Cf-252 data obtained w/ new detector w/ PMT holders.

A. Zero time measurement + BKG.

Run 3453. U(NaI) = -1050 V, 50 Ohm signal splitter is out, CFD threshold (NaI) = - 14mV, U(E1,2) = -1400 V, CFD threshold (E1,2) = -3 mV, CFD delay (E1) = 12 ns (ch 6 in CFD), CFD delay (E2) = 8 ns (ch 4 in CFD). NaI is in front of plastic scintillator (~20 cm away). There is 2" lead shielding with small (diam ~1.5 cm) hole in a lead brick. BKG measurement. Rate = 13.92 Hz.

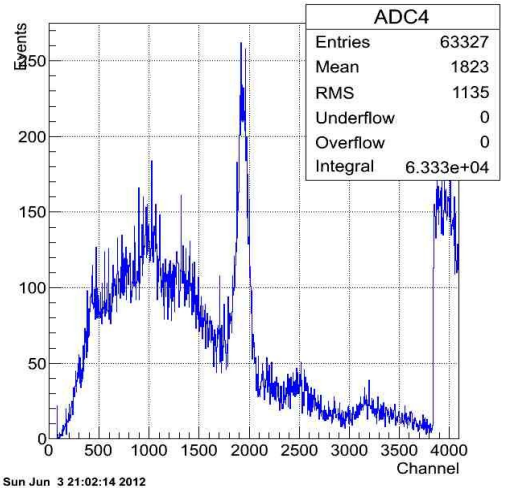

Fig. 1. ADC BKG spectrum.

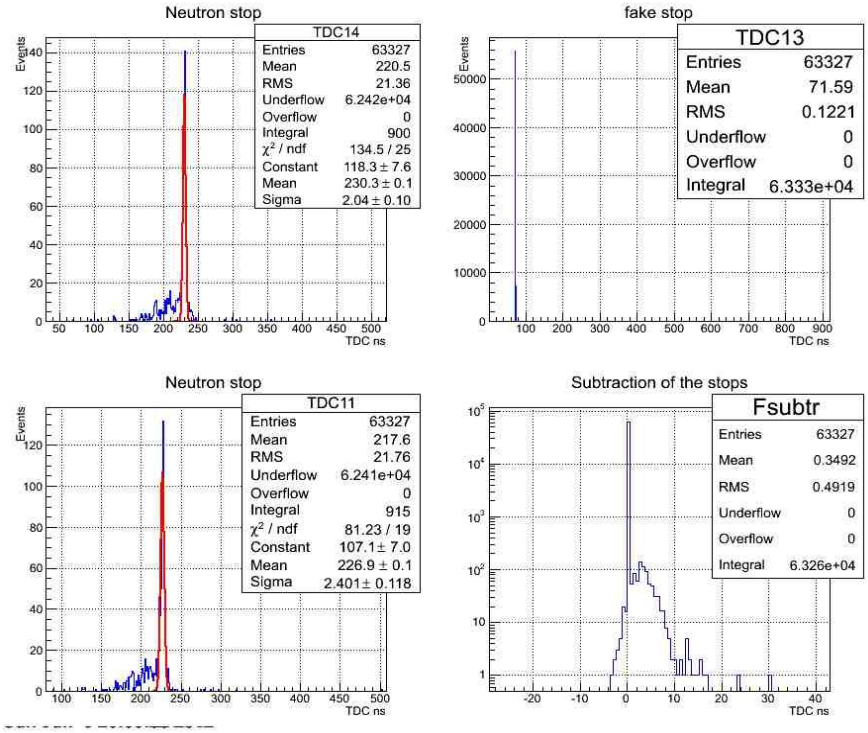

Fig. 2. TDC BKG spectrum.

