

Charge Injection System (CIS) Update

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Introduction

- We are updating CIS constants using calibration runs taken in April. By **Wednesday, 10th May** we will push the constants to the database
- Last month's update had some problems because of UPD4 tagging, so it accidentally reverted channels back to their calibration constant values for 2022 reprocessing (**This time, we will verify that the proper channels are being updated**)
- **Overall Status:** There are no major new problems or flag changes to be made this month. Most constants that will actually change are **Bad CIS** channels
- CIS is now working in LBA14, so we can update the constants there

Introduction

Channels in Update	59
Good (>1 Successful Calibration)	17
$>5\%$ Change	8
Masked	16
Affected	26

Table: Summary of channels included in the update. Runs are taken from the period 1 April 2023 - 30 April 2023. There are 8 channels with greater than 0.5% change, the usual update threshold we use.

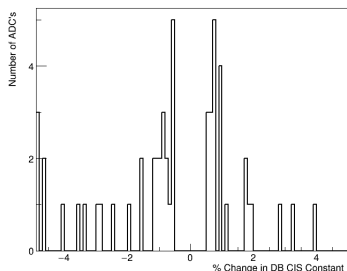


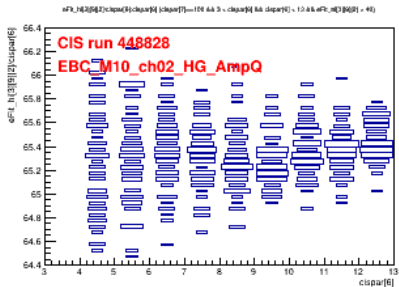
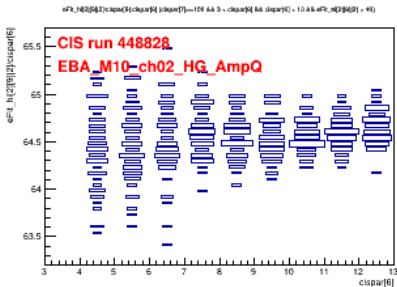
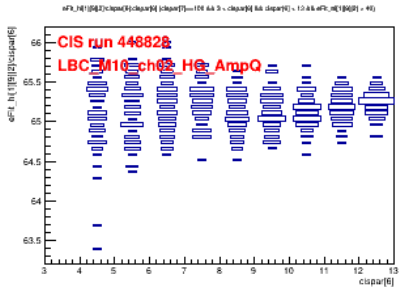
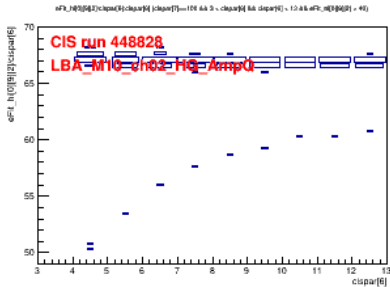
Figure: Distribution of CIS constants for the entire detector. The histogram omits channels for which change is less than 0.5% since the last update.

Run Selection

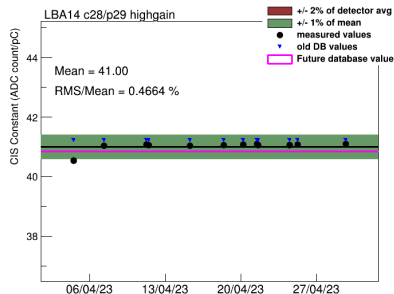
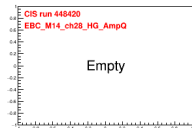
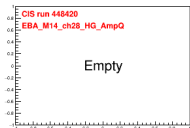
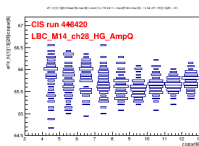
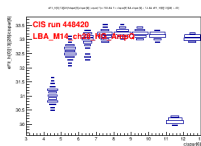
Date Range	1 April 2023 - 30 April 2023
Runs Included	448575 448776 448850 449201 449640 449942 450171 450206 450464 450488 450567 451018
Runs Excluded	448420 ^a 448427 ^b 448828 ^c 449942 ^d 450805 ^e

