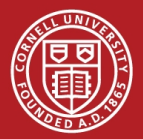

Cornell University
Laboratory for Elementary-Particle Physics

Filtering Noise in QSPU Measurements by Averaging Time Intervals

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Cornell Laboratory for Accelerator-Based Sciences and Education

Electron Cloud Meeting

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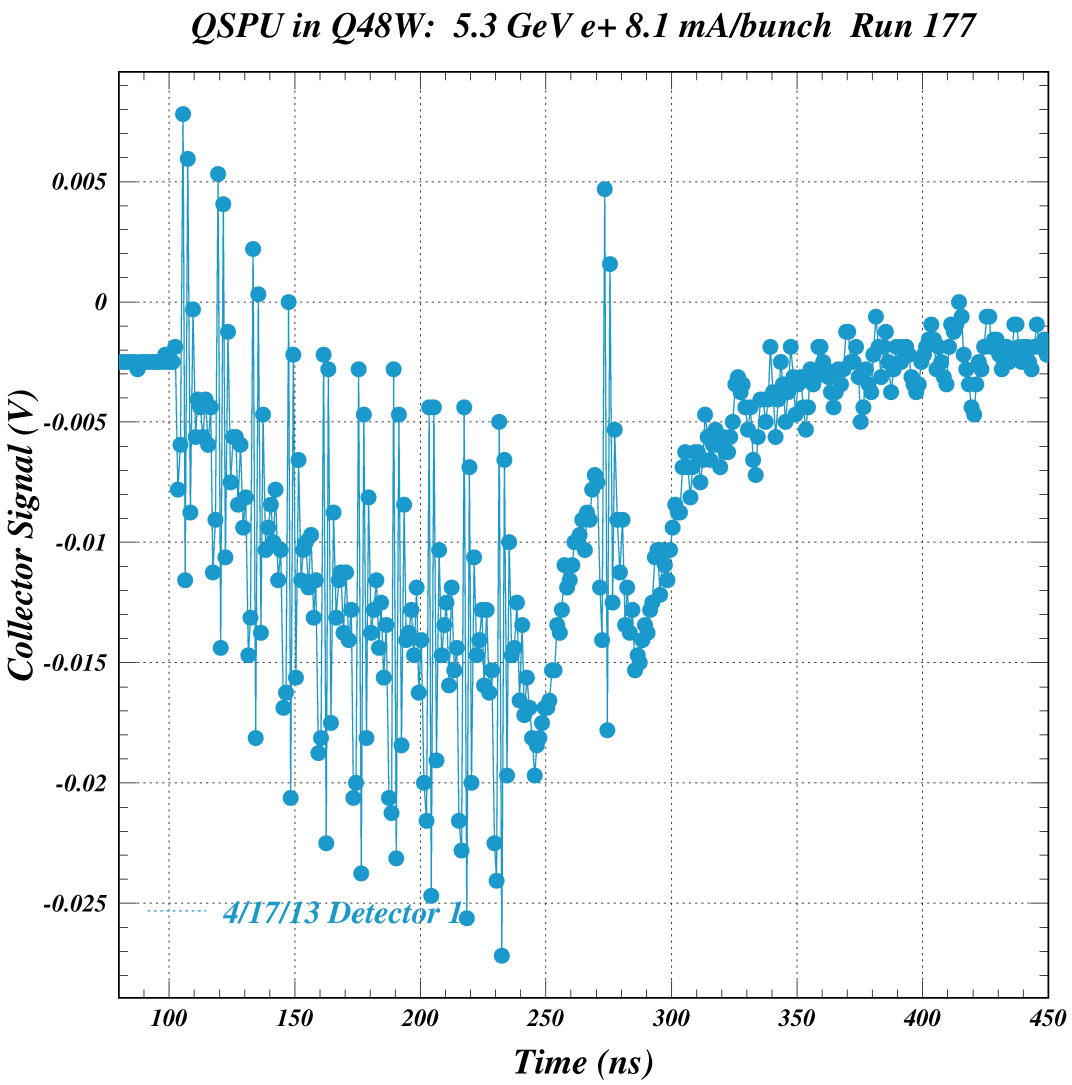
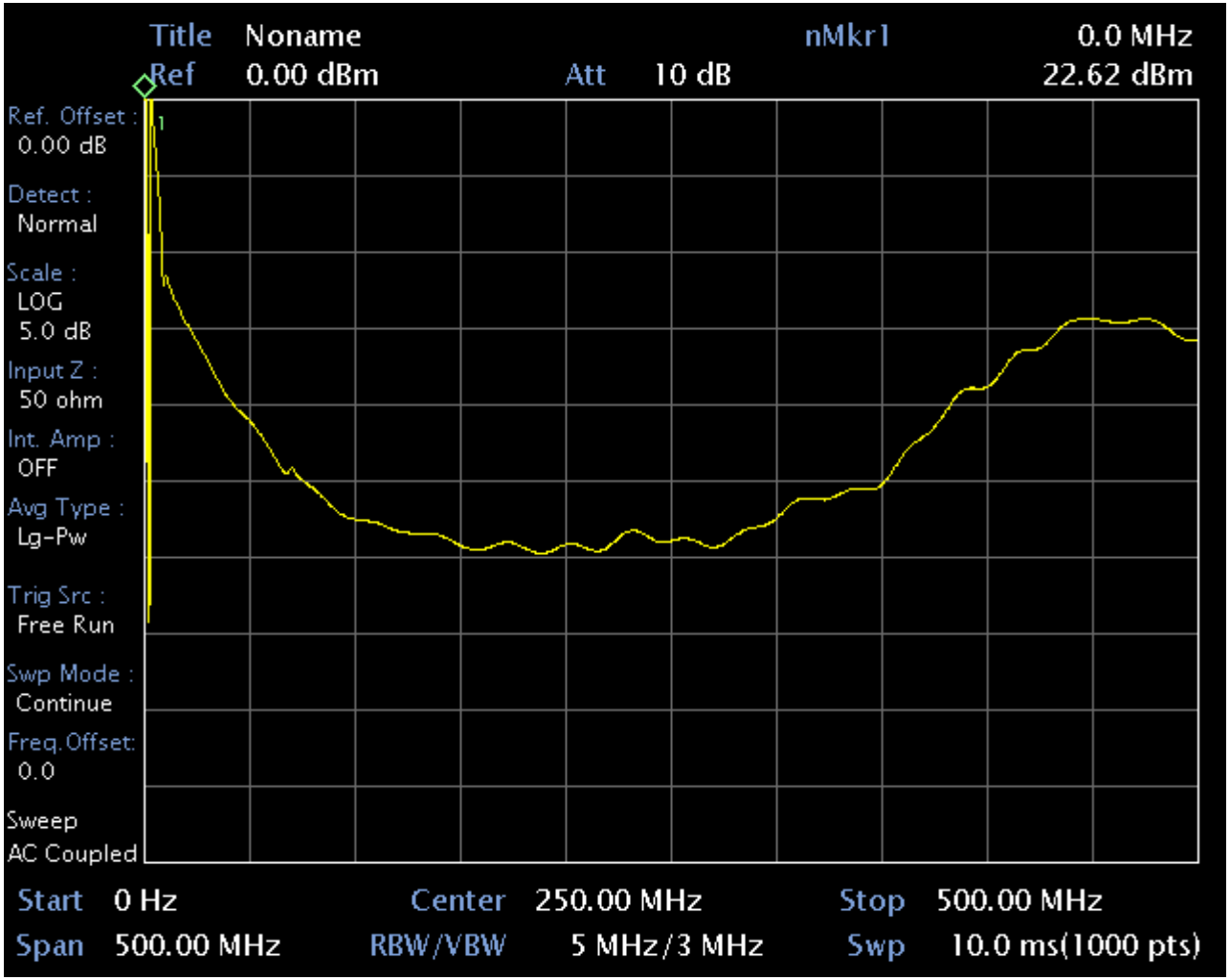
Original Witness Bunch Measurements (0.5-ns bins)



