

# **Sticky-code Simulation and Mitigation**

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# ADC Sticky Code Issue

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- Linearity study of 35t ADC ASICs found that 6 LSBs frequently “stick” at 000000 (0x00) or 111111 (0x3F)
- Brian Kirby presented these slides at LAr-FD Cold Electronics meeting last week, in DocDB 11328
- Currently working to simulate sticky codes in DetSim and interpolate over sticky codes in reconstruction

# Simulating Sticky Codes

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- Each ADC vector entry has some probability of sticking at 0x00 or 0x3F, proportional to input signal size
- SimStuckBits Boolean fcl parameter added to detsimmodules\_lbne.fcl
- For each non-zero entry, use random number generator to determine if it sticks to either 0x00 or 0x3F
- Flip 6 LSBs with bitwise operators:
  - 0x00: set ADC value  $\text{adcvec\_a}[i] = \text{adcvec\_a}[i] \& 0\text{xffc0}$
  - 0x3f: set ADC value  $\text{adcvec\_a}[i] = \text{adcvec\_a}[i] | 0\text{x003f}$

# ADC Sticking Probabilities

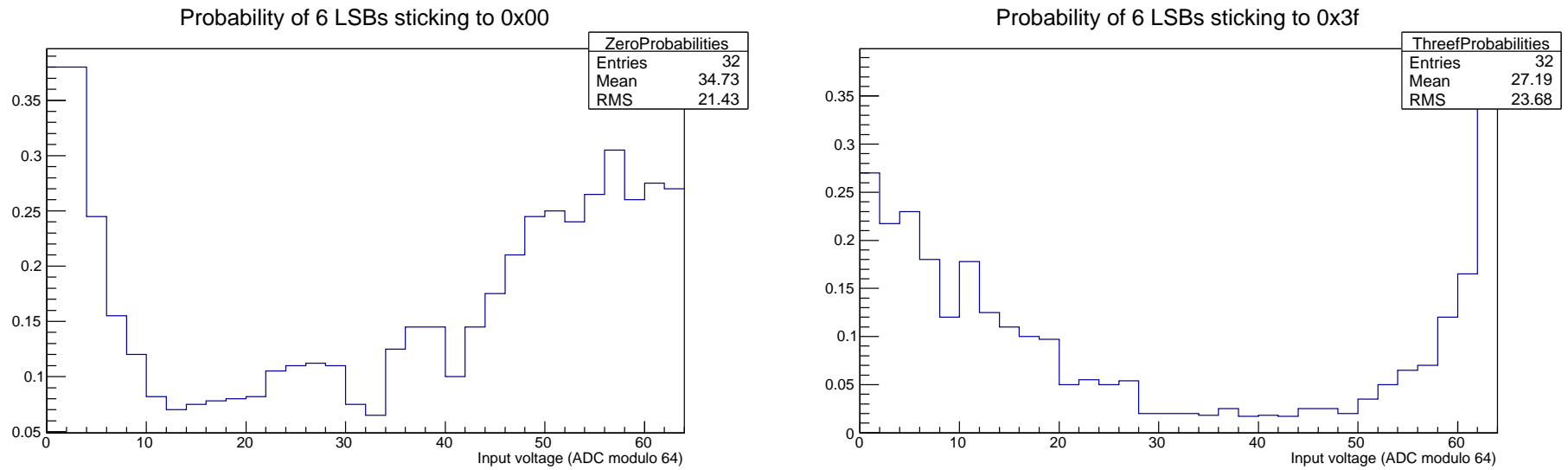


Figure 1: Sticky code probabilities, read from distributions in DocDB 11328

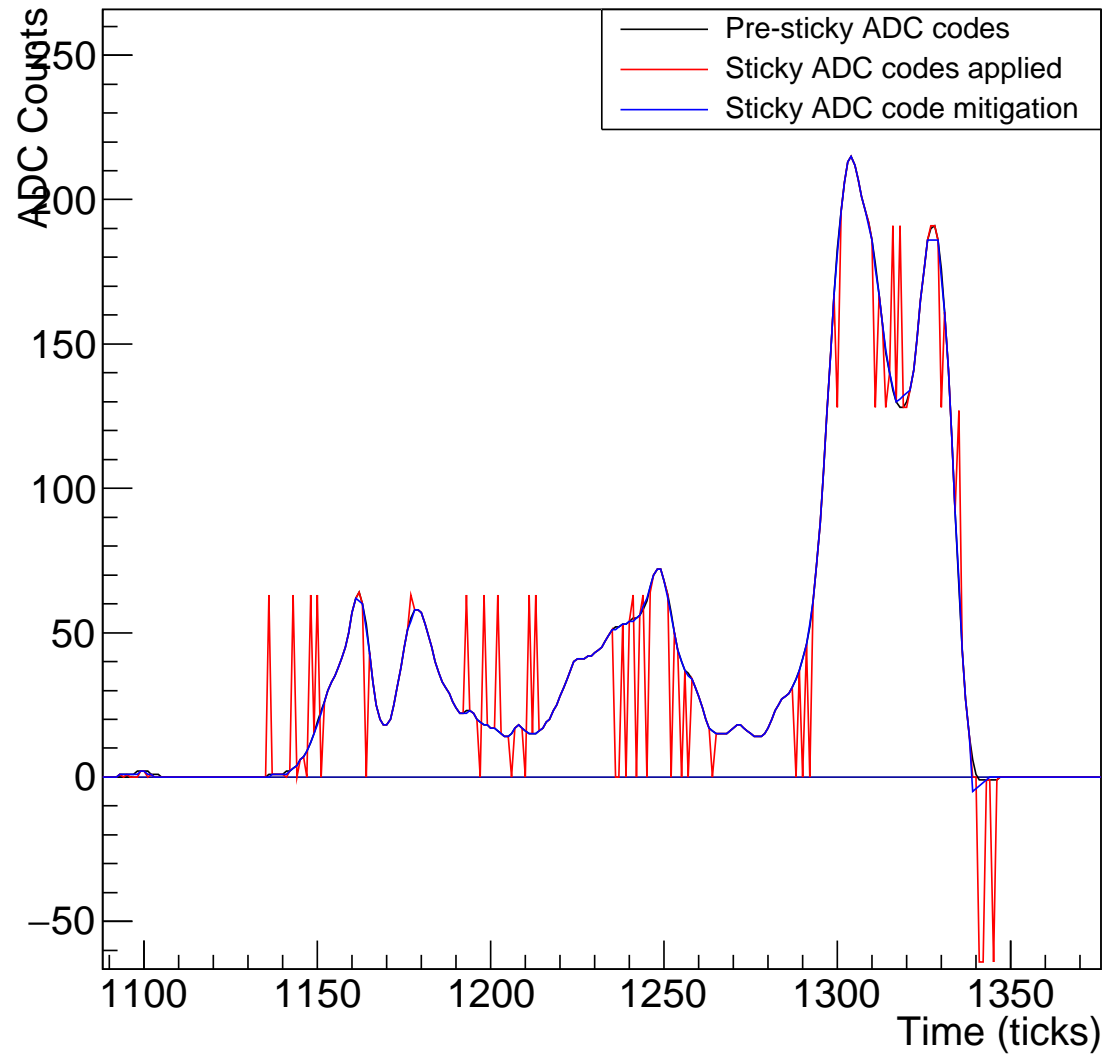
# ADC Sticky Code Mitigation

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- New module “UnstickADCCodes” created to read in RawDigit collections and output mitigated RawDigit ADC vectors as first step in reconstruction
- Each ADC vector is scanned over for entries ending in 000000 or 111111
- If 6 LSBs of code are found to be 0x00 or 0x3f, we scan ahead to find next entry without 6 LSBs
  - If over some number (default 3) of following ADC codes appear to be sticking at 0x00, we give up as they may be true values
- Mitigated value is computed from linear extrapolation between previous entry and next unsticking entry

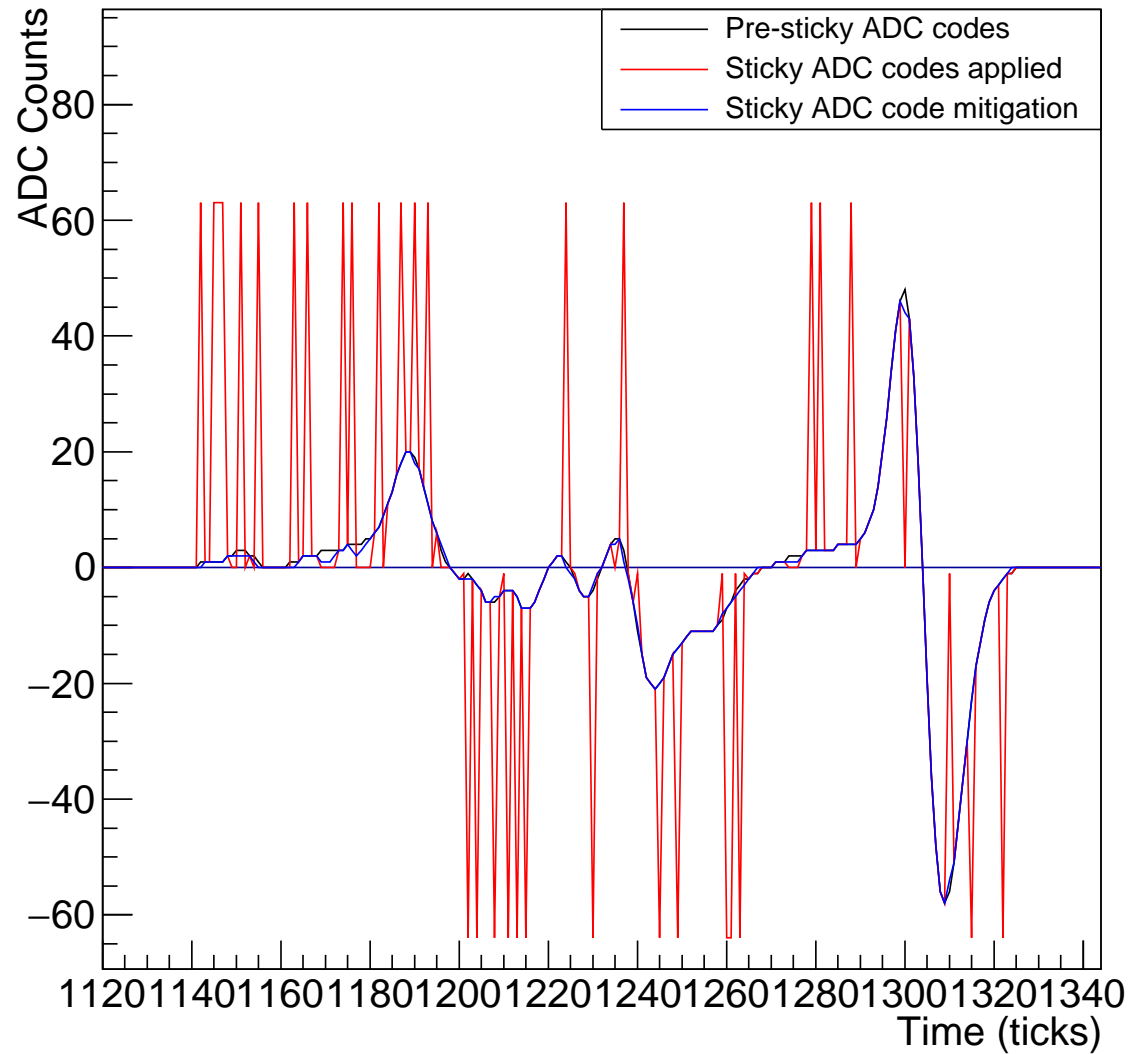
# ADC Sticky Code Simulation and Mitigation

