Effect of Oxygen Contamination on Pulse Behavior

Faig Ahmadov

JINR & IP MSE

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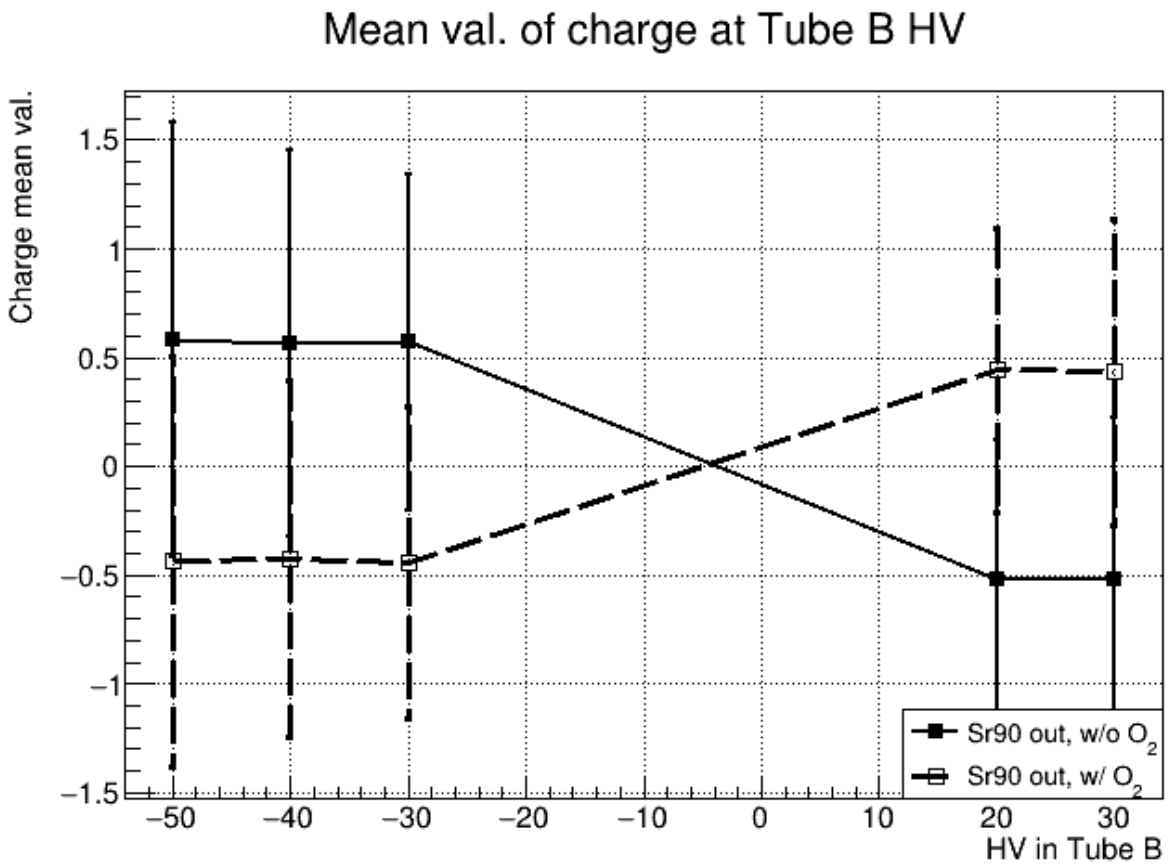
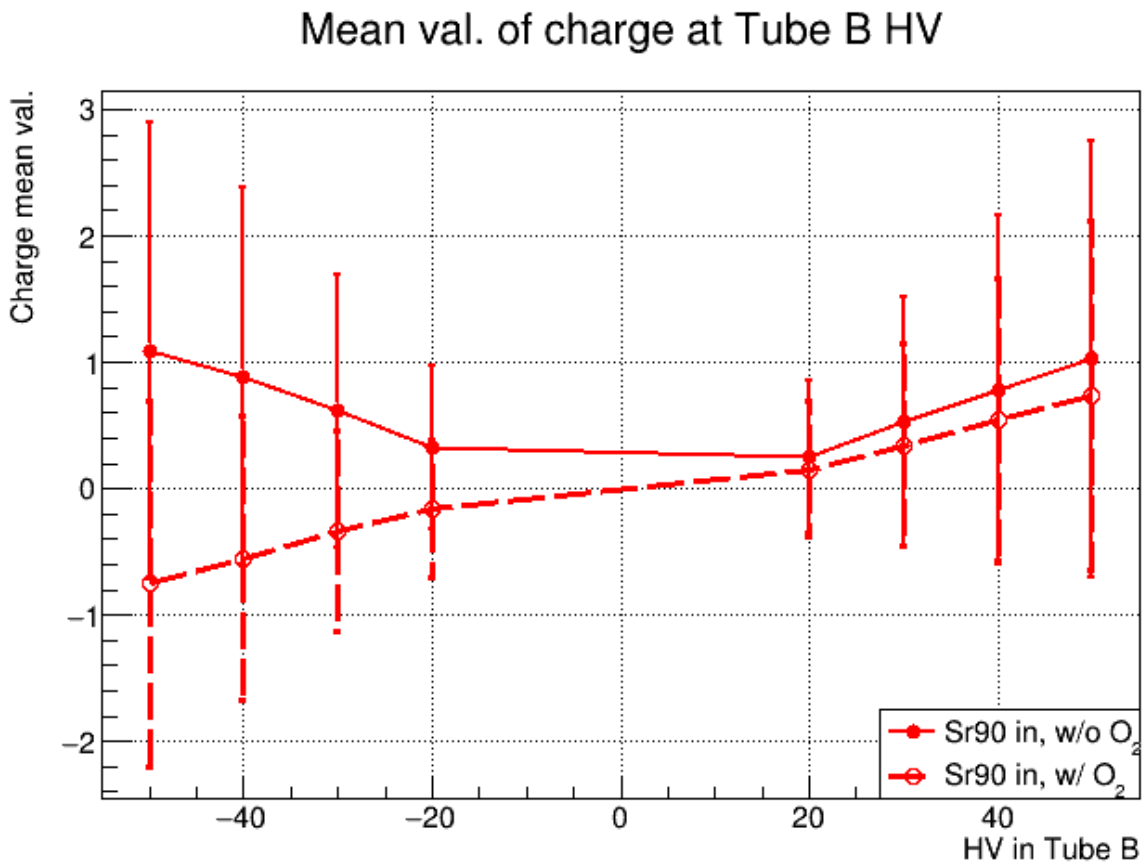
The mean value of the charge in different HV



