TDC Calibrations

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Abstract

The TDC channels of the ZDCs have been calibrated with an Ortec time calibrator. All the channels are within 0.5% of the nominal 100ps/channel and nonlinearities are negligible. Yuri has developed a procedure to calibrate all the Beam-Beam counter TDC channels in one pass. This can easily be extended to TOFW, H1 and H2. The Beam-Beam counter TDCs are all close to 25ps/channel except for 1 channel. This note lists the serial numbers of all TDCs used in 2000. Run 2552 contains data for the calibration of all BRAHMS TDCs

1 Introduction

Because of imperfections in components the TDCs may not have exactly the same relation between counts and time that is advertised. For this reason it is best to calibrate the them against a known time interval. The Ortec 662 Time Calibrator produces START and STOP signal with a very precise interval between them.

$$STOP = START + n * STEP \tag{1}$$

where n is a random variable between 1 and m and $m = RANGE/STEP$.

When first used on the ZDC LRS 2221A TDC this device produced beautiful "picket fence" TDC spectra At 100ps/channel the width of the peaks was so narrow that Andrei did not have to use a gaussian fit. The precision of the fit could be improved by using the "DISPERSION" swith on the Ortec 662 to smear out the peaks while keeping the mean in the same position. Then we could use a gaussian fit to get a more accurate determination of the mean.

BRAHMS has 4 CAMAC crates of Phillips 7186 16 channel TDCs. These modules have a TEST input which is fanned out to all 16 channels and is daisy chained from 1 module to the next. The STOP signal from the Time Calibrator is split 4 ways and sent to one module in each crate. For the ZDCs the STOP from the time calibrator is put into the COMMON STOP input which fans it out to all 8 channels. Thus all channels can be calibrated at the same time.

2 Setting up a TDC calibration Run

Eric and I have done a TDC calibration (for H1, H2, BB, TOFW) run 2544. In order do a TDC calibration run connect the STOP from the Ortec Time Calibrator in Rack 6,Crate 3 slot 1 to the discriminator channel 5 in the 3rd slot of the crate. Then go to the FAN-In/Out in Rack 5, Crate 1, Slot 3 and select "D TDC calibration". Select partitions CAMAC , Fb3 and Fb4 and triggers

- 7 pulser down-scaled 10
- 8 sync down-scaled 1

Make sure you direct the DAQ to write to HPSS and the local disk. Then just start a normal pulser run, 60000 events is enough.

After you have finished the run, reconfigure the pulser trigger FanIn/FanOut back to "A" and disconnect the output of the Ortec Time Calibrator. To check that everything is OK view the spectra with SuperMon. Figure 1 shows the TDC spectrum of the first module of the left ZDC for run 2552. The peaks are all about 100 channels apart implying a scale of .1ns/channel.

3 Results and Analysis Procedure

Figure 2 shows the position of the TDC peaks versus time for one channel of the beam-beam counters. The fit is to a first order polynomial. Note that the input to this plot should be the mean of each peak and the error on the mean as determined by a gaussian fit.

Figure 3 summarizes the results for the beam-beam counter. The errors are larger than they should be because Yuri used the RMS of individual peaks in the TDC spectra rather than the error on the mean as the input

channel	$P1$ channels/ns	$P1'$ channels/ns	$P2'$ 10^-5
			(channels/ns)^2
0 Left 1	9.967 ± 0.004	9.951 ± 0.019	7.0 ± 8.6
1 Left 2	9.958 ± 0.004	9.945 ± 0.019	5.7 ± 8.6
2 Left 3	9.948 ± 0.004	9.920 ± 0.019	12.5 ± 8.6
3 Left Sum	10.070 ± 0.004	10.040 ± 0.019	12.0 ± 8.6
4 Right 1	10.080 ± 0.004	10.060 ± 0.019	8.1 ± 8.6
5 Right 2	10.010 ± 0.004	9.986 ± 0.019	10.7 ± 8.6
6 Right 3	10.010 ± 0.004	9.984 ± 0.019	13.9 ± 8.6
7 Right Sum	10.000 ± 0.004	9.981 ± 0.019	9.4 ± 8.6

Table 1: Fit parameters for the ZDC TDC calibration

to Fig. 2. This will be fixed. Also the unit of time in BRAT is ns so the constants should be devided by 1000 before being stored in the database.

Table 1 shows the final results for the ZDCs. Fits to first ($P1$) and second order polynomials ($P1'$ and $P2'$) are shown. The nonlinearity at the middle of the range, ie 1000 TDC channels is given by $1000 * P2/P1 \approx .001$ and so it can be ignored.

These constants need to be inverted inorder to be in the same format as the beam-beam counters, ie ns/channel.

4 Databases and serial numbers

These calibrations should of course be stored the database. In NA44 the calibrations were done one module at a time and the TDC database was keyed on the serial number of the module. We then needed to figure out which module went with which set of hodoscope slats. Since it is so simple to calibrate I think we should store the serial numbers but store the calibration constants directly for each channel number. We could calibrate once a year and then recalibrate a particular detector any time a TDC is changed. The serial numbers of the modules are shown below.

