REVISION TO 06/01/2023: SNS 2020 Fitting Update

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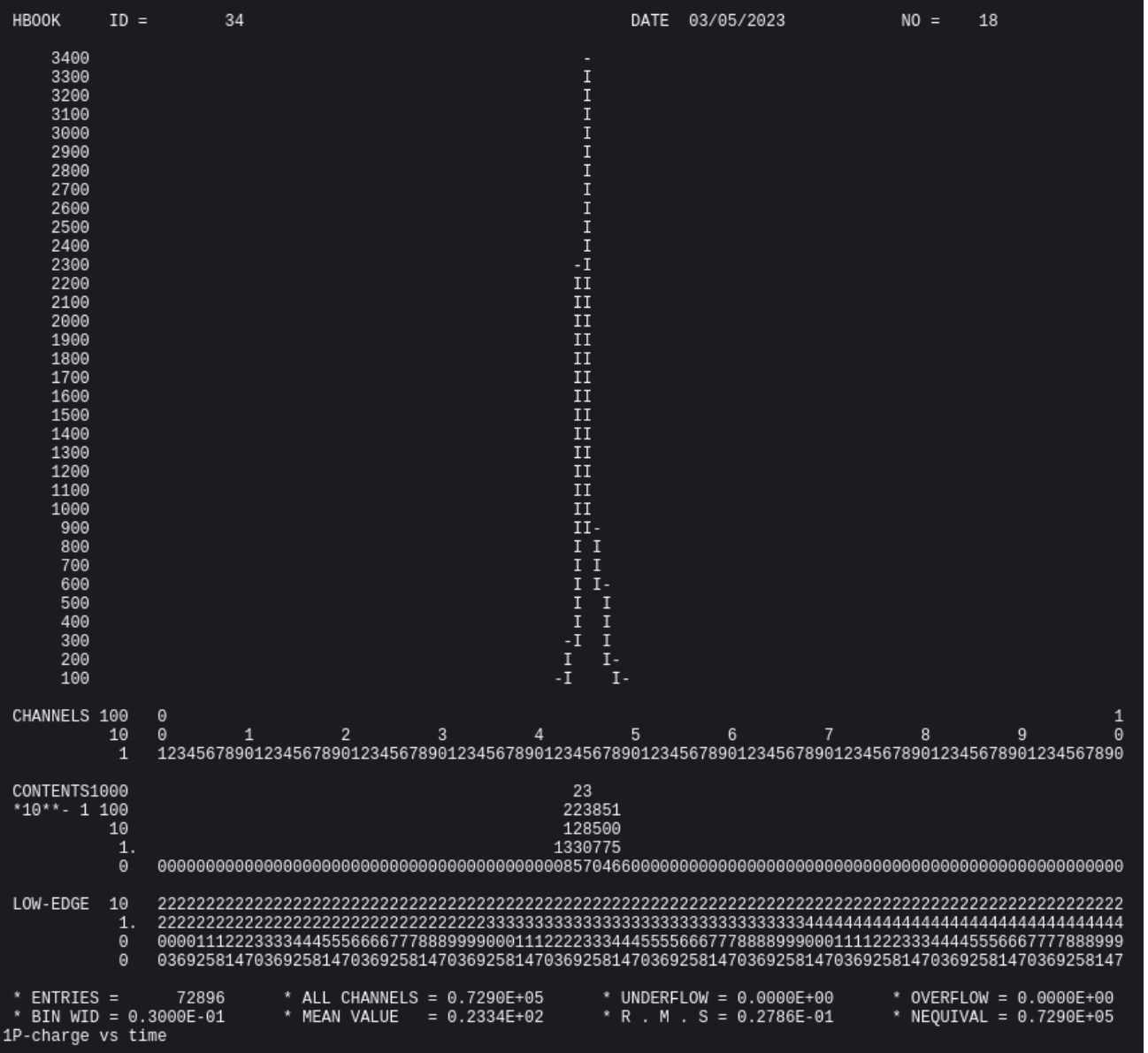
Beam Charge per Frame “Instability”

- The SNS is a real beamline, with real physics. The beam is not a delta-function at some value, it’s got some “width”
- The error introduced by this is not insignificant – it is sometimes dominant



Screenshot of the histogram of the frame charge vs time in pc-18-log.txt on OneDrive.

