Beetle1.3 validation for Velo

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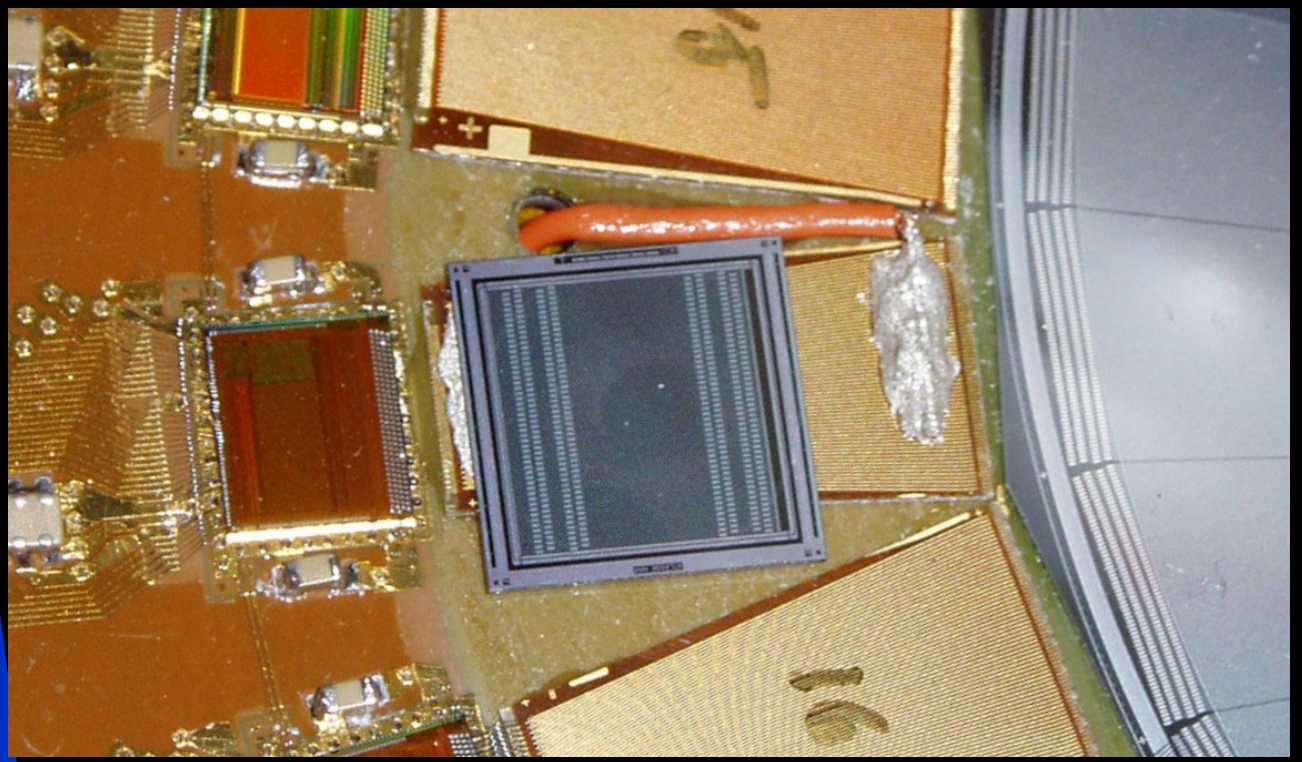
Velo issues related to the Beetle :

- lower then expected S/N.
- Variation of pedestal and noise (and gain ?) with readout and trigger rate in real load conditions (i.e. on Velo hybrid).
- Collective behaviour of 16 Beetle's on hybrid.
- Cross-talk, pulse shape

Understanding lower then expected S/N ...

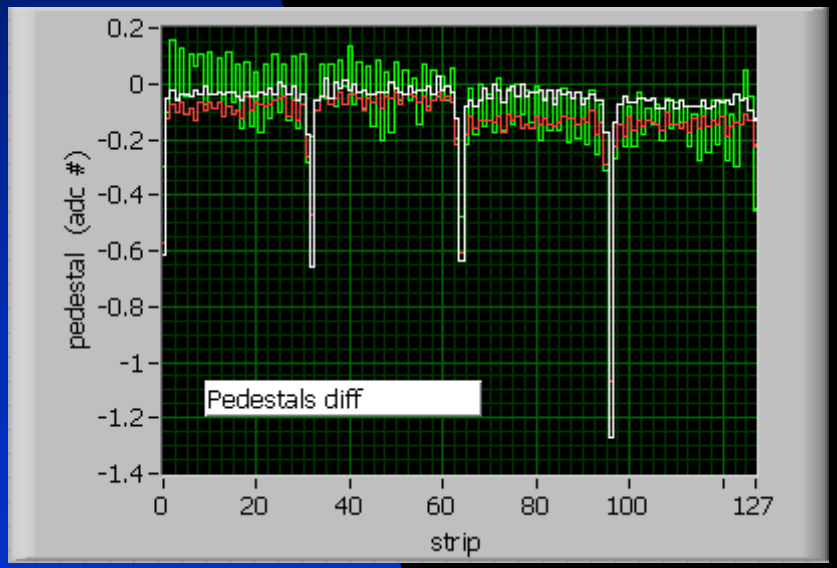
- Noise analysis of ’03 testbeam data seems to confirm noise is correct,
  - ★ i.e. bonded channel = 2x unbonded channels, assuming C_strip ~ 7pF.
- But no proof yet of missing signal… Compare signal between area’s of M1 only to M1 + M2. (J. Palacios)
- Data with SR90 source on Atlas baby sensor (~ 1cm^2, 280 um, single metal, large strip) collected and being analysed (M. Pivk).

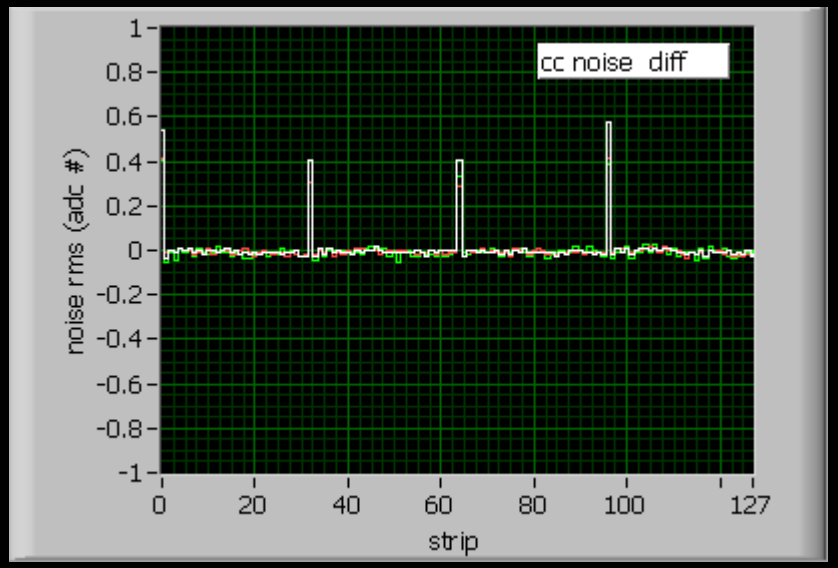
Atlas baby sensor

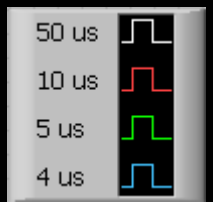


Pedestal and noise vs. event readout rate.