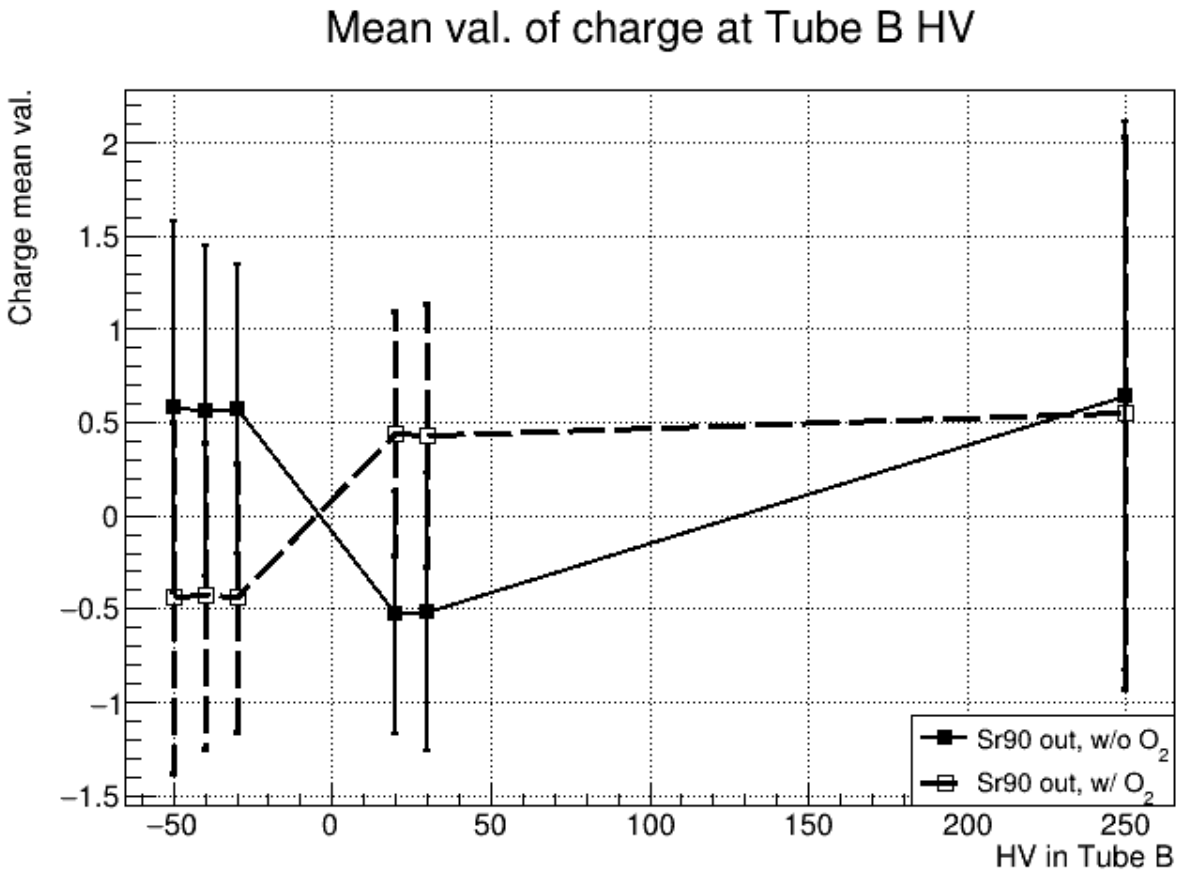


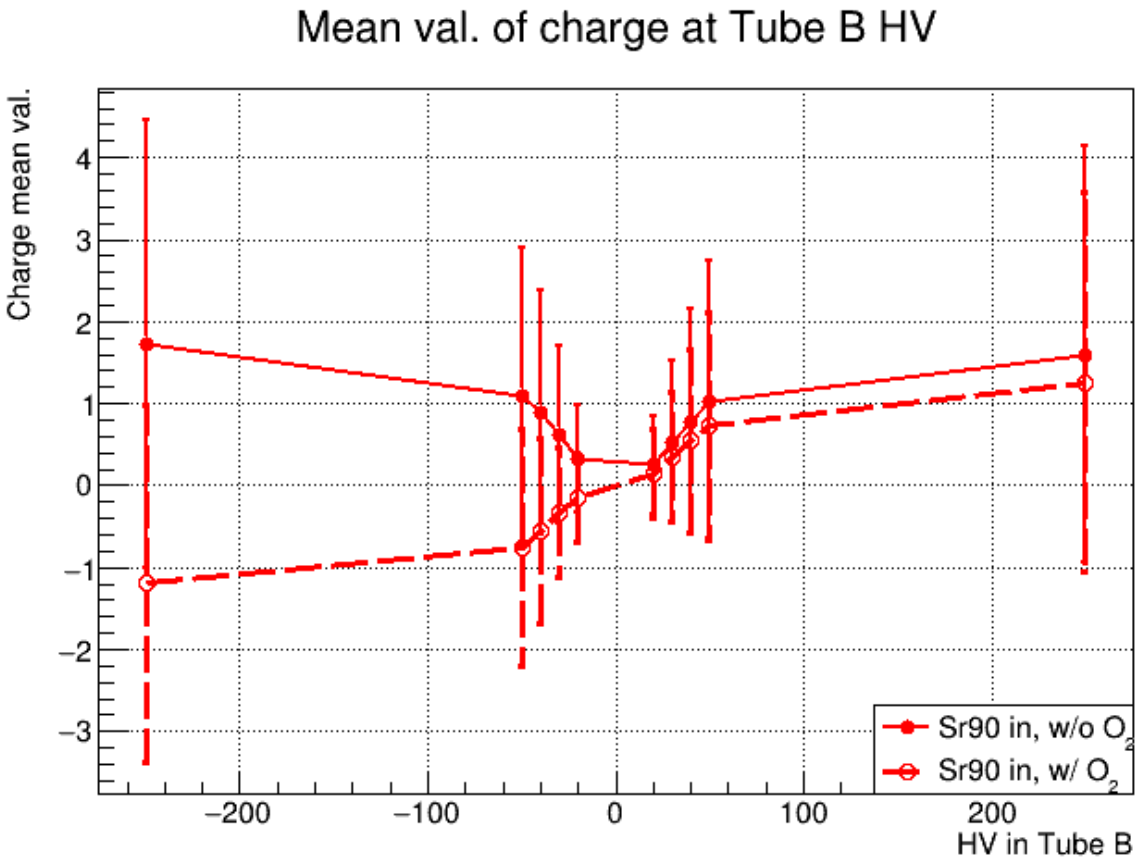
Sr90 out

Sr90 in

We expect symmetry around HV=0V, but we only observe for the case Sr90 in, w/o O_2 .
The error bar is the standard deviation of the charge plots (see back-up slides).

The mean value of the charge in different HV including 250V





Sr90 out

Sr90 in

We expect symmetry around HV=0V, but we only observe for the case Sr90 in, w/o O_2 .
The error bar is the standard deviation of the charge plots (see back-up slides).

Definition of the O_2 contamination value ρ

$$Q_{\text{polluted}}/Q_{\text{pure}} = \lambda/d \times (1 - \exp(-d/\lambda))$$

the formula is taken from the paper [link]

We define the variables as follows:

λ(cm)= 0.14×E(kV/cm)/ρ(ppm),

d = 0.2 cm *is the a cell gap size,*

Q_{polluted} – *charge mean value with O_2 contamination*

Q_{pure} – *charge mean value w/o O_2 contamination*

E(kV/cm) – *HV in tube B*

$$Q_{O_2}/Q=0.7\cdot E/\rho\cdot(1-\exp(-\rho/0.7\cdot E))$$

$$y=0.7*x/p[0]*(1-\exp(-p[0]/(0.7*x)))$$

$$y = Q_{O_2}/Q\ ,\ \ x = E,\ \ \rho = p[0].$$

Fitting for each HV point separately

