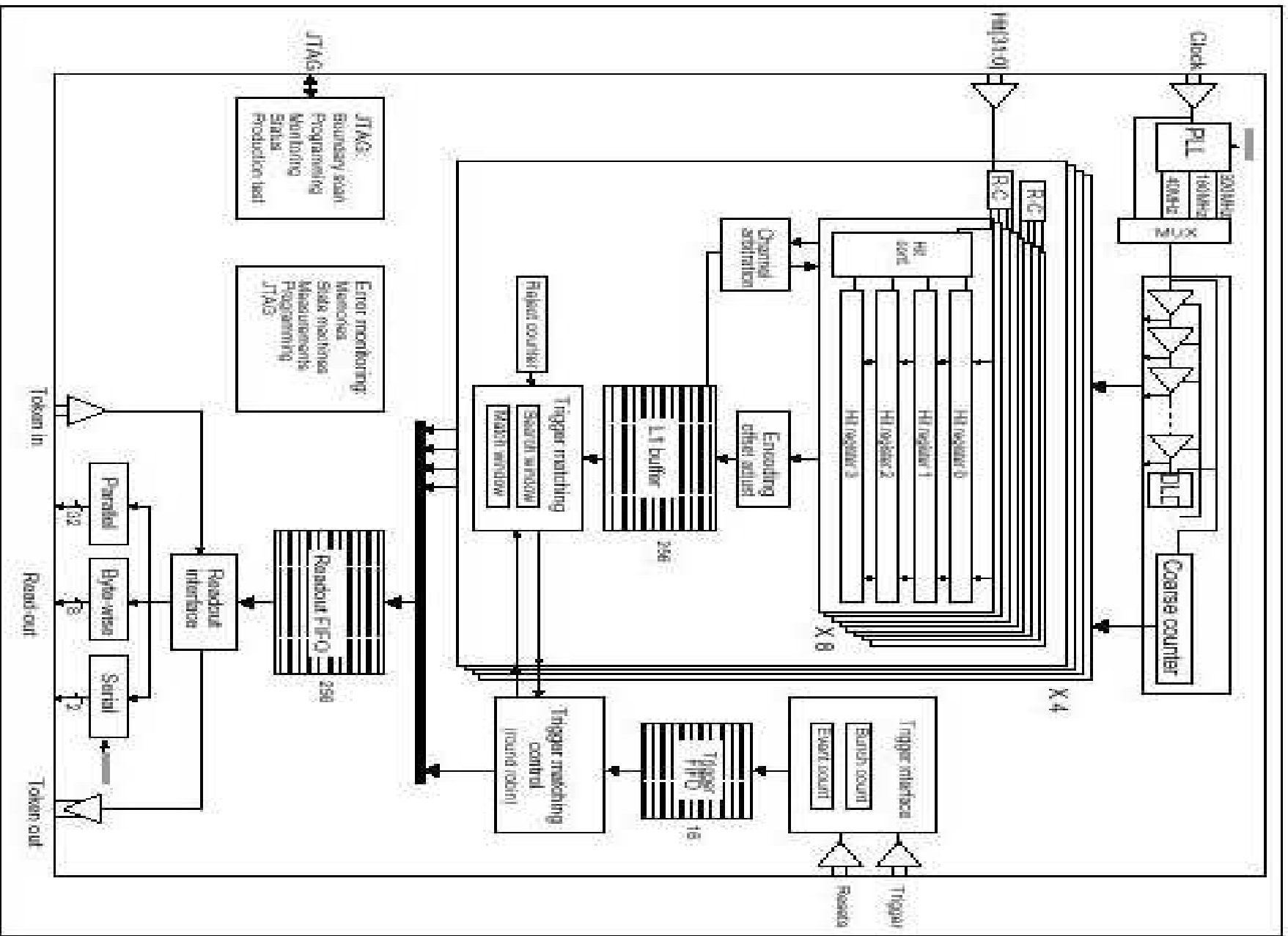


**FUNCTIONAL TEST OF HPTDC v1.0**

**AT GIF TEST BEAM**



## TDC ARCHITECTURE

# HPTDC PACKET FORMAT

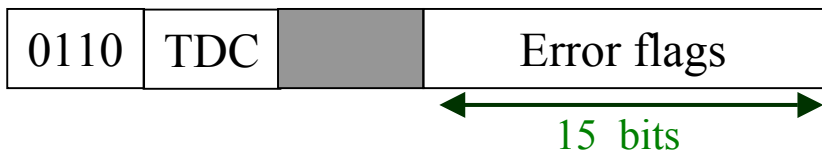
## Global header:



