

heartbeat trigger and packet

- heartbeat packet have $PKT = 0$
- payload is empty
- BX count is the data to look at

→ for the DualSampa, one heartbeat trigger will generate 2 packets with only the headers present.

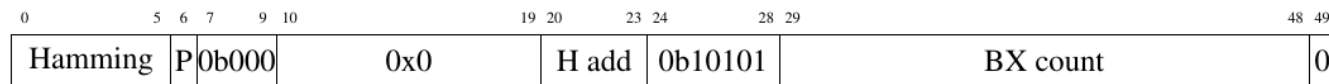
Name	Bits	Description
Hamming	6	Hamming code
P	1	Parity (odd) of header including hamming
PKT	3	Packet type, see table 2.6
Num words	10	Number of 10 bit words in data payload
H add	4	Hardware address of chip
CH add	5	Channel address
BX count	20	Bunch-crossing counter (40MHz counter)
DP	1	Parity (odd) of data payload

Table 2.5: Protocol bit field descriptions of data sent from the SAMPA.

Data	Heartbeat	Sync	Trigger too early	Data truncated	Num words [10]	PKT [2]	PKT [1]	PKT [0]
X					0	1	0	0
X					1	1	0	1
X			X		0	1	1	0
X			X		1	1	1	1
X	X				0	0	0	0
X				X	0	0	0	1
X		X			0	0	1	0
X			X	X	0	0	1	1

Table 2.6: Packet type coding (PKT).

The heartbeat packets are only sent on serial link 0 and has the highest priority, it will be sent after the transmission of the current packet has been completed.



→ this will appear as channel 21

Heartbeat trigger send in trigger mode

- **Dual Sampa configure in triggered mode.**

- we used our test bench software (Altera based) with DS345v1-MPW2 board connected on carrier board
- zero-suppression with high threshold, pedestal sub., cluster sum, pulses generated on each channel
- send 100 heartbeat trigger with a 100 Hz
 - BX counter depth is $2 \times 20 \times \text{bx_clock_period} \sim 26$ milliseconds
- send a few normal/hardware triggers