ADC Vectors with and without Stuck 6 LSBs



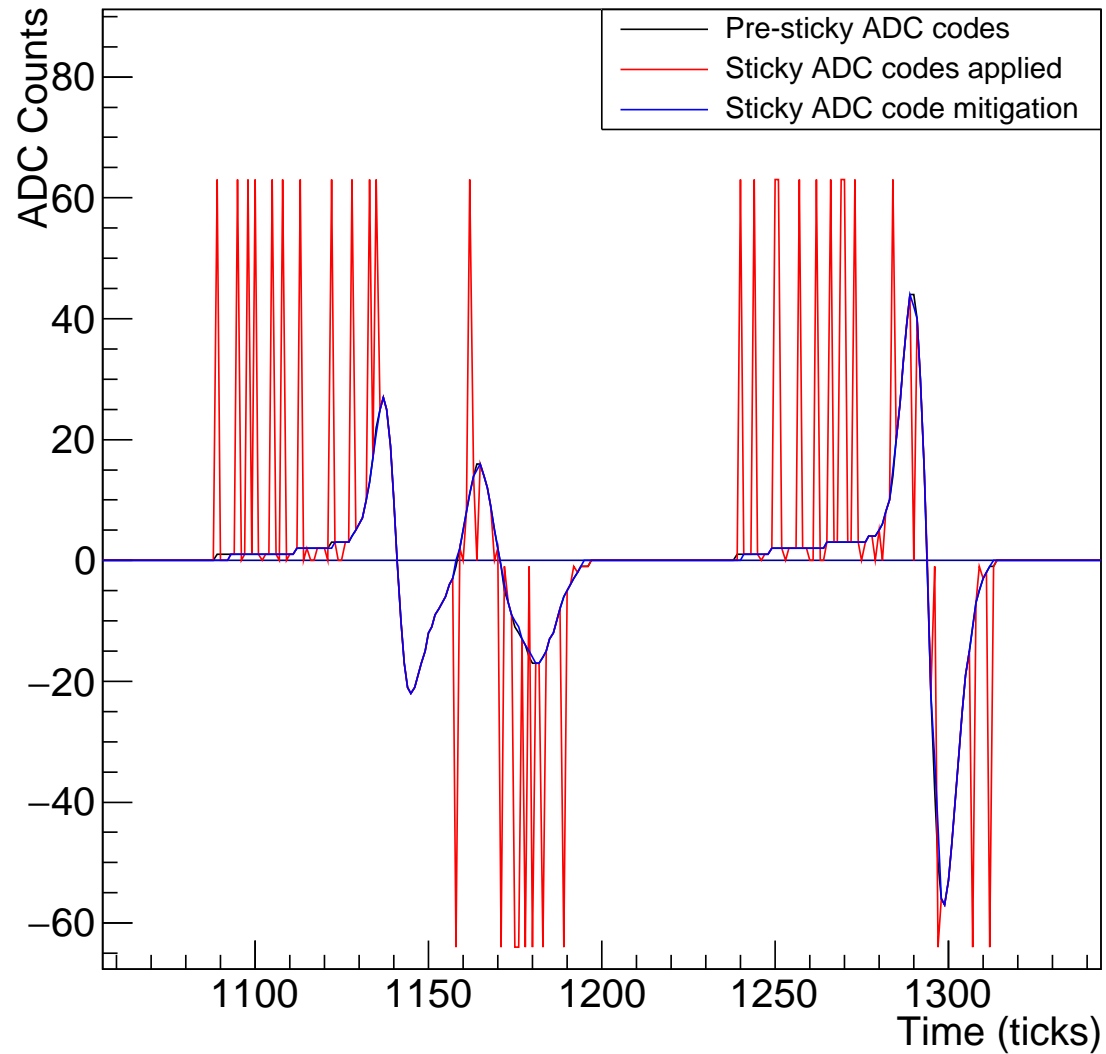
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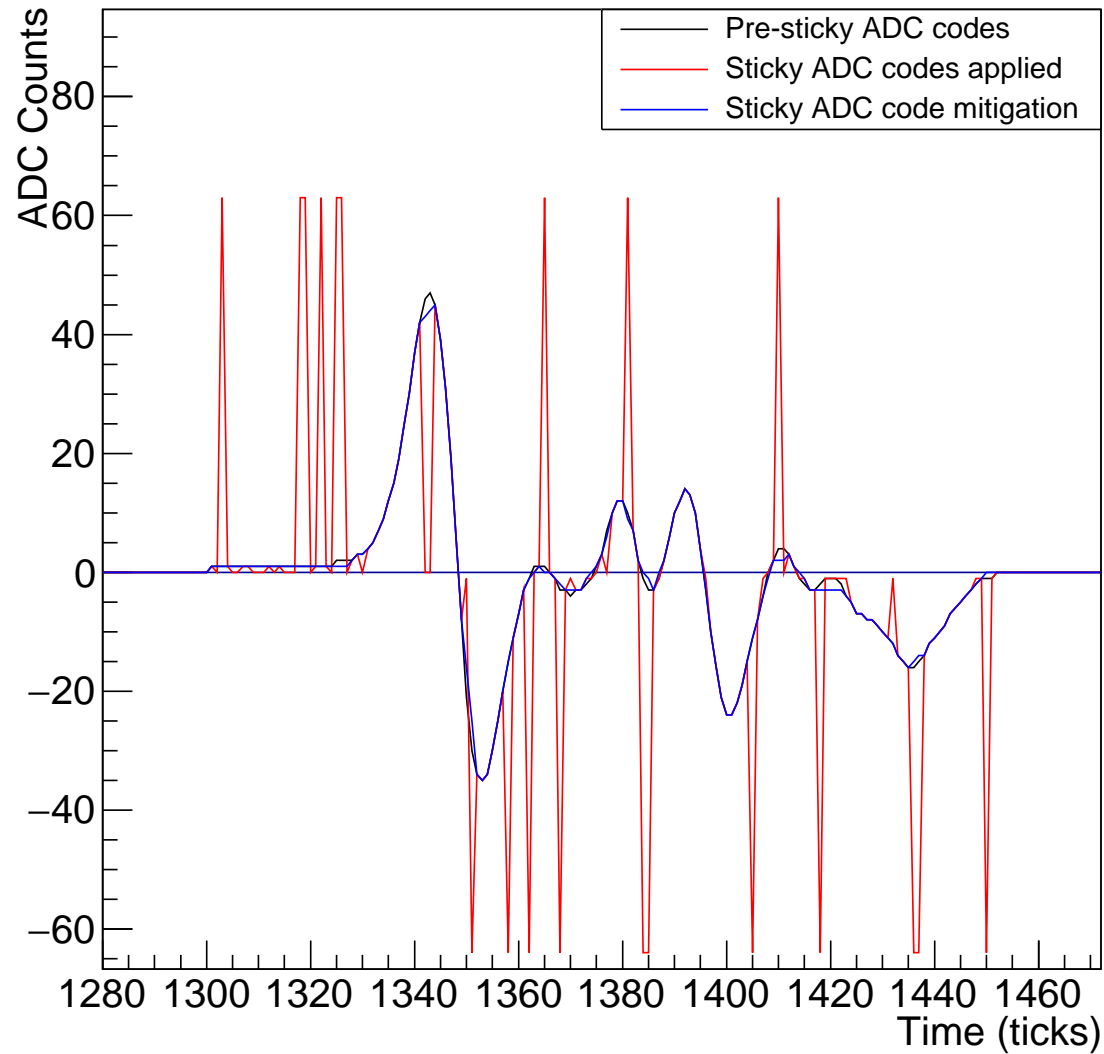