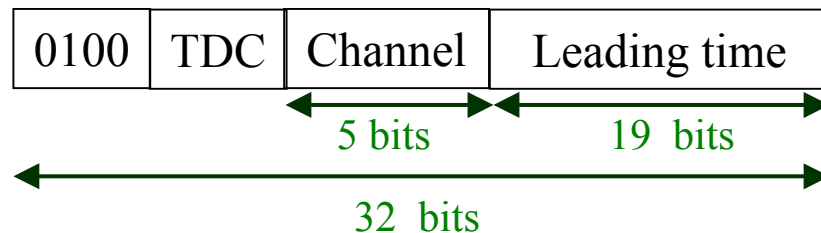
## Global trailer:



## Error flags:



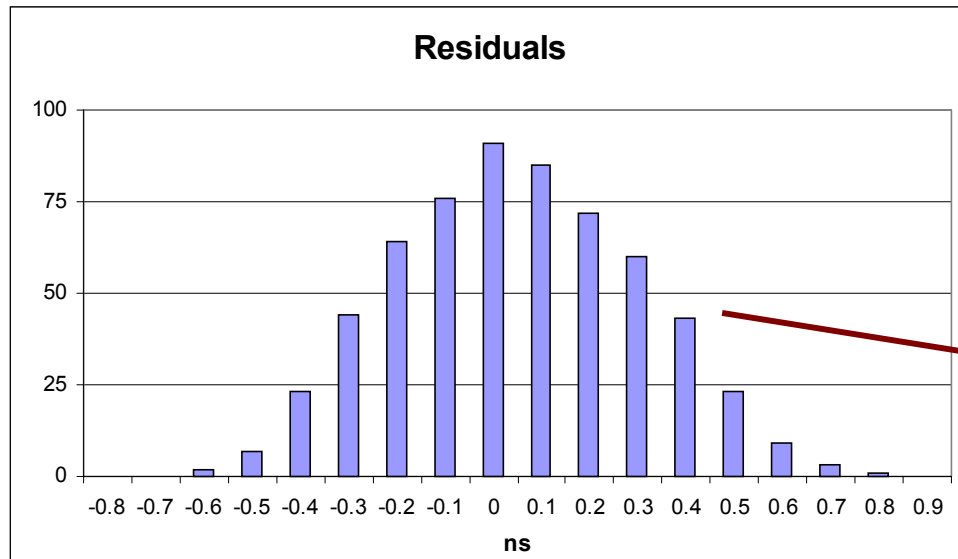
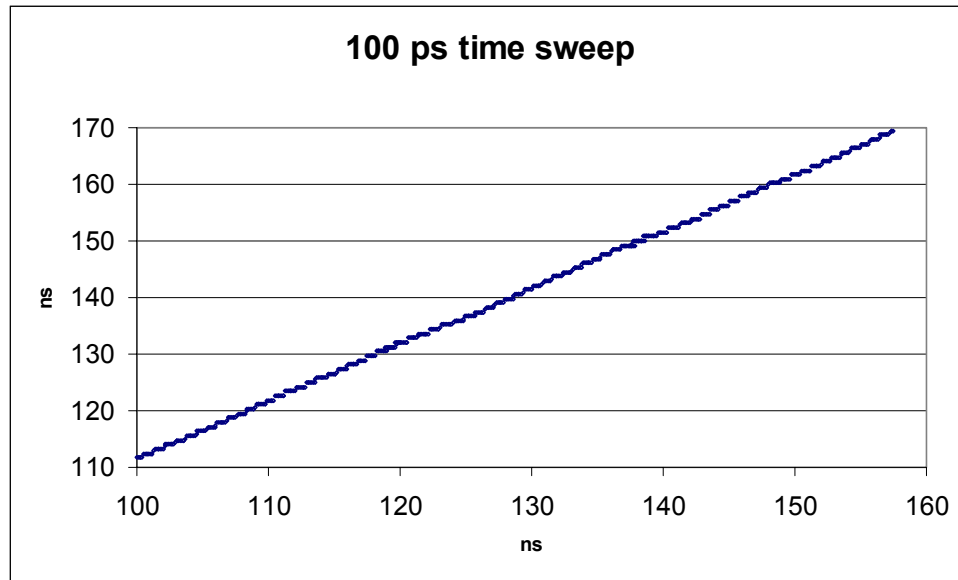
## Leading measurement:



- Internal fatal chip error has been detected
- Hit lost in group X from read-out fifo overflow
- Hit lost in group X from L1 buffer overflow
- Hit error have been detected in group X
- Hit rejected because of programmed event size limit
- Event lost (trigger fifo overflow)

- Vernier error
- Coarse error
- Select error
- L1 buffer error
- Trigger FIFO error
- Matching state error
- Read-out FIFO error
- Read-out state error
- Setup error
- Control error
- JTAG error

# LINEARITY AND RESOLUTION



$\sigma = 0.26 \text{ ns}$

# GENERAL DESCRIPTION

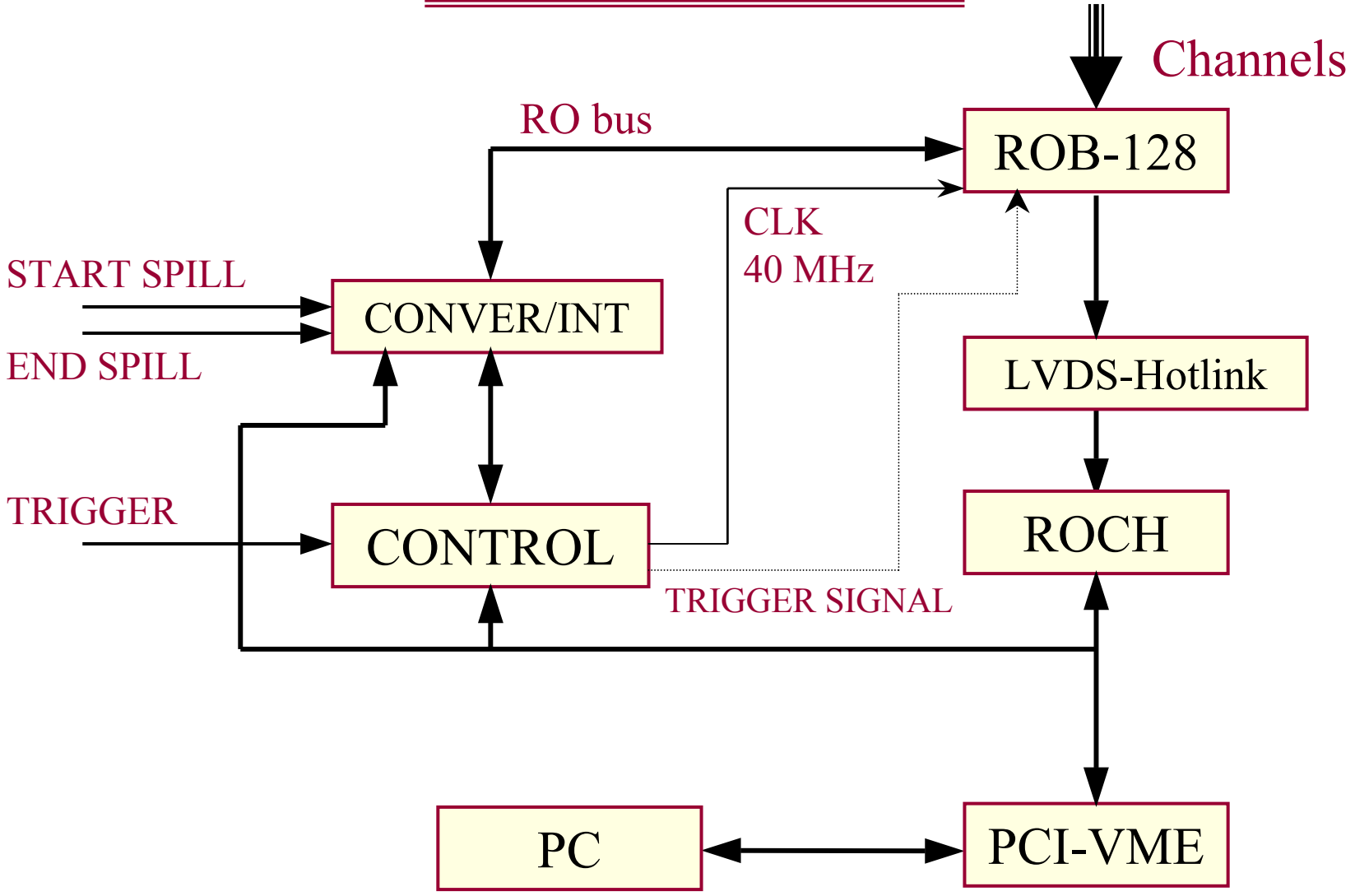
## ◆ 2 TEST BEAM PERIODS AT GIF:

- ◆ P2B (14/OCT./01): 6000 TRIGGERS/SPILL
- ◆ P2C (26-27/OCT./01):  $\left\{ \begin{array}{l} 26000 \text{ TRIGGERS/SPILL} \\ 25 \text{ ns STRUCTURED} \end{array} \right.$

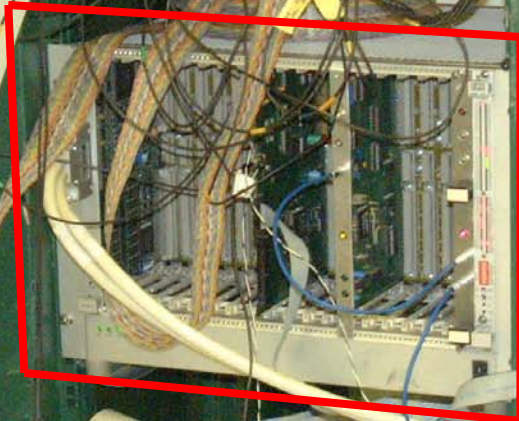
## ◆ TDC PARAMETERS SET-UP:

- DLL clock  $\left\{ \begin{array}{l} \text{source: 40 MHz from PLL} \\ \text{mode: 40 MHz} \end{array} \right.$
- Leading measurement (781 ps bin resolution)
- Enabled global headers
- 8 bits parallel readout (20 MHz)
- Ring configuration of 4 TDC's / ROB
- Search window, latency, debugg information, local headers...