Tube B HV – E (V)	Q_{o_2}/Q	Calculation of ρ by formula: $Q_{o_2}/Q=0.7\cdot E/\rho\cdot(1-\exp(-\rho/(0.7\cdot E)))$	Finding ρ by fitting a function: y=0.7*x/p[0]*(1-exp(-p[0]/(0.7*x)))
-250	-0.6907	138.62	138.43 ± 582.31 (Chi2=1.1e-07)
-50	-0.6933	27.43	27.39 ± 115.86 (Chi2=8.1e-08)
-40	-0.6199	29.31	29.28 ± 108.91 (Chi2=6.9e-08)
-30	-0.5438	28.84	28.81 ± 99.18 (Chi2=5.0e-08)
-20	-0.4773	24.1	23.98 ± 80.25 (Chi2=1.6e-06)
20	0.6030	15.6	15.58 ± 56.69 (Chi2=1.4e-07)
30	0.6508	19.55	19.49 ± 75.99 (Chi2=6.3e-07)
40	0.7029	21.05	21.03 ± 90.9 (Chi2=4.5e-08)
50	0.7181	24.6	24.6 ± 110.25 (Chi2=1.9e-08)
250	0.7898	86.1	86.1 ± 482.5 (Chi2=1.5e-10)

In the formula, the module of Q_{o_2}/Q & E is taken

Fitting for some HV interval (1)

x[] = { 20,30,40,50 }

y[] = {0.6030,0.6508,0.7029,0.7181};

ρ = 19.06 ± 1.87 (Chi2 = 0.006).

x[] = { 20,30,40,50,250 };

y[] = { 0.6030,0.6508,0.7029,0.7181,0.7898 };

ρ = 19.74 ± 3.62 (Chi2 = 0.031).

Negative HV:

x[] = {-50,-40,-30,-20}

y[] = {-0.6933,-0.6199,-0.5438,-0.4773 };

ρ = -1.3.e+05 ± 3.7e+05 (Chi2 = 1.39)

x[] = { -250,-50,-40,-30,-20};

y[] = {-0.6907,-0.6933,-0.6199,-0.5438,-0.4773 };

ρ = -1.5e+06 ± 7.8e+06 (Chi2 = 1.87).