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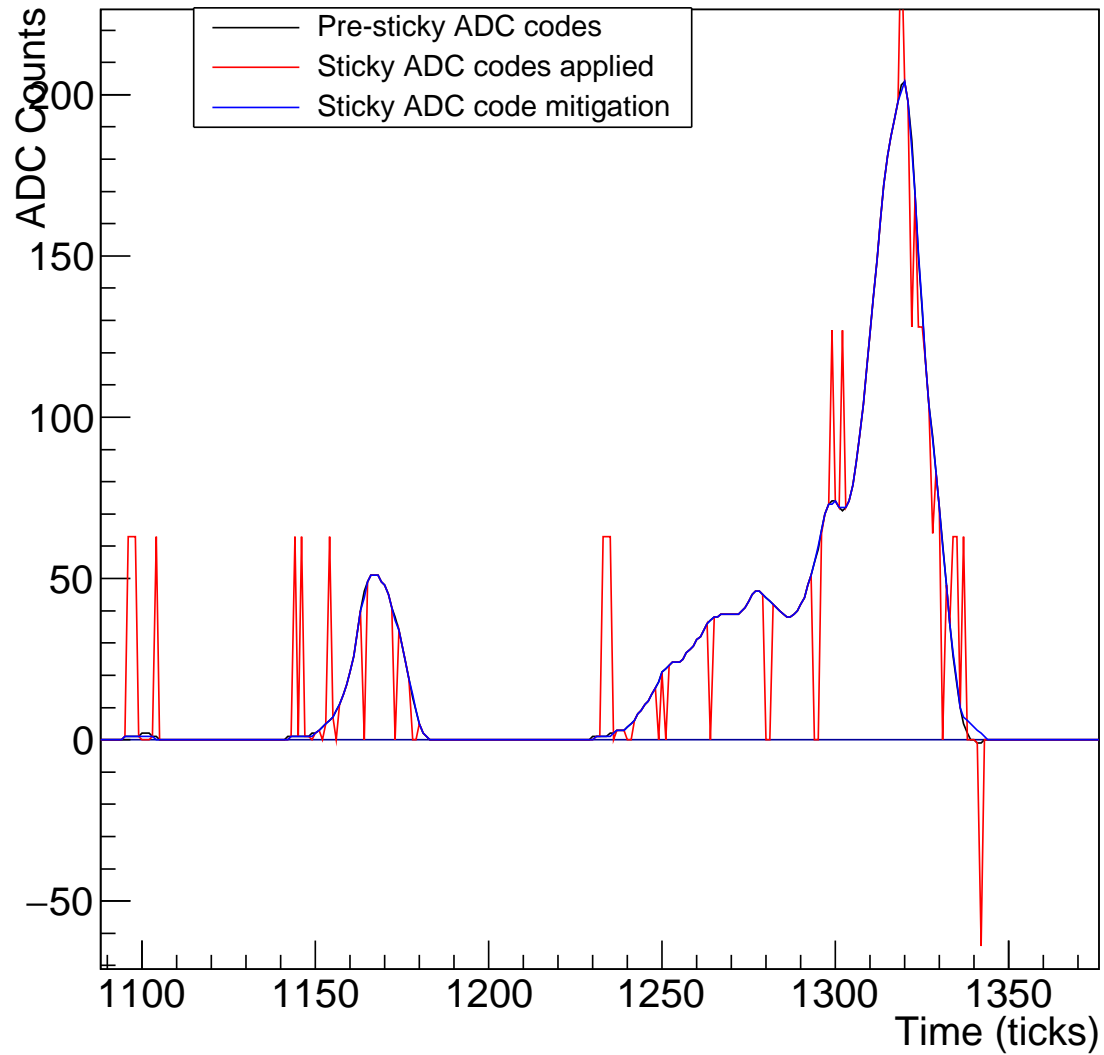
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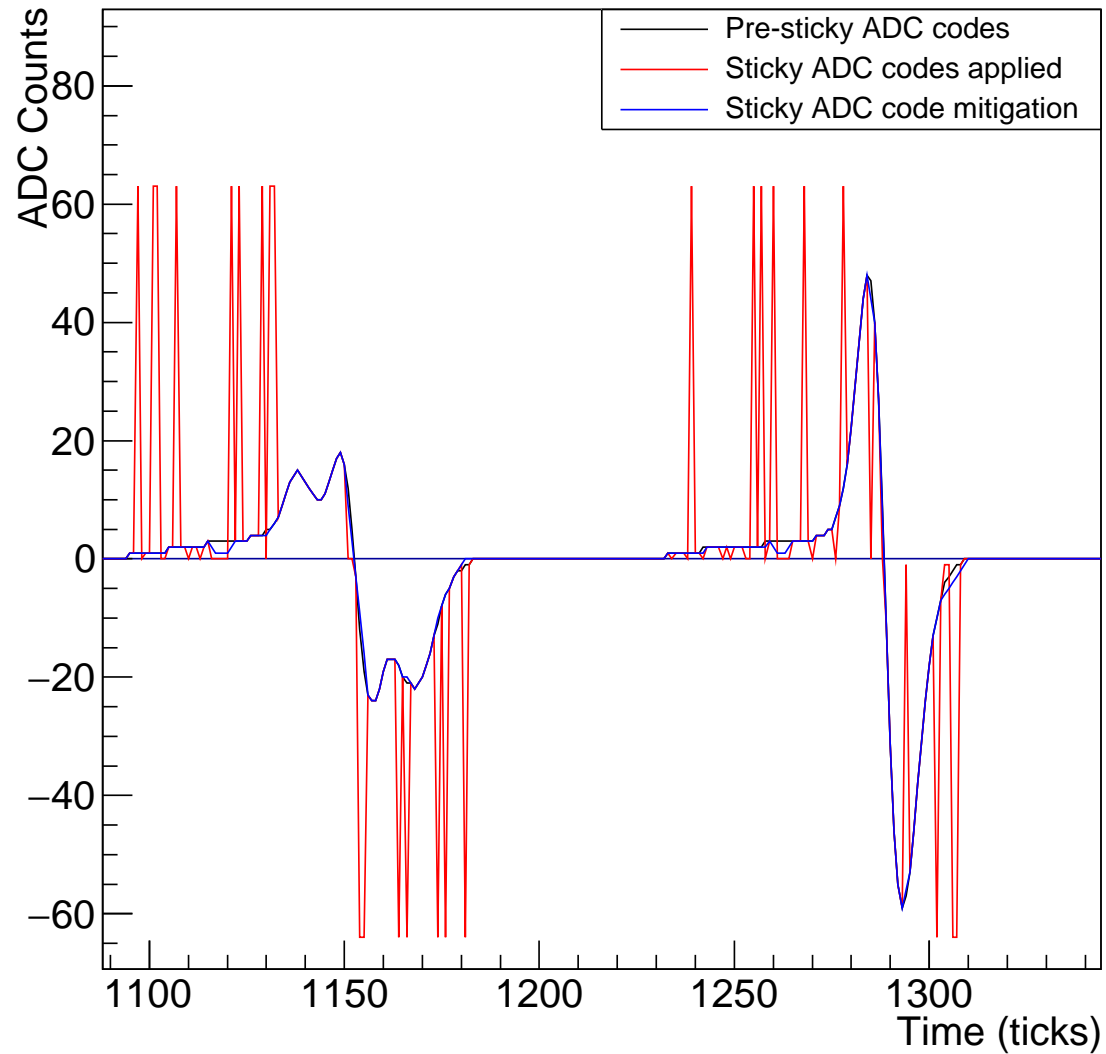
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