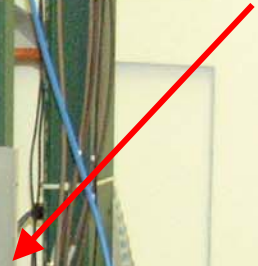
# SET-UP DIAGRAM



**DAQ**



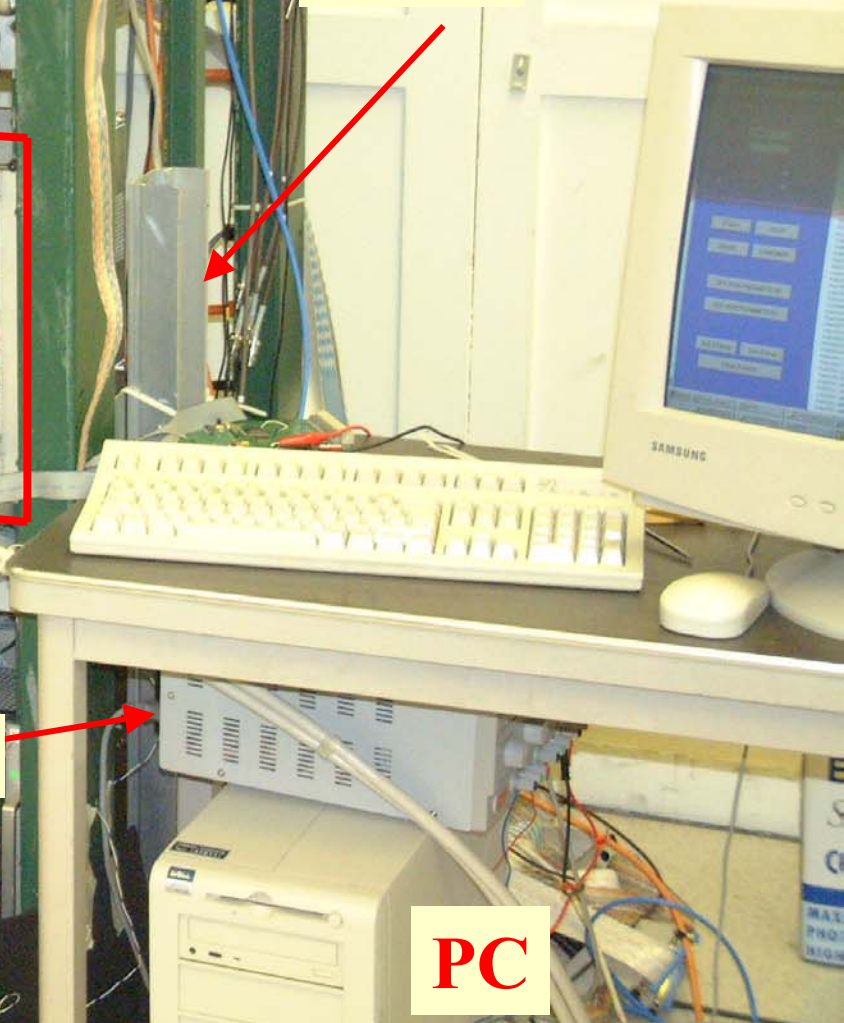
**TDCs**



**Voltage supply**

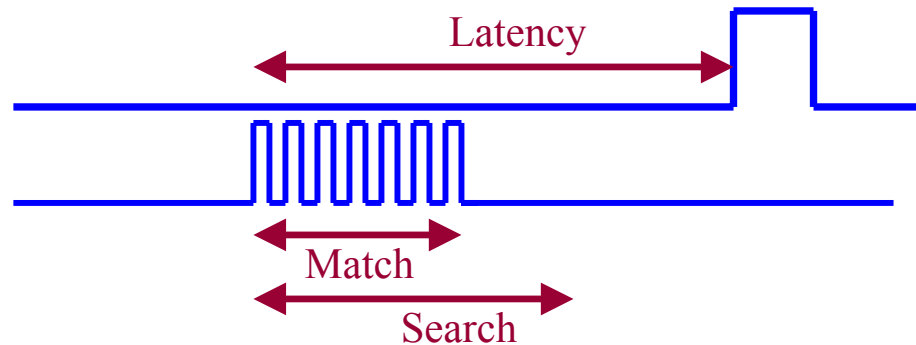


**PC**



# P2B TEST BEAM

<b>Roll over</b>	<b>3563</b>
<b>Latency</b>	<b>1100 ns</b>
<b>Search window</b>	<b>800 ns</b>
<b>Match window</b>	<b>1000 ns</b>



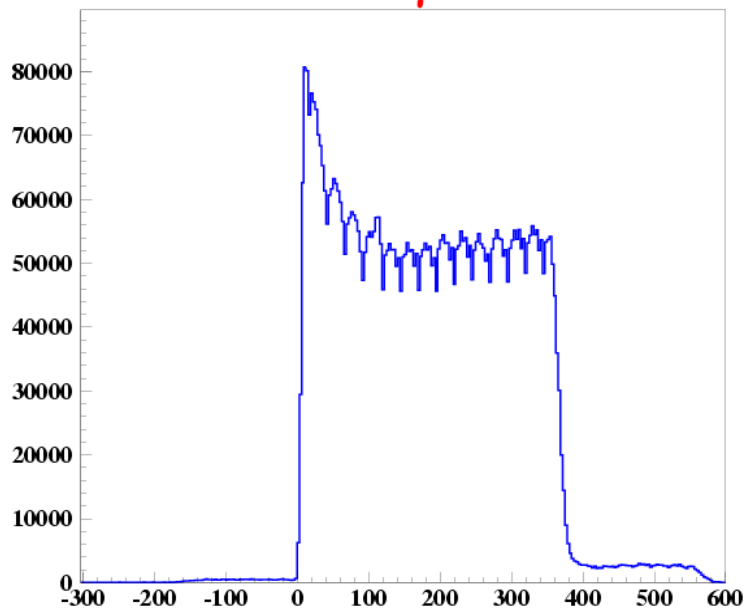
	<b>RUN 15</b>	<b>RUN 16</b>	<b>RUN 17</b>	<b>RUN 21</b>
<b>Events</b>	465159	510774	500904	834
<b>search window</b>	700 ns	700 ns	700 ns	700 ns
<b>match window</b>	900 ns	900 ns	900 ns	900 ns
				Debugg Flag

~ 3 10<sup>6</sup> total events  
 ~ 16 words/event  
 ~ 36 words/event  
 with debug information

	<b>RUN 24</b>	<b>RUN 26</b>	<b>RUN 28</b>
<b>Events</b>	366646	504409	507624
<b>search window</b>	800 ns	900 ns	700 ns
<b>match window</b>	1000 ns	1100 ns	1000 ns
			Gammas

