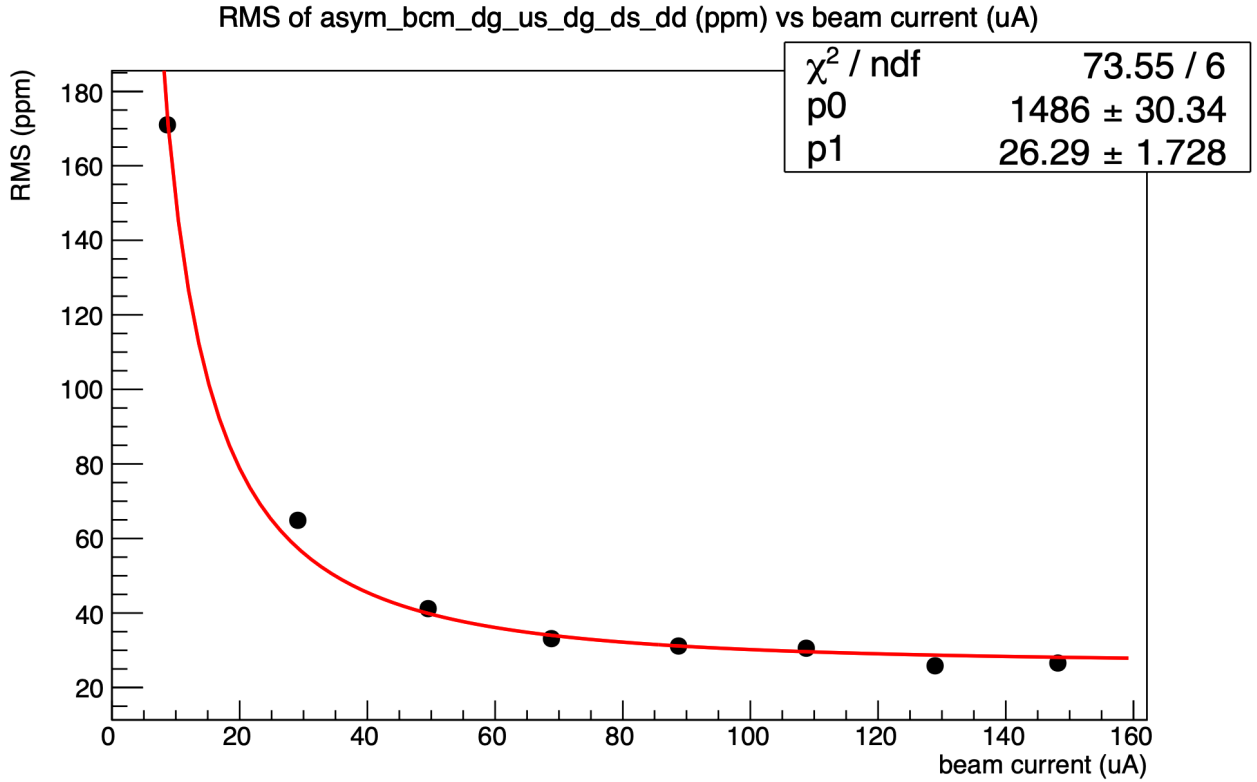
Fit by simple functional form:

$$\Gamma = \sqrt{\left(\frac{592\,\text{ppm}\,\mu\text{A}}{\text{I}}\right)^2 + (31.7\,\text{ppm})^2} \qquad \Gamma = \sqrt{\left(\frac{553\,\text{ppm}\,\mu A}{I}\right)^2 + (57.4\,\text{ppm})^2}$$

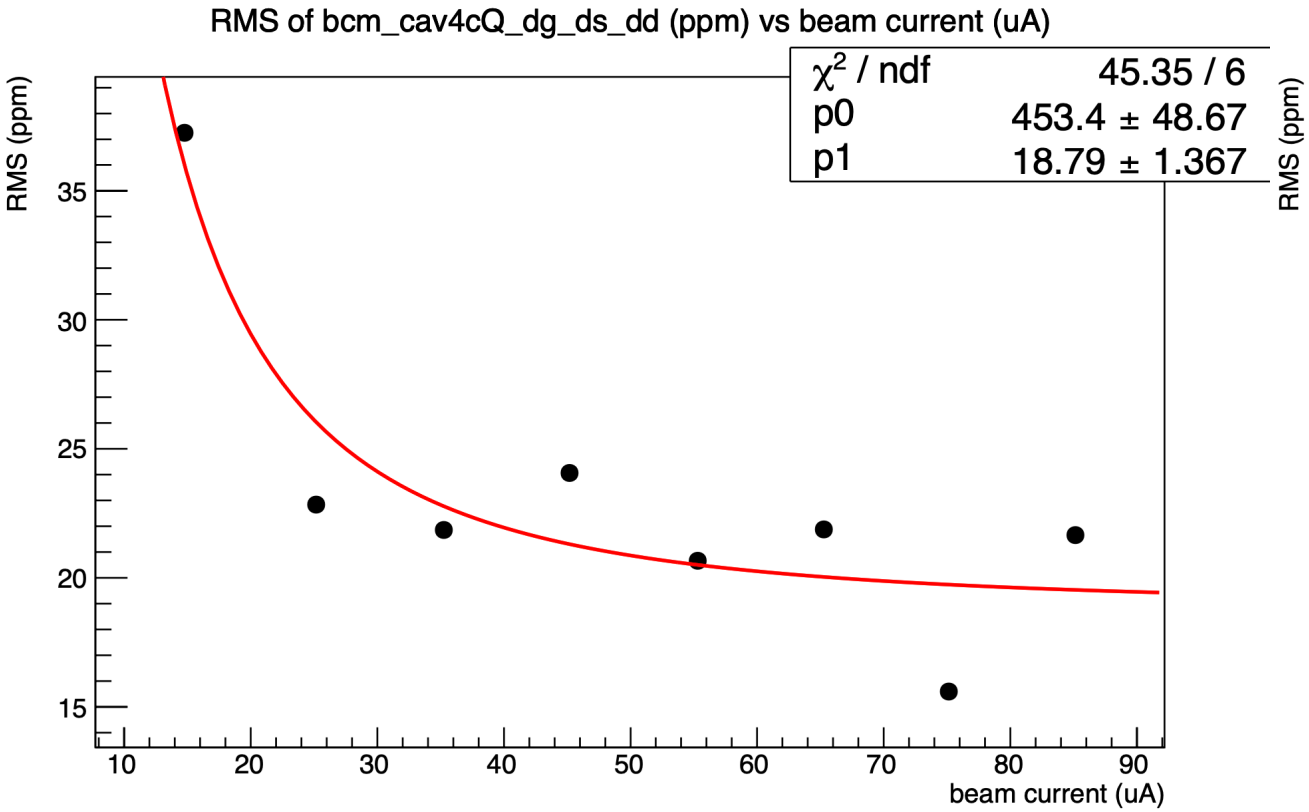
→ Significantly improved noise floor for "new" (32 ppm) vs. "Qweak" (57 ppm)