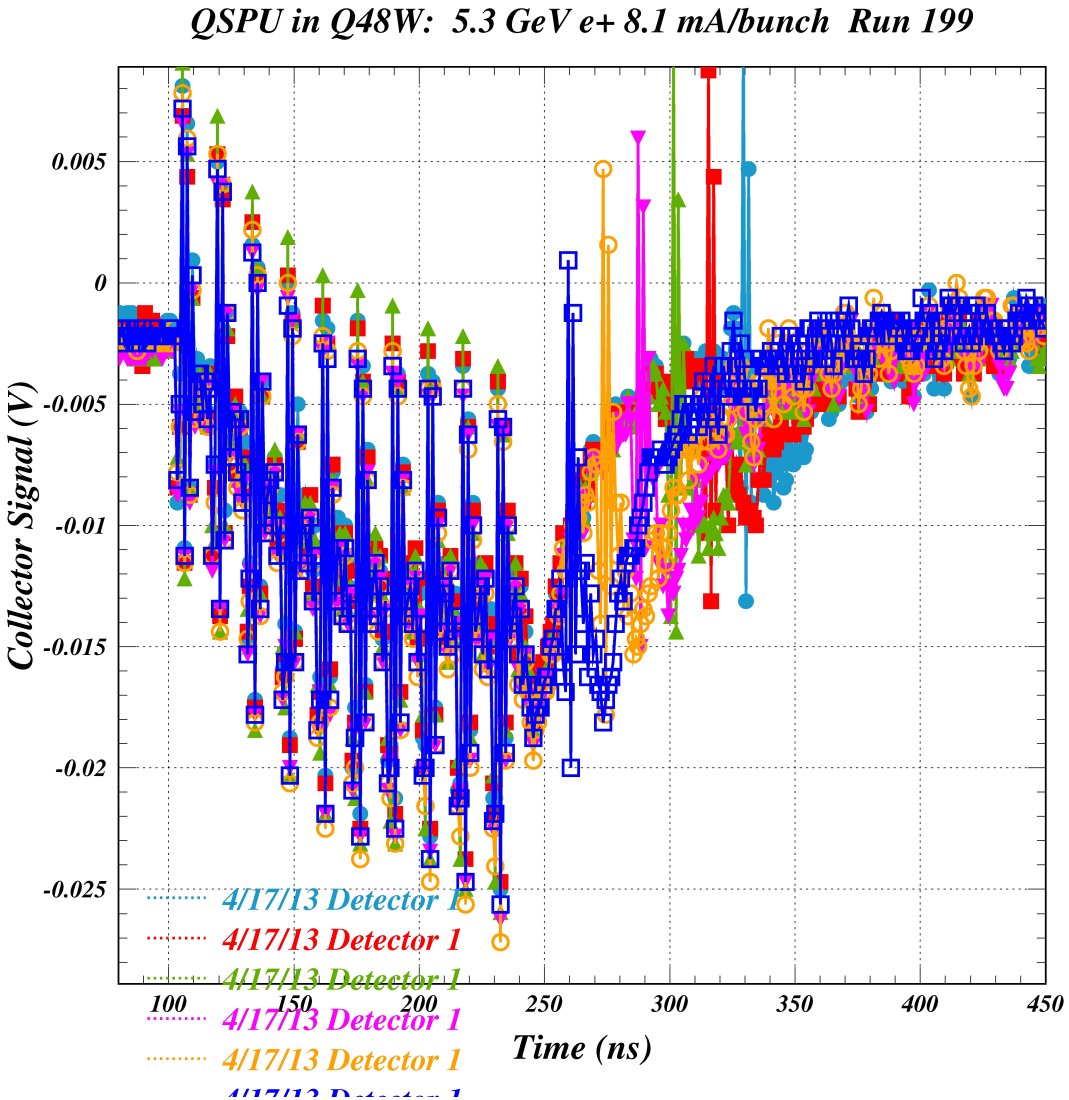
- Witness test used in studying EC decay rate
- Beam-synchronous noise obscures data
- Time-interval averaging allows us to minimize some of the noise

JPS measurements of QSPU detector frequency response



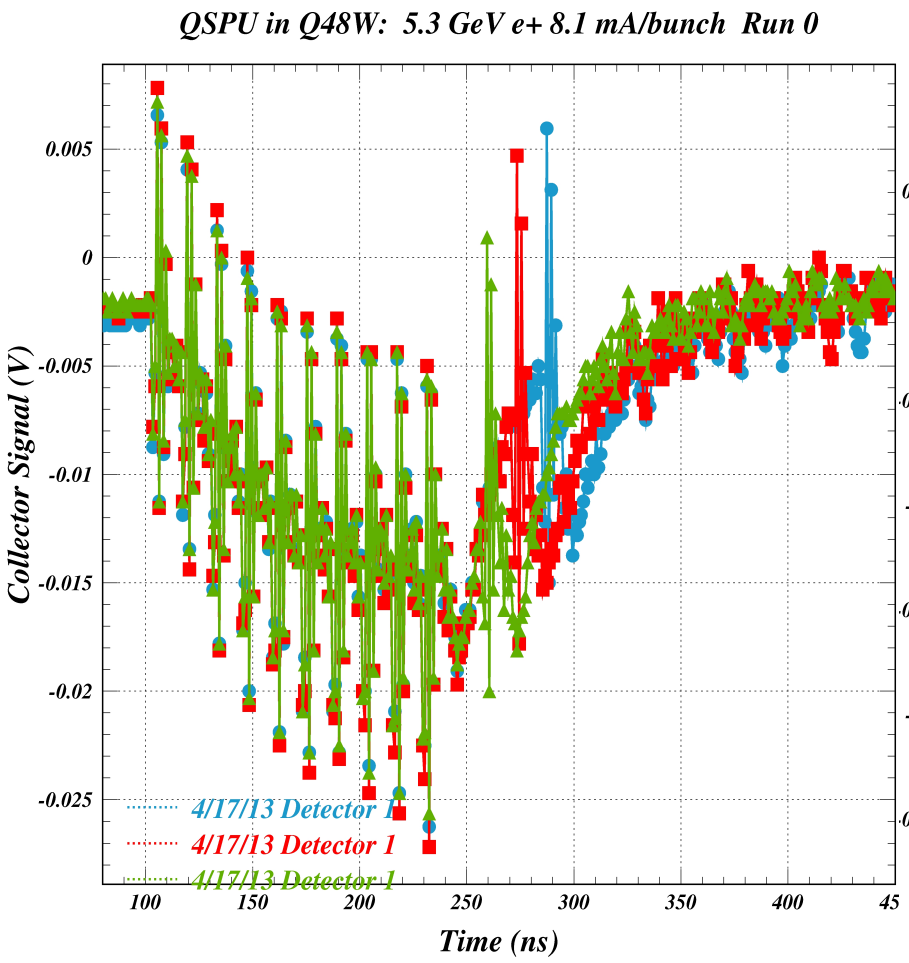
- Detector response falls off 0 - 100 MHz
- High-pass begins around 300 MHz
- The signal of interest has frequencies below 100 MHz.
- We hope to use time-averaging to filter the higher frequencies out of the measured data. For now just use simple interval averaging.