- Sustained rates @ 50, 10, 5, 4 us. (Will measure downto 1 us)
- 1 ADC ~ 16mV diff ~ 500 e-.
- No influence on noise after cnc (“correlated noise correction”) . Spikes are crosstalk from headerbit in first channels.

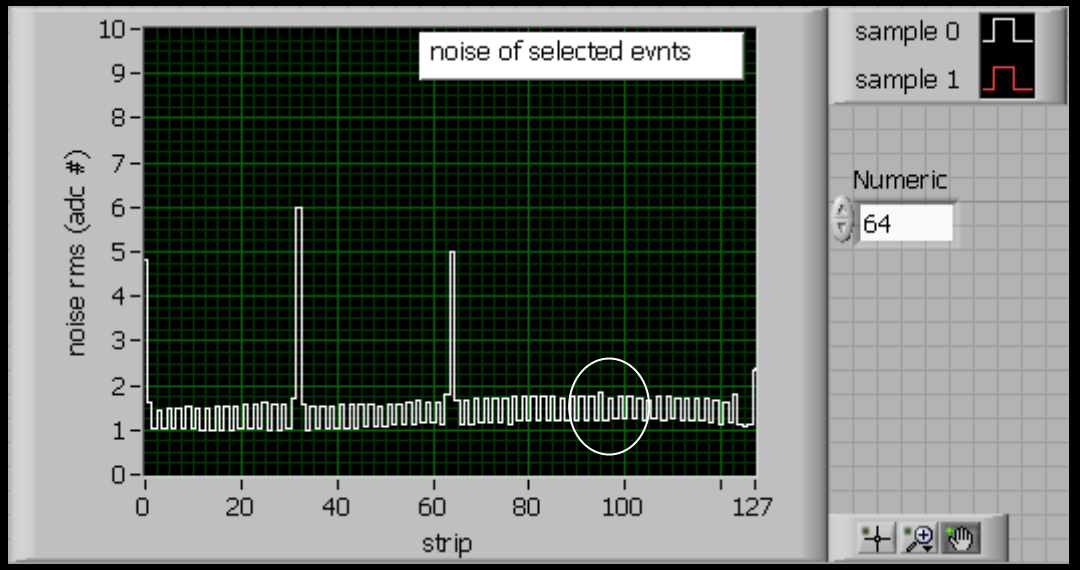






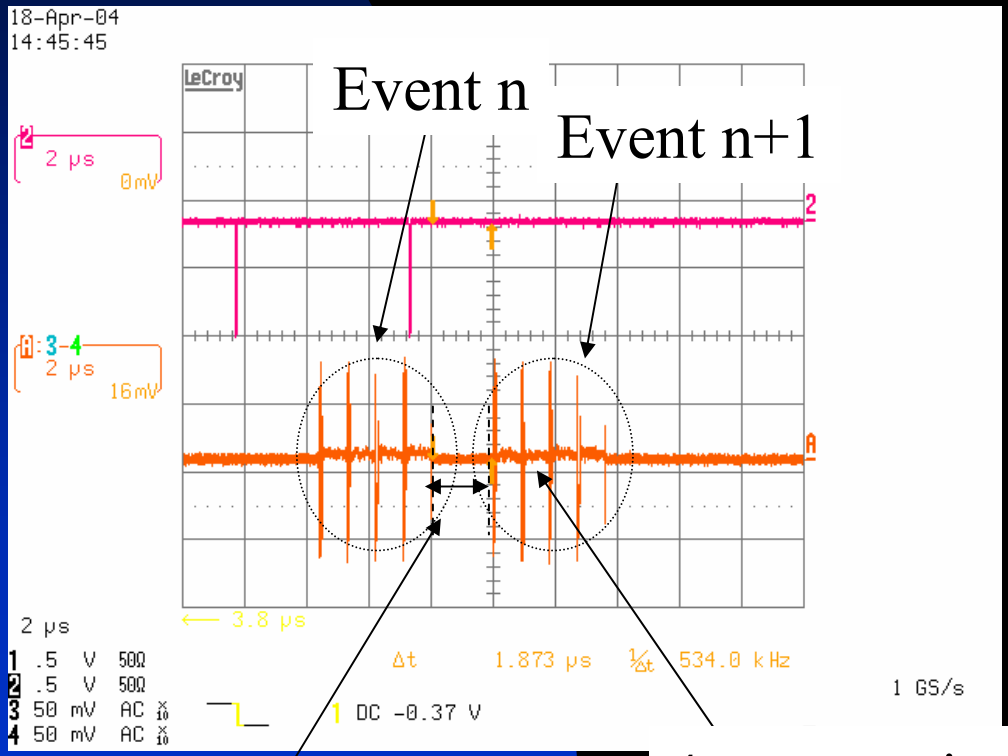
Header bit crosstalk.

- Example : select events with constant 7th header bit -> noise is normal.
- Ignore : not a Beetle problem.



Variation of pedestal and noise.

Data taking scenario :



Analysis :

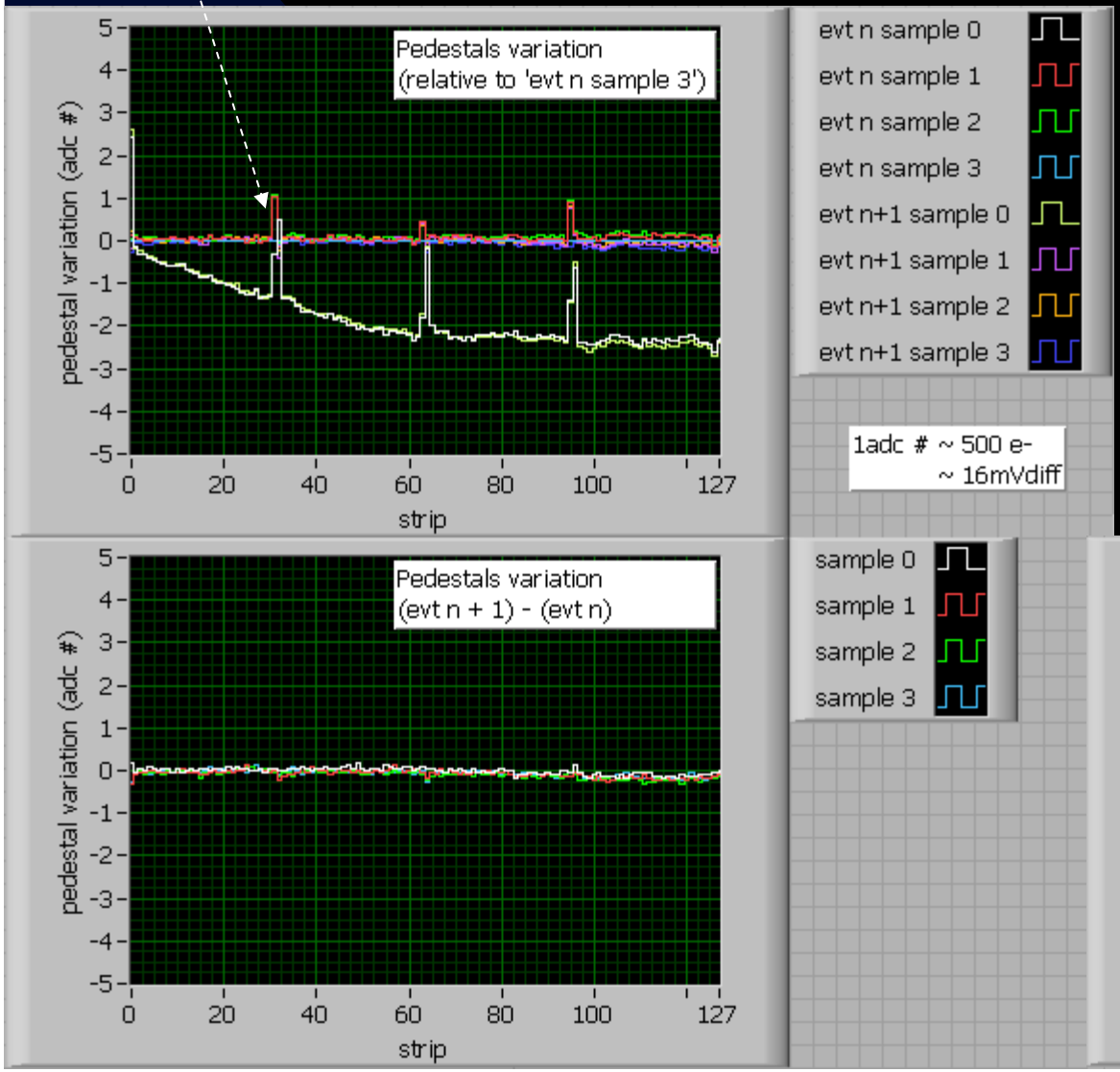
- Compute 8 individual pedestals.
- Compute single common pedestal.
- Compare noise after cnc.