→ **no errors seen**

```

*****
*   Row   *   type * bunchcro *   len *   hadd *   chanadd *
*****
*     0   *     0 *   929002 *     0 *     1 *     21 *
*     1   *     0 *   929002 *     0 *     0 *     21 *
*     2   *     0 *   280426 *     0 *     1 *     21 *
*     3   *     0 *   280426 *     0 *     0 *     21 *
*     4   *     0 *   680426 *     0 *     1 *     21 *
*     5   *     0 *   680426 *     0 *     0 *     21 *
*     6   *     0 *   31850  *     0 *     1 *     21 *
*     7   *     0 *   31850  *     0 *     0 *     21 *
*     8   *     0 *   431850 *     0 *     1 *     21 *
*     9   *     0 *   431850 *     0 *     0 *     21 *
*    10   *     0 *   831850 *     0 *     1 *     21 *
*    11   *     0 *   831850 *     0 *     0 *     21 *
*   ....
*    192  *     0 *   531690 *     0 *     1 *     21 *
*    193  *     0 *   531690 *     0 *     0 *     21 *
*    194  *     0 *   931690 *     0 *     1 *     21 *
*    195  *     0 *   931690 *     0 *     0 *     21 *
*    196  *     0 *   283114 *     0 *     1 *     21 *
*    197  *     0 *   283114 *     0 *     0 *     21 *
*    198  *     0 *   683114 *     0 *     1 *     21 *
*    199  *     0 *   683114 *     0 *     0 *     21 *
*****
==> 200 selected entries

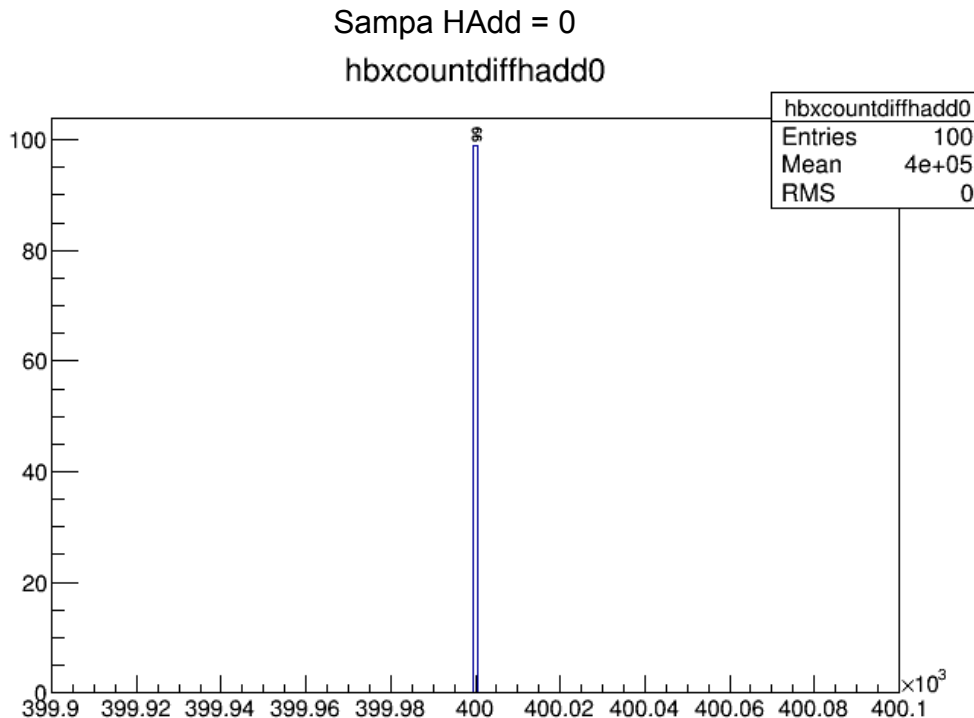
```

100 heartbeat triggers
200 heartbeat packets
 → **type = 0**
 → **len = 0**
 → **channel id = 21**
Everything looks fine