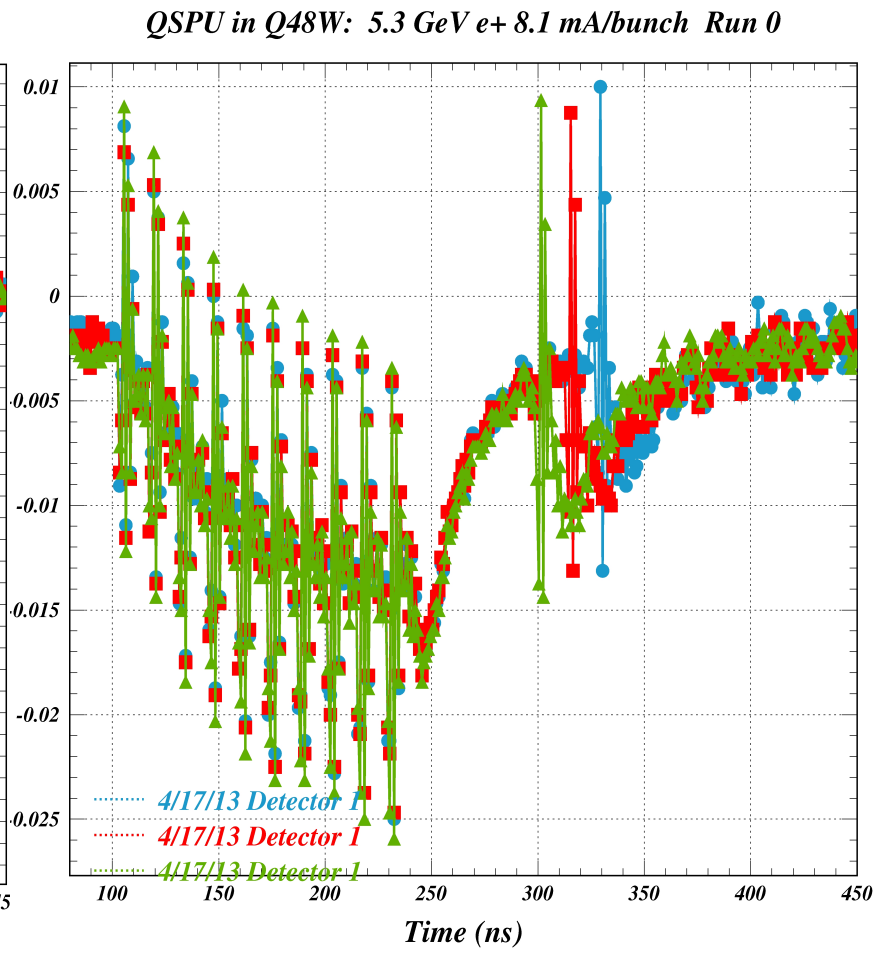
Original Witness Bunch Measurements (0.5-ns bins)



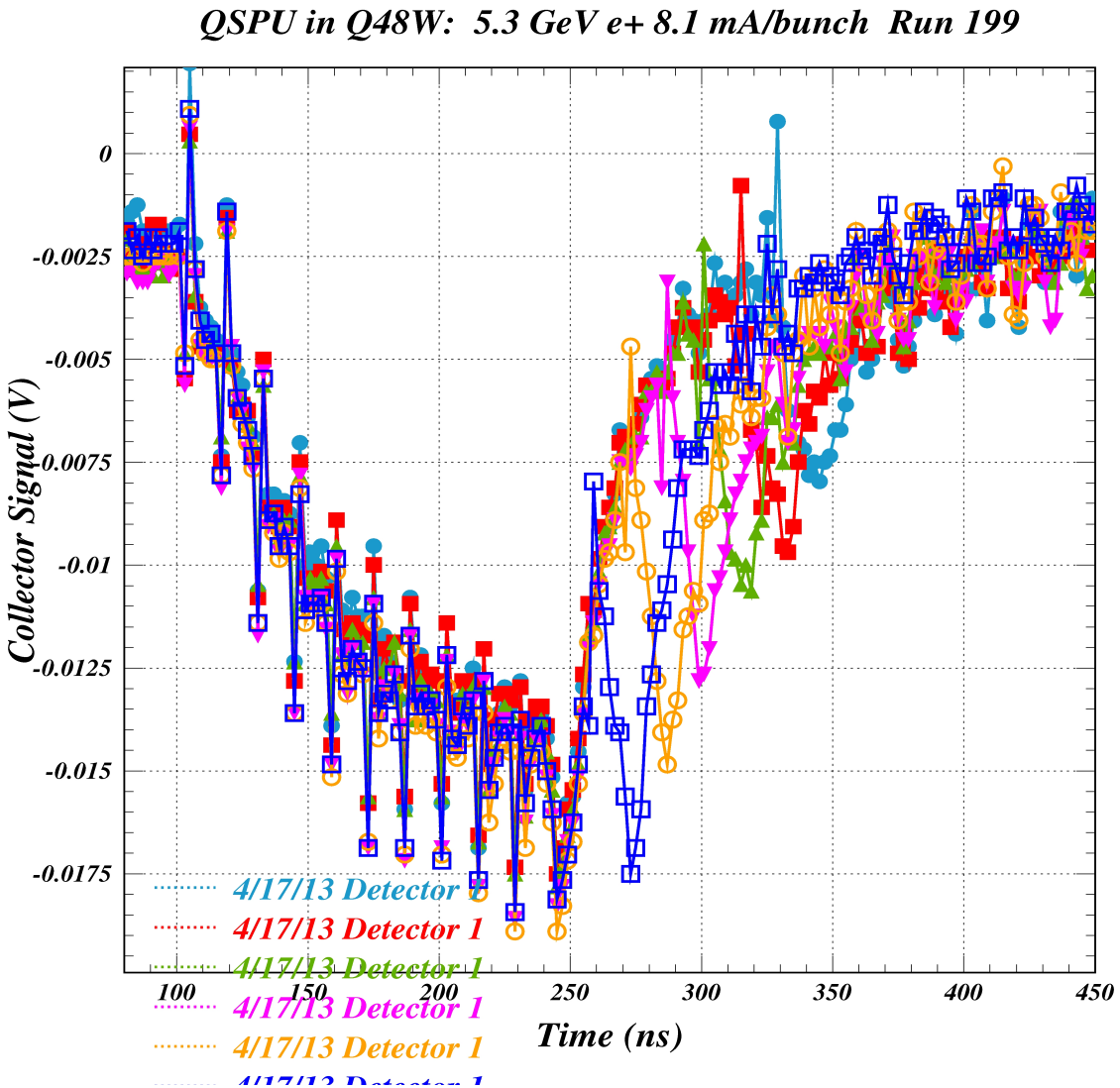
- Bunches passages cause beam-synchronous noise
- Difficult to analyze
- Lines are blurred together
- Decay rate is noticeable but inconclusive