If we change all negative values to positive:

x[] = {50,40,30,20}

y[] = {0.6933,0.6199,0.5438,0.4773 };

ρ = 27.14 ± 1.3 (Chi2 = 0.002)

x[] = { 250,50,40,30,20};

y[] = {0.6907,0.6933,0.6199,0.5438,0.4773 };

ρ = 28.7 ± 6.3 (Chi2 = 0.056).

Fitting for some HV interval (2)

x[] = { -50,-40,-30,-20,20,30,40,50 };
y[] = { -0.6933,-0.6199,-0.5438,-0.4773,
0.6030,0.6508,0.7029,0.7181 };
ρ = -9.98 ± 10.23 (Chi2 = 9.365).

Full HV Interval:

x[] = { -250,-50,-40,-30,-20,20,30,40,50,250 };
y[] = {-0.6907,-0.6933,-0.6199,-0.5438,-0.4773,
0.6030, 0.6508, 0.7029, 0.7181, 0.7898 };
ρ = -10.2767 ± 10.1999 (Chi2 = 12.1859).

Back up

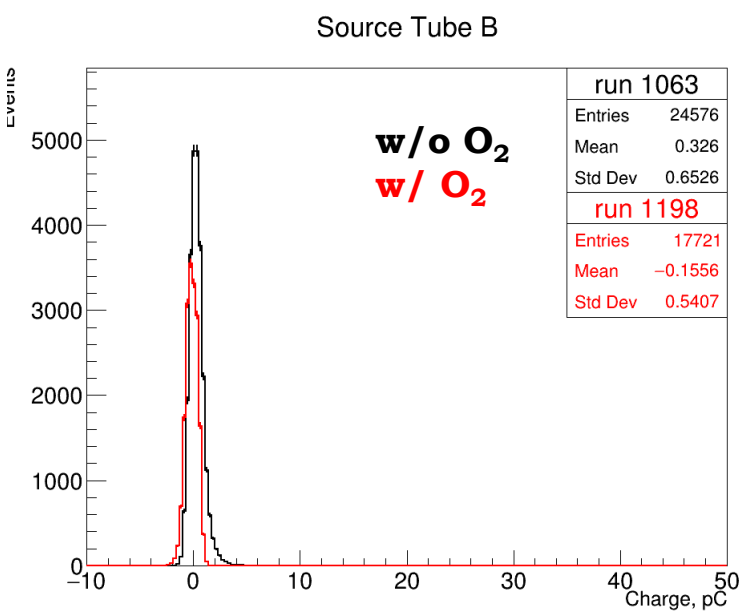
runs w/o O_2 contamination

Run #	N_{ev} paper LB	N_{ev} in files	Source in/out	FCal mid HV	FCal out HV	Scal HV	Charge pC mean
1170	21329	21329	in	-250	-250	-800	1.72
1060	27624	27624	in	-50	-50	+800	1.088
1061	27648	27648	in	-40	-40	+800	0.8901
1062	23511	23511	in	-30	-30	+800	0.6153
1063	24576	24576	in	-20	-20	+800	0.326
1024	20480	20480	in	+20	+20	+800	0.2544
1022	20480	20480	in	+30	+30	+800	0.5318
1021	20480	20480	in	+40	+40	+800	0.7803
1020	20480	20480	in	+50	+50	+800	1.026
1163	30**403**	30990	in	+250	+250	-800	1.594
1092	17229	17229	out	-50	-50	+800	0.5798
1093	17095	17095	out	-40	-40	+800	0.564
1094	17078	17078	out	-30	-30	+800	0.5715
1043	2146**9**	21465	out	+20	+20	+800	-0.5224
1042	2043**9**	20435	out	+30	+30	+800	-0.5183
1176	20967	20967	out	+250	+250	-800	0.6383