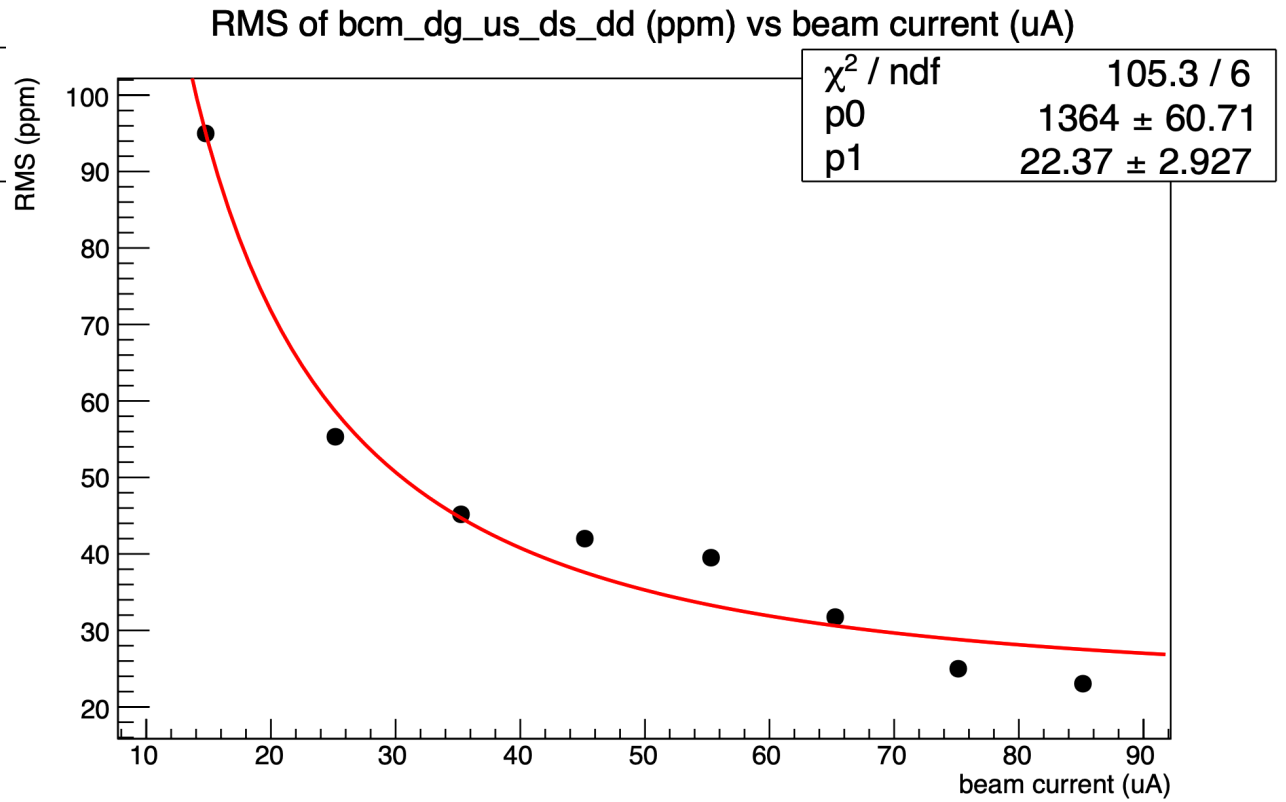
BCM Digital Receiver Tests (CREX run7282, Helicity Freq: 120 Hz Quartet)





BCM Digital Receiver Tests (PREX run4901, Helicity Freq: 240 Hz Octet)





Verified that the parity DAQ runs fine and the BCM signals are connected to the DAQ.
Next, we will try to test the BCMs with RF source signals.