0.5-ns bins
Plot 3 and 3



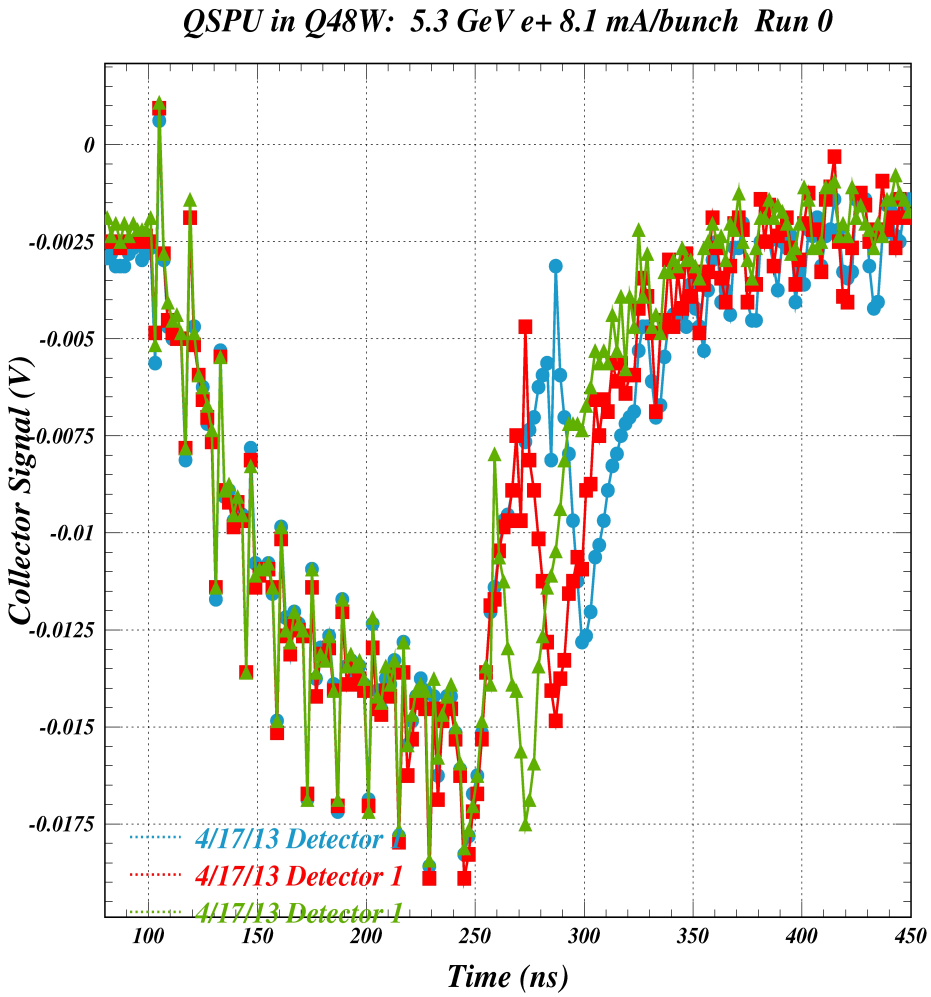


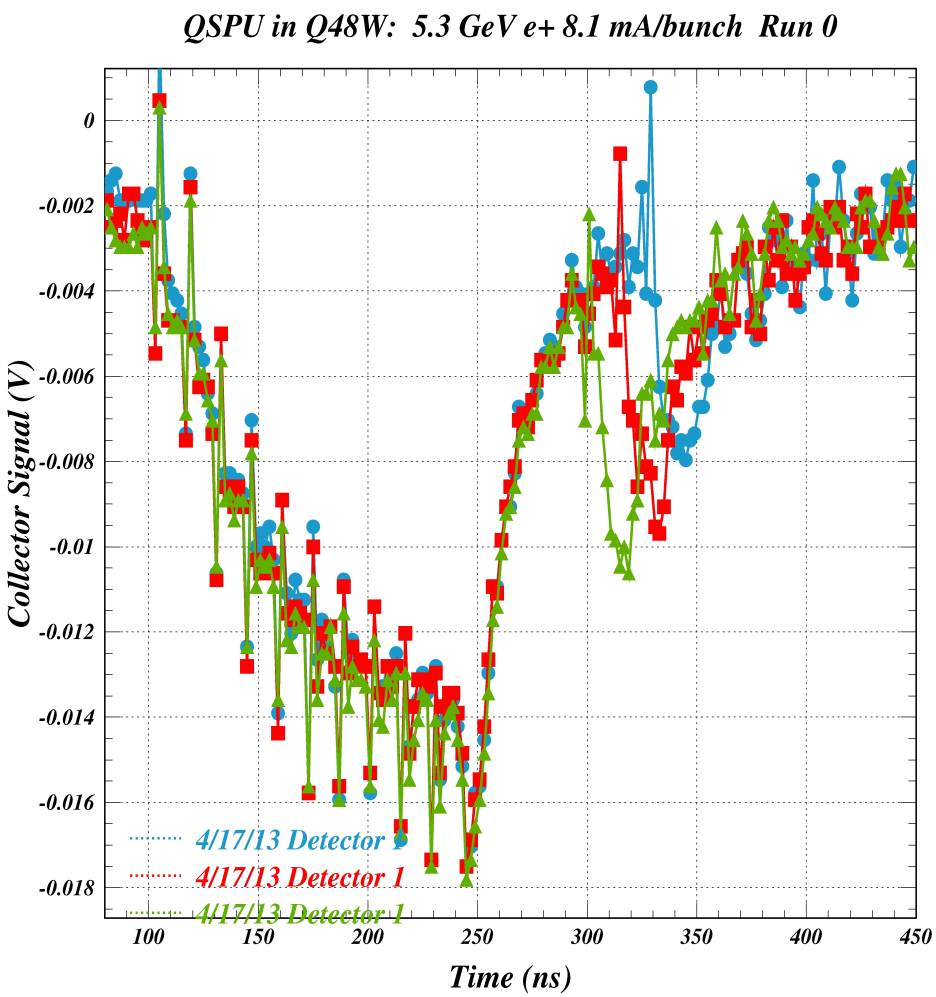
Averaging over 1 ns



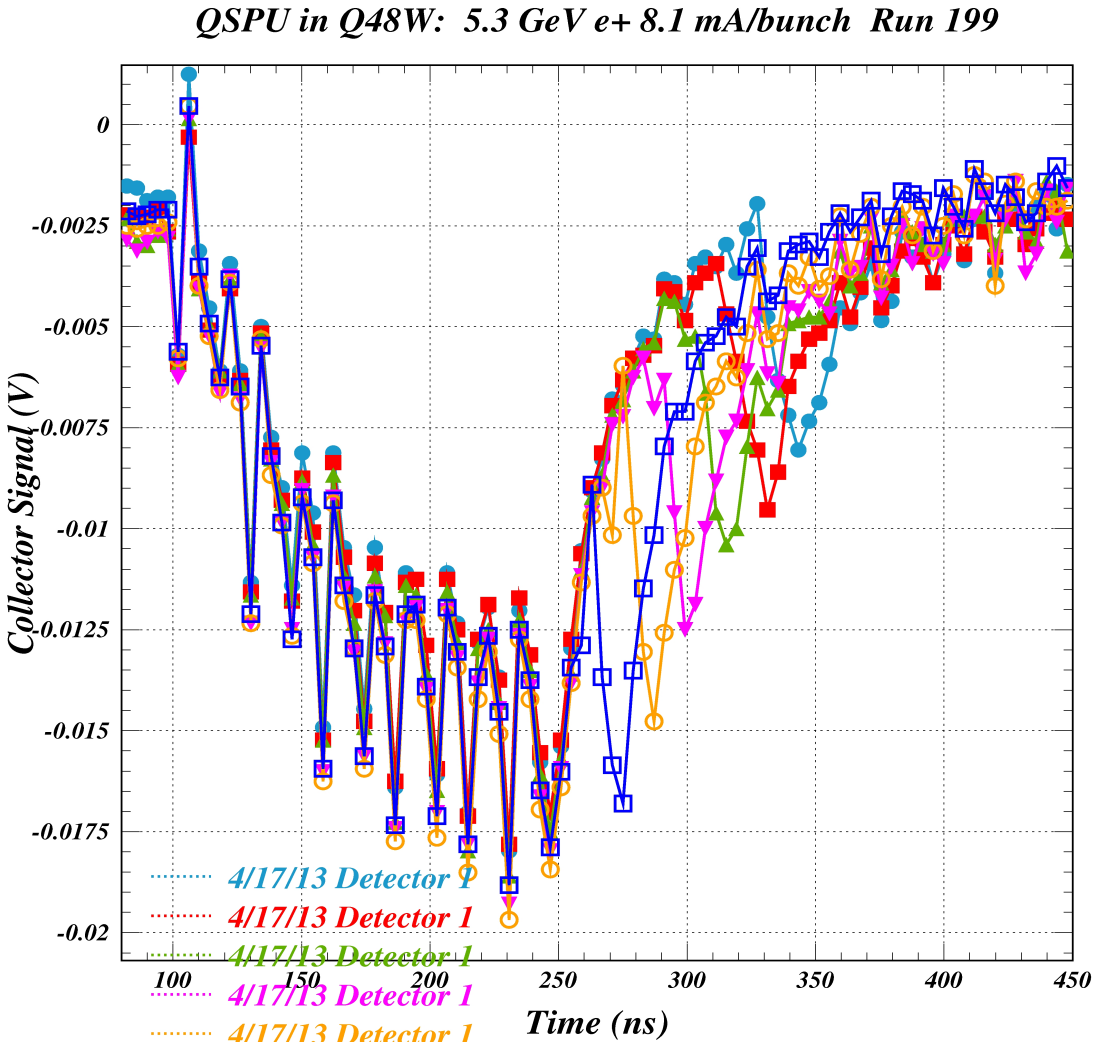
- Some noise present
- Lines are less blurred
- Bunch passages are more clearly evident
- Witness signals clear