4 consecutive‘timesamples’

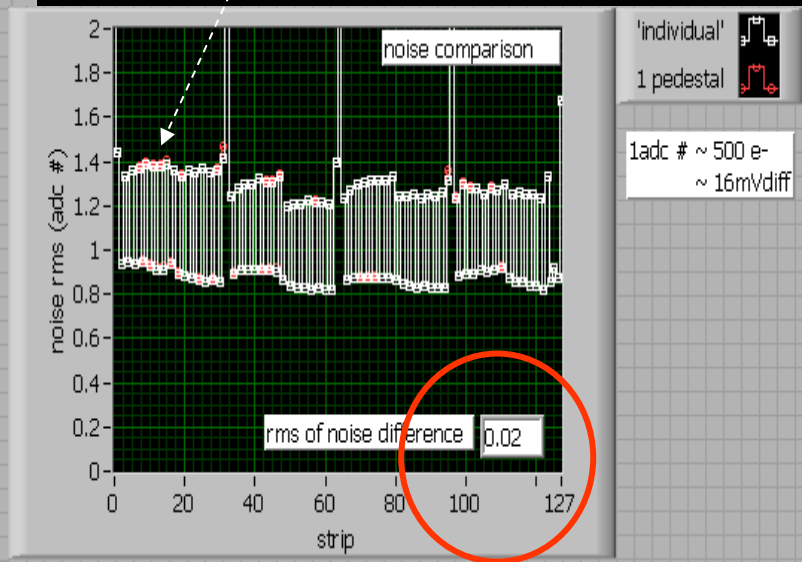
Interval (100, 200, 400, 800, 1000, 1500, 5000 ns)

