Charge Injection System (CIS) Update

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Introduction

- We are updating CIS constants using calibration runs taken in March, the first update since a full recalibration of all channels post-YETS. By **Wednesday, 19 April**, we will push to the database
- Overall, there is no major unusual or problematic behaviour except for a few isolated channels

Summary

Channels in Update	62
Good (>1 Successful Calibration)	31
>5% Change	10
Masked	12
Affected	19

Table: Summary of channels included in the update. Runs are taken from the period March 1 - March 31, 2023. There are 10 channels with greater than 0.5% change, the usual update threshold we use.

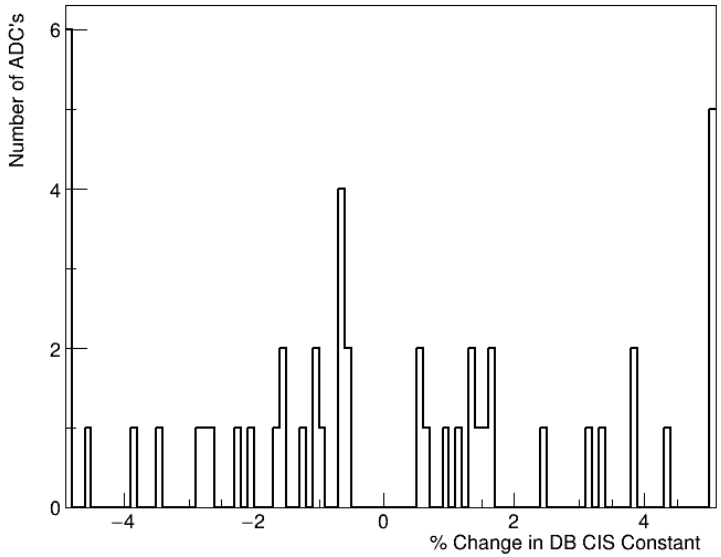


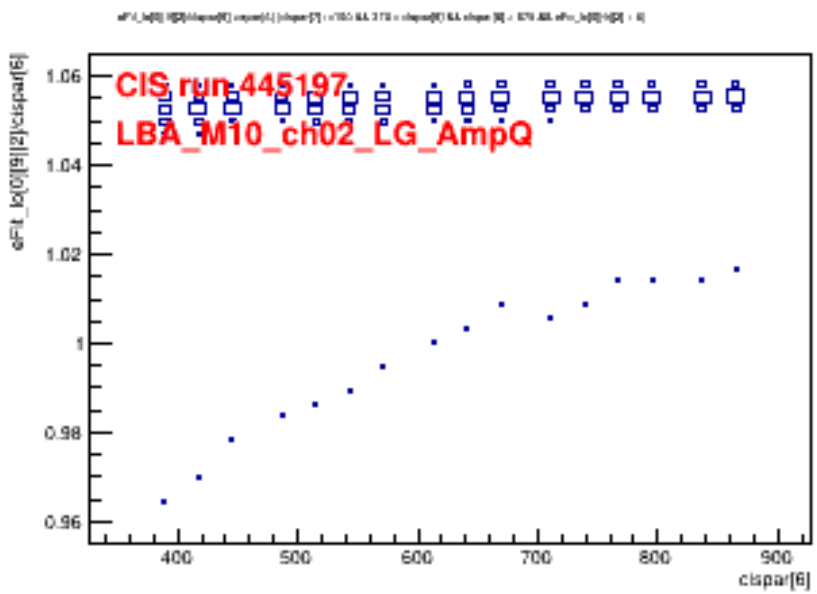
Figure: Distribution of CIS constants for the entire detector. The histogram omits channels for which change is less than 0.5% since the last update.

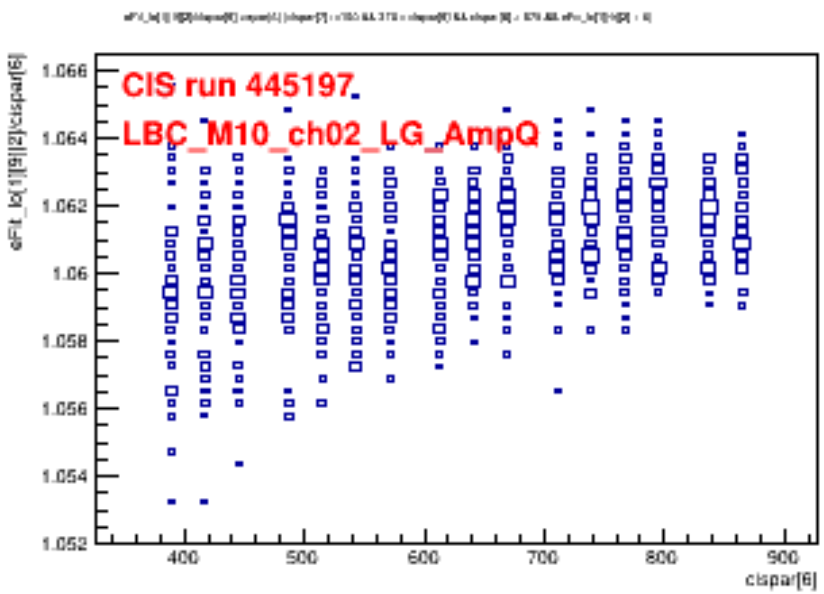
Run Selection

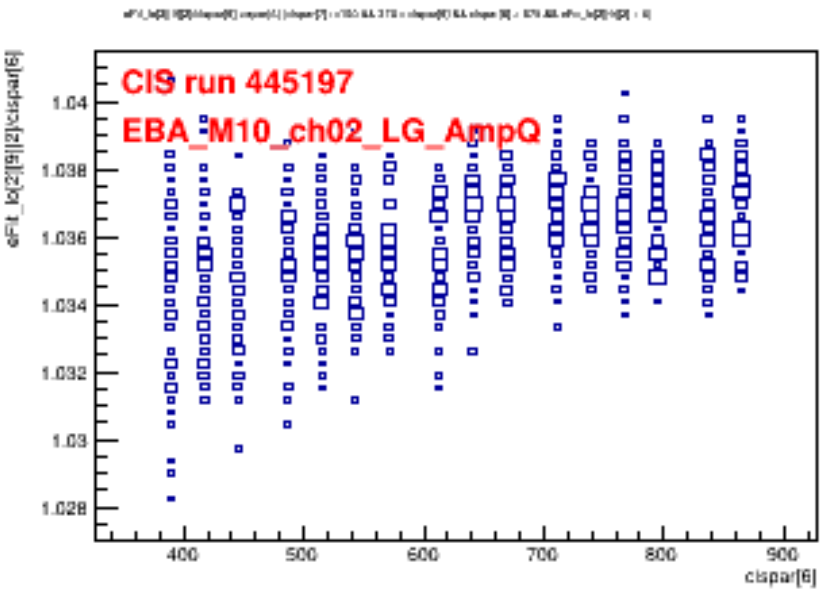
Date Range	1 March 2023 - 31 March 2023
Runs Included	444983 445096 445338 445749 445929 446573 446738 447390 447442 447551
Runs Excluded	445197[a] 445634[b] 447564[c] 447641[d] 447987[e]

