

Charge Injection System (CIS) Update

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Introduction

- We are preparing a full database update using the “-recalALL” option to have a new CIS constant for all the channels to start the year after maintenance. By **Wednesday, 8 March**, we will push to the database
- We use all February runs, but if there were maintenance interventions in specific modules, we recalibrate using runs after the intervention date and after passing DVS test for validation.
- The last few slides show important lists of
 - Channels to recalibrate
 - Channels with 5% deviation from database
 - Channels whose flags need to be updated (GoodCIS/BadCIS)and whether these modules were involved in the maintenance campaign
- New database constant cannot be calculated for channels with **No CIS**. These will be masked elsewhere by Data Quality?

Summary

Channels in Update	19704 (ALL)
Good (>1 Successful Calibration)	19662
>5% Change	19
Masked	18
Affected	24

Table: Summary of channels included in the update. Runs are taken from the period 1 February 2023 - 28 February 2023. There are 168 channels with greater than 0.5% change, the usual update threshold we use.

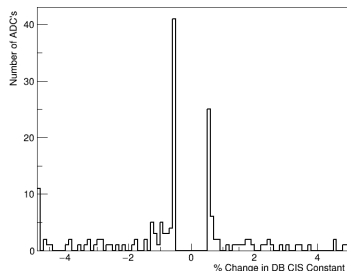


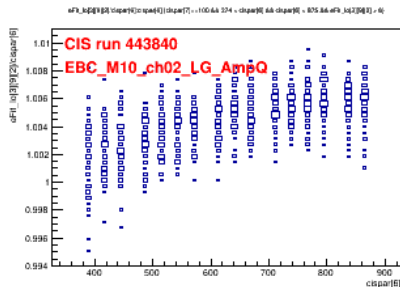
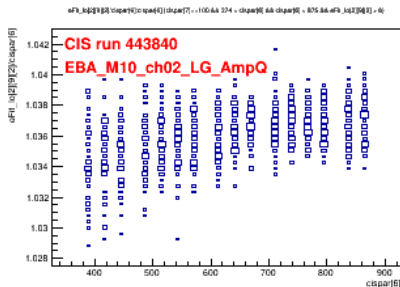
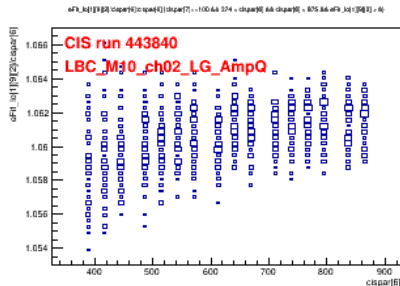
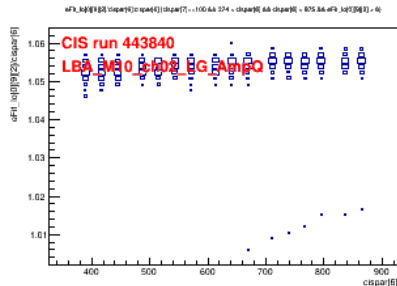
Figure: Distribution of CIS constants for the entire detector. The histogram omits channels for which change is less than 0.5% since the last update.

Run Selection

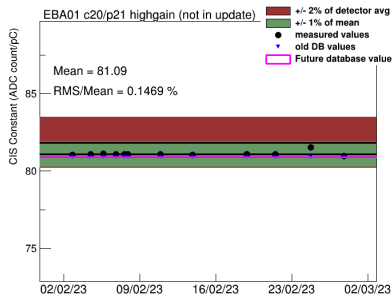
Date Range	1 February 2023 - 28 February 2023
Runs Included	442620 442775 442791 442820 442935 443018 443364 443414 443831 443835 444001 444007 444633
Runs Excluded	443840 ^a 444474 ^b

- Run 443840^a was excluded due to bad amplitude/charge ratio seen in LBA
- Run 444474^b was excluded due to being an outlier run for most channels. The outlier was not always in the same direction, however.