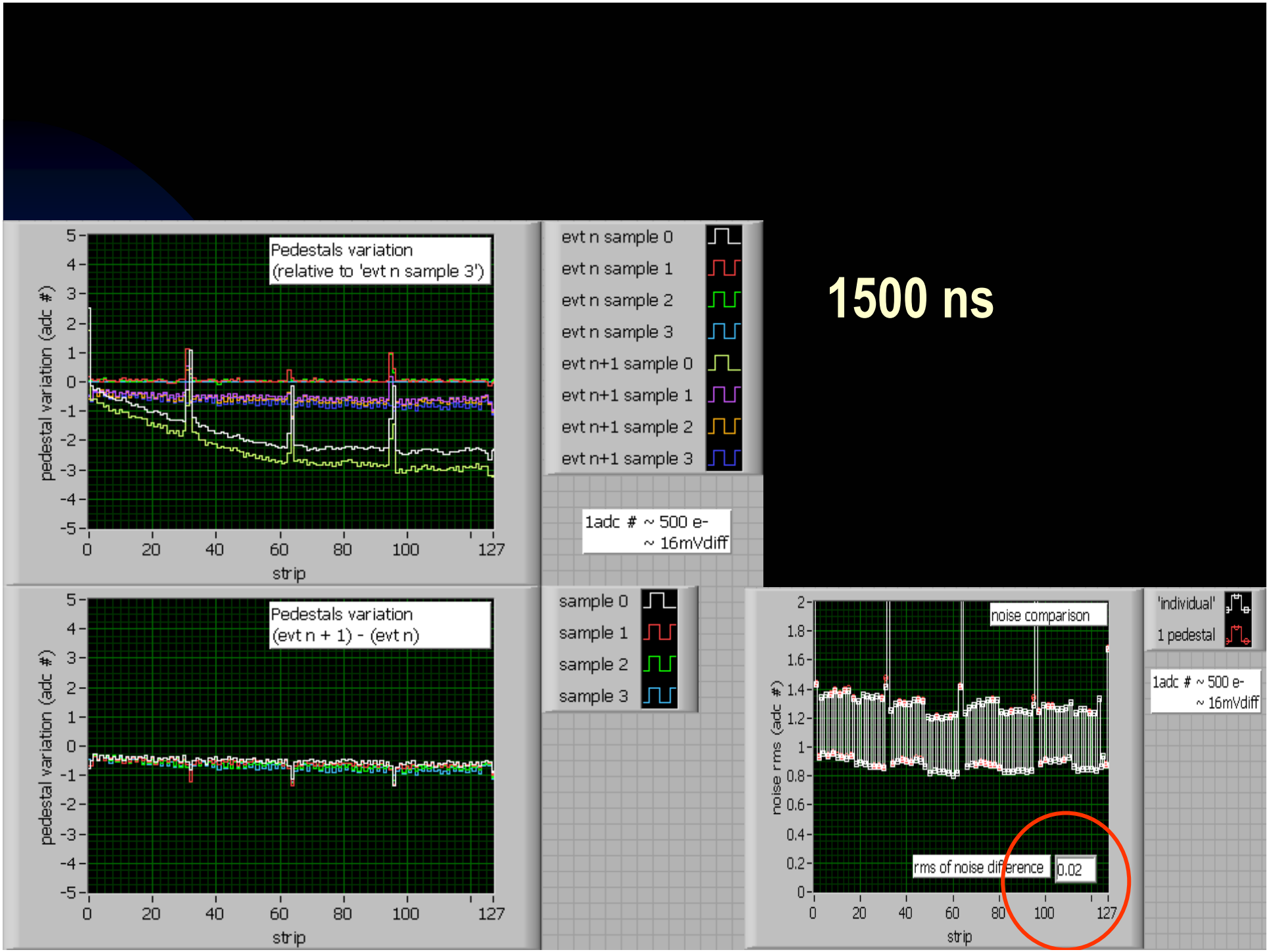
Spikes again due to headerbit

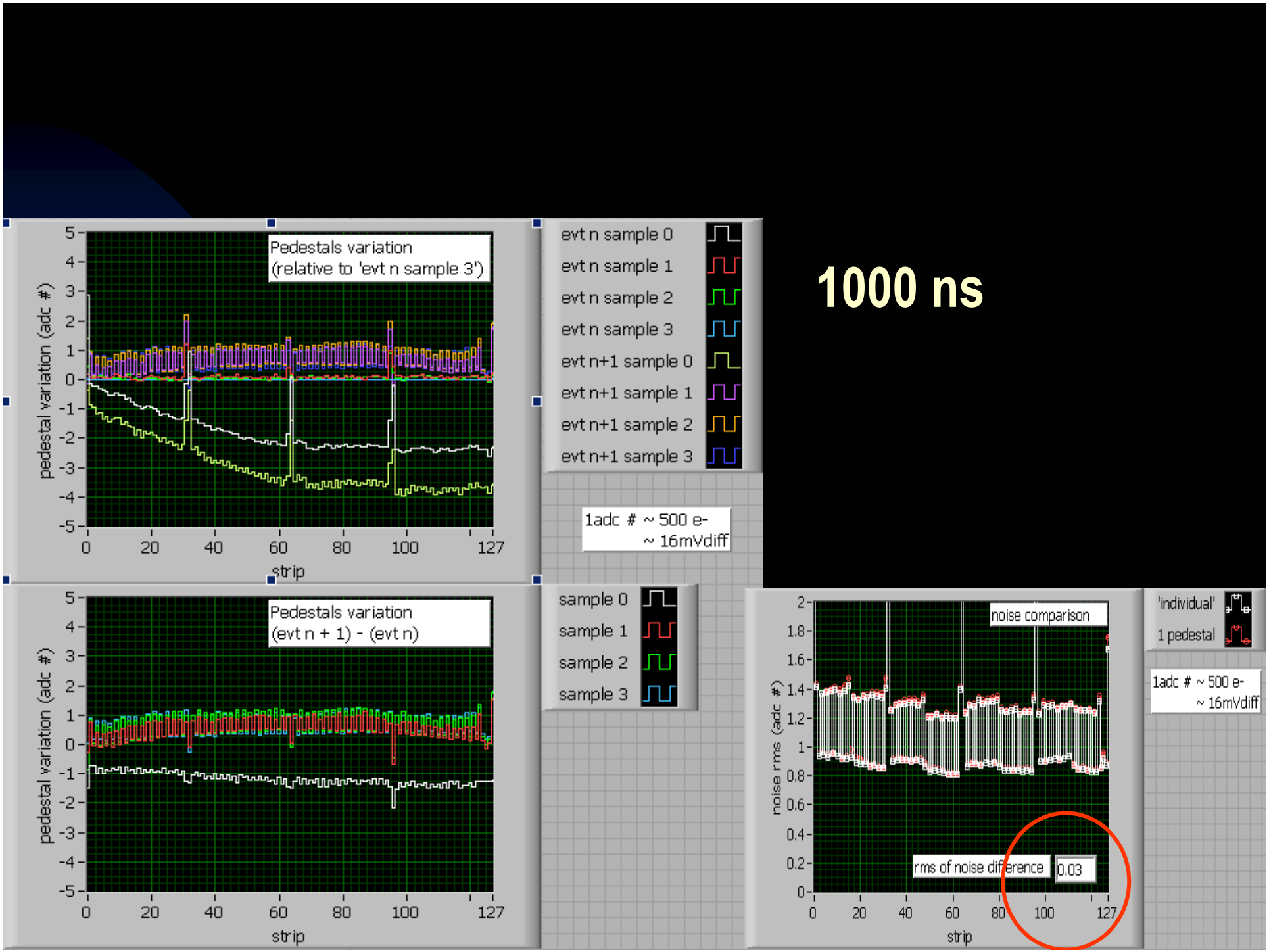
5000 ns