Heartbeat trigger send in triggered mode

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- **no errors seen**

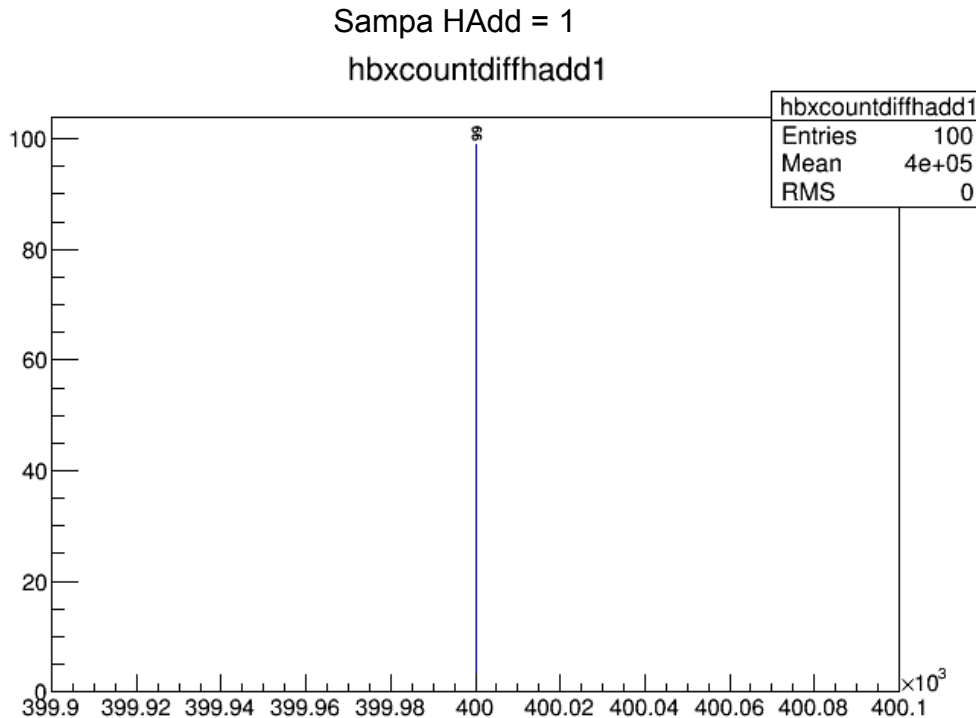


time between heartbeat triggers should be 10 ms (generated precisely by the FPGA) or 400000 bx_counts

Heartbeat trigger send in triggered mode

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 - send 100 heartbeat triggers with a 100 Hz
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time between heartbeat triggers should be 10 ms (generated very precisely by the FPGA) or 40000 bx_counts

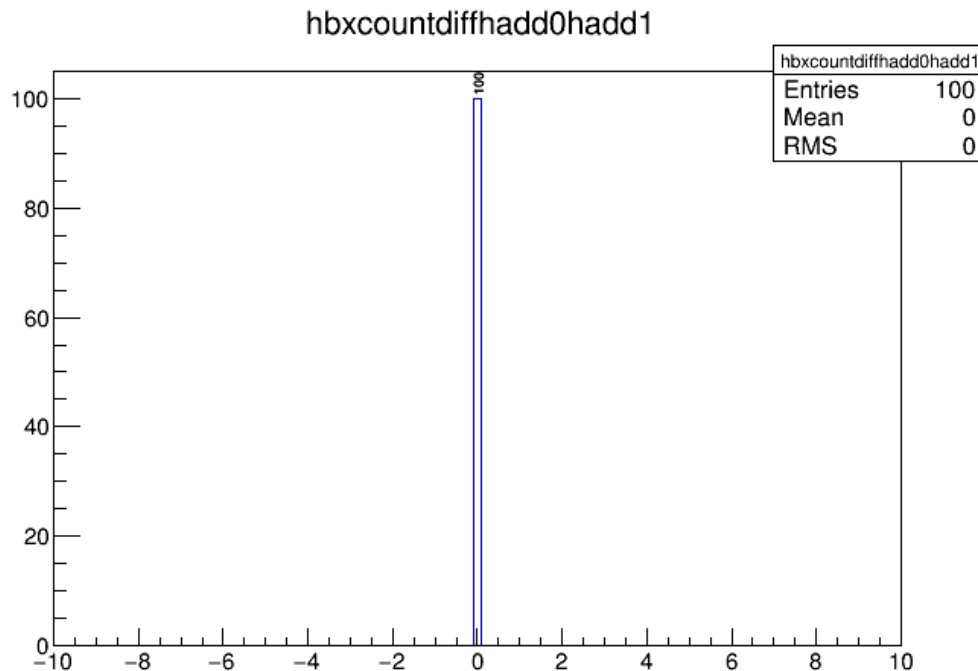
Heartbeat trigger send in triggered mode



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- send 100 heartbeat triggers with a 100 Hz
 - BX counter depth is $2^{**}20 * \text{bx_clock_period} \sim 26$ milliseconds
- send a few normal/hardware triggers
- **no errors seen**