Run Selection: Run 443840 AmpQ Ratio

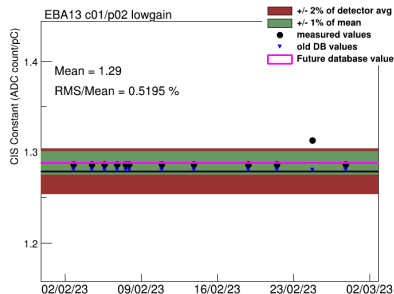


Run Selection: Run 4474 Outliers



qlags: Large Inj. RMS Low Chi2 Stuck Bit

Figure: EBA01 Channel 20: Outlier in penultimate run of calibration window



qlags:

Figure: EBA01 Channel 20: Outlier in penultimate run of calibration window

- The behavior of the outlier point is not consistent – sometimes above or below the average for that channel – but it generally bad for many channels in the update

CIS Constant Distributions

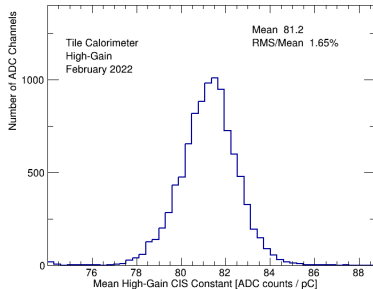


Figure: Distribution of Mean HG CIS constants for calibration runs in February 2023

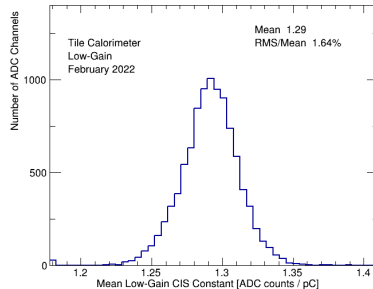


Figure: Distribution of Mean LG CIS constants for calibration runs in February 2023

Monthly Stability

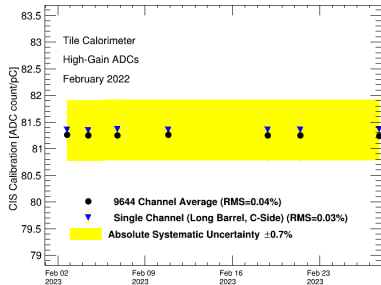


Figure: February stability of CIS constant in TileCal compared to a single channel (HG)

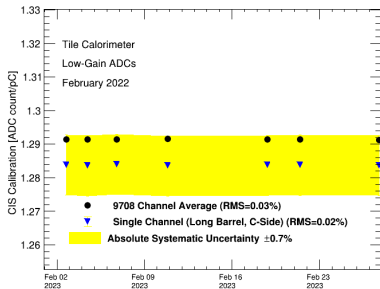


Figure: February stability of CIS constant in TileCal compared to a single channel (LG)

Detector History

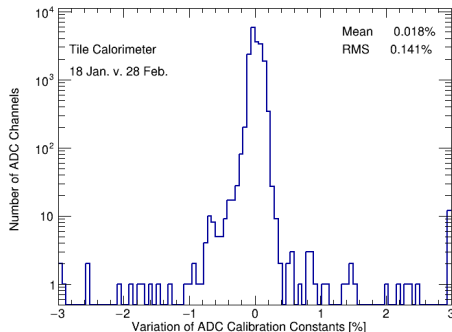


Figure: Change in CIS constants by channel from mid-January to end of February 2023

- Here, we list the channels that underwent a drift of greater than 3% between runs 441631 (18 January) and 444633 (28 February). These correspond the outlier bins in the previous histogram.
- These channels in the overflow bins all need to be recalibrated. See a later slide with an extensive list of channels to recalibrate.