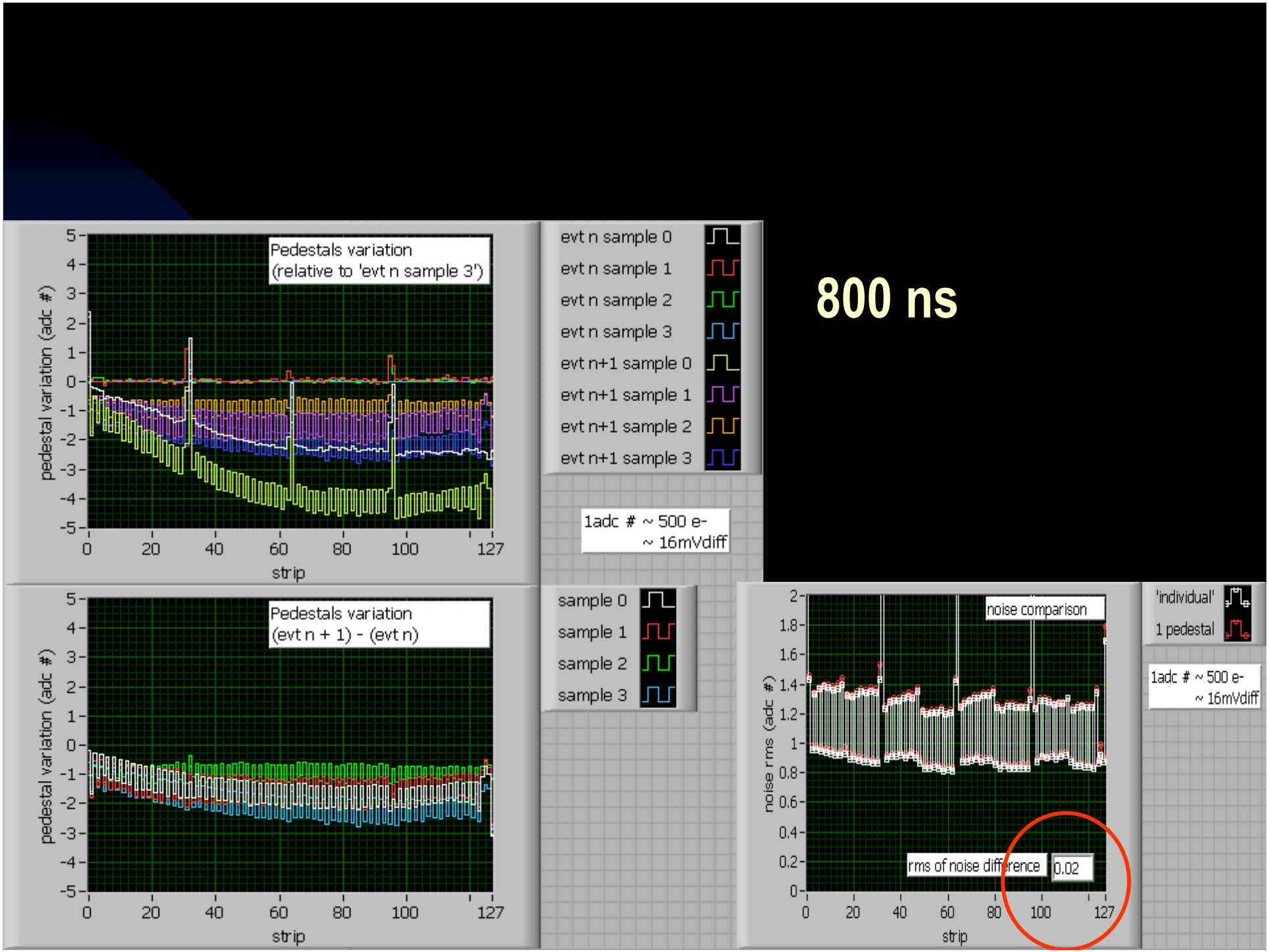


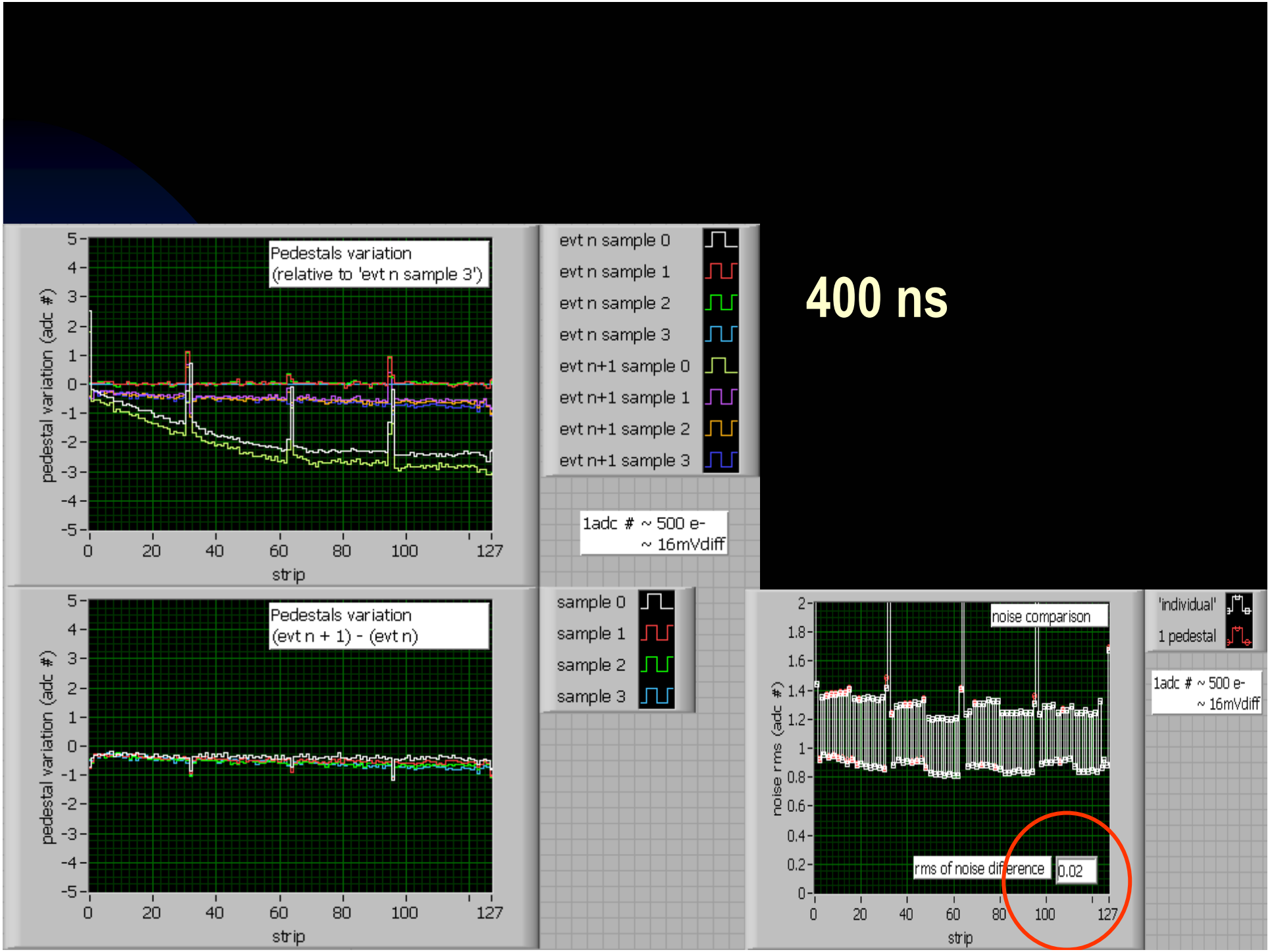
Alternatively bonded/unbonded to ‘baby sensor’