Slot	Serial number
1	16073
3	17556
5	16066
7	17565
9	17568
11	10561
15	14753
17	13956
19	16067
21	16071

Table 2: H1,H2 TDC serial numbers, Rack 2 Crate 4.

Slot	Serial number	Channel number
12	17567	1-16
14	17555	17-32
16	12203	33-36 70-77
18	10670	37-52
20	10671	53-66
22	13232	78-82

Table 3: Beam Beam TDC serial numbers, Rack 5 Crate 4

Slot	Serial number
2	17566
4	17100
6	17533
8	17558
10	17562
12	16859
14	17561
16	17101
18	17563
20	17099

Table 4: TOF Wall CA-5 TDC serial numbers, Rack 10 Crate 5

Slot	Serial number
2	17554
4	10669
6	12205
8	12204
10	12202
12	12206
14	17560
16	17570
18	17552
20	17559

Table 5: TOF Wall CA-6 TDC serial numbers, Rack 10 Crate 6

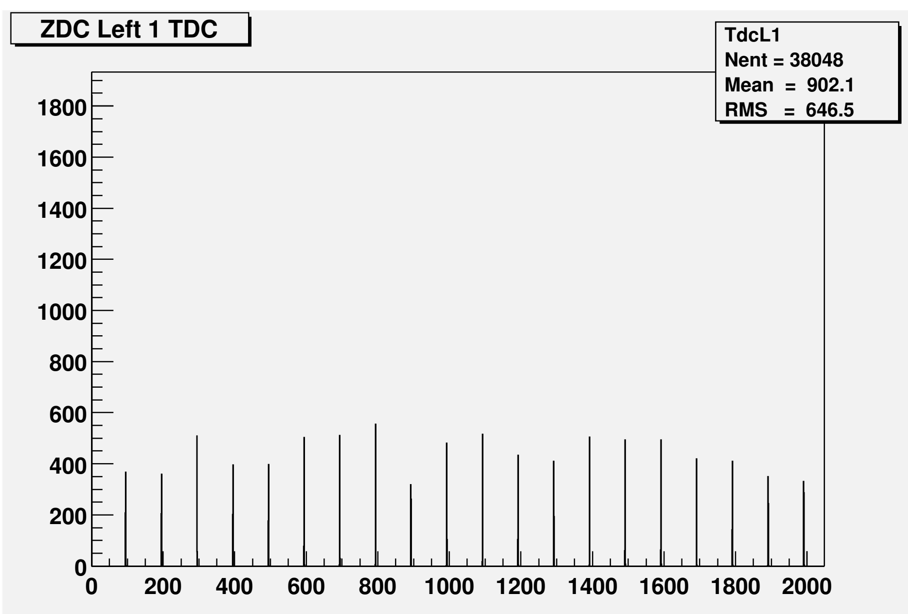

Figure 1: TDC channel vs time for one of the beam-beam counter channels. The fit is too a first order polynomial