RMS Distributions

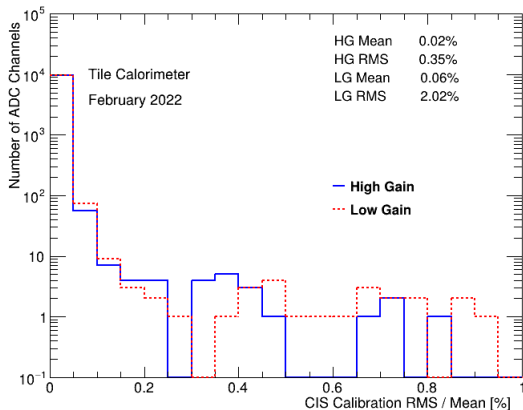


Figure: RMS/MEan distribution of CIS constant. This month there is a lot of overflow (cut off) because of modules being off and this affecting the calculation of RMS and Mean

TUCS Quality Flags

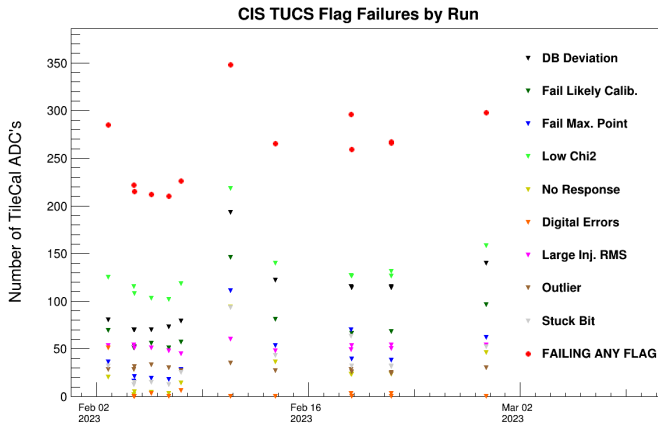


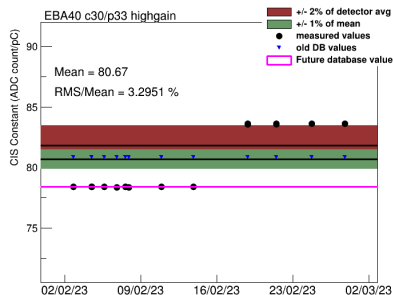
Figure: TUCS quality flags of CIS runs 1 February to 28 February.

Channels to Recalibrate

Module	Channel	Gain	Maintenance	Recalibrate From Date
EBA40	30-32,37-40	H/L	Yes	16.2
EBA40	35,36,41	H	Yes	16.2
EBA61	15	H/L	No	16.2-23.2
EBC34	30-32,35-37	H/L	Yes	10.2
LBC17	06-08	H/L	Yes	10.2
LBC49	24-29,33-35	H/L	Yes	16.2
LBC52	34	H/L	No	16.2

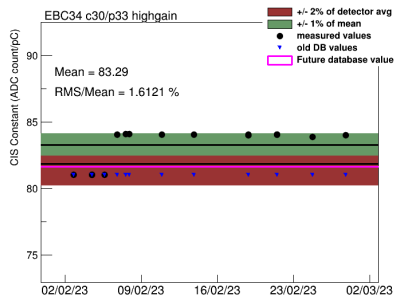
- Maintenance interventions above are linked by clicking on “Yes.” They correspond to the replacement of digitizers affecting the listed channels

Channels to Recalibrate



qlags:

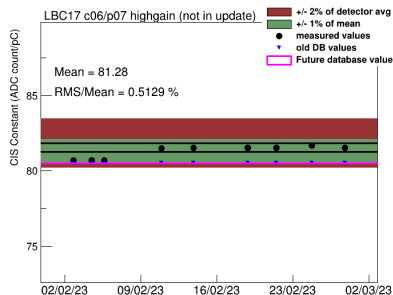
Figure: Recalibration EBA40 Channel 30 HG



qlags:

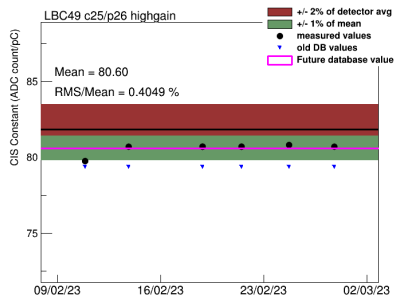
Figure: Recalibration EBC34 Channel 30 HG

Channels to Recalibrate



qlags:

Figure: Recalibration LBC17 Channel
06 HG



qlags:

Figure: Recalibration LBC49 Channel
25 HG

Flag Changes

Module	Channel	Gain	Maintenance	Change Flag To
EBA20	31	H	No	Good CIS
EBA40	35	H	Yes	Bad CIS
EBC20	10	L	No	Bad CIS
EBC23	01	L	No	Bad CIS
EBC34	38	H	Yes	Bad CIS
LBA02	06	L	No	Bad CIS
LBA03	17	L	No	Bad CIS
LBA30	13	H	Yes	Bad CIS
LBA35	08	H	Yes	Bad CIS
LBA38	46	L	No	Bad CIS
LBA51	12	H	No	Bad CIS
LBC19	26	H	No	Bad CIS
LBC20	37	H/L	No	Bad CIS
LBC44	34	H	No	Good CIS
LBC57	06	H	No	Bad CIS

Flag Changes: To Good CIS

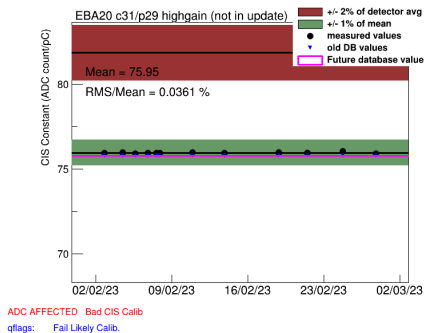


Figure: Good CIS in EBA20 Channel 31 HG

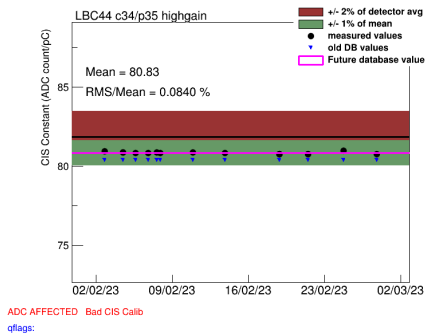
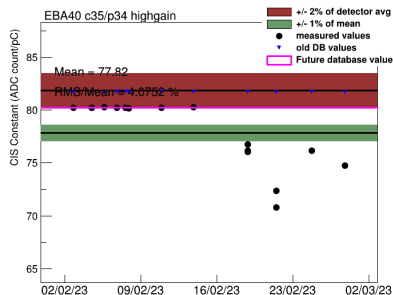


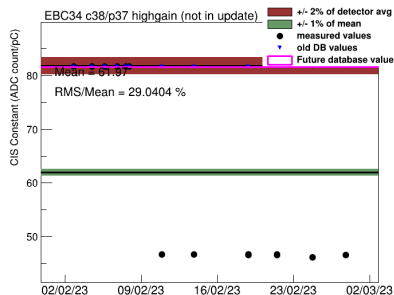
Figure: Good CIS in LBC44 Channel 34 HG

Flag Changes: Maintenance



qlags:

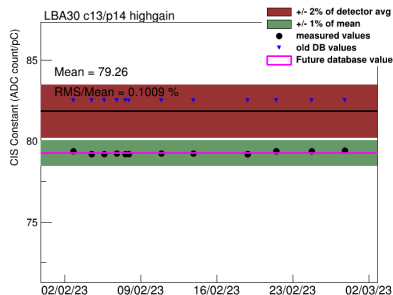
Figure: Post-intervention in EBA40 Channel 35 HG



qlags: Fail Max. Point Fail Likely Calib. Low Chi2

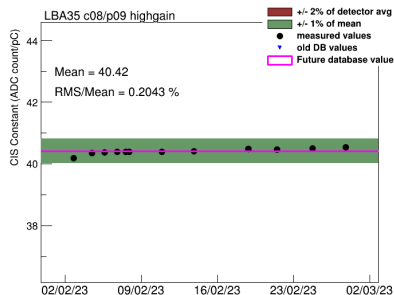
Figure: Post-intervention in EBC34 Channel 38 HG

Flag Changes: Maintenance



qflags:

Figure: Post-intervention in LBA30
Channel 13 HG



ADC BAD ADC masked (unspec.)

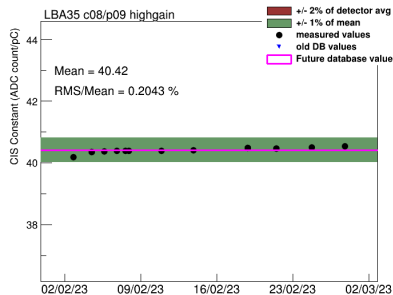
qflags: Fail Max. Point Fail Likely Calib. Low Chi2

Figure: Post-intervention in LBA35
Channel 08 HG

Channels with > 5% Change

Channel	Old DB Value	New DB Value	Change	Status
EBA m07 c31 lowgain	0.83	0.98	0.17	Bad CIS
EBC m18 c04 lowgain	0.98	0.63	-0.36	Bad CIS
EBC m22 c16 lowgain	1.06	1.20	0.13	Bad CIS
EBC m34 c39 lowgain	1.30	0.92	-0.29	YETS Intervention
EBC m34 c41 lowgain	1.29	1.12	-0.13	YETS Intervention
EBC m46 c07 lowgain	1.20	1.28	0.07	Bad CIS
EBC m56 c41 lowgain	1.18	0.99	-0.16	Bad CIS
EBC m61 c08 lowgain	1.16	0.68	-0.41	Bad CIS
LBA m30 c13 lowgain	1.25	1.34	0.07	YETS Intervention
LBA m35 c08 highgain	78.14	40.42	-0.48	Moved to Half Gain
LBA m37 c21 highgain	40.55	76.36	0.88	Bad CIS
LBA m38 c46 lowgain	1.30	1.14	-0.12	Masked
LBA m62 c26 highgain	69.13	56.53	-0.18	Bad CIS
LBC m19 c26 highgain	82.17	67.26	-0.18	High Scatter
LBC m47 c35 lowgain	0.65	0.89	0.38	Bad CIS
LBC m52 c34 highgain	81.08	87.03	0.07	No Information
LBC m52 c34 lowgain	1.30	1.40	0.07	No Information
LBC m57 c06 highgain	77.14	56.90	-0.26	High Scatter

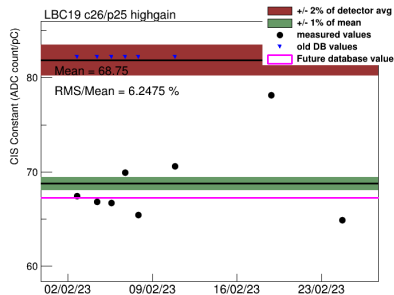
Channels with $> 5\%$ Change



ADC BAD ADC masked (unspec.)