Table Layout and Explanation

PC	RAW in FROI	4-Fit Only	RAW – 4-Fit (Signal)	Stat'l. Err.	Syst. Error	Proton charge correction	Total Error
18	2.98E+06	151797.93	2.83E+06	1639.48	1894	3380.40	4207.40

PC : The corresponding # of PC plates
"RAW" : The unmodified number of points in the FROI
"Bkg. Fit Only": The estimated number of background points via which fit (here, the 4-Fit)
"RAW – FIT" : The "signal" estimated after subtracting the fitted background
"Stat'l. Err" : The relative error (sqrt(RAW) / RAW) times the signal
"Syst. Err" : The relative error (est. syst. / signal) times the signal – here, just the syst.
Historically, those errors provided by James
"Proton Charge Correction": The relative error of the charge deposited by the beam
Calculated by (RMS / mean) times the signal
"Total Error" : Sq. Root of the sum of the squares of the errors

4-FIT Correction Table - Uncorrected

PC	RAW in FROI	4-Fit Only	RAW – 4-Fit (Signal)	Stat'l. Err.	Syst. Error	Proton charge correction	Total Error
18	2.98E+06	151797.93	2.83E+06	1639.48	1894	3380.40	4207.40
19	1.98E+06	125574.18	1.85E+06	1316.34	1787	2645.72	3453.40
20	1.36E+06	104627.70	1.25E+06	1075.33	1667	1002.96	2222.87
21	9.20E+05	89793.39	8.28E+05	862.82	1590	820.49	1986.39
22	6.37E+05	77873.70	5.61E+05	700.70	1478	752.42	1800.45
24	3.14E+05	62164.92	2.54E+05	449.84	1318	300.92	1424.79

Other fits are receiving the same treatment

4-FIT Correction Table – Charge + Deadtime Corrected

PC	RAW in FROI	4-Fit Only	RAW – 4-Fit (Signal)	Stat'l. Err.	Syst. Error	Proton charge correction	Total Error
18	1.78E+06	91064.44	1.6856E+06	975.87	1127.37	2012.13	2504.39
19	1.21E+06	77237.04	1.1292E+06	803.34	1090.58	1614.65	2107.56
20	8.13E+05	63070.89	7.5066E+05	644.27	998.77	600.92	1331.81
21	5.47E+05	53944.36	4.9355E+05	515.90	950.70	490.59	1187.71
22	3.81E+05	46678.06	3.3401E+05	418.43	882.59	449.31	1075.14
24	1.87E+05	37130.11	1.5026E+05	267.98	785.16	179.27	848.78

Other fits are receiving the same treatment

4-FIT Correction Table – In case X^2 is large after including charge RMS (ID=34) to error

Note: these errors are computed using sqrt(cov. matrix) and will not match YK's errors as mentioned previously.

With Frame Charge Correction

Optimal Parameters:

F0 : 2.50411e+09 +/- 9.30266e+07

eta : 6.66507e-01 +/- 1.26745e-03

Chi2/4: 10.0649

Without Frame Charge Correction

Optimal Parameters:

F0 : 2.50209e+09 +/- 8.36725e+07

eta : 6.66546e-01 +/- 1.16940e-03

Chi2/4: 13.4620

Chi2 values are still large for this fit: frame charge correction required, but not complete picture

Other fits are receiving the same treatment for completeness

With Beam Charge Correction

MINUIT
F0: 2.504278e9 +/- 0.0250411e9
Eta: 0.666505 +/- 0.0004000
Chi2: 10.064849

Python
F0: 2.504278e9 +/- 0.0930266e9
Eta: 0.666505 +/- 0.001267
Chi2: 10.064849

Without Beam Charge Correction

MINUIT
F0: 2.502260e9 +/- 0.0228181e9
Eta: 0.666543 +/- 0.000319
Chi2: 13.461658

Python
F0: 2.504278e9 +/- 0.0836725e9
Eta: 0.666505 +/- 0.000117
Chi2: 13.4620

END