Run 3452. U(NaI) = -1050 V, 50 Ohm signal splitter is out, CFD threshold (NaI) = - 14mV, U(E1,2) = -1400 V, CFD threshold (E1,2) = -3 mV, CFD delay (E1) = 12 ns (ch 6 in CFD), CFD delay (E2) = 8 ns (ch 4 in CFD). NaI is in front of plastic scintillator (~20 cm away). There is 2" lead shielding with small (diam ~1.5 cm) hole in a lead brick. Na-22 source in. Rate = 54.7 Hz.

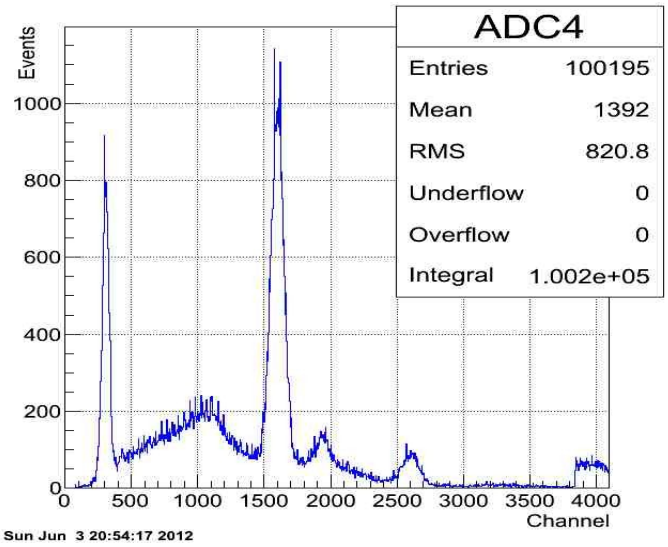

Fig.3 Na-22 ADC spectrum.

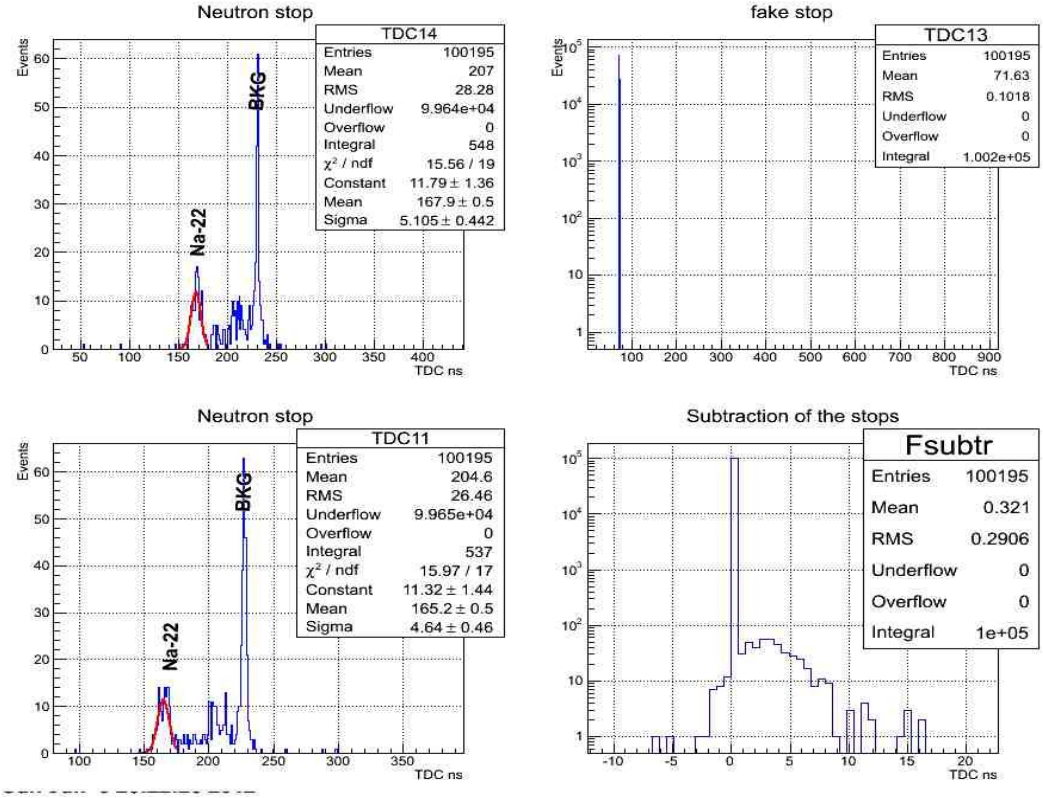

Fig. 4. TDC spectrum.