qlflags: Fail Max. Point Fail Likely Calib. Low Chi2

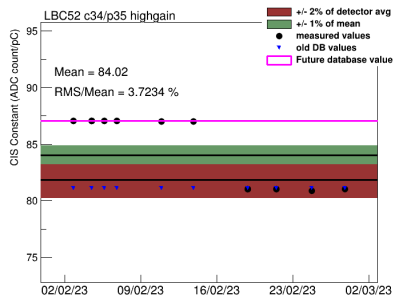
Figure: Moved to half-gain in LBA35 Channel 08 HG



qlflags: Fail Likely Calib. Large Inj. RMS Low Chi2

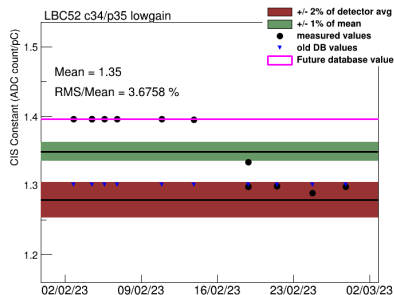
Figure: Large Scatter (also will be marked as **Bad CIS**) in LBC19 Channel 26 HG

Channels with $> 5\%$ Change



qlags: Fail Likely Calib.

Figure: Large deviation in LBC52 Channel 34 HG



qlags: Fail Likely Calib.

Figure: Large deviation in LBC52 Channel 34 LG

Masked/Affected Channel List

Masked (18)

LBC23 c20/p21 lowgain
LBC43 c24/p27 highgain
LBC47 c35/p34 lowgain
LBC52 c18/p19 highgain
EBA19 c41/p41 highgain
EBA07 c31/p29 lowgain
EBC56 c41/p41 lowgain
EBC18 c04/p05 lowgain
EBC22 c16/p17 lowgain
EBC23 c31/p29 lowgain
LBA02 c06/p07 lowgain
LBA02 c06/p07 highgain
LBA52 c36/p39 highgain
LBA57 c45/p48 lowgain
LBA62 c26/p25 highgain
LBA35 c08/p09 highgain
LBA38 c46/p47 lowgain
LBA38 c46/p47 highgain

Affected (24)

LBC62 c08/p09 highgain
LBC16 c29/p28 highgain

LBC44 c12/p13 highgain
LBC44 c34/p35 highgain
LBC01 c25/p26 highgain
LBC46 c04/p05 highgain
LBC10 c37/p38 highgain
EBA16 c17/p18 highgain
EBA39 c31/p29 highgain
EBA49 c00/p01 highgain
EBA50 c20/p21 highgain
EBA50 c31/p29 highgain
EBC01 c21/p22 highgain
EBC46 c07/p08 lowgain
EBC16 c36/p44 lowgain
EBC16 c39/p43 highgain
EBC61 c08/p09 lowgain
EBC23 c36/p44 highgain
EBC23 c03/p04 highgain
LBA45 c06/p07 highgain
LBA06 c40/p41 highgain
LBA52 c01/p02 lowgain
LBA64 c29/p28 highgain
LBA37 c21/p22 highgain

TUCS Flags Description

Figure 19: Descriptions of each CIS TUCS quality flag

Flag	Location	Passed If...
No Response	qflag bit 1	At least one successful injection readout
Fail Likely Calib.	qflag bit 3	CIS constant within 6.23% of detector-wide mean
Fail Max. Point	qflag bit 4	≥ 1 point in fit range > 600 ADC counts
Large Injection RMS	qflag bit 5	RMS of all fixed-charge injections in fit range < 5
Digital Errors	qflag bit 6	All digital error checks passed
Low Chi2	qflag bit 7	Linear fit $\chi^2 > 2 \times 10^{-6}$
Edge Sample	qflag bit 8	No events in fit range w/ 1st or 7th sample as max
Next to Edge Sample	qflag bit 9	No events in fit range w/ 2nd or 6th sample as max
Stuck Bit	qflag bit 10	No stuck bits in readout chain detected
Unstable	TUCS	ADC CIS const. RMS/Mean $< 0.39\%$
Mean Deviation	TUCS	CIS constant within 5% of ADC time period avg.
Default Calibration	TUCS	Default CIS constant not used in database
Outlier	TUCS	CIS const. < 6 and $> 15\%$ away from det. avg.
DB Deviation	TUCS	Measured and database const. differ by $< 1\%$