Bx_counts difference between Sampa @ HAdd = 1 and Sampa @ Hadd = 1



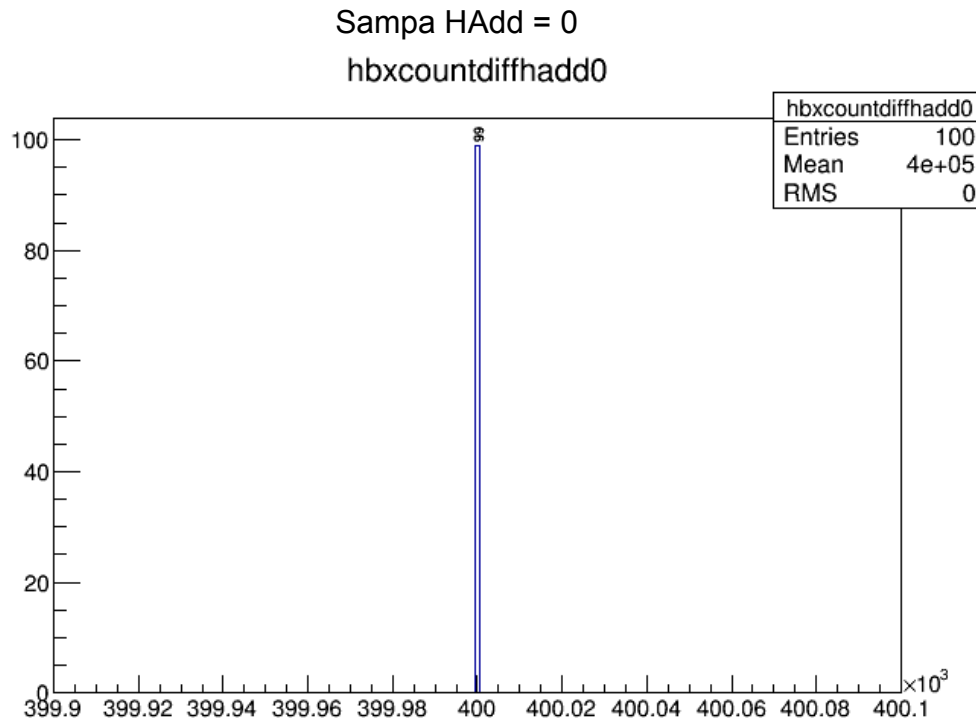
time or number of bx counts in the heartbeat packets for 2 sampas should be 0 if everything went fine.

Heartbeat trigger send in continuous mode

- **Dual Sampa configured in continuous mode at 1kHz**

- we used our test bench software (Altera based) with DS345v1-MPW2 board connected on carrier board
- zero-suppression with high threshold, pedestal sub., cluster sum, pulses generated on each channel
- send 100 heartbeat triggers with at 100 Hz during the continuous readout
 - BX counter depth is $2^{20} \times \text{bx_clock_period} \sim 26$ milliseconds

→ **no errors seen**



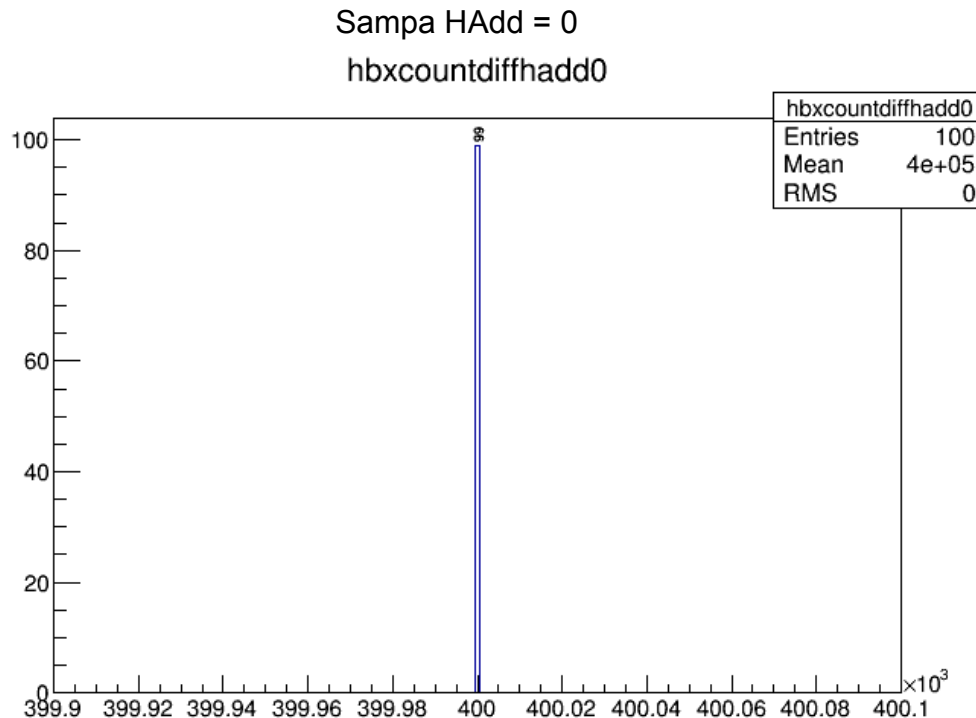
time between heartbeat triggers should be 10 ms (generated precisely by the FPGA) or 400000 bx_counts