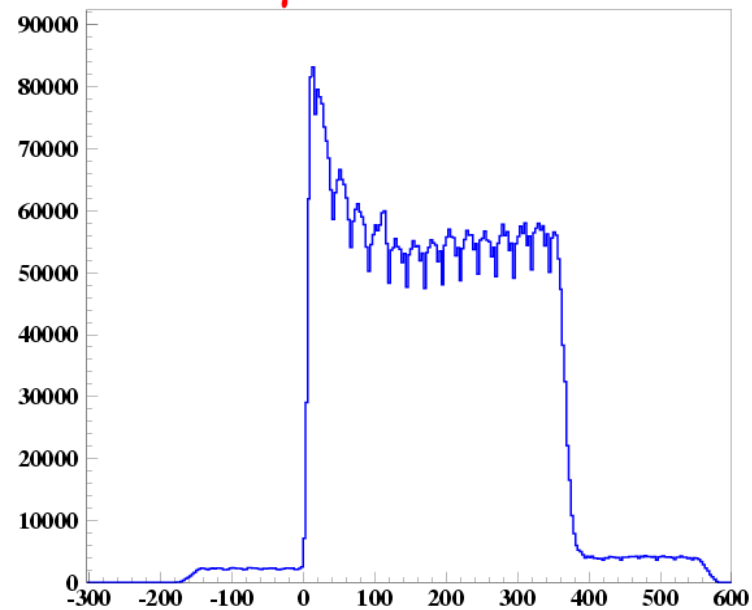


**NO  $\gamma$**



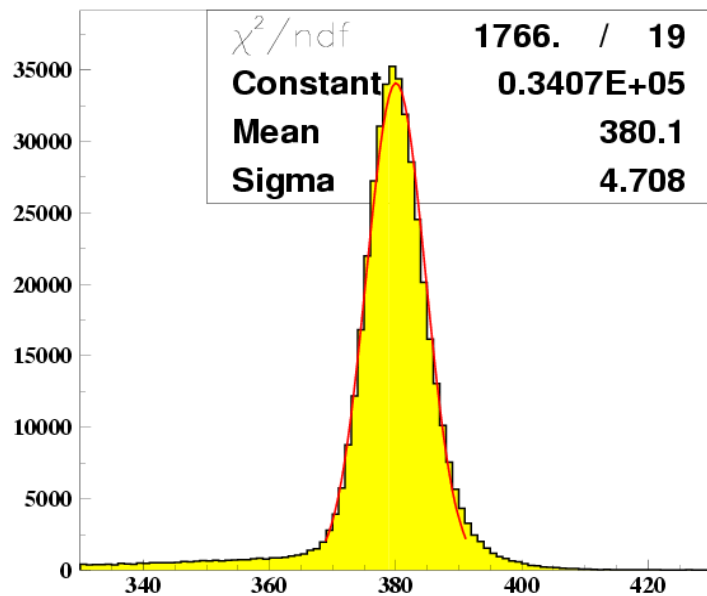
**Time (3 SLs together) (ns)**

**$\gamma$  ABS:10**

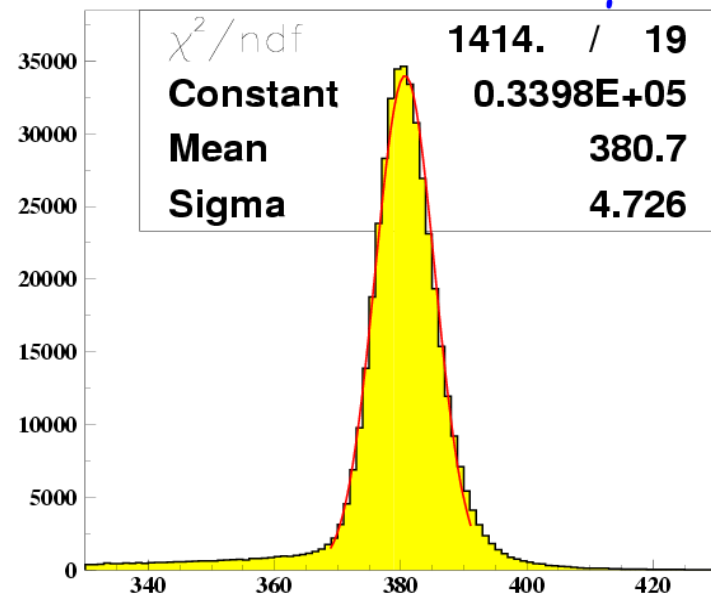


**Time (3 SLs together) (ns)**

**Mean Timer SL1 NO  $\gamma$**



**Mean Timer SL1 NO  $\gamma$**



# P2B TEST BEAM RESULTS

- No TDC error
- No link error
- 0.1 % events without hits
- DAQ errors

800 ns window  
 1 trigger/ms  
 5  $10^5$  events } → ~ 400 expected double triggers

	RUN 15	RUN 16	RUN 17
<b>Block errors</b>	8	3	6
<b>Double Triggers</b>	658	772	733

	RUN 21	RUN 24	RUN 26	RUN 28
<b>Block errors</b>	0	4	3	3
<b>Double Triggers</b>	1	556	713	693

- Few events without trigger signal (~2 per run).
- Most of them at the begining of a block.