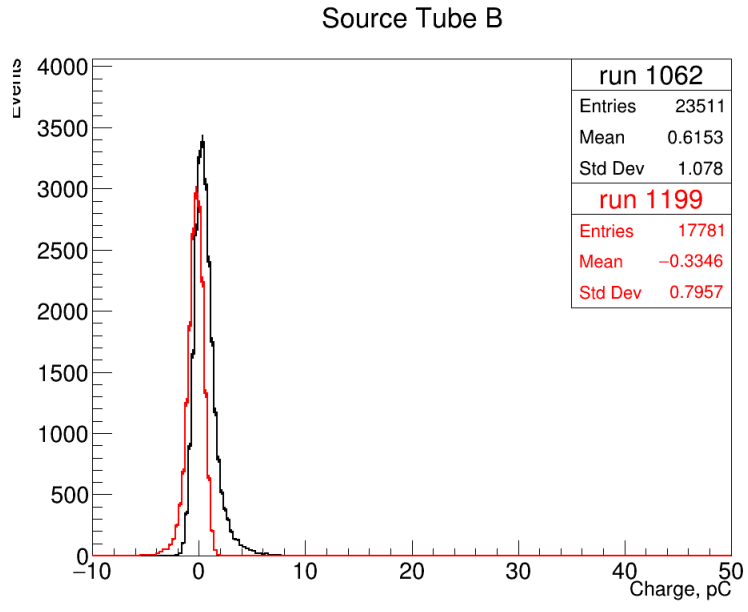
runs w/ O_2 contamination

Run #	N_{ev} paper LB	N_{ev} in files	Source in/out	FCal mid HV	FCal out HV	Scal HV	Charge pC mean
1203	17183	17183	in	-250	-250	-800	-1.188
1202	1**8071**	19095	in	-50	-50	-800	-0.7543
1200	**19883**	20907	in	-40	-40	-800	-0.5518
1199	17781	17781	in	-30	-30	-800	-0.3346
1198	17721	17721	in	-20	-20	-800	-0.1556
1196	17953	17953	in	+20	+20	-800	0.1534
1195	17912	17912	in	+30	+30	-800	0.3461
1194	176**28**	17678	in	+40	+40	-800	0.5485
1193	1**8K**	17915	in	+50	+50	-800	0.7368
1192	1**7733**	18757	in	+250	+250	-800	1.259
1207	1**7K**	18124	out	-50	-50	-800	-0.4367
1206	1**7K**	17528	out	-40	-40	-800	-0.4296
1208	-	18018	out	-30	-30	-800	-0.4397
1211	1**7K**	18693	out	+20	+20	-800	0.4424
1212	3928	3928	out	+30	+30	-800	0.4347
1210	1**7K**	18222	out	+250	+250	-800	0.5494