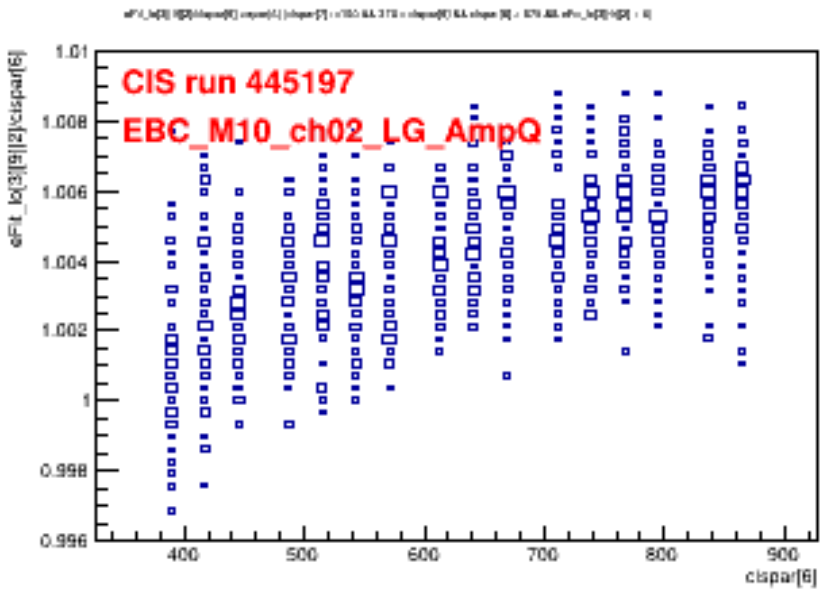
- (a-e) Bad Amplitude-Charge ratio seen in LBA

Run Selection: Run 445197 AmpQ Ratio (Example)









CIS Constant Distributions

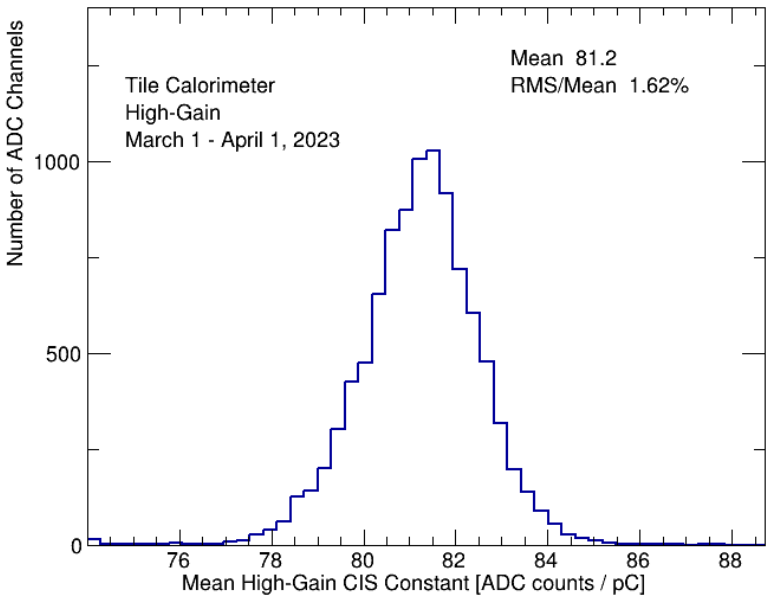


Figure: Distribution of Mean HG CIS constants for calibration runs in March 2023

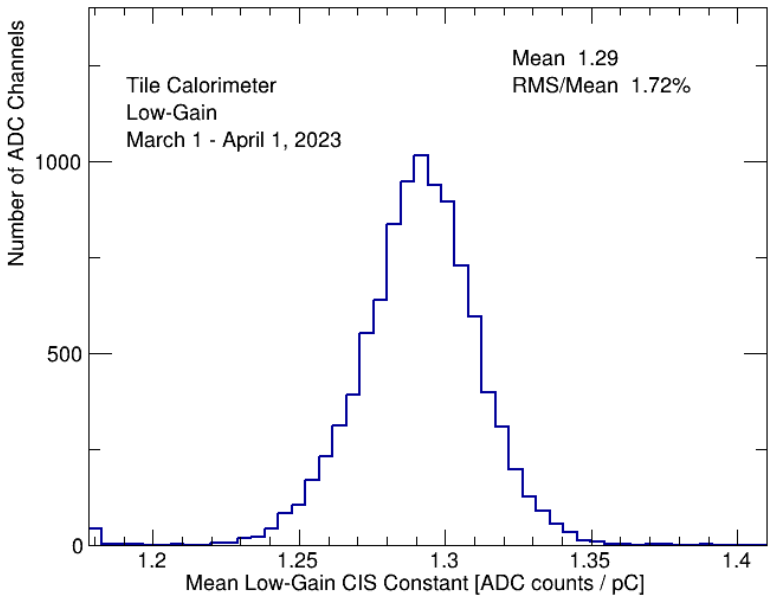


Figure: Distribution of Mean LG CIS constants for calibration runs in March 2023

Monthly Stability

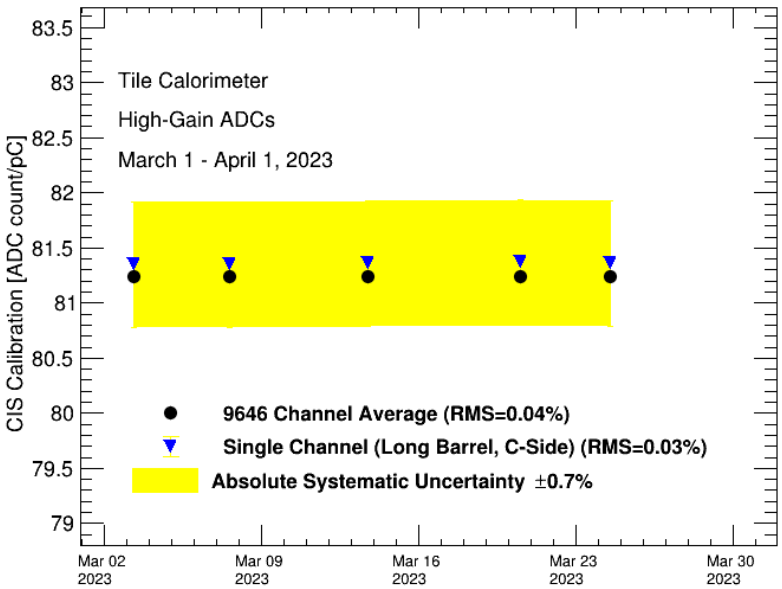


Figure: February stability of CIS constant in TileCal compared to a single channel (HG)