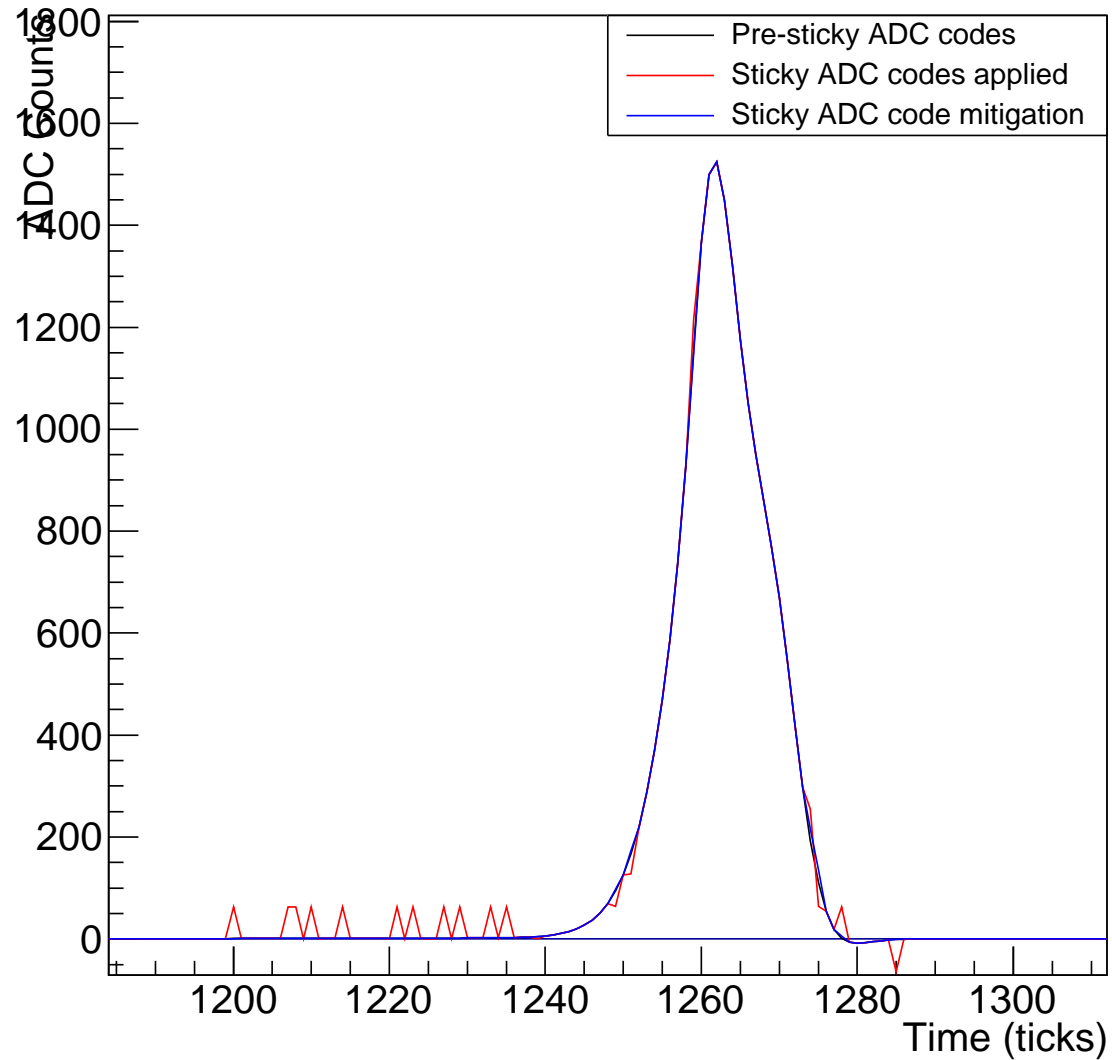
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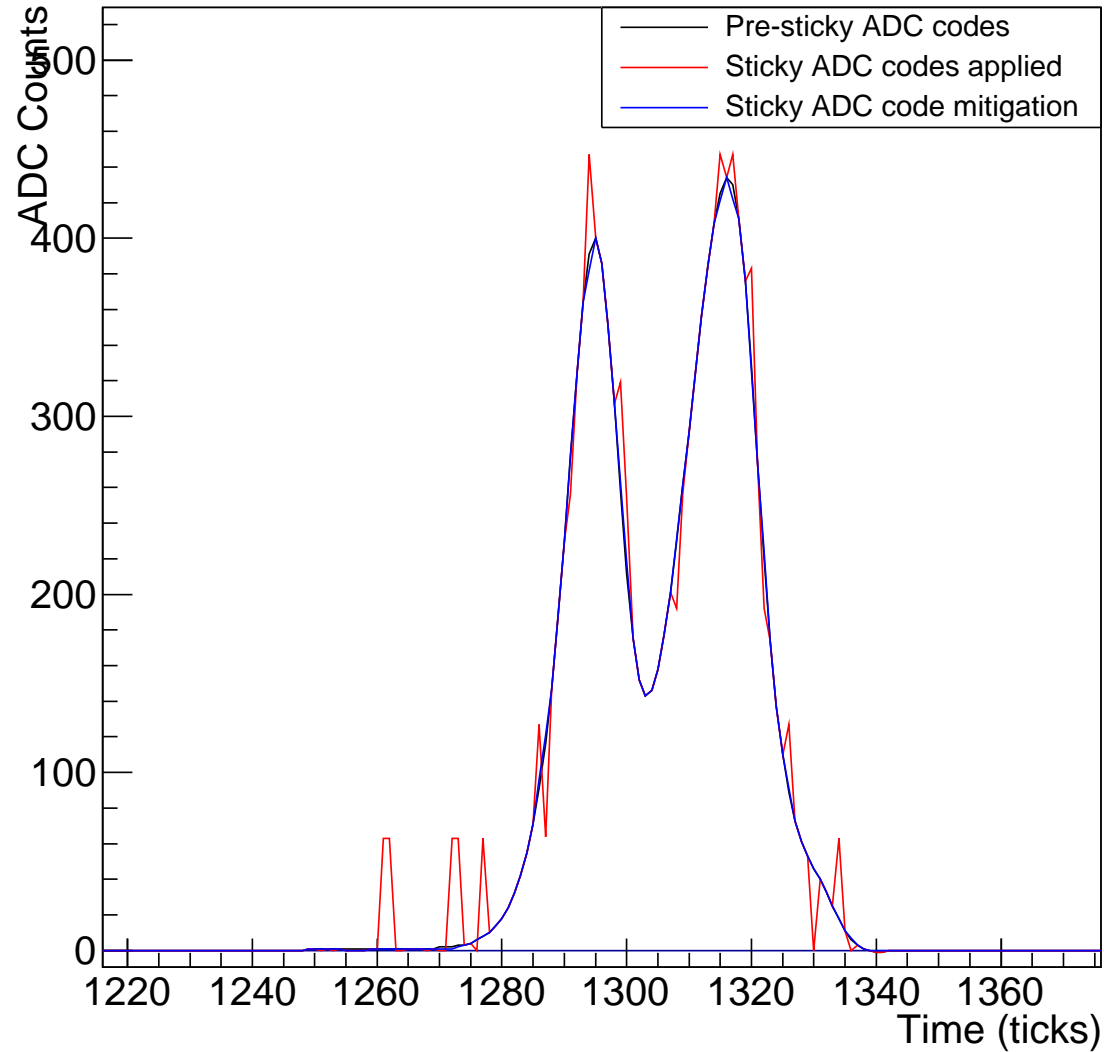
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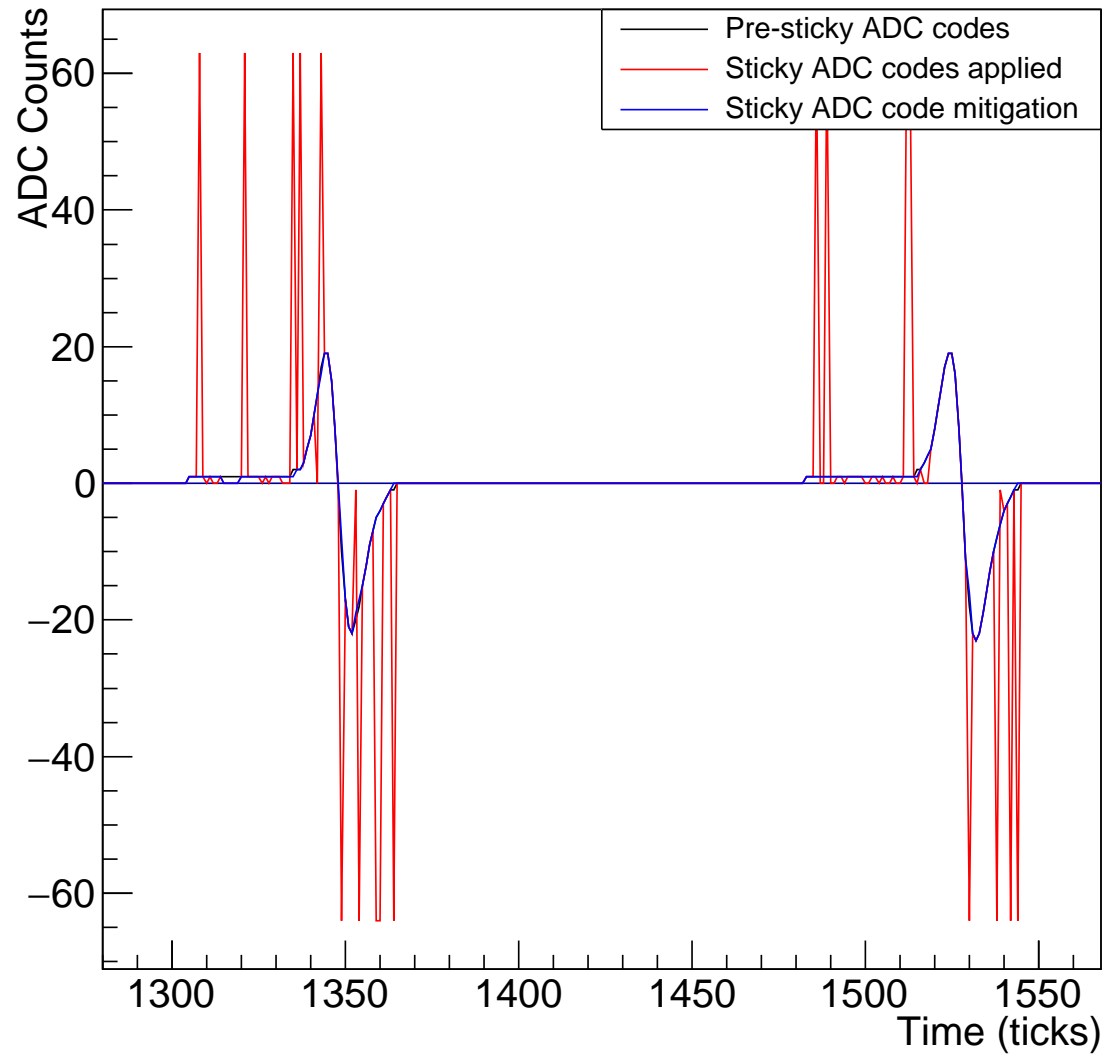