Heartbeat trigger send in continuous mode

- **Dual Sampa configured in continuous mode at 1kHz**

- we used our test bench software (Altera based) with DS345v1-MPW2 board connected on carrier board
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- send 100 heartbeat triggers with at 100 Hz during the continuous readout
 - BX counter depth is $2^{20} \times \text{bx_clock_period} \sim 26$ milliseconds

→ **no errors seen**

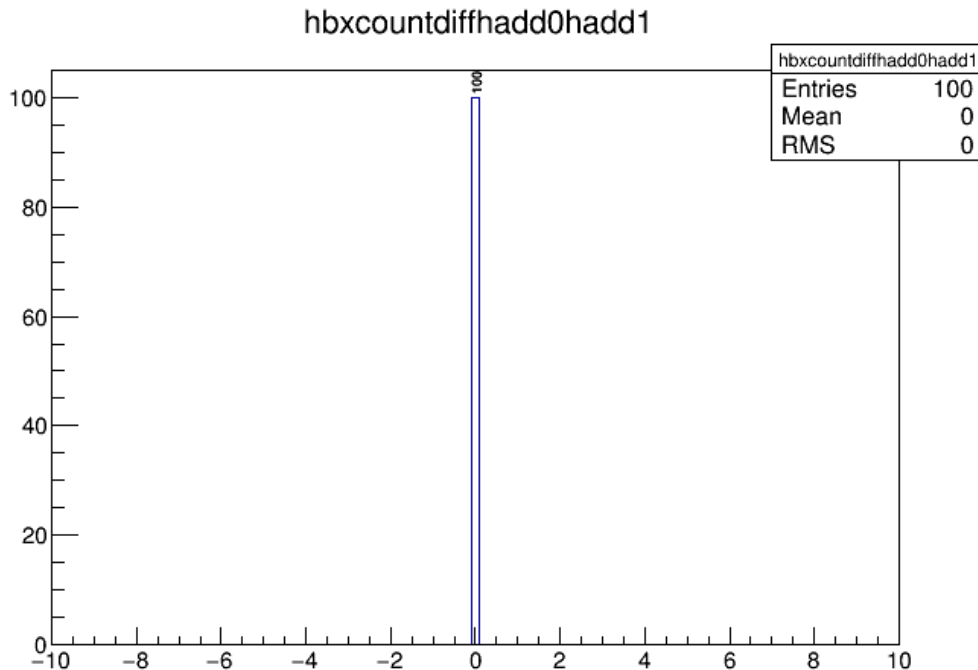


time between heartbeat triggers should be 10 ms (generated precisely by the FPGA) or 400000 bx_counts

Heartbeat trigger send in continuous mode

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 - we used our test bench software (Altera based) with DS345v1-MPW2 board connected on carrier board
 - zero-suppression with high threshold, pedestal sub., cluster sum, pulses generated on each channel
 - send 100 heartbeat triggers with at 100 Hz during the continuous readout
 - BX counter depth is $2^{**}20 * bx_clock_period \sim 26$ milliseconds
- **no errors seen**

Bx_counts difference between Sampa @ HAdd = 1 and Sampa @ Hadd = 1



time or number of bx counts in the heartbeat packets for 2 sampas should be 0 if everything went fine.