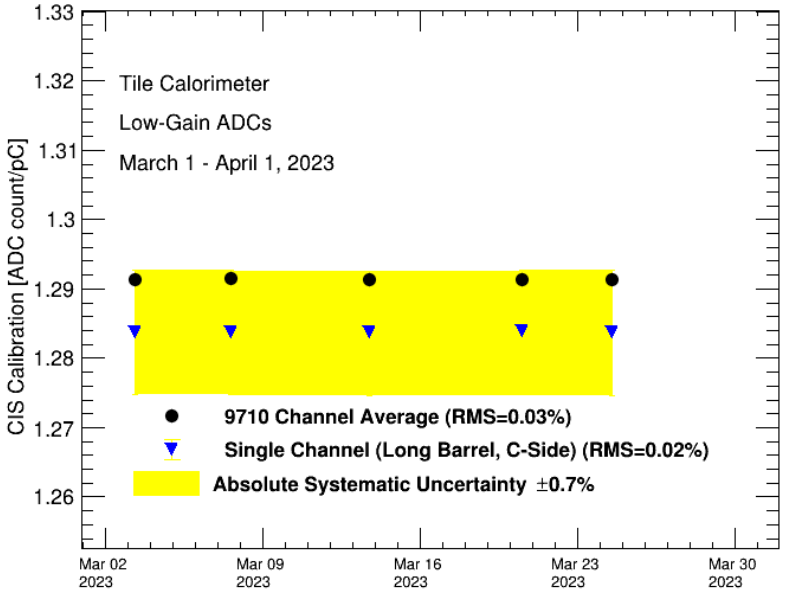


Figure: February stability of CIS constant in TileCal compared to a single channel (LG)

Detector History

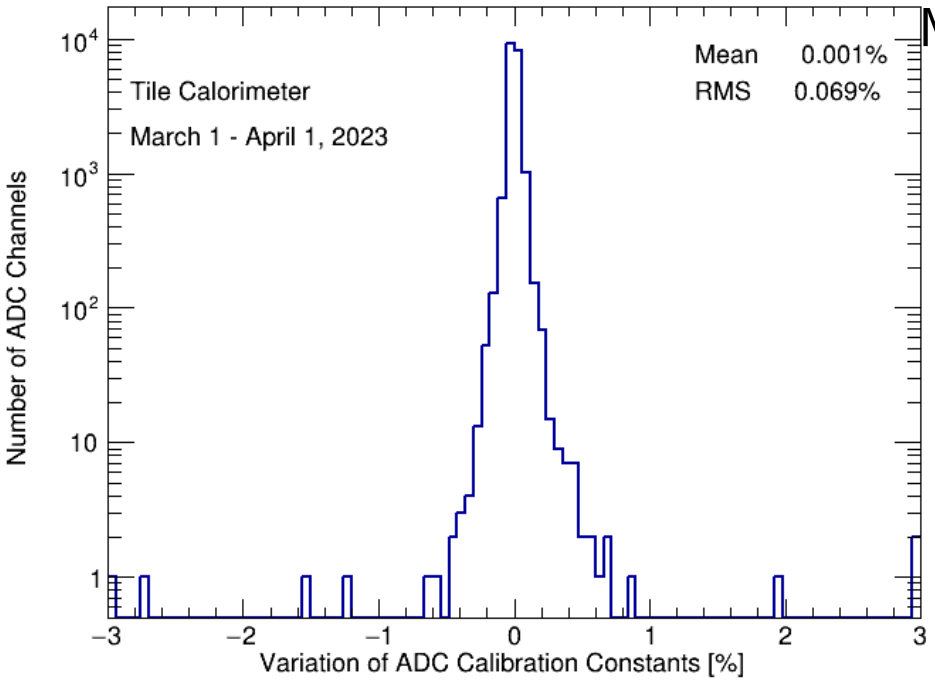


Figure: Change in CIS constants by channel from beginning to end of March 2023

- Here, we list the channels that underwent a drift of greater than 3% between runs 444983 and . These correspond the overflow bins in the histogram.
  - EBA m16 c17 highgain (-4.1%)
  - LBC m10 c37 highgain (4.2%)

RMS Distributions

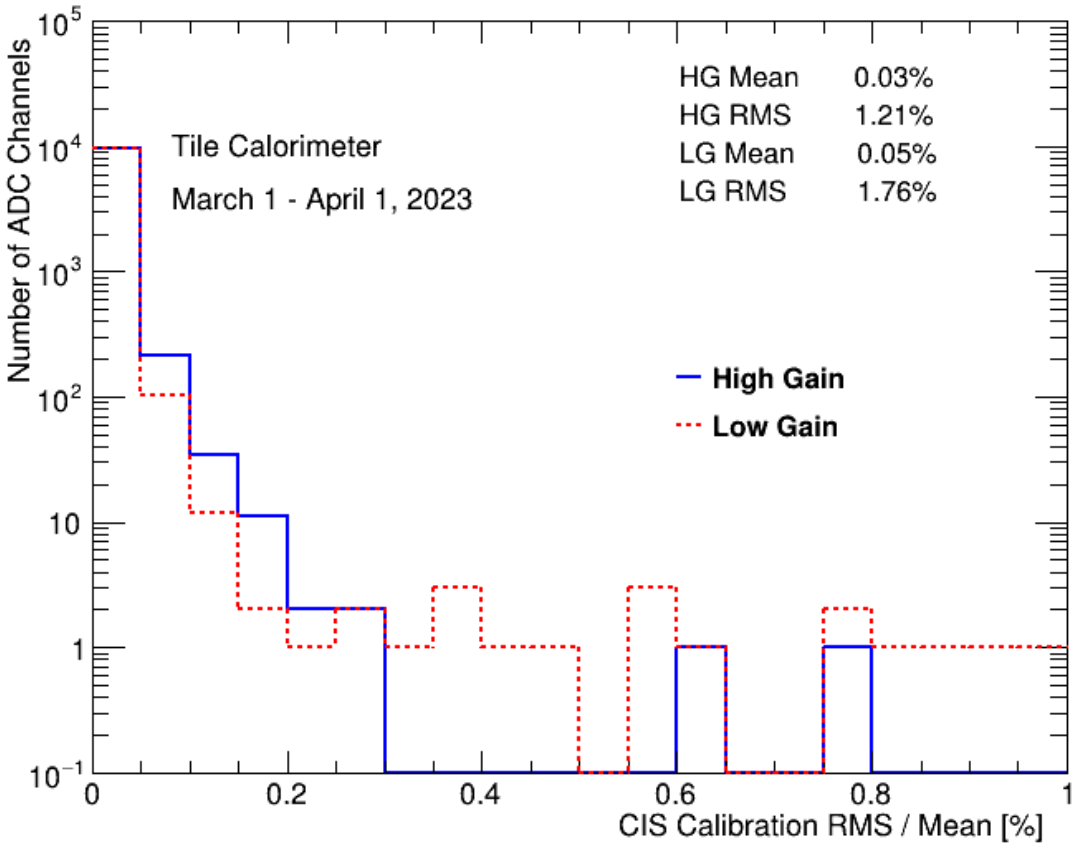


Figure: RMS/MEan distribution of CIS constant. This month there is a lot of overflow (cut off) because of modules being off and this affecting the calculation of RMS and Mean

Channels to Recalibrate

Module	Channel	Gain	Recalibrate From Date
EBA49	0	H	16.3
LBA03	17	L	20.3
LBA35	8	H	20.3
LBA51	12	H	23.3
LBC10	37	H	16.3-24.3
LBC52	34	L	20.3