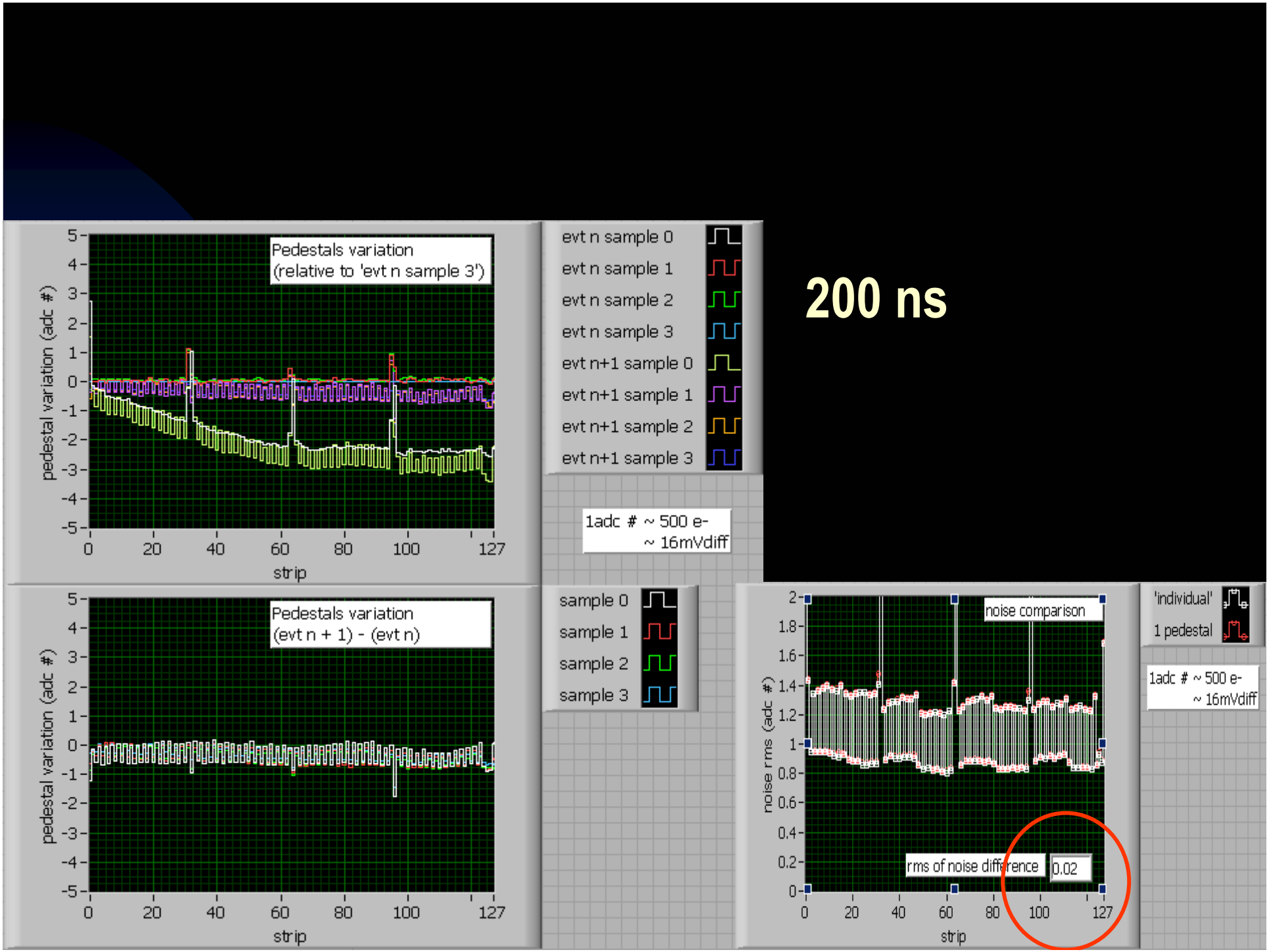


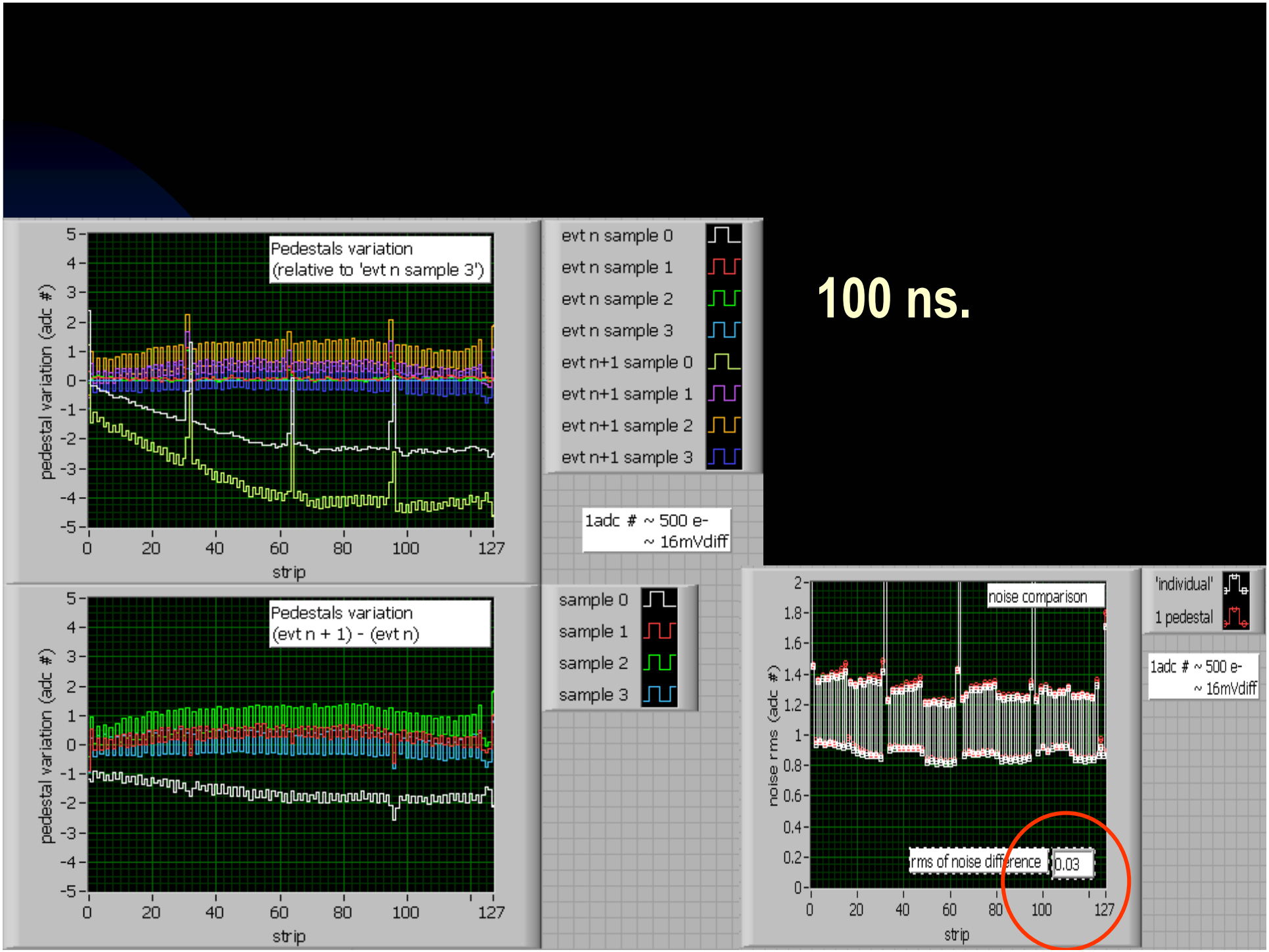

Pedestals variation
(relative to 'evt n sample 3')
pedestal variation (adc #)
strip
evt n sample 0
evt n sample 1
evt n sample 2
evt n sample 3
evt n+1 sample 0
evt n+1 sample 1
evt n+1 sample 2
evt n+1 sample 3
1adc # ~ 500 e-
~ 16mVdiff
1500 ns
Pedestals variation
(evt n + 1) - (evt n)
pedestal variation (adc #)
strip
sample 0
sample 1
sample 2
sample 3
noise comparison
noise rms (adc #)
strip
rms of noise difference
0.02
'individual'
1 pedestal
1adc # ~ 500 e-
~ 16mVdiff


Pedestals variation
(relative to 'evt n sample 3')
pedestal variation (adc #)
strip
evt n sample 0
evt n sample 1
evt n sample 2
evt n sample 3
evt n+1 sample 0
evt n+1 sample 1
evt n+1 sample 2
evt n+1 sample 3
1adc # ~ 500 e-
~ 16mVdiff
1000 ns
Pedestals variation
(evt n + 1) - (evt n)
pedestal variation (adc #)
strip
sample 0
sample 1
sample 2
sample 3
noise comparison
noise rms (adc #)
strip
rms of noise difference
0.03
'individual'
1 pedestal
1adc # ~ 500 e-
~ 16mVdiff


Pedestals variation
(relative to 'evt n sample 3')
pedestal variation (adc #)
strip
evt n sample 0
evt n sample 1
evt n sample 2
evt n sample 3
evt n+1 sample 0
evt n+1 sample 1
evt n+1 sample 2
evt n+1 sample 3
1adc # ~ 500 e-
~ 16mVdiff
800 ns
Pedestals variation
(evt n + 1) - (evt n)
pedestal variation (adc #)
strip
sample 0
sample 1
sample 2
sample 3
noise comparison
noise rms (adc #)
strip
rms of noise difference
0,02
'individual'
1 pedestal
1adc # ~ 500 e-
~ 16mVdiff


Pedestals variation
(relative to 'evt n sample 3')
pedestal variation (adc #)
strip
evt n sample 0
evt n sample 1
evt n sample 2
evt n sample 3
evt n+1 sample 0
evt n+1 sample 1
evt n+1 sample 2
evt n+1 sample 3
1adc # ~ 500 e-
~ 16mVdiff
400 ns
Pedestals variation
(evt n + 1) - (evt n)
pedestal variation (adc #)
strip
sample 0
sample 1
sample 2
sample 3
noise comparison
noise rms (adc #)
strip
rms of noise difference
0.02
'individual'
1 pedestal
1adc # ~ 500 e-
~ 16mVdiff


Pedestals variation
(relative to 'evt n sample 3')
pedestal variation (adc #)
strip
evt n sample 0
evt n sample 1
evt n sample 2
evt n sample 3
evt n+1 sample 0
evt n+1 sample 1
evt n+1 sample 2
evt n+1 sample 3
200 ns
1adc # ~ 500 e-
~ 16mVdiff
Pedestals variation
(evt n + 1) - (evt n)
pedestal variation (adc #)
strip
sample 0
sample 1
sample 2
sample 3
noise comparison
noise rms (adc #)
strip
rms of noise difference
0.02
'individual'
1 pedestal
1adc # ~ 500 e-
~ 16mVdiff


Pedestals variation
(relative to 'evt n sample 3')
pedestal variation (adc #)
strip
evt n sample 0
evt n sample 1
evt n sample 2
evt n sample 3
evt n+1 sample 0
evt n+1 sample 1
evt n+1 sample 2
evt n+1 sample 3
1adc # ~ 500 e-
~ 16mVdiff
Pedestals variation
(evt n + 1) - (evt n)
pedestal variation (adc #)
strip
sample 0
sample 1
sample 2
sample 3
noise comparison
noise rms (adc #)
strip
rms of noise difference
0.03
'individual'
1 pedestal
1adc # ~ 500 e-
~ 16mVdiff

100 ns.