Averaging over 1 ns



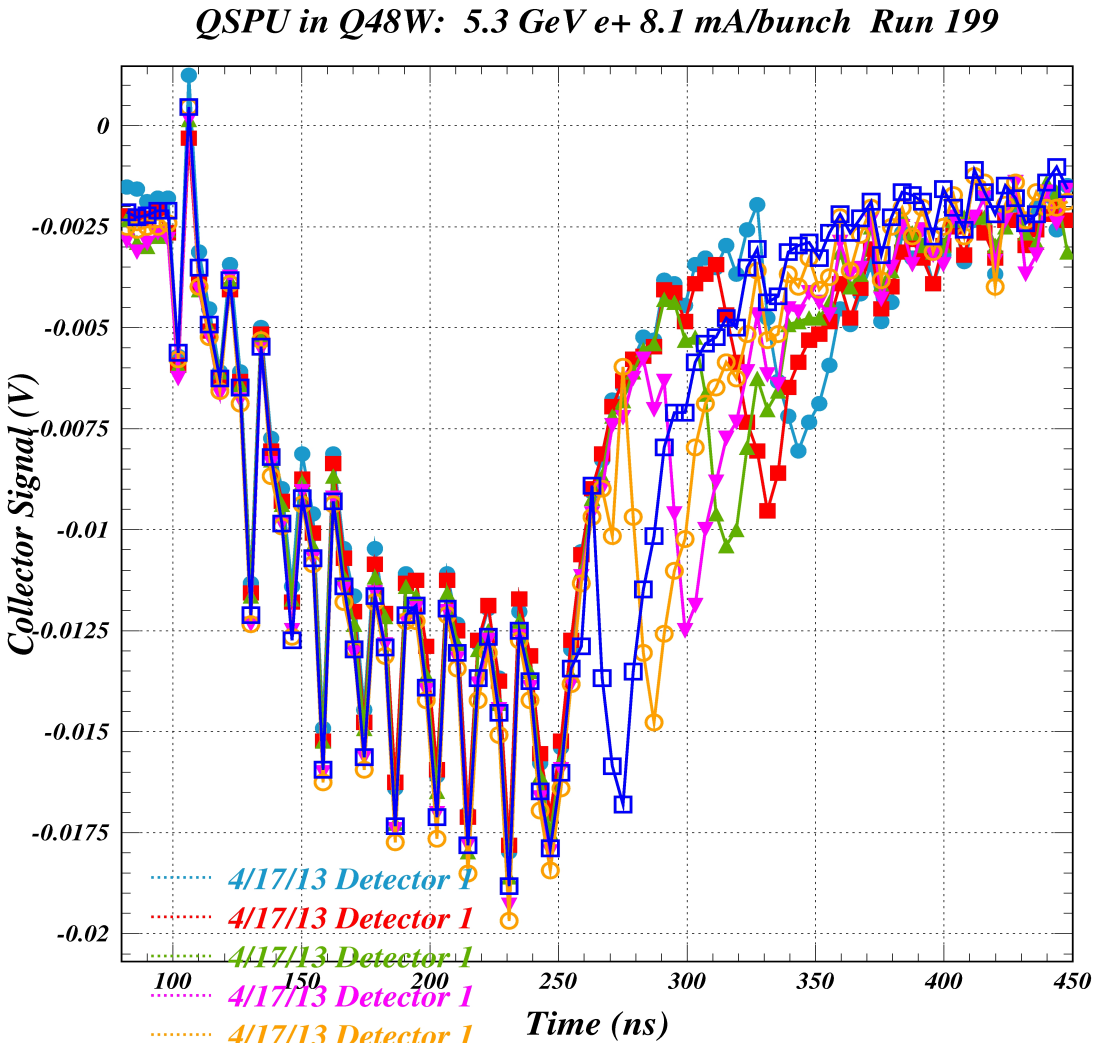


Averaging over 2 ns



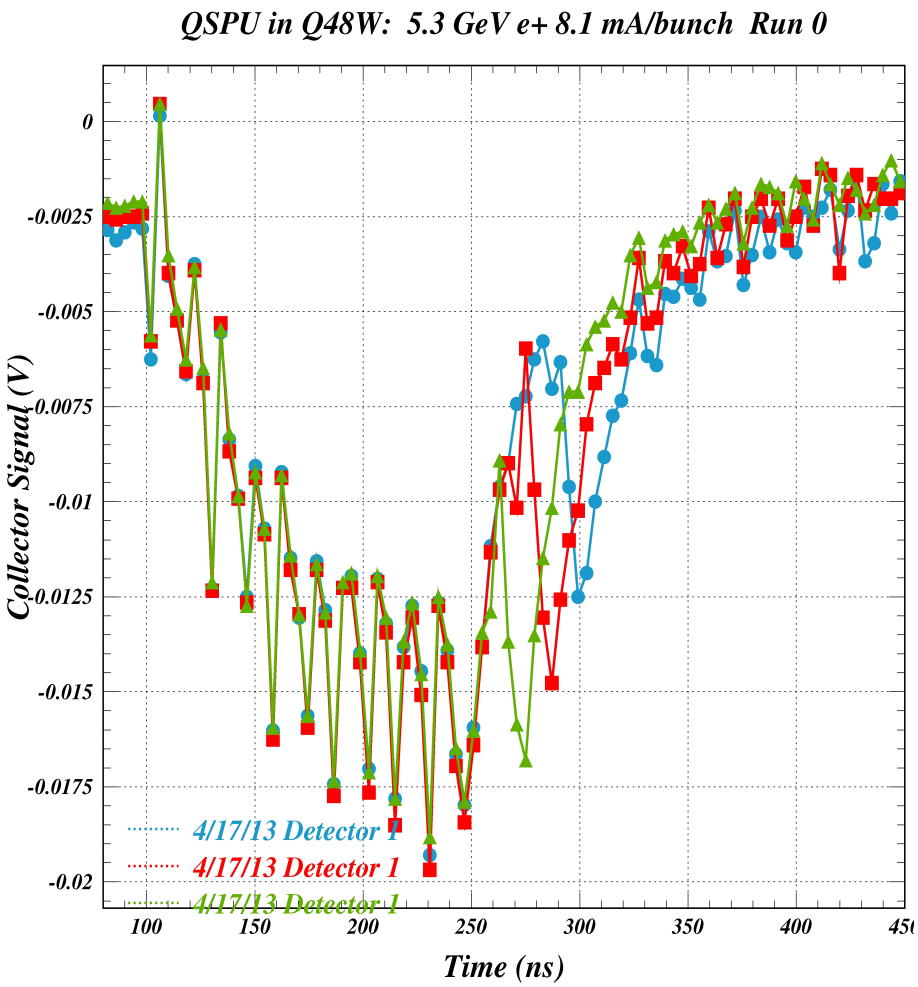
- Noise is somewhat minimal
- All Bunches passages are visible
- Easier to analyze
- Seems to be the best option with bunch data still present