The neutron time interval was established for TDC14(E1) to be 150 ns: [167.9ns+5.1ns=173ns,323ns].

The neutron time interval was established for TDC11(E2) to be 150 ns: [165ns+5ns=170ns,320ns].

B. BKG+Efficiency measurement.

Run 3455. U(NaI) = -1050 V, 50 Ohm signal splitter is out, CFD threshold (NaI) = - 14mV, U(E1,2) = -1400 V, CFD threshold (E1,2) = -1 mV, CFD delay (E1) = 12 ns (ch 6 in CFD), CFD delay (E2) = 8 ns (ch 4 in CFD). NaI is inside the regular shielding (65 cm away from plastic). There is 2" lead shielding in front of plastic scintillator. BKG measurement. Rate = 0.86 Hz.

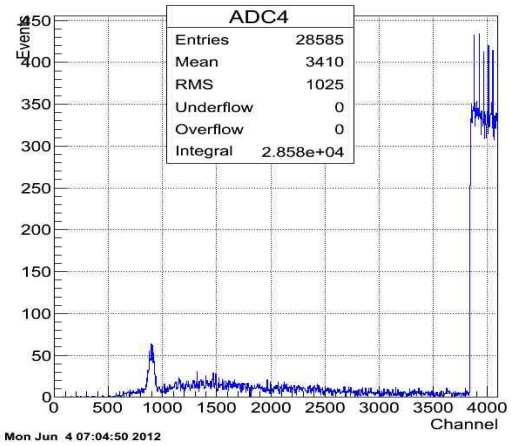

Fig. 5. ADC BKG spectrum.

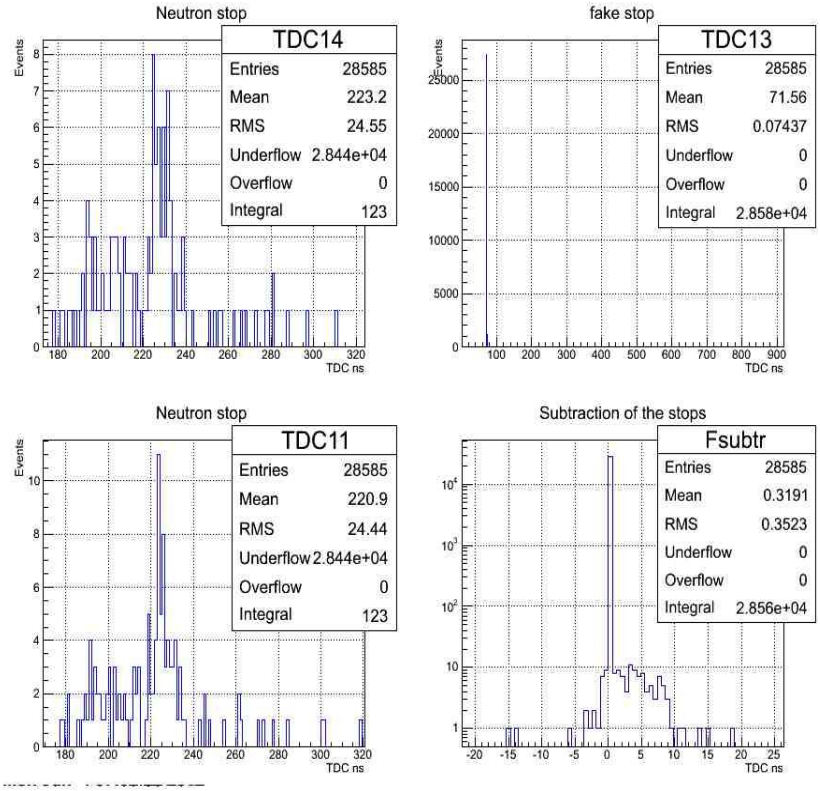

Fig. 6. BKG TDC spectrum.