Conclusion

- Preliminary tests show **no problems in continuous and triggered mode with heartbeat triggers**
 - heartbeat packets are all present with correct format and `bx_count` values
 - no shifts observed

- Few **more checks to do**
 - verify data packets are not affected by heartbeat triggers
 - tests at higher heartbeat frequency (up to LHC orbit frequency)

Heartbeat trigger send in triggered mode

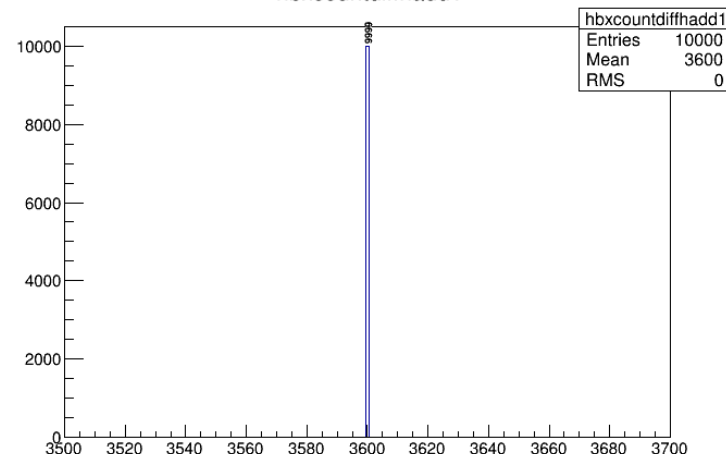
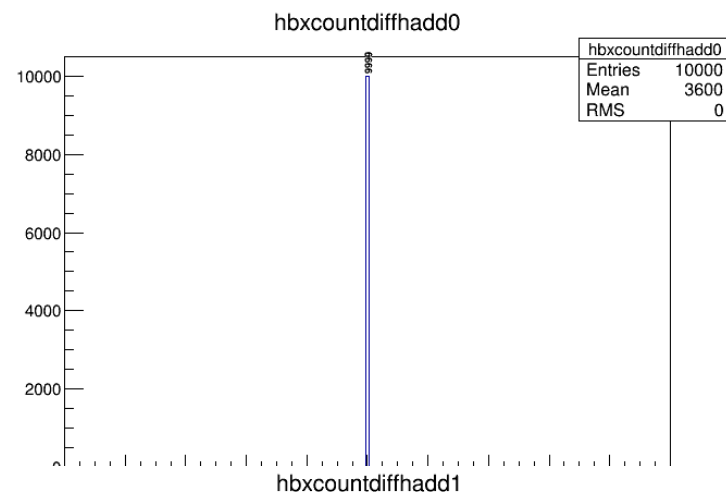
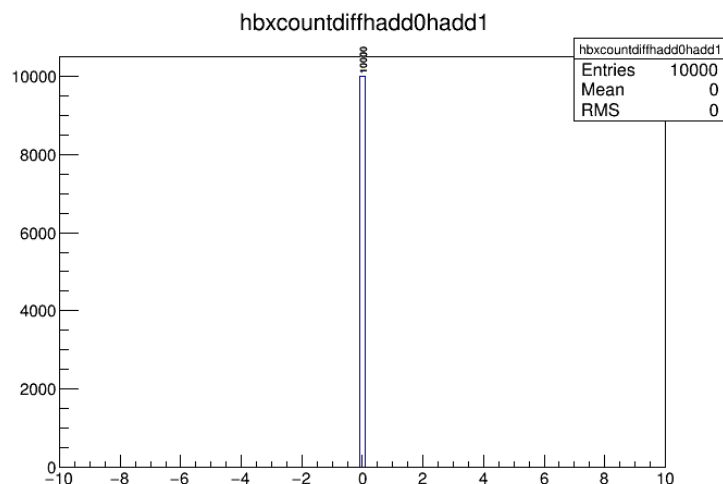
- **Dual Sampa configured in triggered mode.**