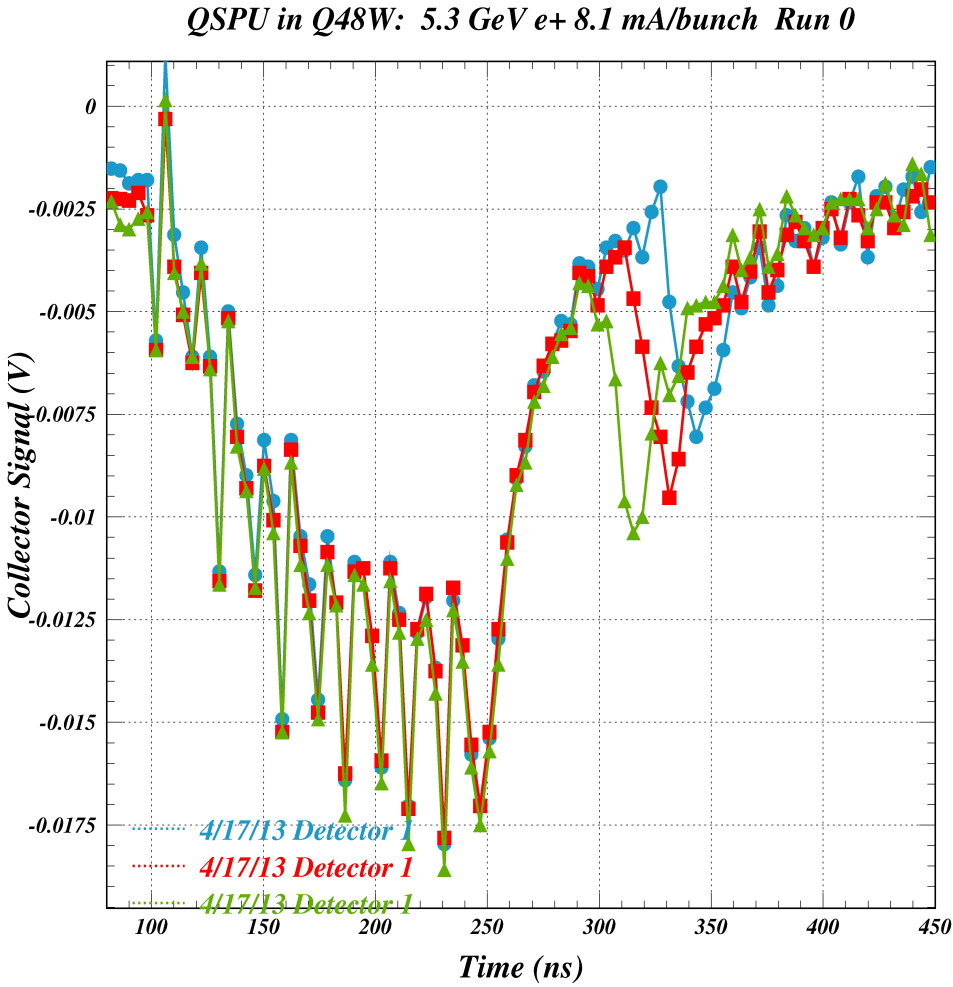
Averaging over 2 ns



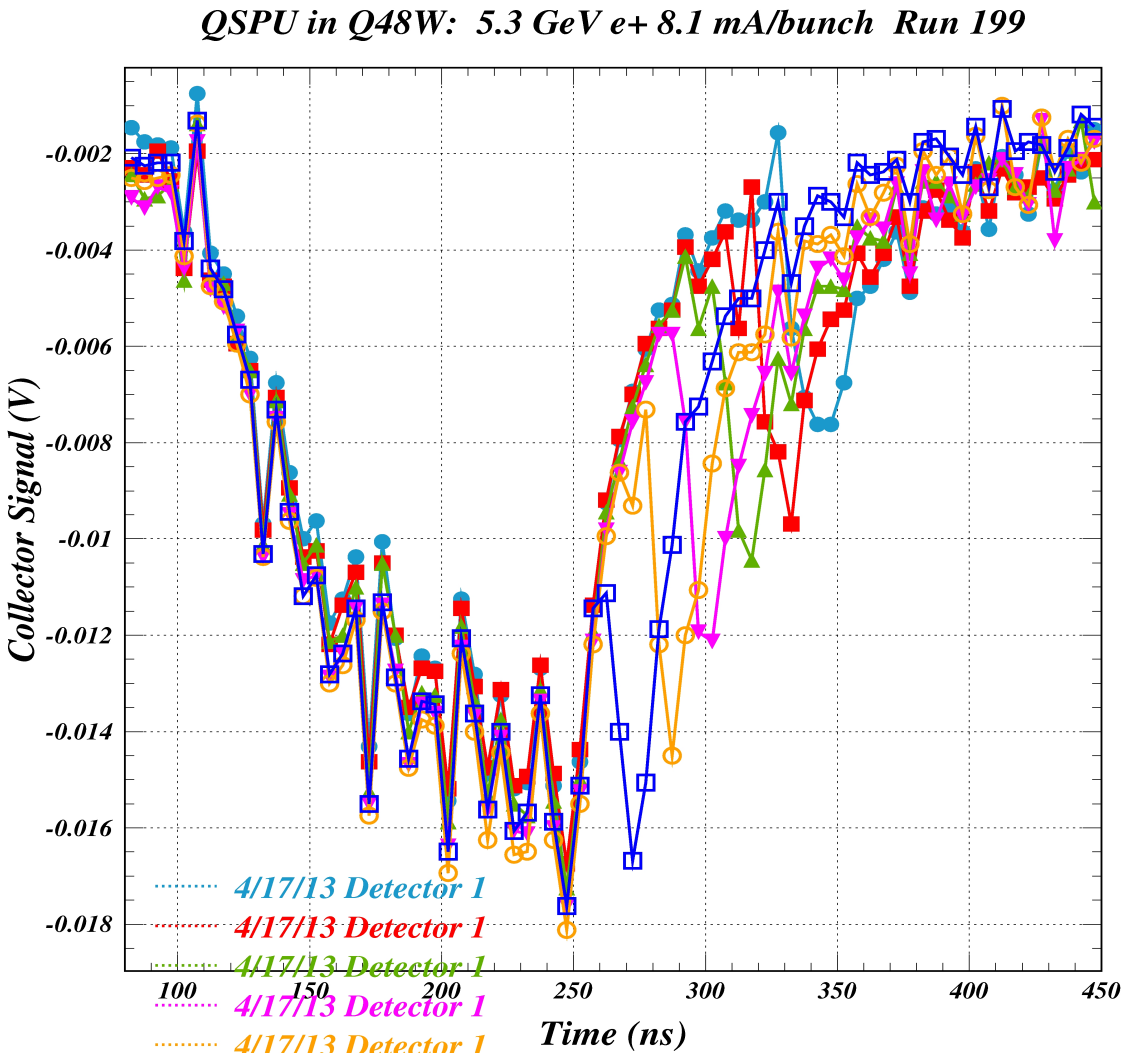
- Noise is reduced
- All bunches passages are visible
- Easier to analyze
- Seems to be the best option with bunch data still present (see following plots)