# P2C TEST BEAM

- **Trigger read as a hit in two different TDCs (TDC2-16, TDC3-16) to confirm the loss of trigger signals.**
- **Testing the behaviour under new beam conditions.**

<b>RUN 2</b>	<b>RUN 4</b>	<b>RUN 6</b>	<b>RUN 7</b>	<b>RUN 8</b>	<b>RUN 26</b>
26/10/01	26/10/01	27/10/01	27/10/01	27/10/01	27/10/01
306077	498799	99799	497798	498399	10079
match=700 ns	R.O.=4000	Local headers	match=1975 ns	Trigger:	Debbug
search=900 ns	Latency=1100 ns	and trailers	search=2175 ns	C2.C3	
			Latency=2200 ns		

<b>RUN 27</b>	<b>RUN 32</b>	<b>RUN 46</b>
499599	10029	450999
Mask on	Test pulse	Gammas
noisy channels		

~ 5 10<sup>6</sup> total events  
 ~ 20 words/event disabling noisy channels  
 ~ 40 words/event without disabling

# P2C TEST BEAM RESULTS

- TDC error flag: buffer overflow. Noisy channels: 16 & 19 (TDC 1).
- Few events without hits.
- Block errors not eliminated.
- Transmission error flag (run 2 (1,5  $\mu$  s) and 4 (5,5  $\mu$  s)), no data lost.
- Few events without trigger signal.
- 0.002% events without hits.

	RUN 2	RUN 4	RUN 6	RUN 7
<b>TDC buff.ovflw.</b>	7 (0) 10(1)	354 (1)	3 (1)	211 (1)
<b>Block errors</b>	5	7	3	12
<b>Multiple triggers</b>	~42000	~56000	~11100	~99000

	RUN 8	RUN 26	RUN 27	RUN 32	RUN 46
<b>TDC buff.ovflw.</b>	6 (1)	0	0	0	0
<b>Block errors</b>	9	1	3	1	491
<b>Multiple triggers</b>	~59000	~972	~56000	0	~26000

# P2C TEST BEAM RESULTS (2)

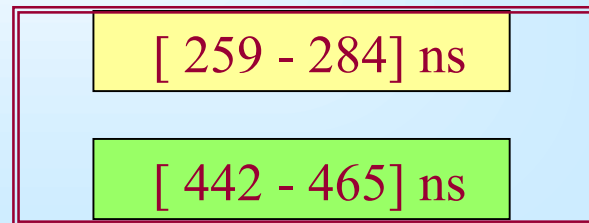
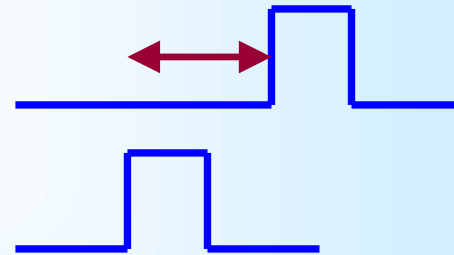
- Maximum number of triggers/event = 5 (higher than in P2B).
- Different number of multiple triggers, but correlated.
- Lost of trigger signals in both channels simultaneously.

N° triggers TDC 2/16

	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>0</b>	23	0	0	0	0	0
<b>1</b>	0	263852	73	0	0	0
<b>2</b>	0	69	38610	18	0	0
<b>3</b>	0	0	13	3256	2	0
<b>4</b>	0	0	0	1	154	0
<b>5</b>	0	0	0	0	0	6

N° triggers TDC 3/16

Table 1: Run 2 example



# P2C TEST BEAM RESULTS (3)

## •DEBUGG INFORMATION (RUN 26):

L1 buffer (max)	TDC 0	TDC 1	TDC 2	TDC 3
group 0 (0-7)	6	16	14	11
group 1 (8-15)	17	17	21	12
group 2 (16-23)	16	254	5	5
group 3 (24-31)	13	15	0	0