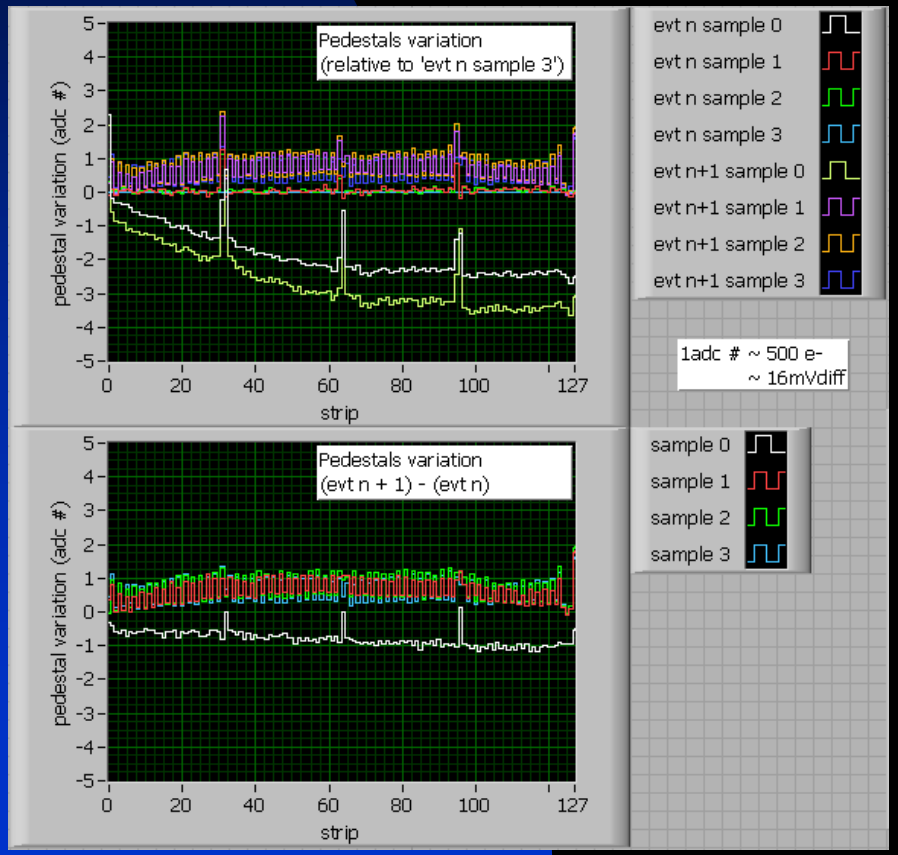
Remarks.

- ‘Smooth’ pedestal changes are effectively eliminated by cnc …
- except ‘hairy structure’. But it is small (250 e-) and ⊕ 700 e- = 6%).
- Hairy structure origin understood:
  - ★Feedback through bonded strips of detector.