- a,b: The runs were systematically far from the average in LBA14 (see next slide for reason)
- c,d: The runs had a bad Amplitude-Charge ratio in LBA for high and low gain runs
- e: More-than-usual database deviations

Run Selection: Run 448828 AmpQ Ratio (a,b)

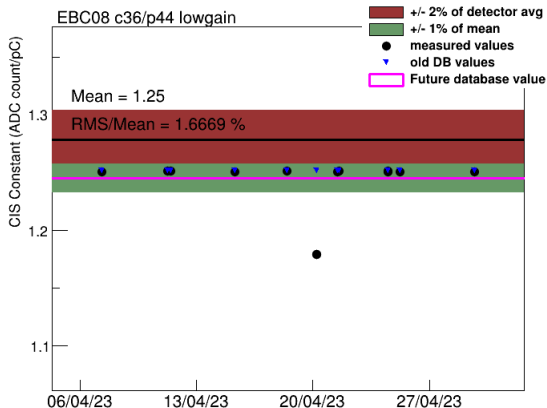


Run Selection: Run 448420 AmpQ Ratio (c,d)



qlags: Low Chi2

Run Selection: Run 449942 (e)



qlags:

Figure: Deviation from database value for about 100 more runs than the monthly average. Here is one such example. There are no problems with amplitude-charge ratio, pulse shape, or timing. Do we see this deviation in laser too?

CIS Constant Distributions

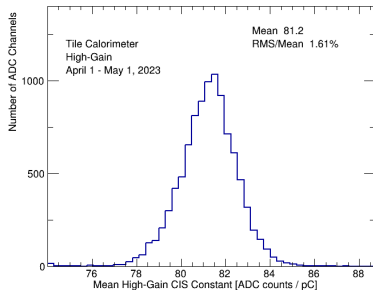


Figure: Distribution of Mean HG CIS constants for calibration runs in March 2023

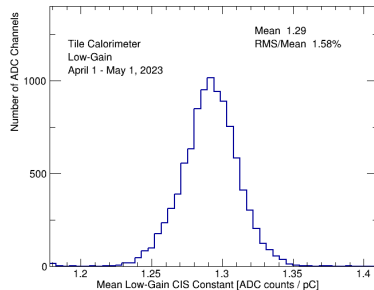


Figure: Distribution of Mean LG CIS constants for calibration runs in March 2023

Monthly Stability

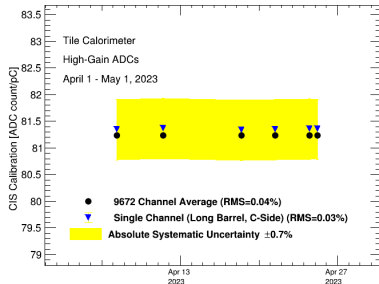


Figure: February stability of CIS constant in TileCal compared to a single channel (HG)

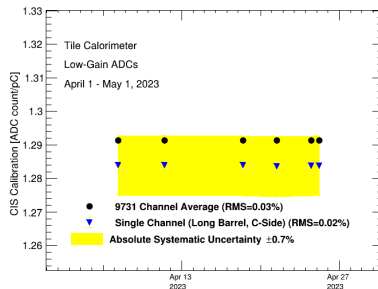
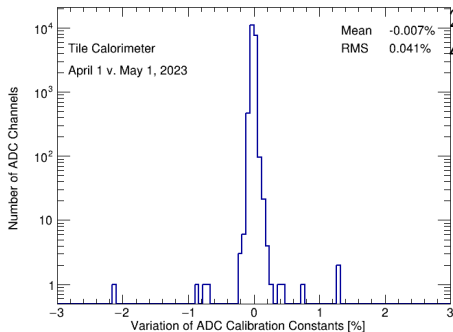


Figure: February stability of CIS constant in TileCal compared to a single channel (LG)

Detector History

Figure: Change in CIS constants by channel from beginning to end of April 2023 (comparing run 448575 to run 451018)