- All of the channels listed are Bad CISanyways

Channels to Recalibrate

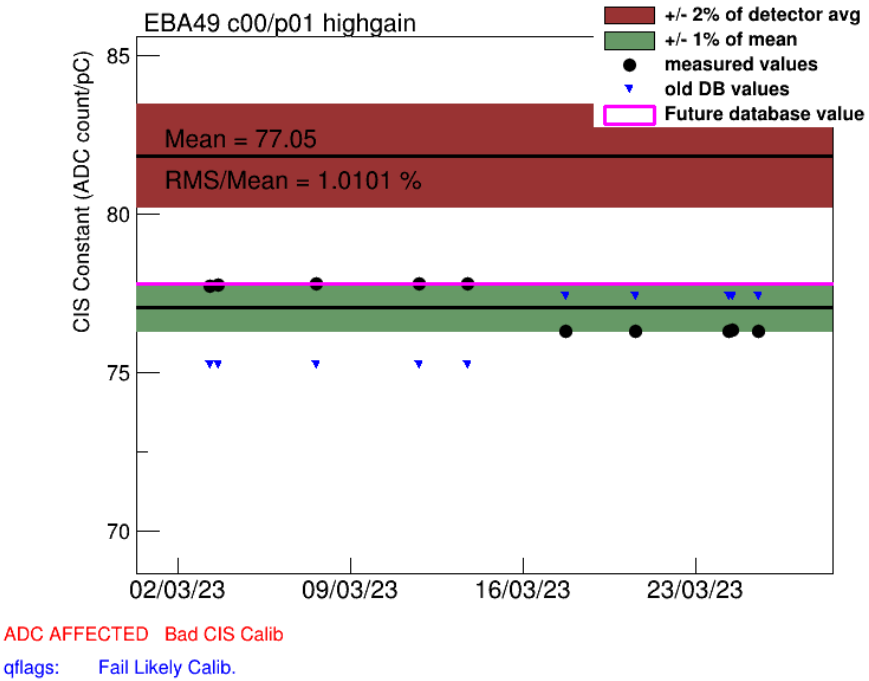


Figure: Recalibration EBA49 Channel 00 HG

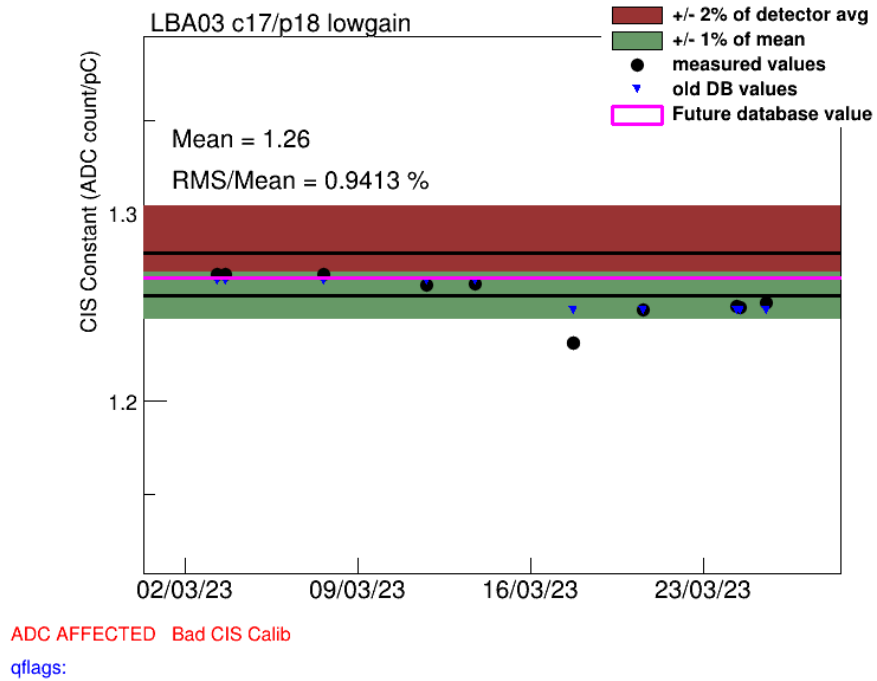


Figure: Recalibration LBA03 Channel 17 LG

Flag Changes

Module	Channel	Gain	Change Flag To
EBA48	37	H	Bad CIS
EBC16	39	H	Good CIS
EBC23	31	L	Good CIS
EBC30	11	H/L	Bad CIS
EBC59	32	L	Bad CIS
LBA42	07	H	Bad CIS
LBC20	37	H	Bad CIS