Averaging over 2 ns



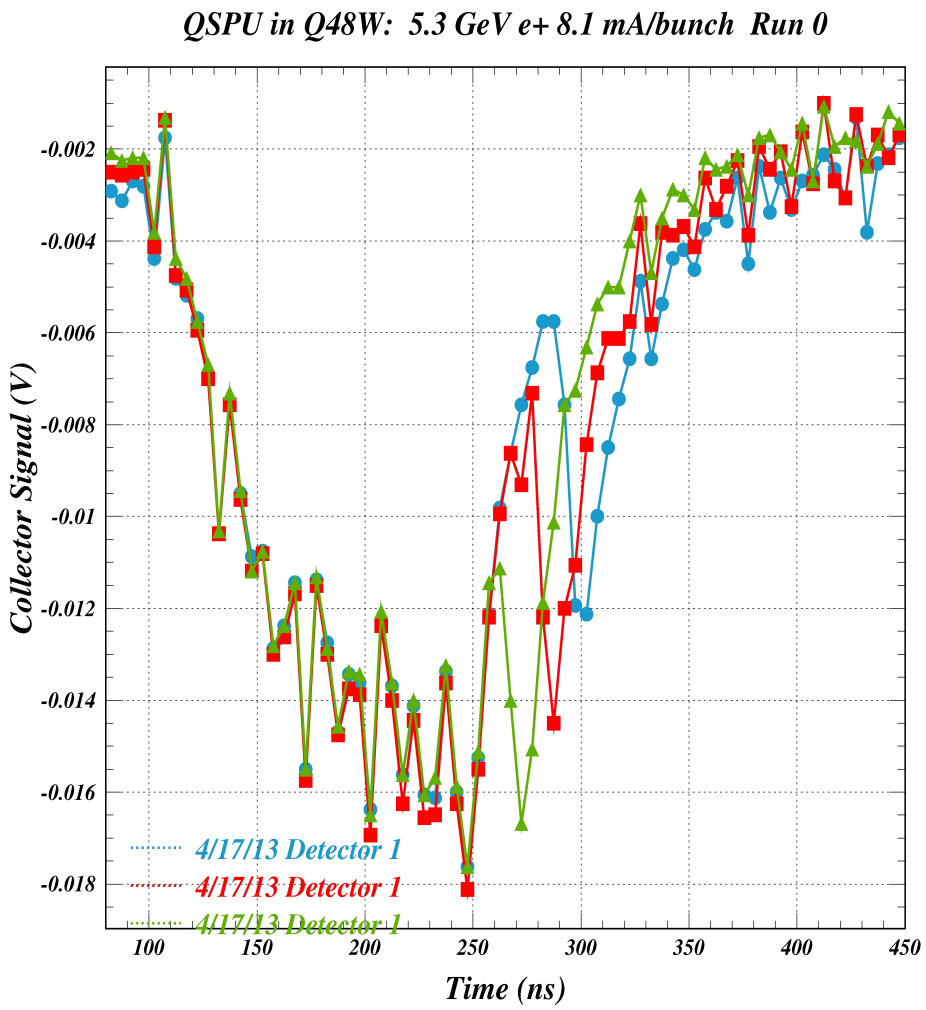


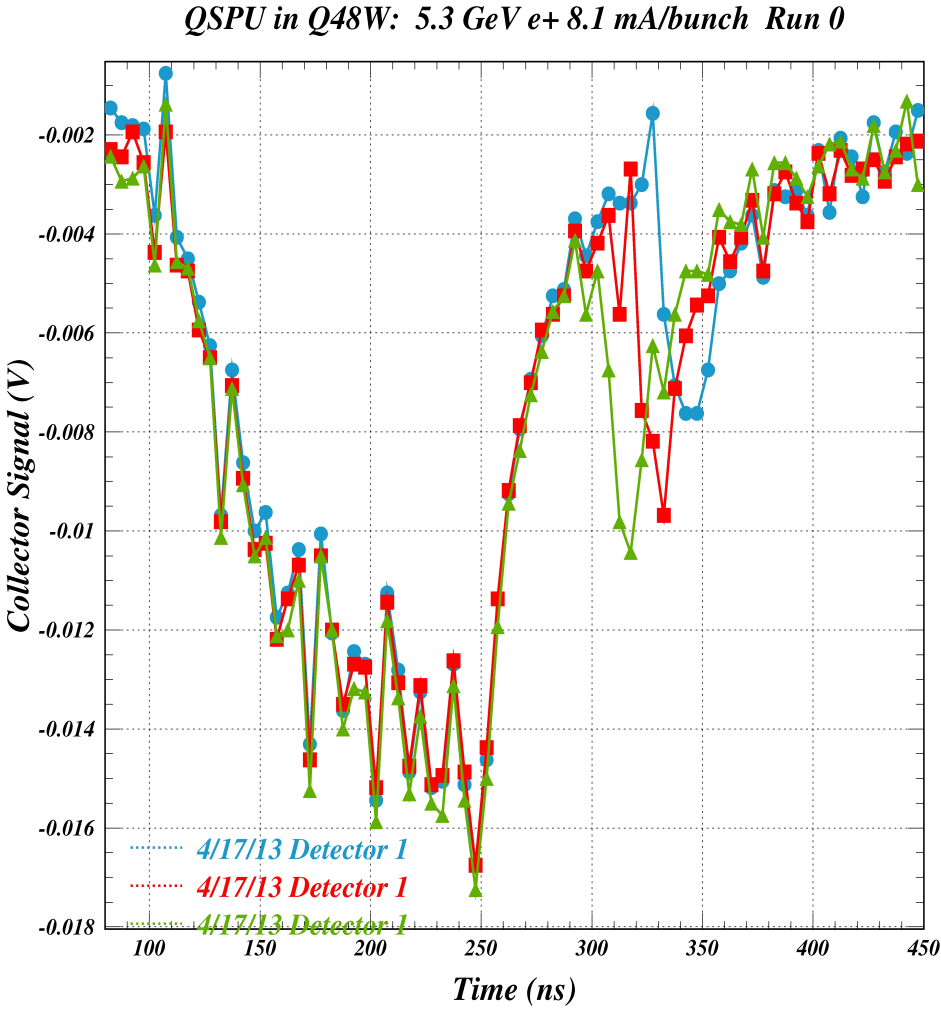
Averaging over 2.5 ns



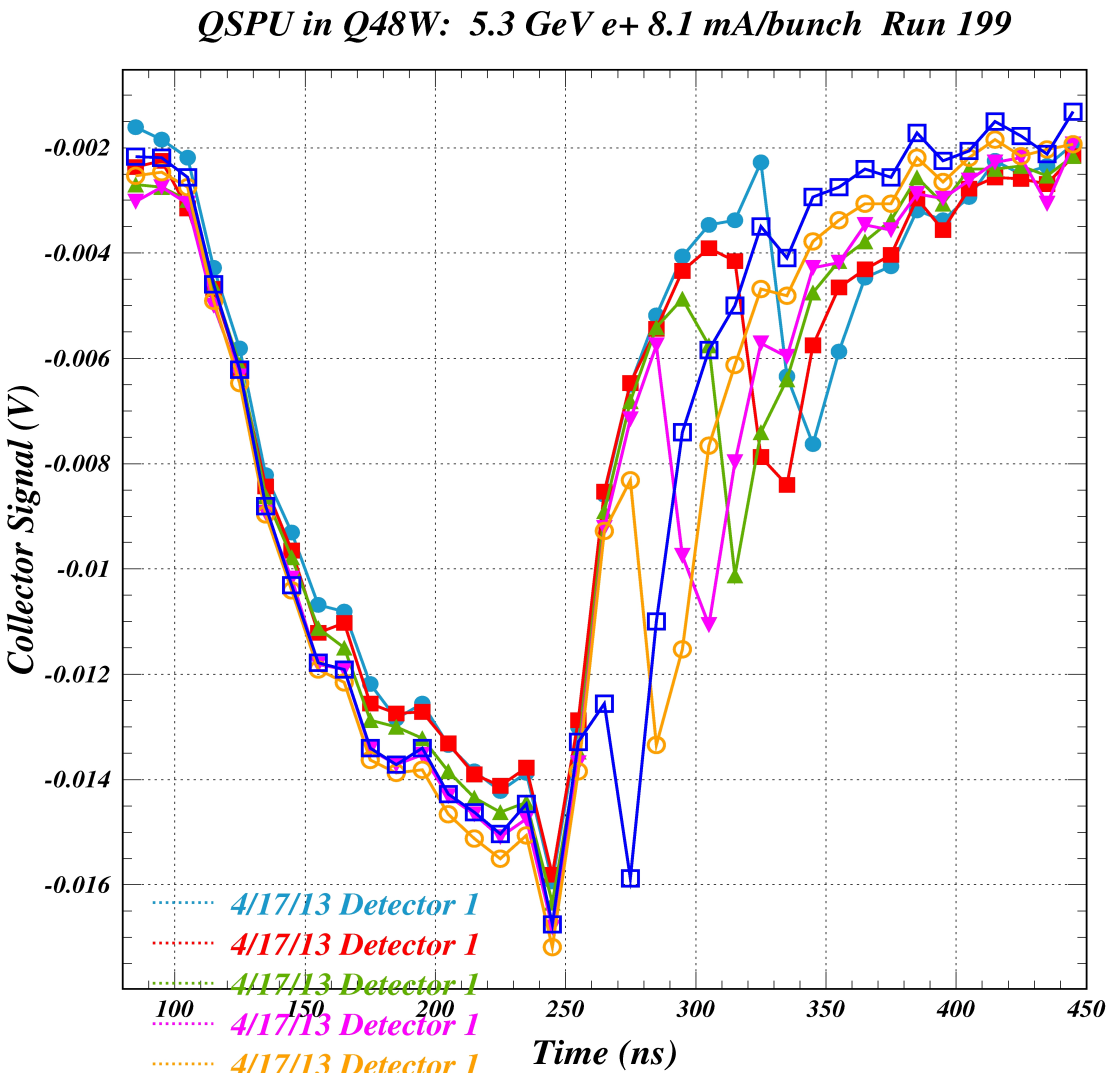
- Data irregular, perhaps some beating between 2.5 ns and 14 ns
- Some bunch signals disappear entirely