Duration of the run was 33238.4 sec. So, the BKG counting rate in the region of interest is: TDC14_BKG = 123/33238.4 = **0.0037 Hz**, TDC11_BKG = 123/33238.4 = **0.0037 Hz**. S/N ratio for our trigger (NaI det) is ~ 47Hz/0.86Hz = 54 (see below for the example of the signal rates).

Run 3446. U(NaI) = -1020 V, 50 Ohm signal splitter is in, CFD threshold (NaI) = - 50mV, U(E1,2) = -1400 V, CFD threshold (E1,2) = -1 mV, CFD delay (E1) = 12 ns (ch 6 in CFD), CFD delay (E2) = 4 ns (ch 4 in CFD). NaI is inside the regular shielding (65 cm away from plastic). There is 2" lead shielding in front of plastic scintillator. Cf-252 source in. Rate = 47.2 Hz.

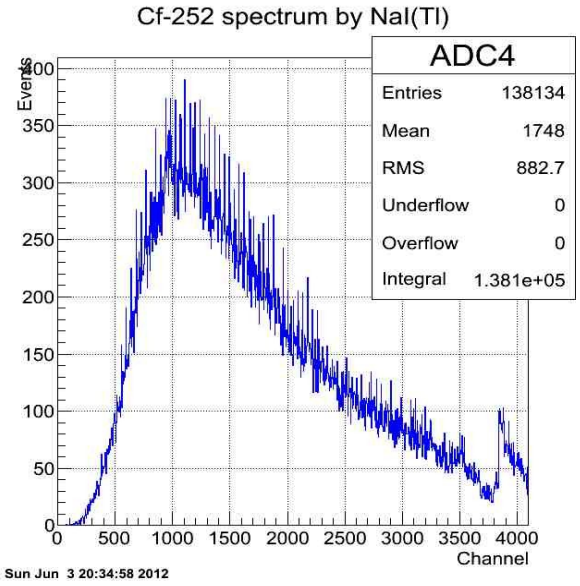

Fig.7 Cf-252 ADC spectrum.