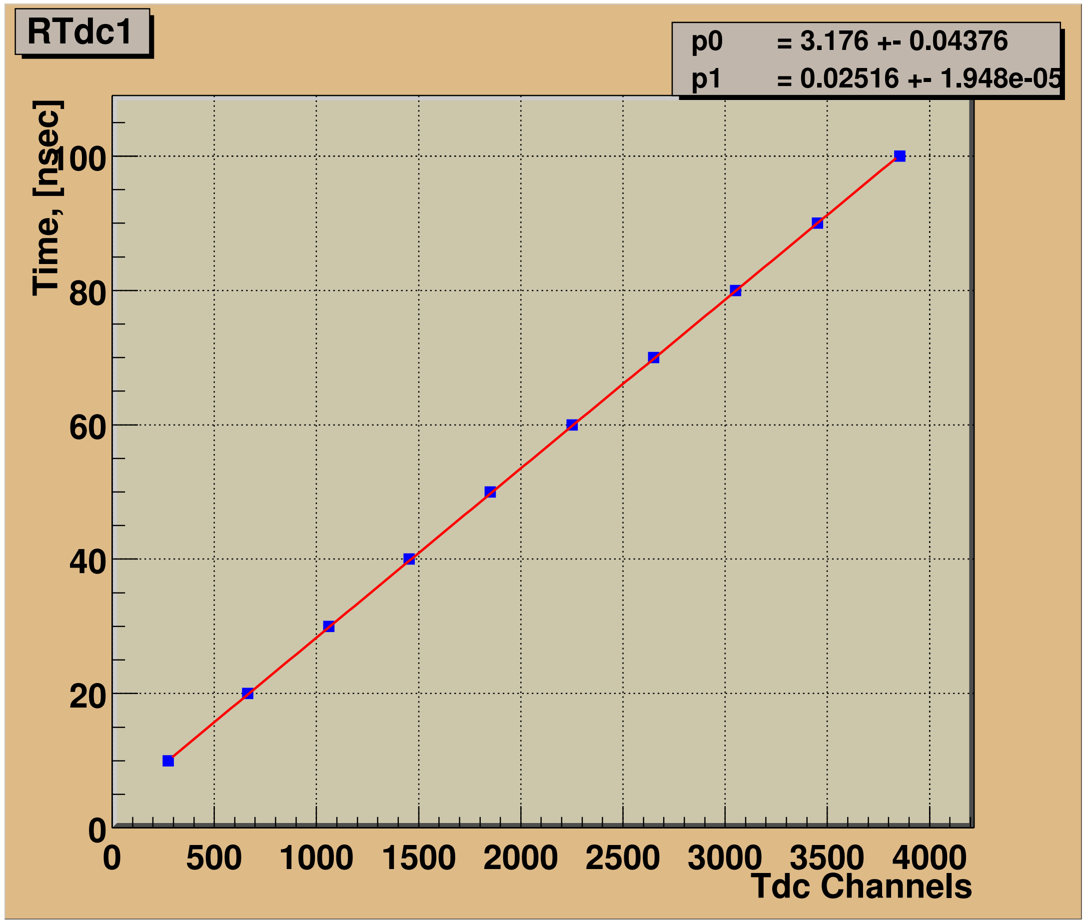

Figure 2: TDC channel vs time for one of the beam-beam counter channels. The fit is too a first order polynomial

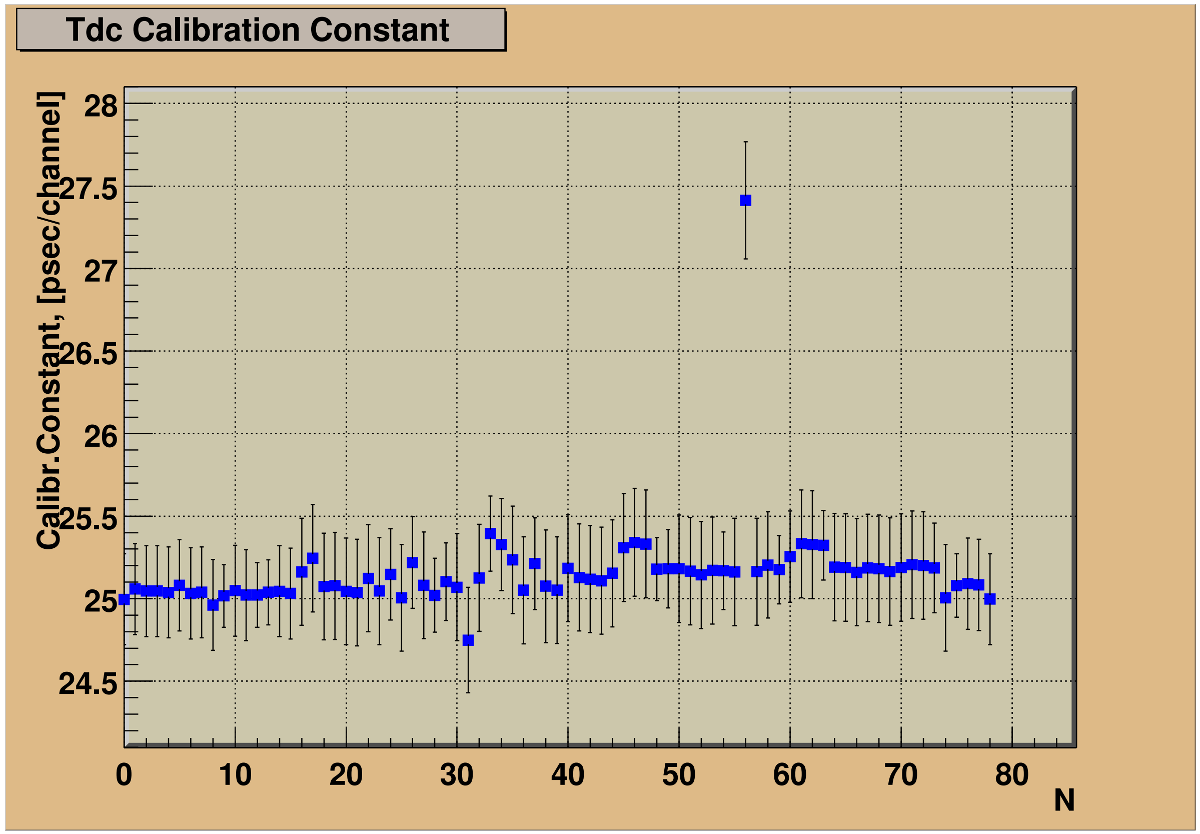

Figure 3: TDC Calibration Constants vs channel for the beam-beam counter