RMS Distributions

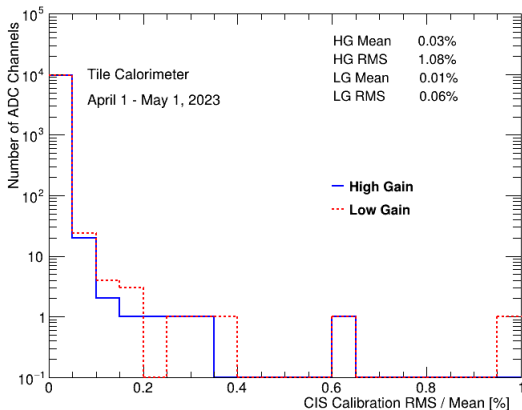


Figure: RMS/Mean distribution of CIS constant. This month there is a lot of overflow (cut off) because of modules being off and this affecting the calculation of RMS and Mean

TUCS Quality Flags

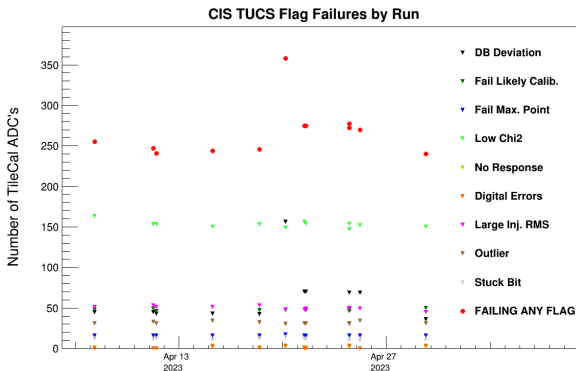


Figure: TUCS quality flags for all runs included in CIS constant update this month (with the addition of run 449942 which has an abnormally high DB deviations)

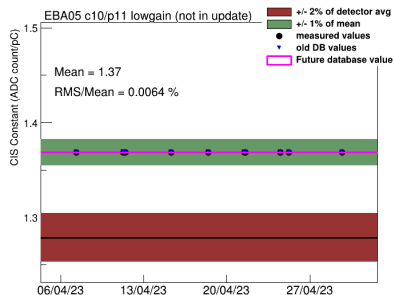
Channels to Recalibrate

- No channels need recalibration
- Even if channels are already **Bad CIS** , there are no cases where they remain stable at one value

Flag Changes

Module	Channel	Gain	Change Flag To
EBA05	10	L	Good CIS
EBA09	16	L	Good CIS
EBA13	04	L	Bad CIS

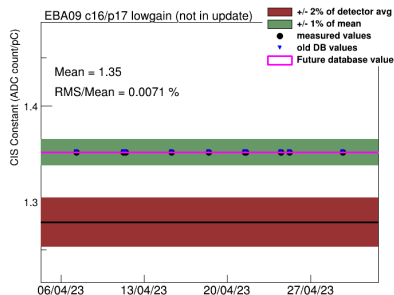
Flag Changes: To Good CIS



ADC AFFECTED Bad CIS Calib

qlags:

Figure: Good CIS in EBA05 Channel 10 LG

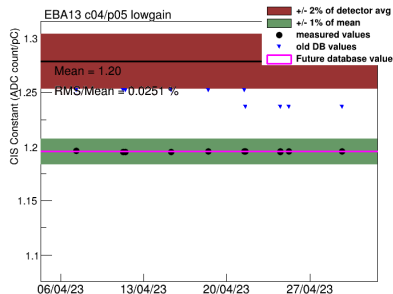


ADC AFFECTED Bad CIS Calib

qlags:

Figure: Good CIS in EBC09 Channel 16 LG

Flag Changes: To Bad CIS



qflags: Fail Likely Calib.

Figure: Bad CIS in EBA13 Channel 04 LG (far from detector average)

Channels with $> 5\%$ Change

Channel	Old DB Value	New DB Value	Change	Status
EBA m07 c31 lowgain	1.02	1.12	9.9	Bad CIS
EBA m16 c17 highgain	79.92	75.71	-5.3	Bad CIS
EBA m40 c35 highgain	70.79	77.9	10.0	Bad CIS
EBA m42 c30 highgain	69.91	74.23	6.2	Bad CIS
EBC m16 c11 lowgain	1.25	1.32	5.5	No CIS
EBC m56 c41 lowgain	0.99	1.05	6.9	Bad CIS
LBC m16 c29 highgain	76.37	72.48	-5.1	Bad CIS
LBC m47 c35 lowgain	1.0	0.65	-35.2	Bad CIS