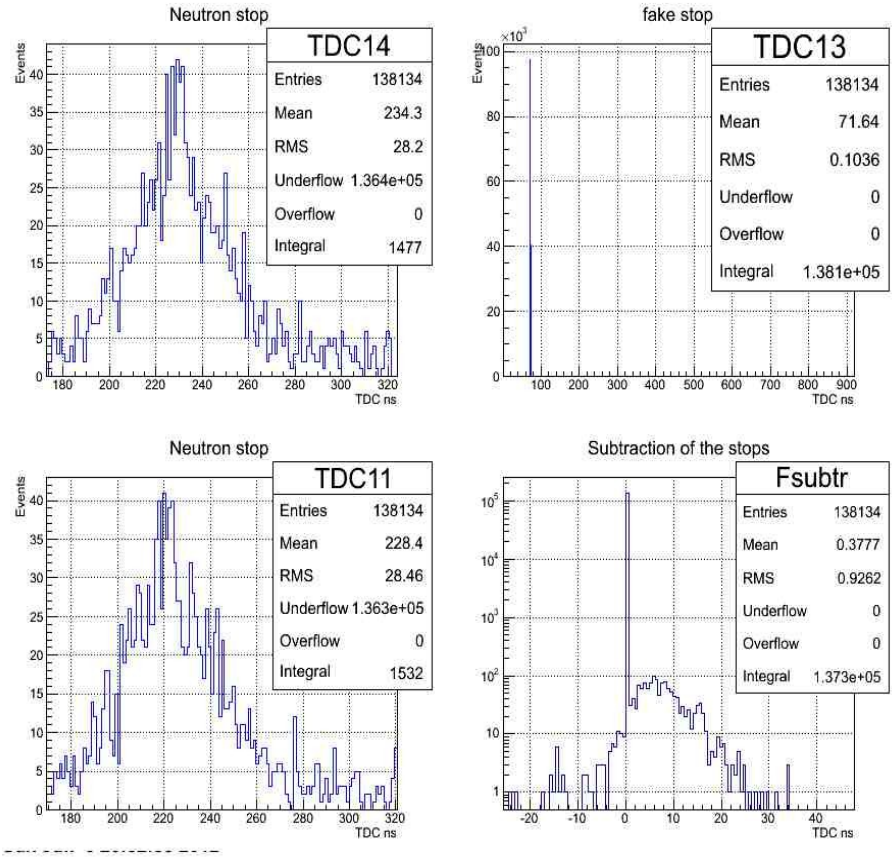

Fig. 8. TDC spectrum.

Run 3445. U(NaI) = -1020 V, 50 Ohm signal splitter is in, CFD threshold (NaI) = - 50mV, U(E1,2) = -1400 V, CFD threshold (E1,2) = -2 mV, CFD delay (E1) = 12 ns (ch 6 in CFD), CFD delay (E2) = 4 ns (ch 4 in CFD). NaI is inside the regular shielding (65 cm away from plastic). There is 2" lead shielding in front of plastic scintillator. Cf-252 source in. Rate = 47.0 Hz.

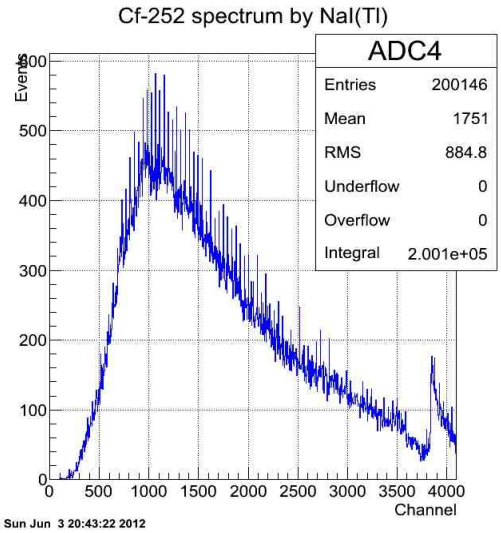

Fig.9. Cf-252 ADC spectrum.