•L1 buffer minimum occupancy = 0; except TDC 1 group 2 = 8

Trigger FIFO	TDC 0	TDC 1	TDC 2	TDC 3
max occupancy	3	3	3	2

•Trigger FIFO minimum occupancy = 0

Read out FIFO	TDC 0	TDC 1	TDC 2	TDC 3
max occupancy	56	120	79	59

•Read out FIFO minimum occupancy = 3

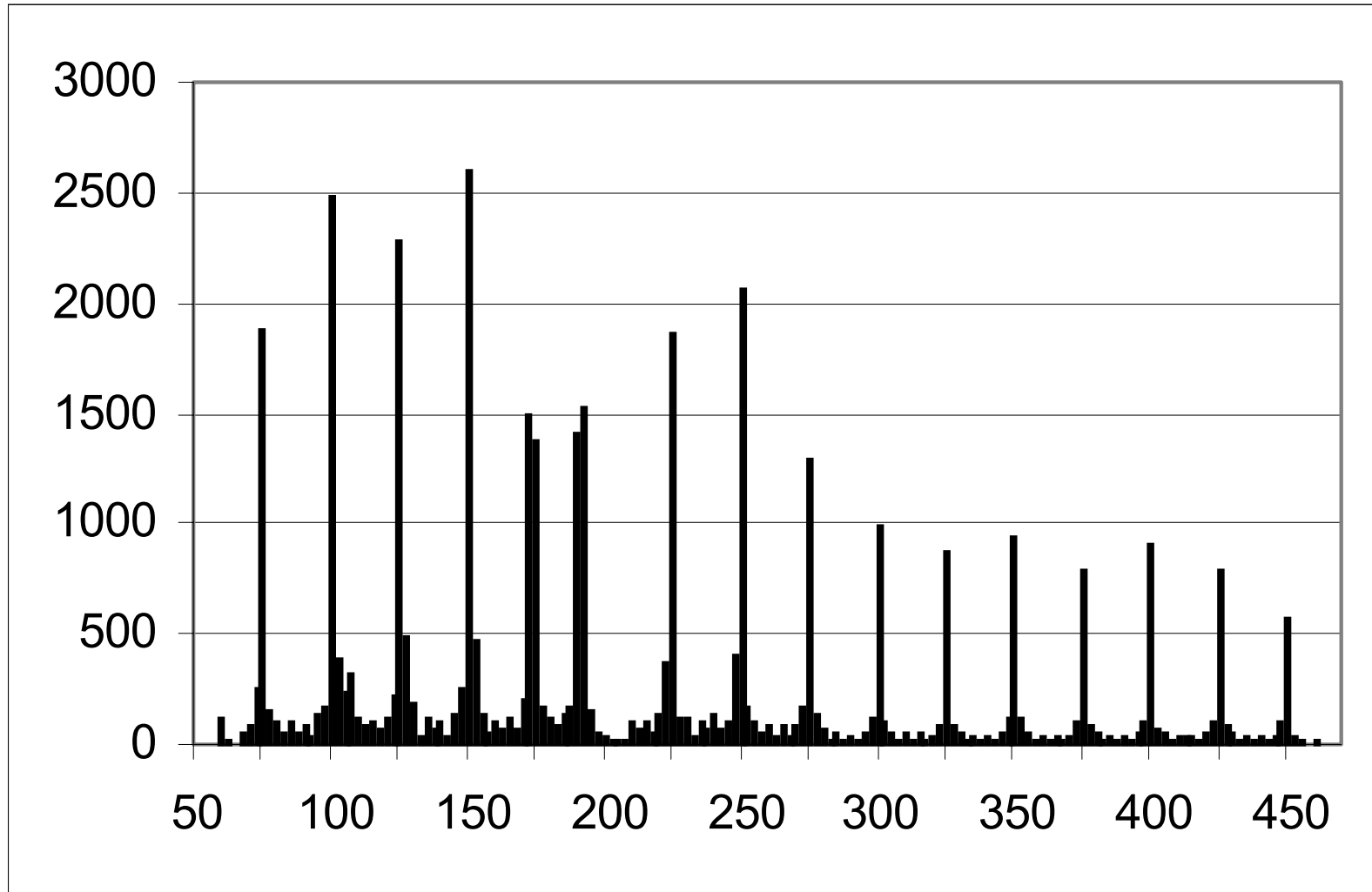
# CONCLUSIONS

- No significant errors found in this TDC v1.0.
- TDC stands high hit rates, even with noisy channels.
- Noisy channels only affect one group (8 channels), and buffer full is flagged.

## NEXT STEPS:

- Check that no errors seem to have been produced by TDC.
- Understand block errors and consequent loss of data (DAQ).
- Analyze in laboratory loss of trigger signals (due to DAQ?)  
and correlation between multiple trigger signals.
- Check unlocking of the LVDS link.
- Understand the difference between the two periods with respect to the ratio of events without hits.

# TIME SEPARATION BETWEEN TRIGGER SIGNALS (DOUBLE TRIGGER EVENT)



P2C TEST BEAM PERIOD (run 2)