- we used our test bench software (Altera based) with DS345v1-MPW2 board connected on carrier board
- zero-suppression with high threshold, pedestal sub., cluster sum, pulses @ 10 kHz generated on each channel
- send 100 hardware triggers – 10000 heartbeat triggers with a 90 μ s period – send 100 hardware triggers

→ **no errors seen**

**- bx_counter values
in heartbeat packet
are correct**

**- no diff. between the
two sampas of the DS**



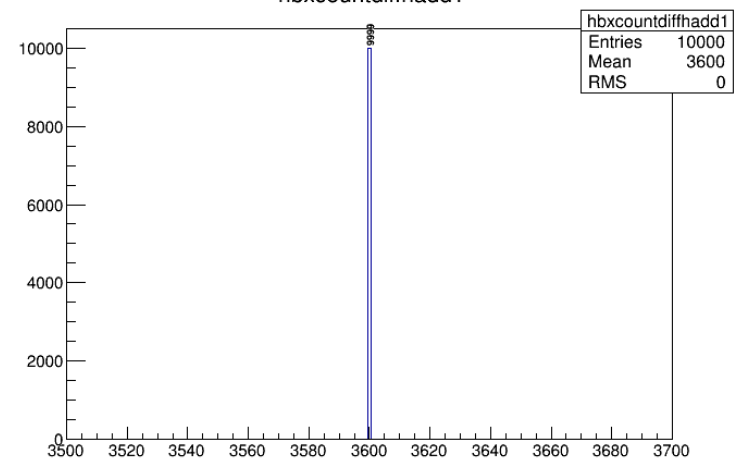
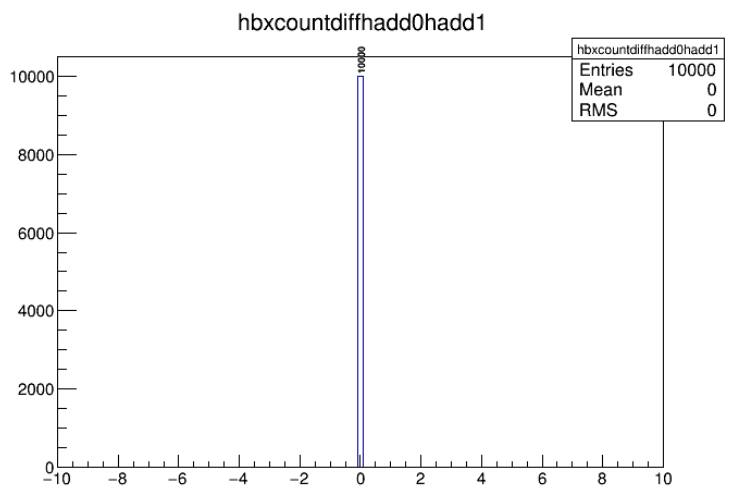
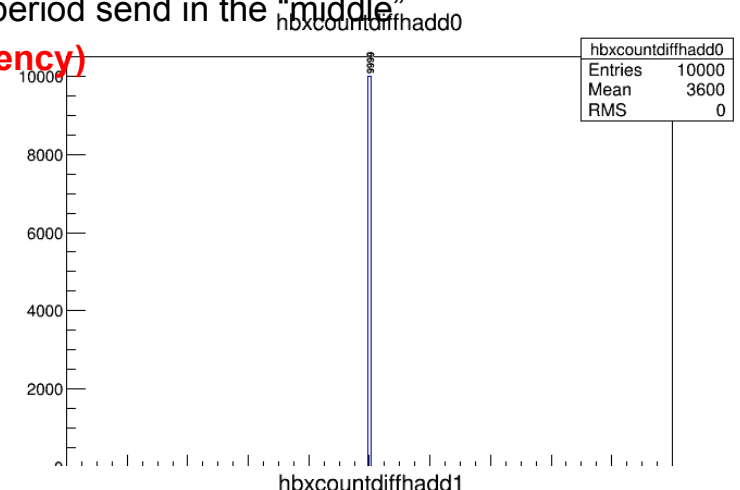
Heartbeat trigger send in continuous mode