Flag Changes: To Good CIS

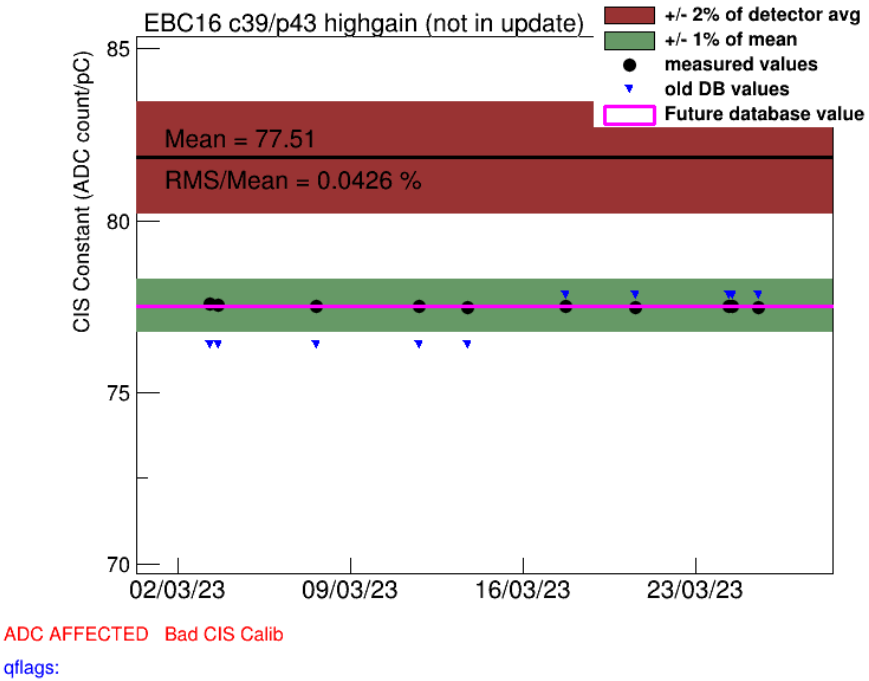


Figure: Good CIS in EBC16 Channel 39 HG

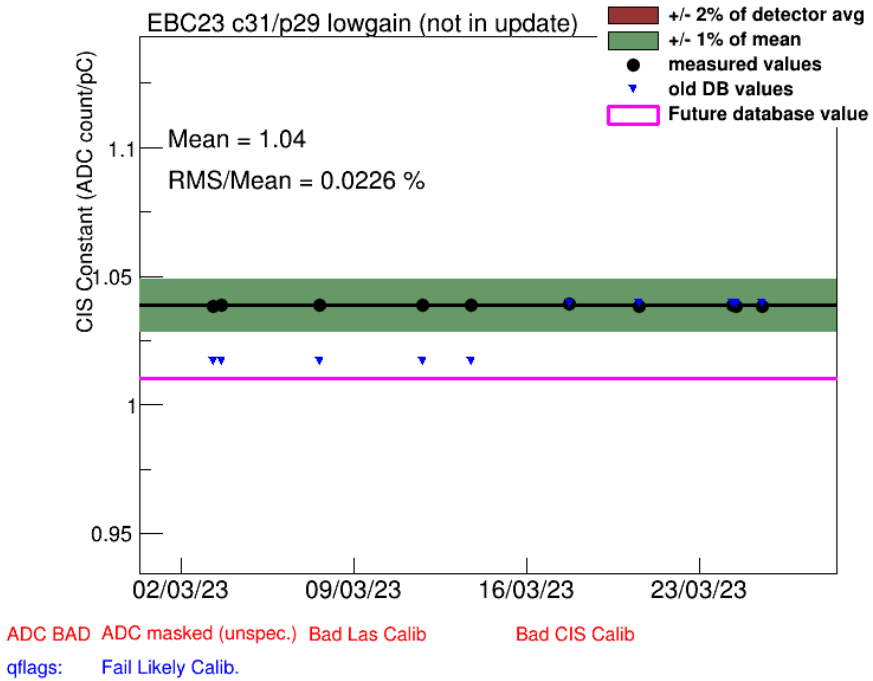


Figure: Good CIS in EBC23 Channel 31 HG

Flag Changes: To Good CIS

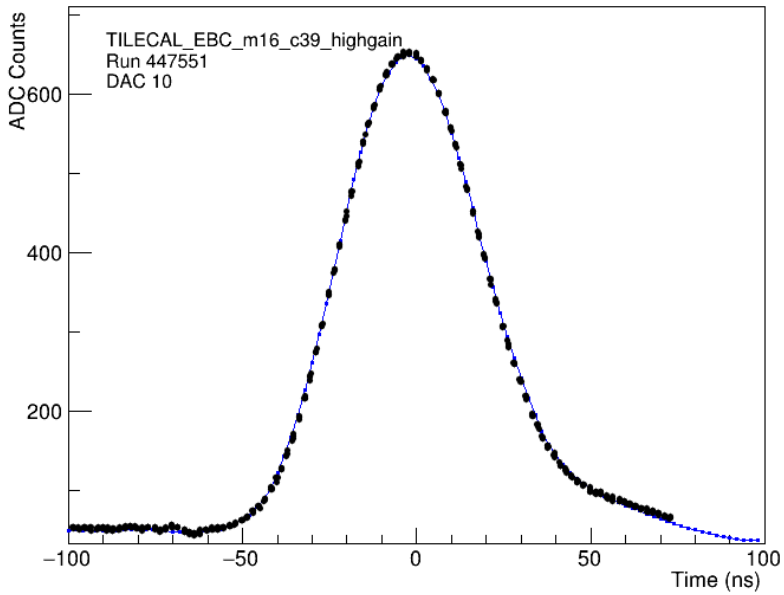


Figure: Good CIS in EBC16 Channel 39 HG

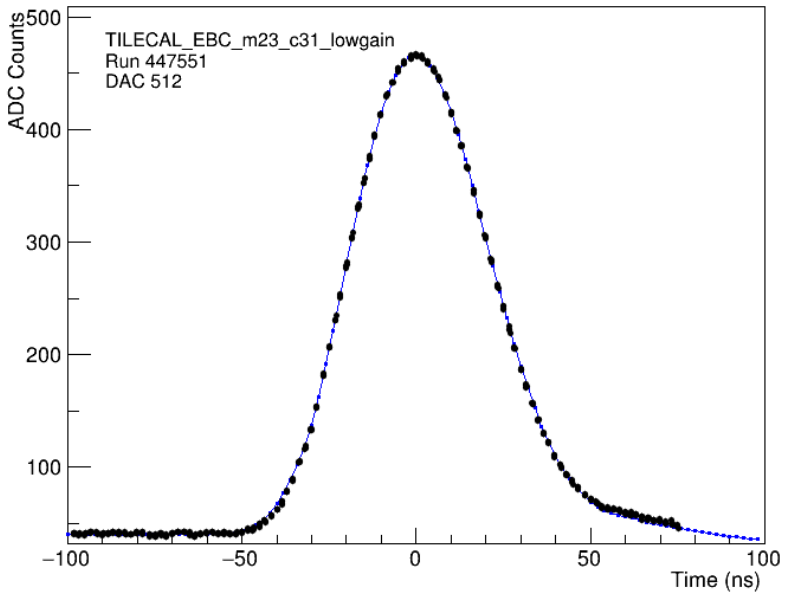


Figure: Good CIS in EBC23 Channel 31 HG

Flag Changes: To Bad CIS

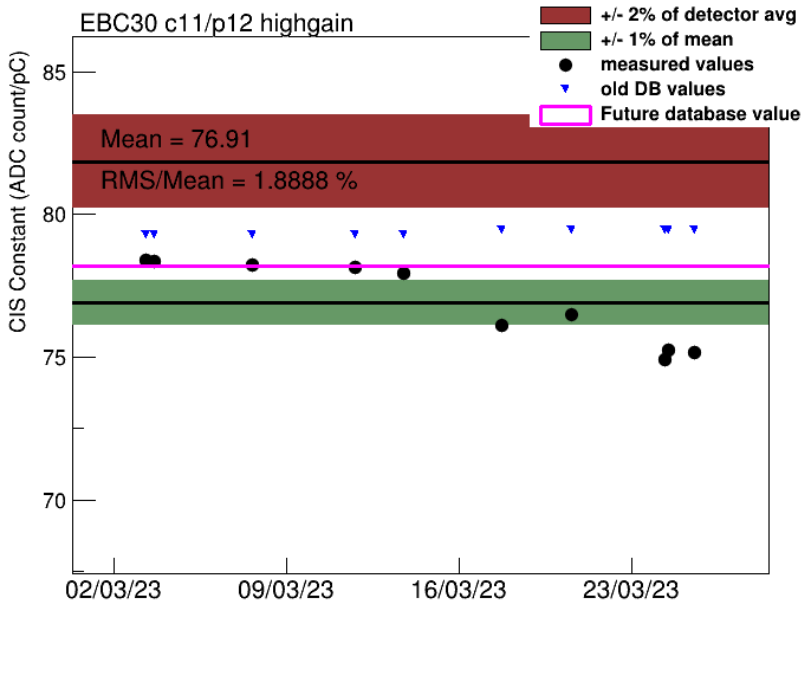


Figure: New problem in EBC30 Channel 11 HG

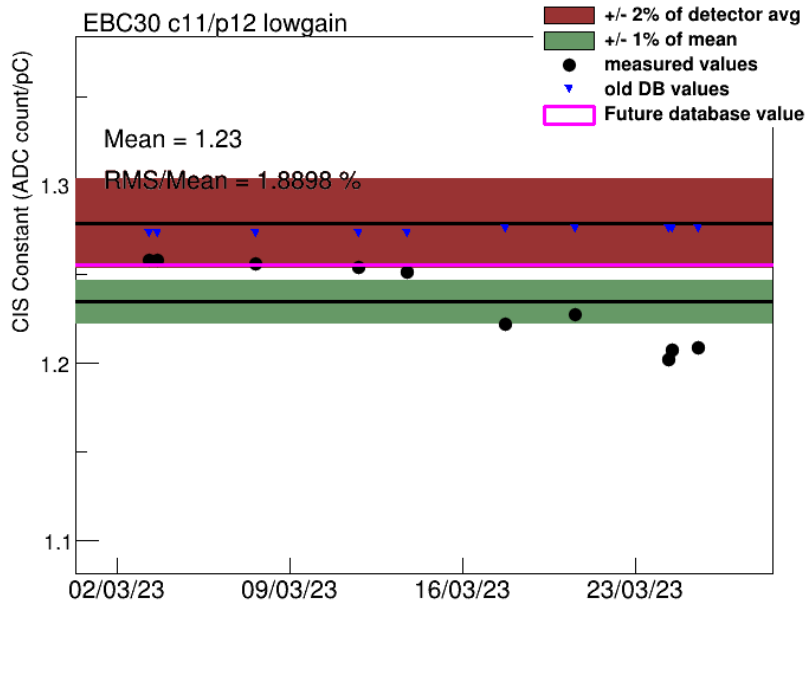


Figure: New problem in EBC30 Channel 11 LG

Channels with $> 5\%$ Change

Channel	Old DB Value	New DB Value	Change	Status
EBA m39 c31 highgain	69.54	74.84	7.6	Bad CIS
EBA m40 c35 highgain	80.24	69.65	-13.2	Bad CIS
EBC m20 c10 lowgain	1.29	1.22	-5.8	Bad CIS
EBC m22 c16 lowgain	1.2	1.12	-7.1	Bad CIS
EBC m34 c38 highgain	81.72	46.65	-42.9	Bad CIS
LBA m62 c26 highgain	55.85	63.48	13.7	Bad CIS
LBC m47 c35 lowgain	0.89	1.0	12.1	Bad CIS
LBC m52 c34 highgain	87.03	80.97	-7.0	Good CIS
LBC m52 c34 lowgain	1.4	1.3	-6.8	Good CIS
LBC m57 c06 highgain	56.94	76.11	33.7	Bad CIS