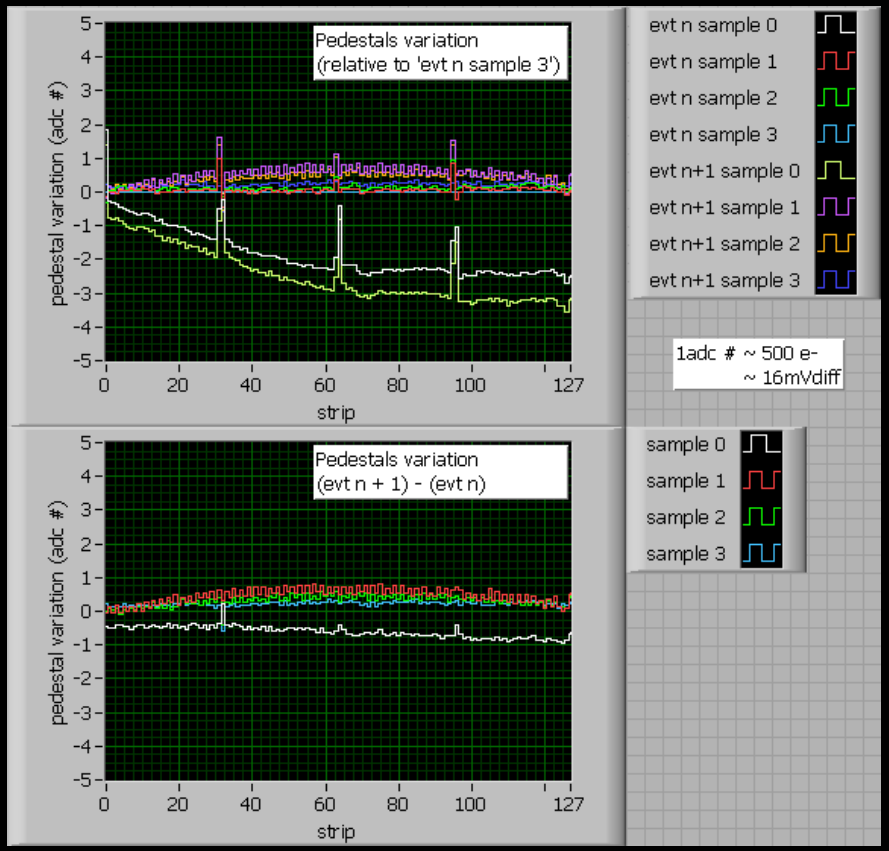
Hairy structure

Interval 1000ns

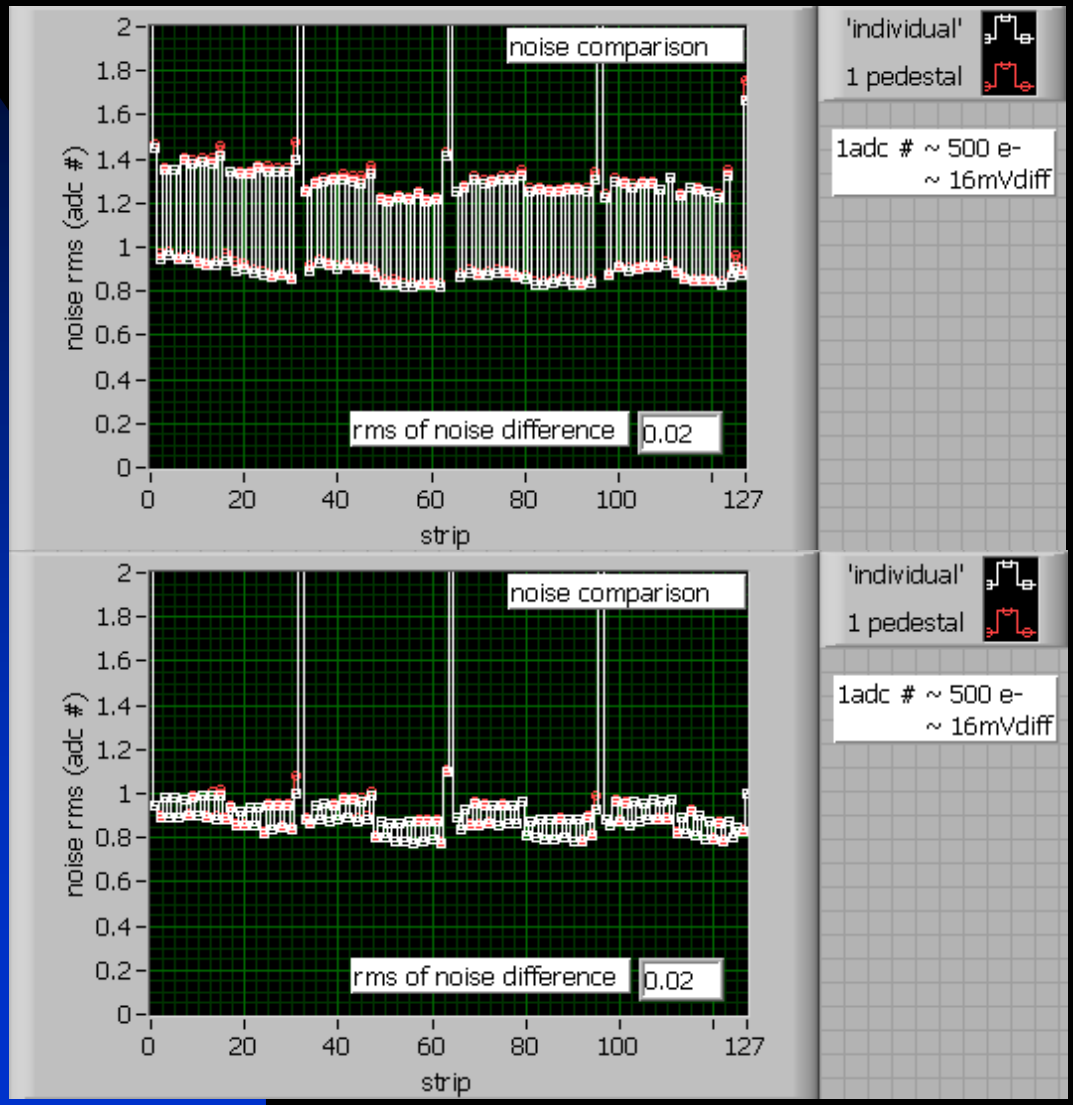
No bias



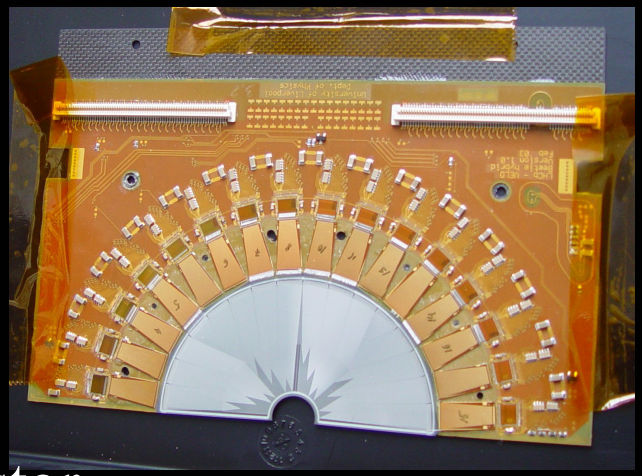
Bias 25V



Hairy structure

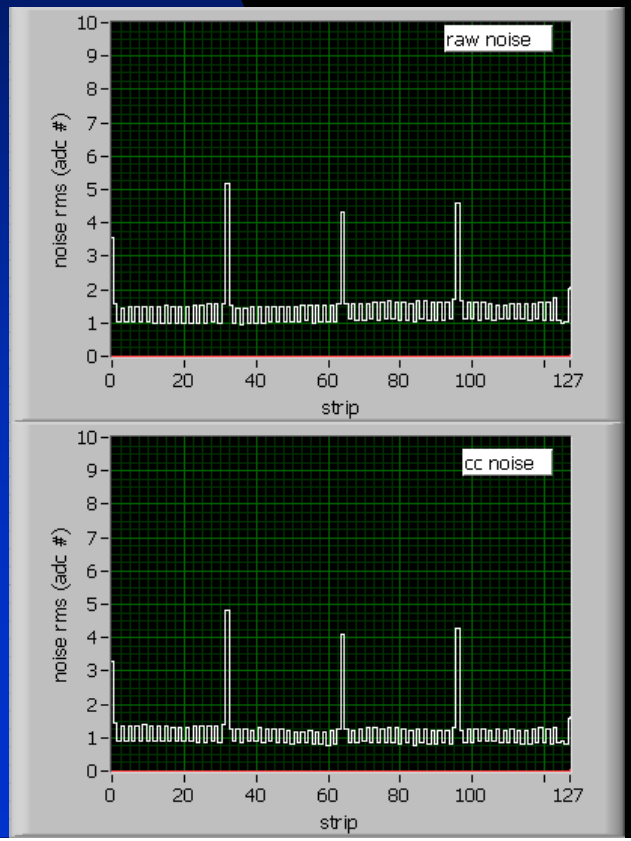


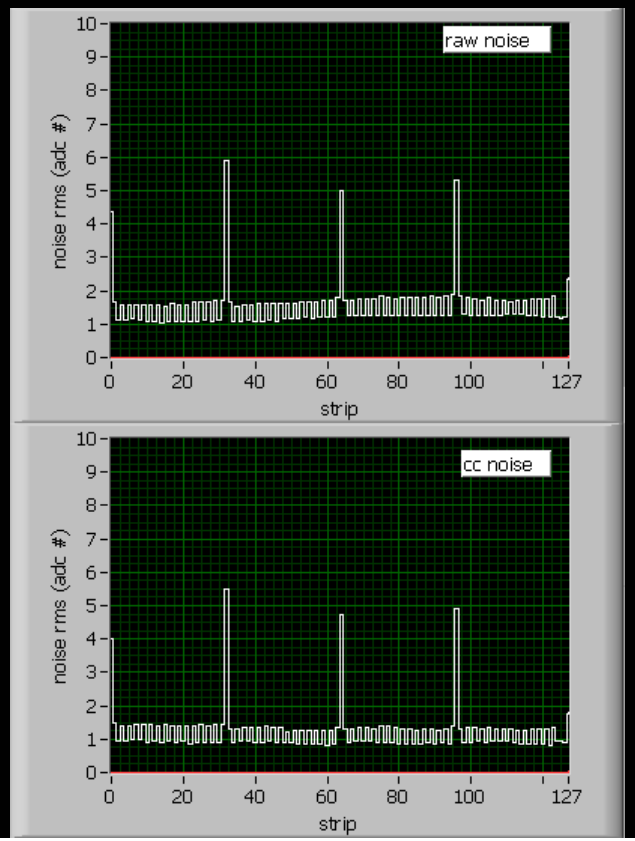
16 chip hybrid.



All biased
(power is 3A)
Not all have load resistor

Only d.u.t. biased
(power is 1.7A)





Xtalk, pulse shape

- Xtalk no measurement done.
- Pulse shapes will be measured on new hybrid before testbeam (May 10).

Conclusion

- Still more measurements (3 testbeams !) must be done to entirely validate and tune-up the Beetle1.3 with final hybrid and sensors, but no significant problem is expected.
- VELO group shares the opinion that the Beetle 1.3 will work properly.