- All of these channels are already marked s ADC Affected/Bad/Masked; the problems are already known

Channels with $> 5\%$ Change

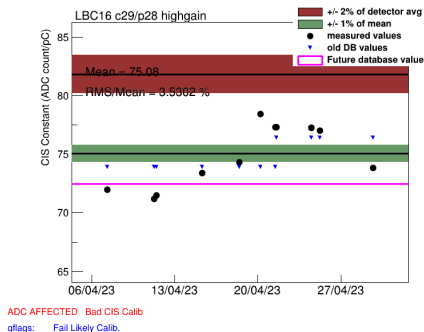


Figure: High scatter in LBC16 Channel 29 HG

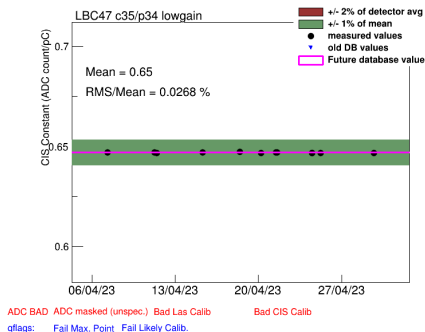


Figure: Far from detector average in LBC47 Channel 35 HG

No CIS in EBC16 Channel 11; Run 449942

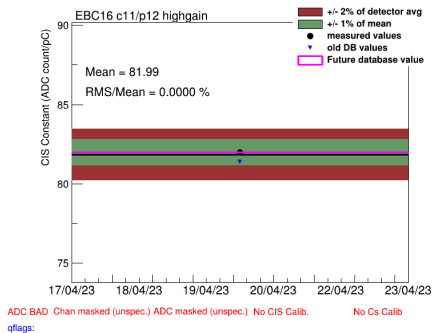


Figure: One observed CIS calibration run: EBC16 Channel 11 HG

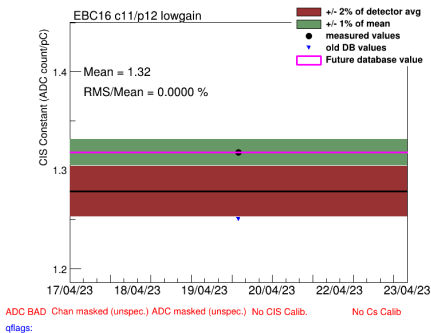


Figure: One observed CIS calibration run: EBC16 Channel 11 LG

Masked/Affected Channel List

Masked (16)

LBC20 c37/p38 highgain
LBC28 c04/p05 lowgain
LBC43 c24/p27 highgain
LBC47 c35/p34 lowgain
LBC52 c18/p19 highgain
LBA62 c26/p25 highgain
LBA35 c08/p09 highgain
LBA38 c46/p47 lowgain
LBA02 c06/p07 lowgain
LBA02 c06/p07 highgain
EBC56 c41/p41 lowgain
EBC16 c11/p12 lowgain
EBC16 c11/p12 highgain
EBC20 c10/p11 lowgain
EBC22 c16/p17 lowgain
EBA07 c31/p29 lowgain

Affected (26)

LBC20 c37/p38 lowgain
LBC44 c12/p13 highgain
LBC62 c08/p09 highgain
LBC46 c04/p05 highgain

LBC10 c37/p38 highgain
LBC16 c29/p28 highgain
LBC57 c06/p07 highgain
LBC19 c26/p25 highgain
LBA06 c40/p41 highgain
LBA51 c12/p13 highgain
LBA52 c01/p02 lowgain
LBA64 c29/p28 highgain
LBA45 c06/p07 highgain
EBC01 c21/p22 highgain
EBC46 c07/p08 lowgain
EBC13 c03/p04 lowgain
EBC23 c36/p44 highgain
EBC30 c11/p12 lowgain
EBC30 c11/p12 highgain
EBC34 c41/p41 lowgain
EBA55 c22/p23 highgain
EBA16 c17/p18 highgain
EBA40 c35/p34 highgain
EBA42 c30/p33 highgain
EBA49 c00/p01 highgain
EBA50 c20/p21 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 $< 1\%$