Channels with $> 5\%$ Change

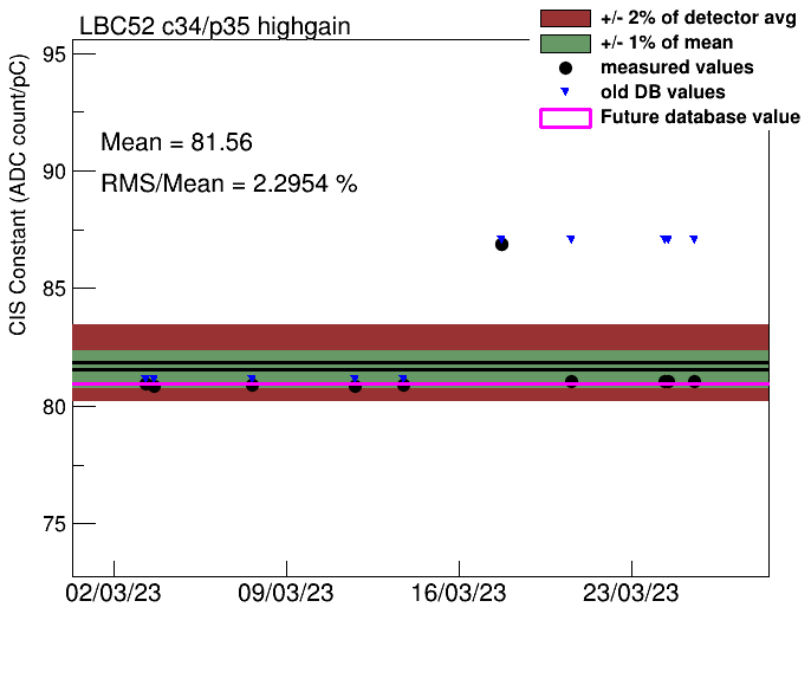


Figure: Candidate for recalibration: LBC52 Channel 34 HG

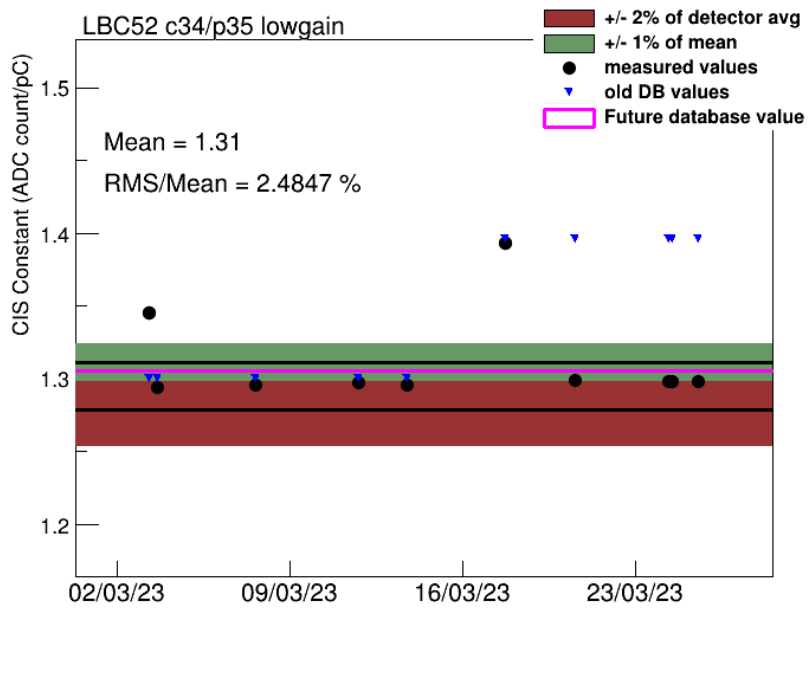


Figure: Candidate for recalibration: LBC52 Channel 34 LG

Channels with $> 5\%$ Change

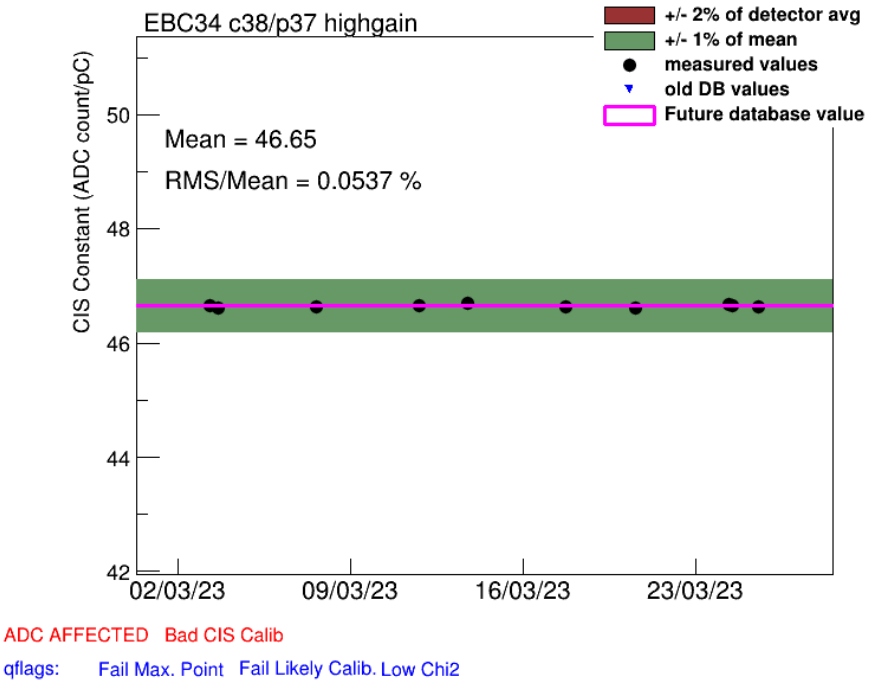


Figure: Moved to half gain? (LG channel set as DEFAULT))EBC34 Channel 38 HG

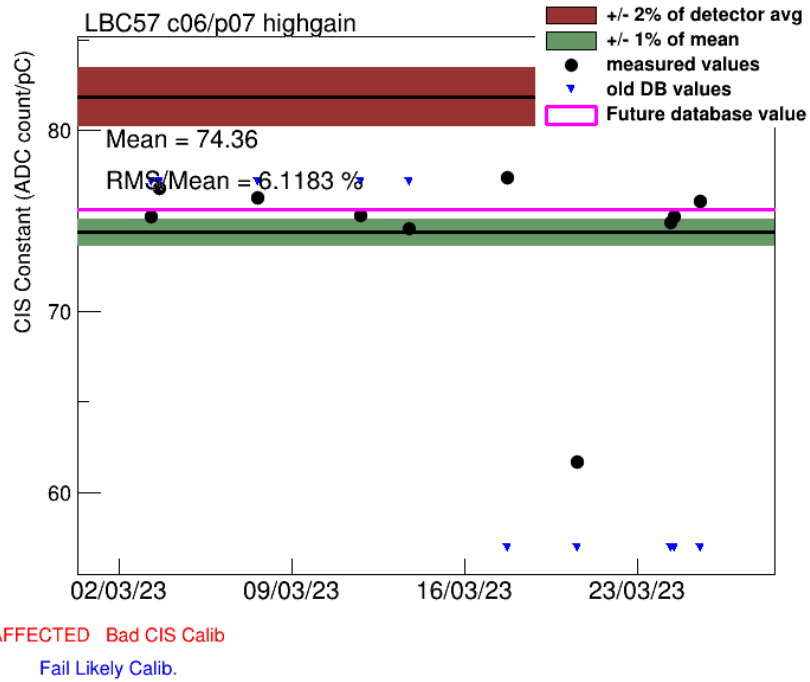
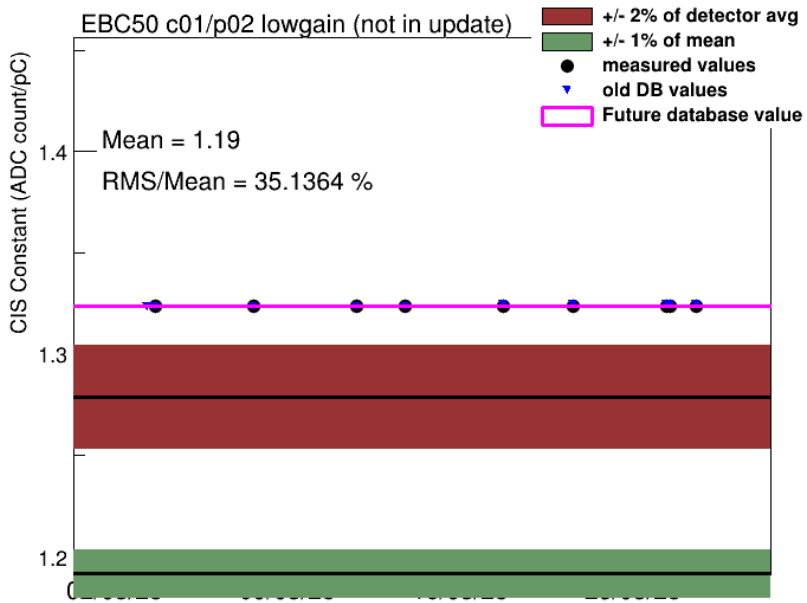


Figure: Large deviation in LBC57 Channel 06 HG

EBC50

- There was an intvervention in USA15 in mid-March concerining EBC50 (elog)
- This was the case for all lowgain channels



qflags:

Cesium Flag Changes

- The following channels' BadCesium/NoCesium Channels were removed recently after LS2 repairs (elog). Here we show their new status in CIS
- All of them are still currently marked as "ADC BAD" at the moment. They are candidates for unmasking.

Module	Channel	Gain	CIS Status
LBA18	07	H/L	Good CIS
LBA59	38	H/L	Good CIS
LBC02	38	H/L	Good CIS
LBC28	35	H/L	Good CIS
LBC29	26	H/L	Good CIS
LBC44	40	H/L	Good CIS