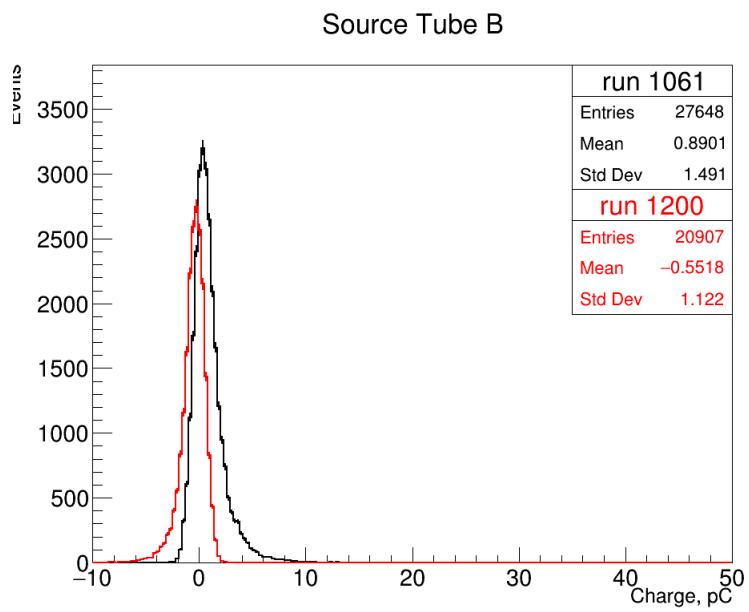
FCal HV = -20V



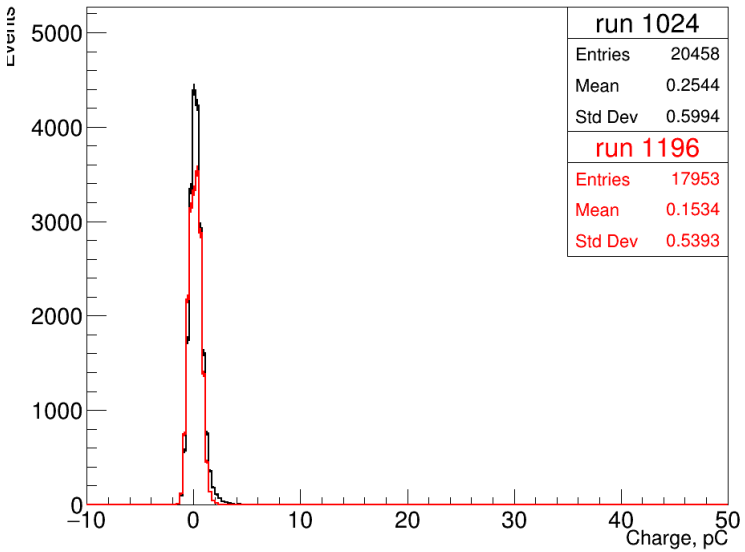
Fcal HV = -30V



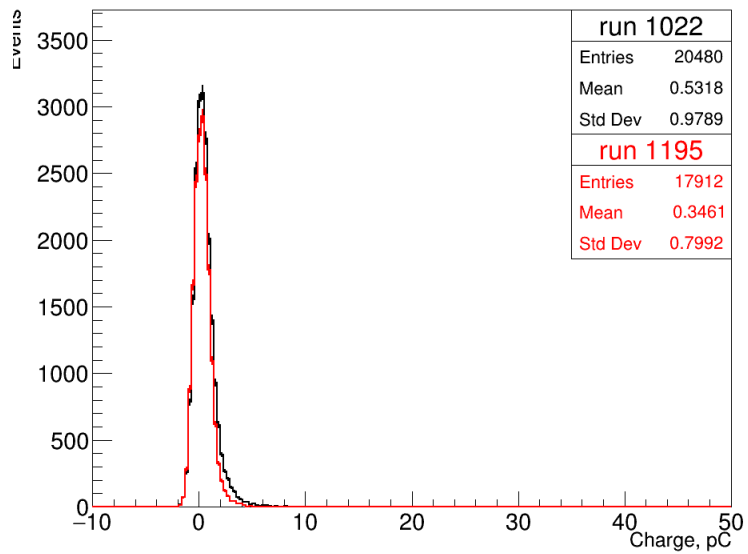
Fcal HV = -40V



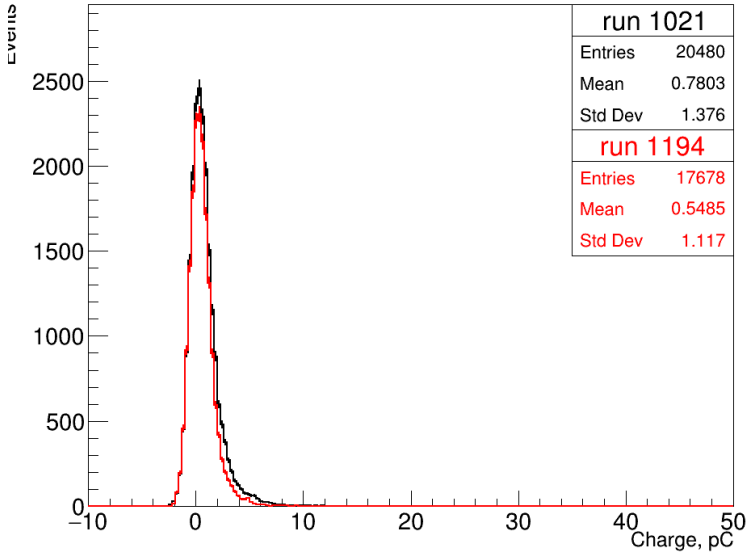
FCal HV = 20V