- **Dual Sampa configured in continuous mode.**

- we used our test bench software (Altera based) with DS345v1-MPW2 board connected on carrier board
- zero-suppression with high threshold, pedestal sub., cluster sum, pulses @ 300 Hz generated on each channel
- continuous readout + 10000 heartbeat triggers with a 90 μ s period send in the “middle”

→ **no errors seen (some seen at higher input pulse frequency)**

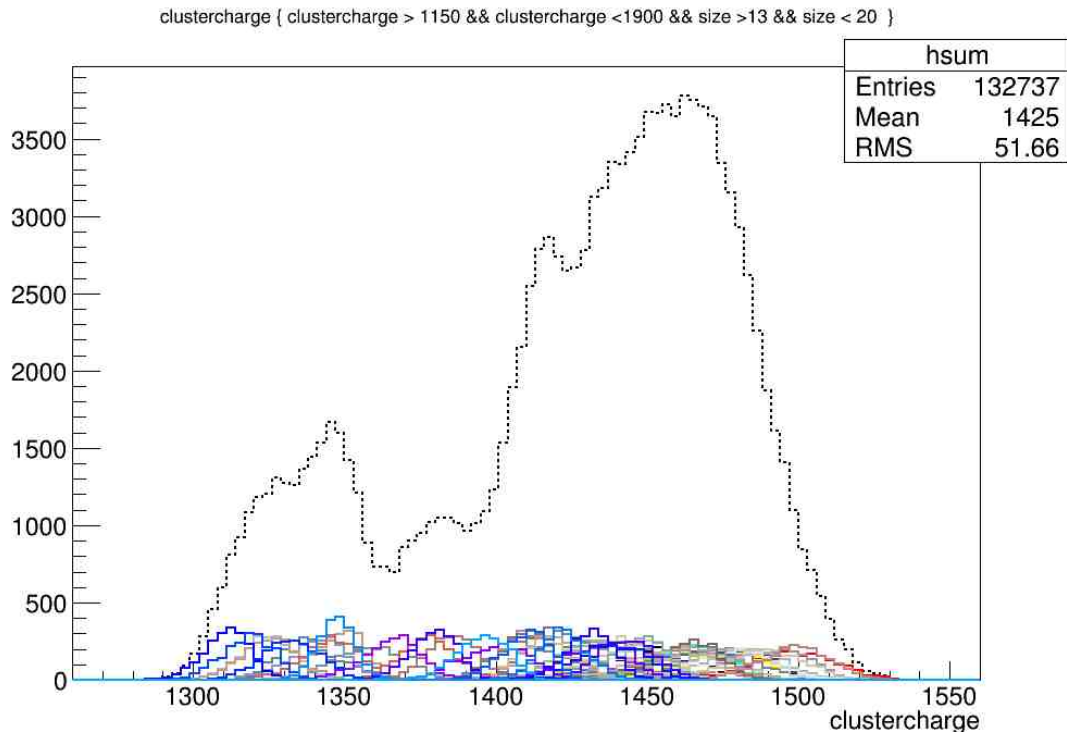
- bx_counter values in heartbeat packet are correct
- no diff. between the two sampas of the DS



Heartbeat trigger send in continuous mode

- **Dual Sampa configured in continuous mode.**

- we used our test bench software (Altera based) with DS345v1-MPW2 board connected on carrier board
- zero-suppression with high threshold, pedestal sub., cluster sum, pulses @ 300 Hz generated on each channel
- continuous readout + 10000 heartbeat triggers with a 90 μ s period send in the “middle”
- **no errors seen (some seen at higher input pulse frequency)**



Total charge from cluster sum per channel shows a 3.6% dispersion with a very 'rough' configuration (BC3 + Zerosupp. threshold at 58 ADC counts !)