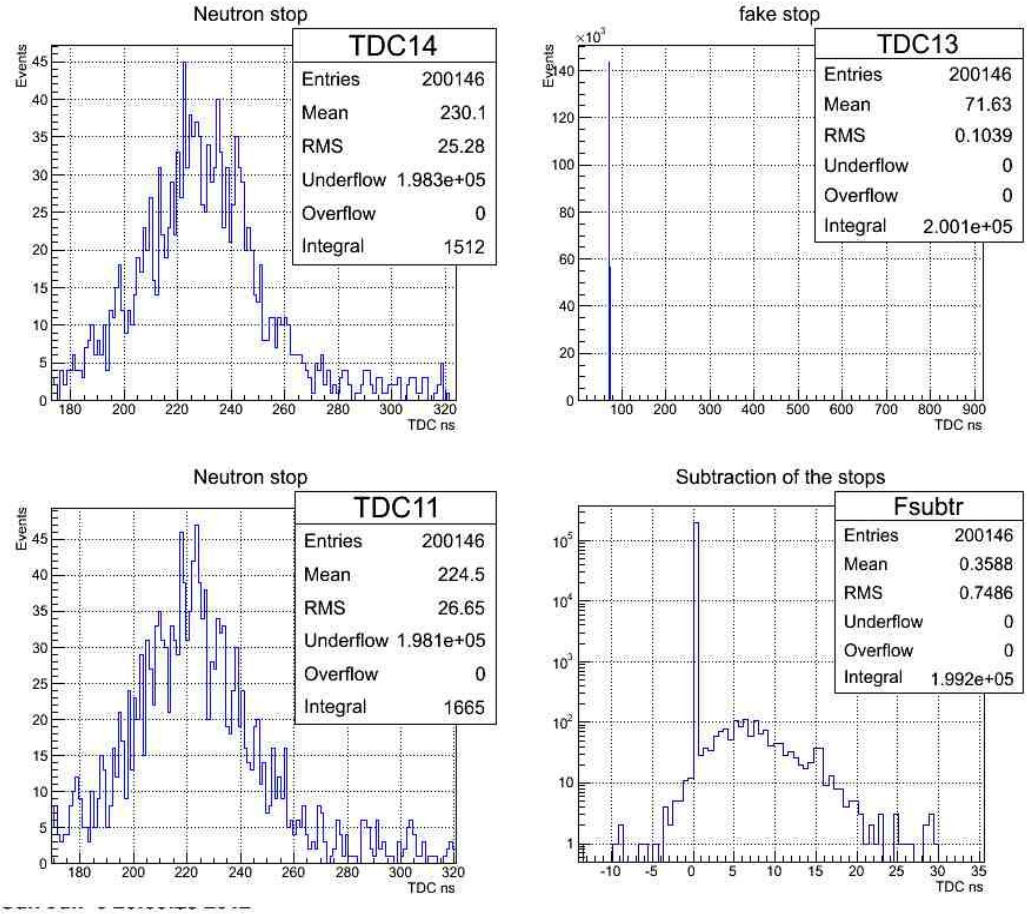

Fig. 10. TDC spectrum.

Run 3448. U(NaI) = -1020 V, 50 Ohm signal splitter is in, CFD threshold (NaI) = - 50mV, U(E1,2) = -1400 V, CFD threshold (E1,2) = -3 mV, CFD delay (E1) = 12 ns (ch 6 in CFD), CFD delay (E2) = 8 ns (ch 4 in CFD). NaI is inside the regular shielding (65 cm away from plastic). There is 2" lead shielding in front of plastic scintillator. Cf-252 source in. Rate = 48.17 Hz.

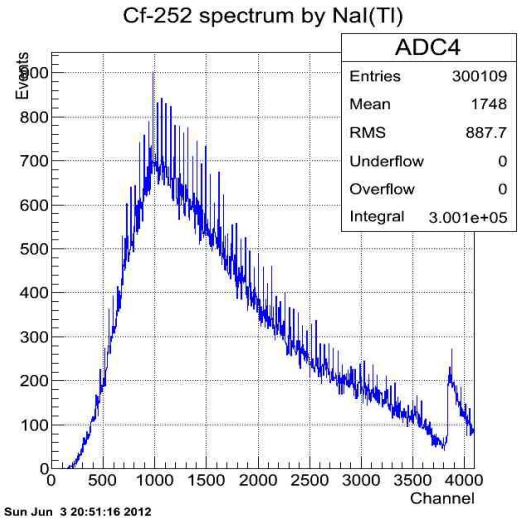

Fig.11. Cf-252 ADC spectrum.