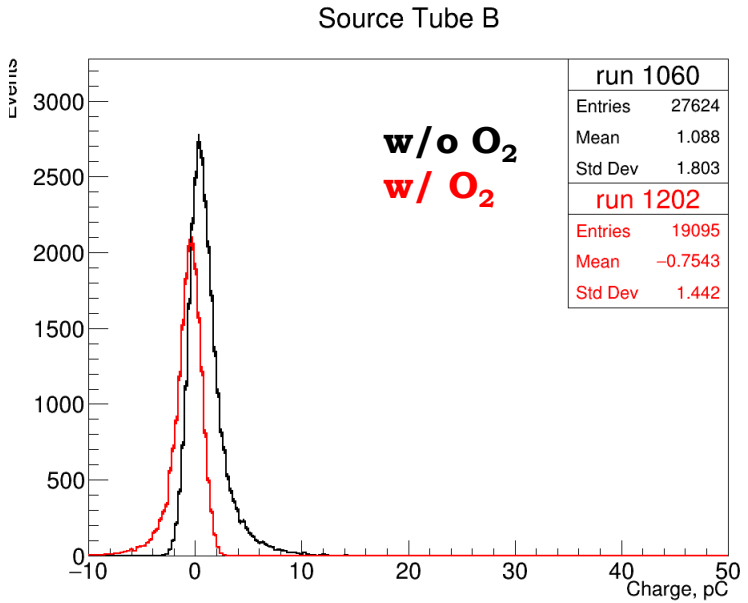
Fcal HV = 30V



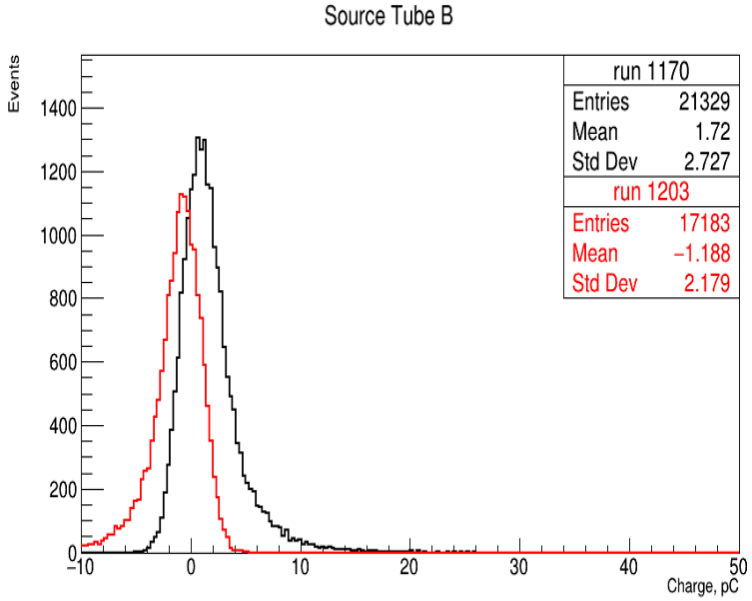
Fcal HV = 40V



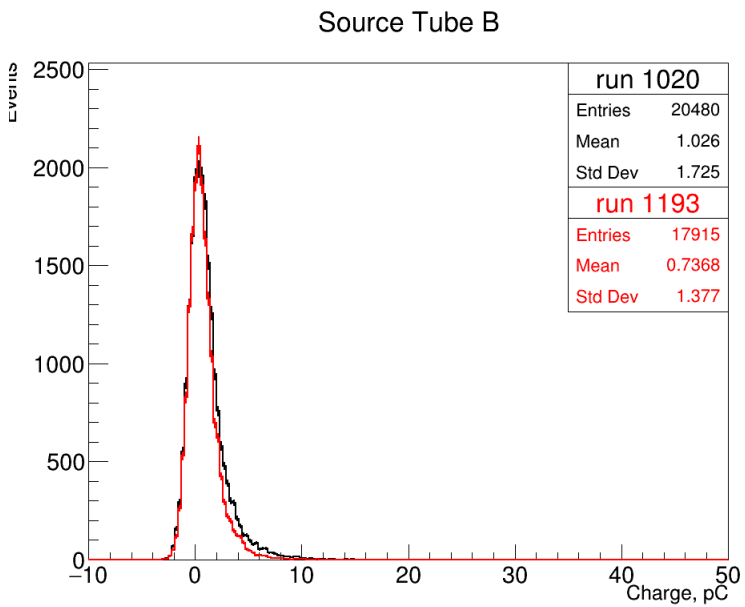
FCal HV = -50V



Fcal HV = -250V



FCal HV = 50V



Fcal HV = 250V