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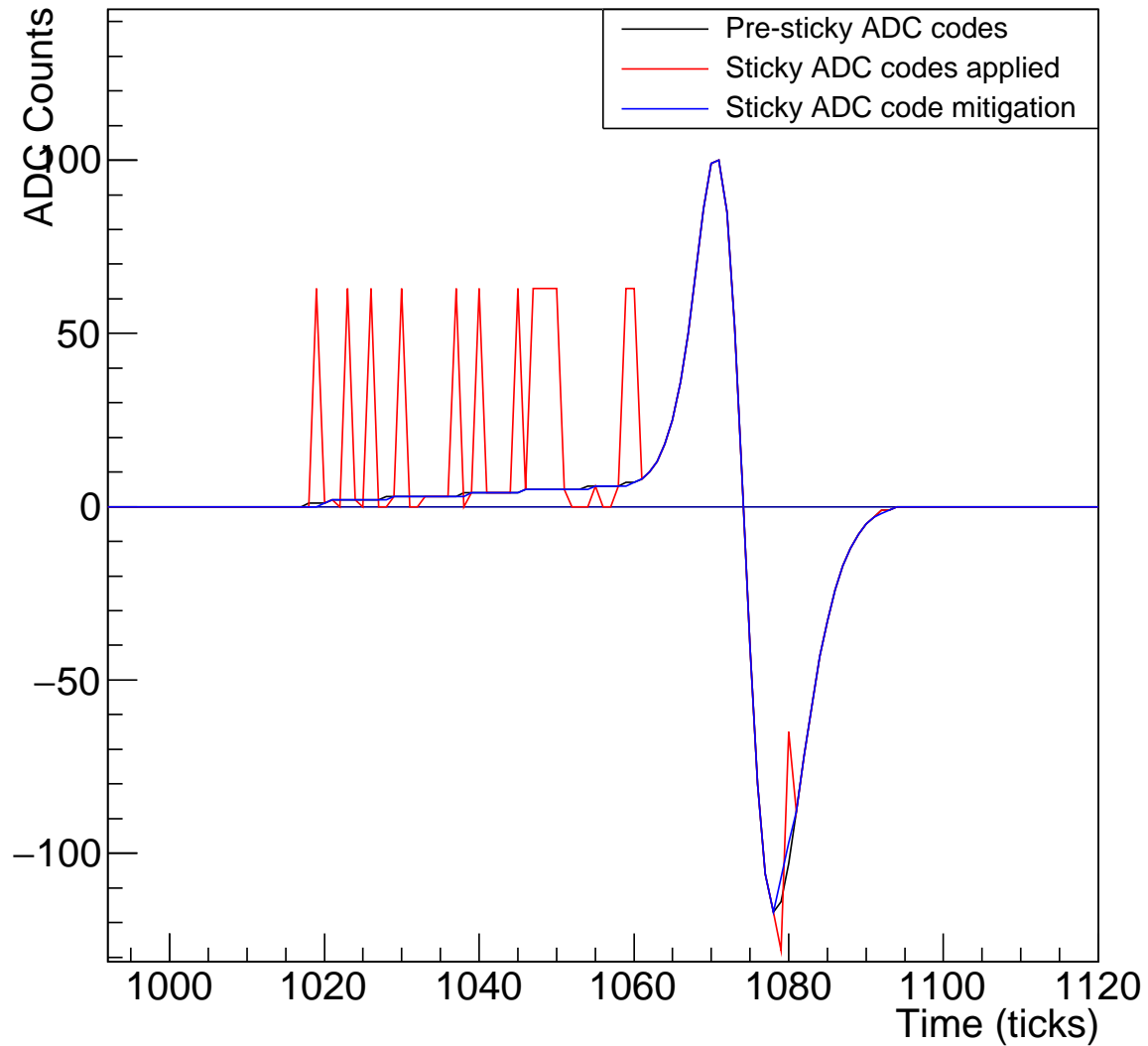
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ADC Vectors with and without Stuck 6 LSBs



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ADC Vectors with and without Stuck 6 LSBs



# Next Steps

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- Implement proper sticky code probabilities taken directly from linearity study with noise subtracted
- Test with nonzero pedestal values
- Rewrite guts of module as algorithm which can be added to other modules
- Evaluate effect on energy resolution