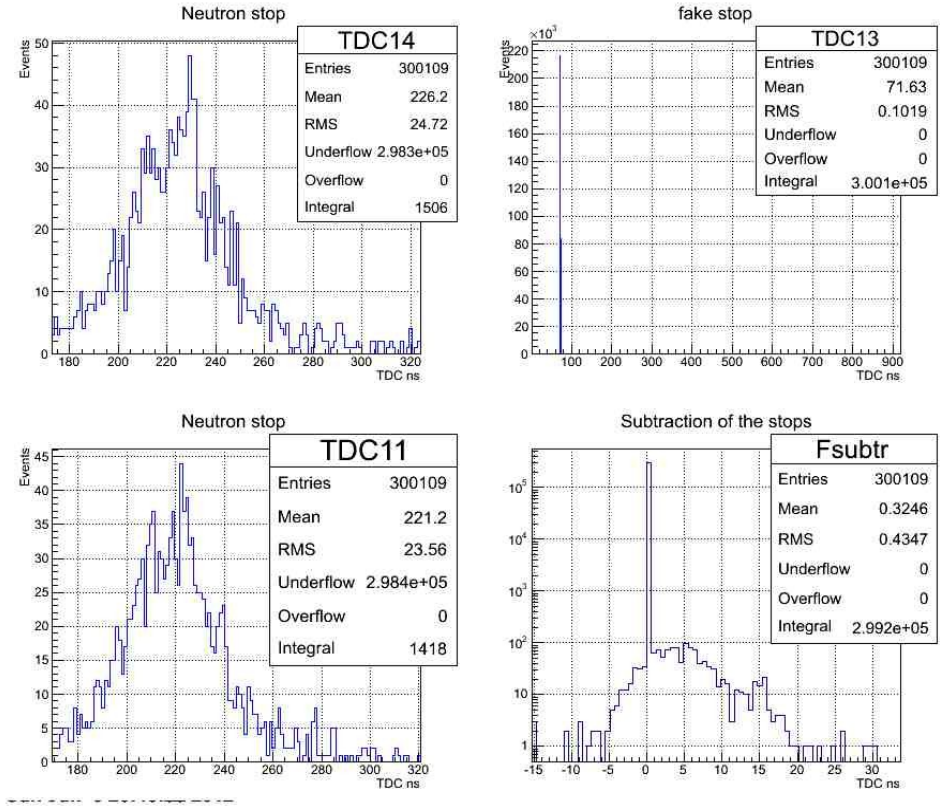

Fig. 12. TDC spectrum.

All the statistics obtained during the runs above is presented in the Table 1 below.

Efficiency was calculated using the following expression:

$$\epsilon = \frac{N_{neutron}}{N_{trigger}} \cdot \frac{1}{\nu} \cdot \frac{4\pi}{\delta\Omega} \quad ,$$

where ν = 3.9 and δΩ = 0.237 sr. Errors (the last column in the Table 1.) were propagated only for the ratio $\frac{N_{neutron}}{N_{trigger}}$ ratio.

Table 1.

run#	**Channel**	**CFD th, mV**	**N_trig**	**N_n (#BKG evt*)**	**Run time, sec**	**Eff, %**	**delta_Eff,%**
3446	TDC14 (173ns-323ns)	-1	138134	1477(10.7)	2908.1	14.53	0.028
	TDC11 (170ns-320ns)			1532(10.7)		15.07	0.03
3445	TDC14 (173ns-323ns)	-2	200146	1512(16.7)	4258.4	10.27	0.02
	TDC11 (170ns-320ns)			1665(16.7)		11.3	0.02
3448	TDC14 (173ns-323ns)	-3	300109	1506(23.05)	6230.2	6.82	0.013
	TDC11 (170ns-320ns)			1418(23.05)		6.42	0.013

*#BKG events was obtained for the CFD threshold -1 mV, i.e. for the worst case scenario.

As an example, S/N ratio for our big neutron detector in the case CFD threshold = -1 mV and TDC14 channel is the following.

S/N(TDC14):

Number of neutrons-BKG = 1477-10.7 = 1466.3;

Neutron counting rate = (Number of neutrons-BKG)/Run duration = 1466.3/2908.1sec = 0.504 Hz;

S/N = 0.504Hz/0.0037Hz = 136.27;

This means that S/N ratio defined via simple counter (S/N_couter ~ 3) is really different from what was obtained using TDC (S/N_tdc = 136.27).