Averaging over 2.5 ns



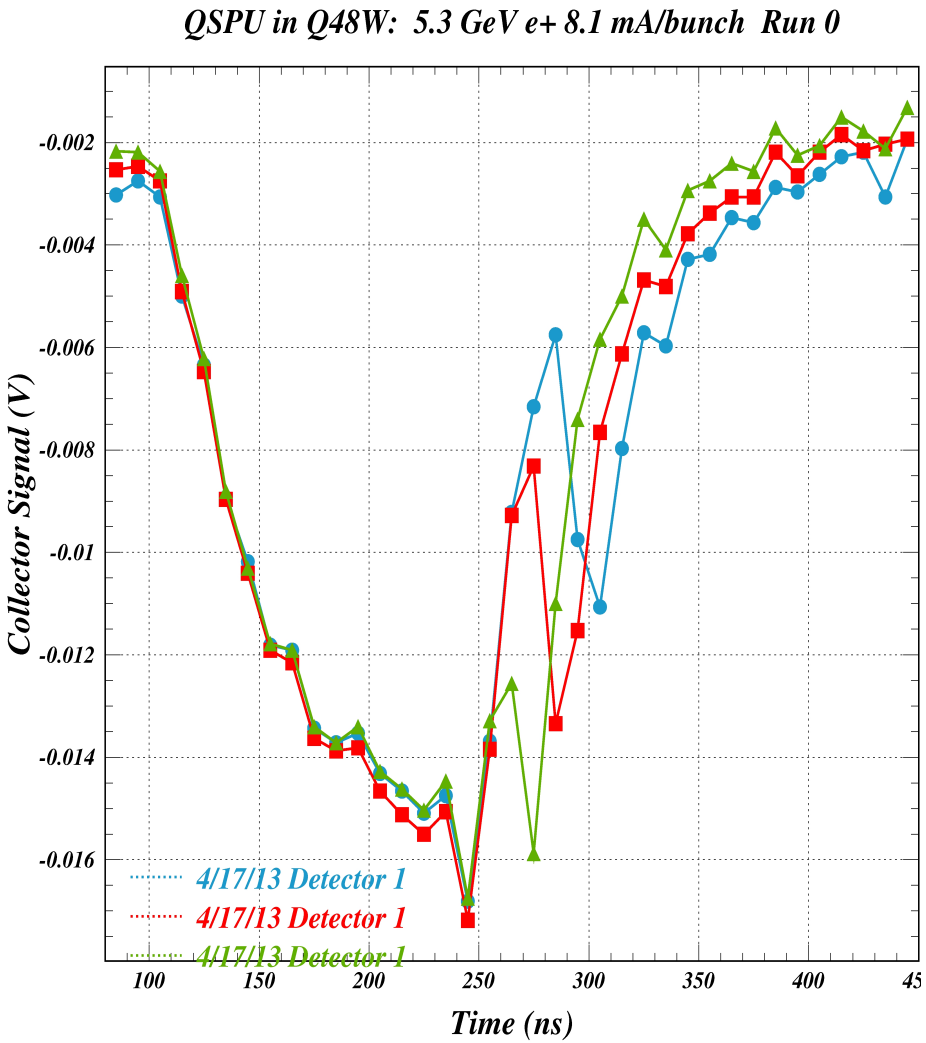


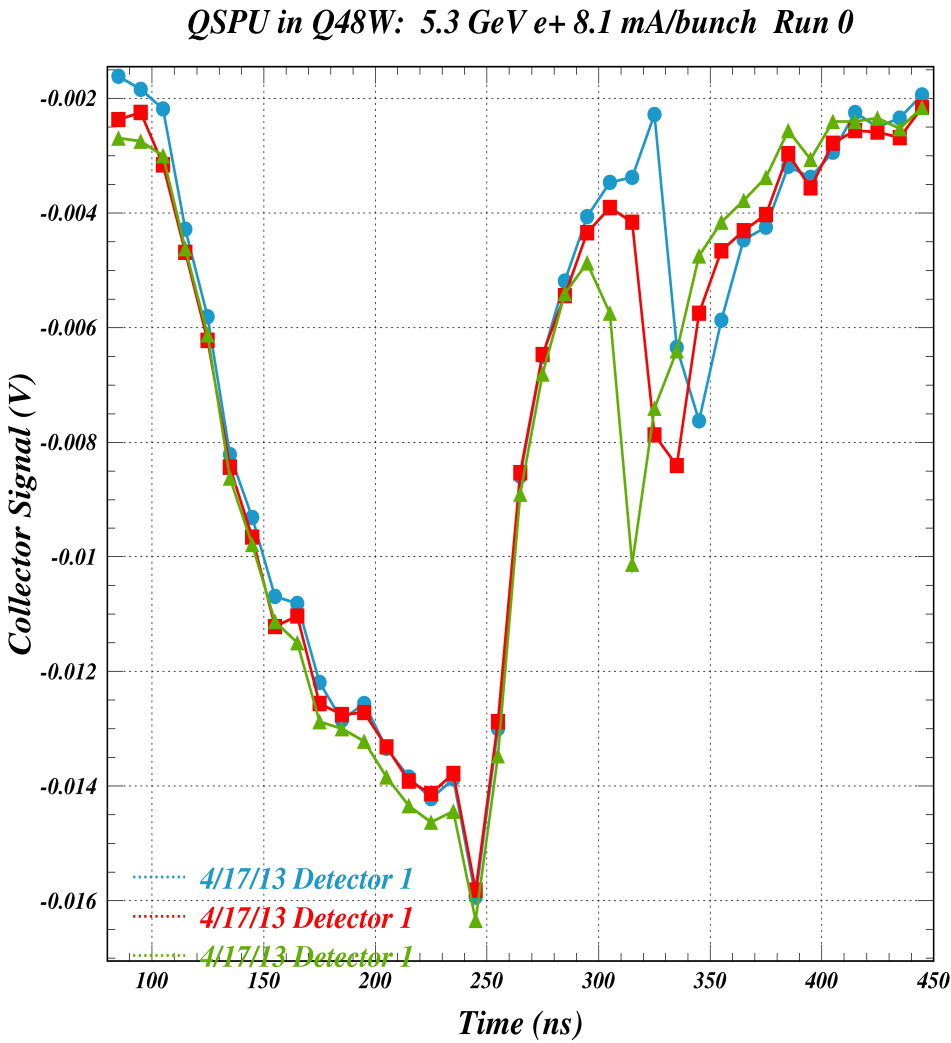
Averaging over 5 ns



- Bunch passage signals averaged out
- Data is smooth and easy to analyze
- Bounceback and witness bunch signals are clear (contain lower frequencies than bunch passage signals)
- Decay rate is easily visible and quantifiable

Averaging over 5 ns





Conclusion

- Time-bin averaging does get rid of some beam-synchronous noise
- This is an approximate method, some information is lost
- We plan to model an RC-like exponential response in both the signal and the model using the type of convolution technique used the the TR_RFA modeling shown at IPAC13. We can expect the appropriate RC time constant to be 3 +- 1 ns.