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%

Cesium Flag Changes

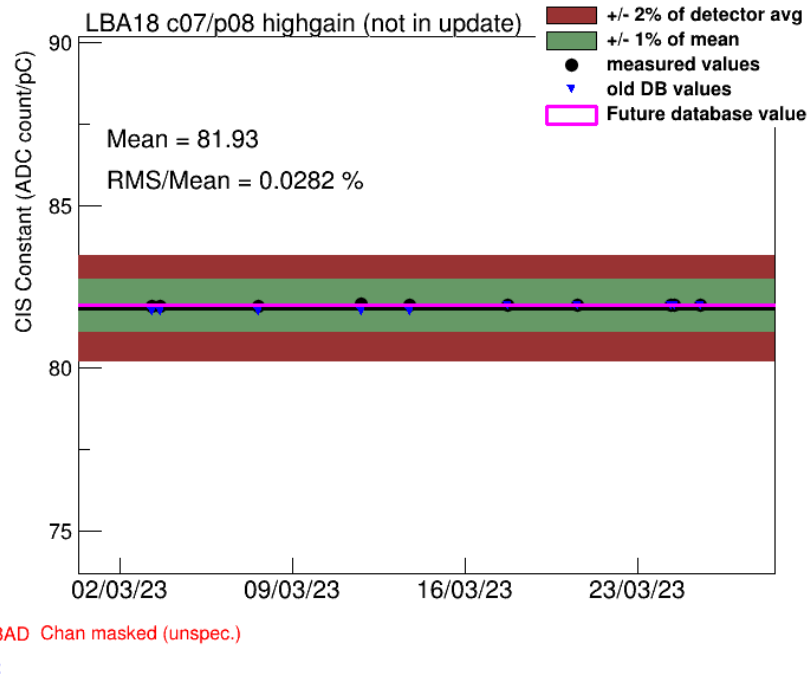


Figure: Good CIS status in LBA18 Channel 07 HG after Cs flag updates

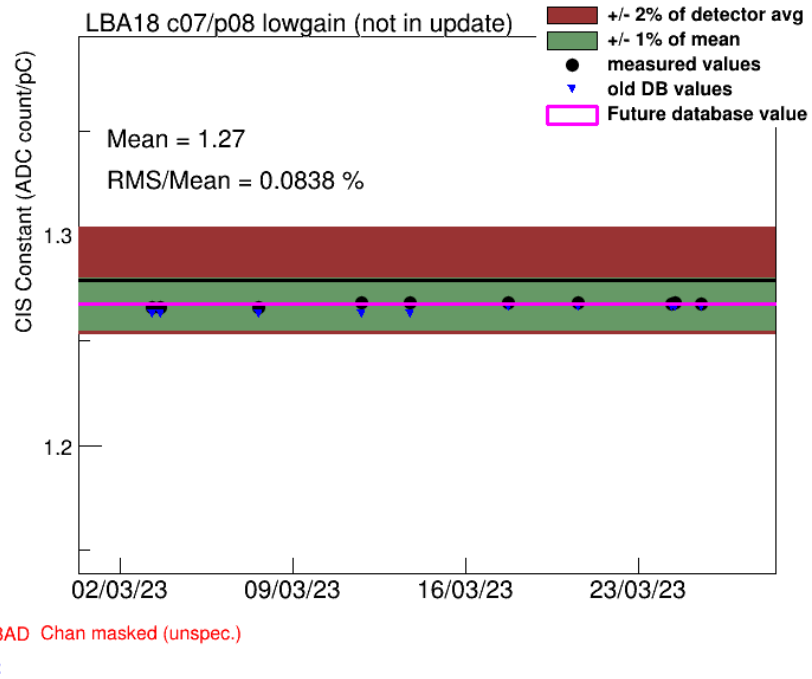


Figure: Good CIS status in LBC18 Channel 07 LG after Cs flag updates

Cesium Flag Changes

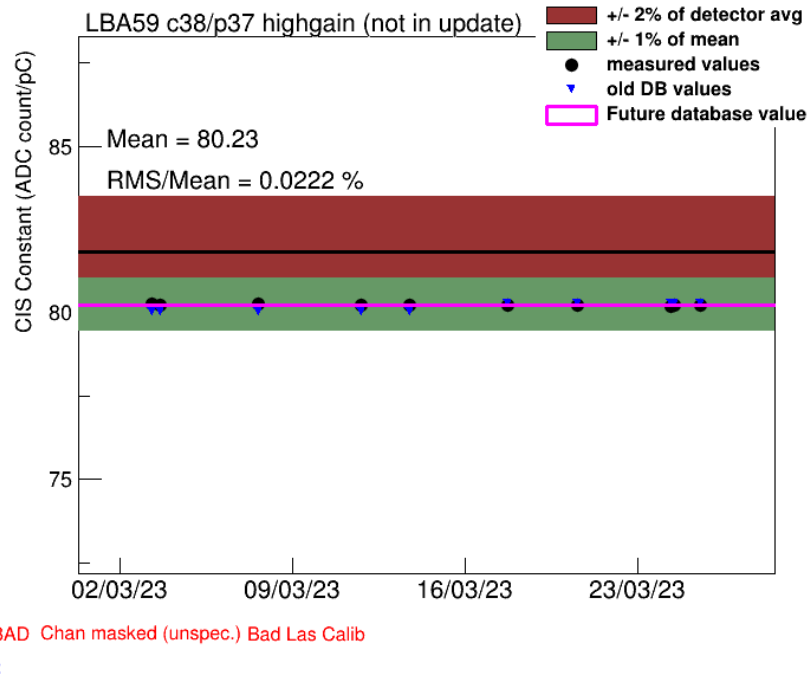


Figure: Good CIS status in LBA59 Channel 38 HG after Cs flag updates

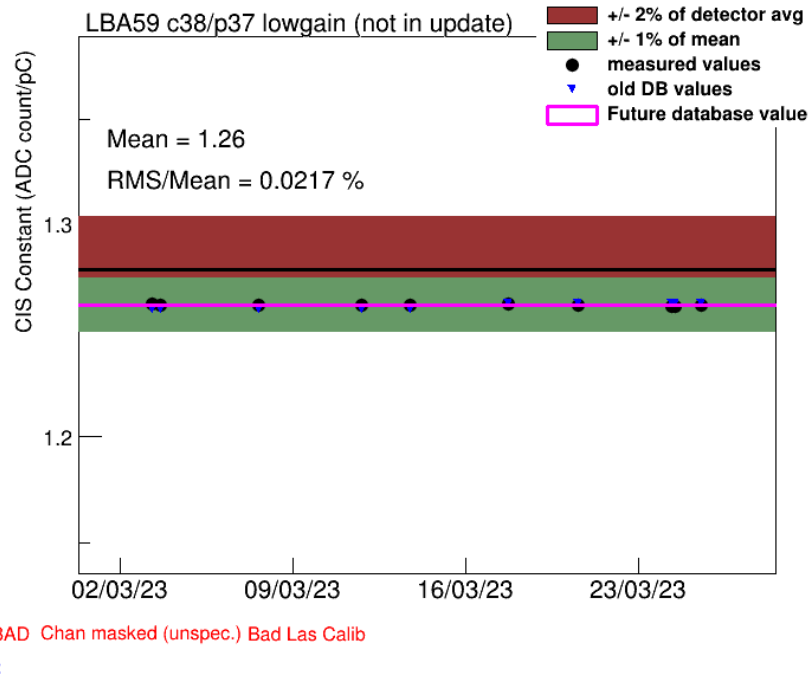


Figure: Good CIS status in LBA59 Channel 38 LG after Cs flag updates

Cesium Flag Changes

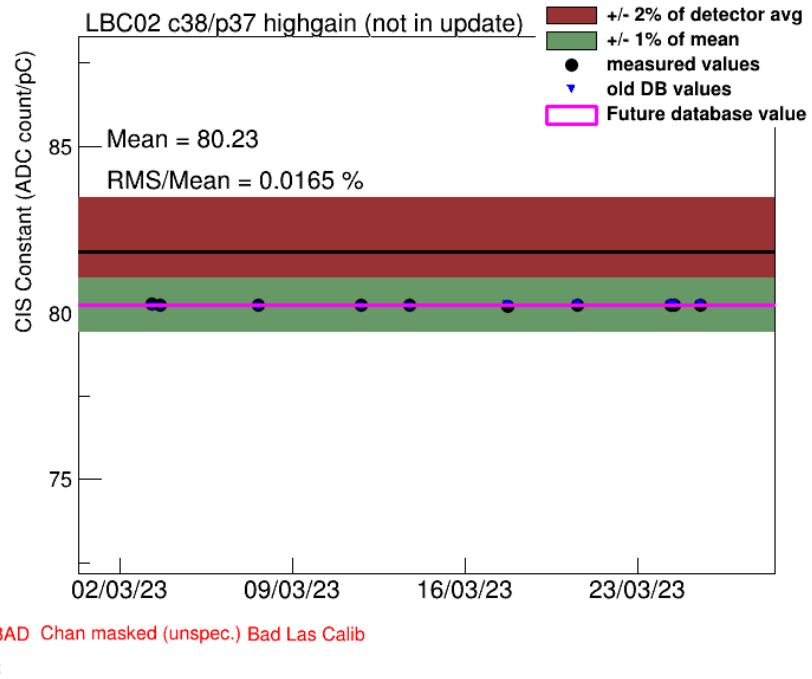


Figure: Good CIS status in LBC02 Channel 38 HG after Cs flag updates

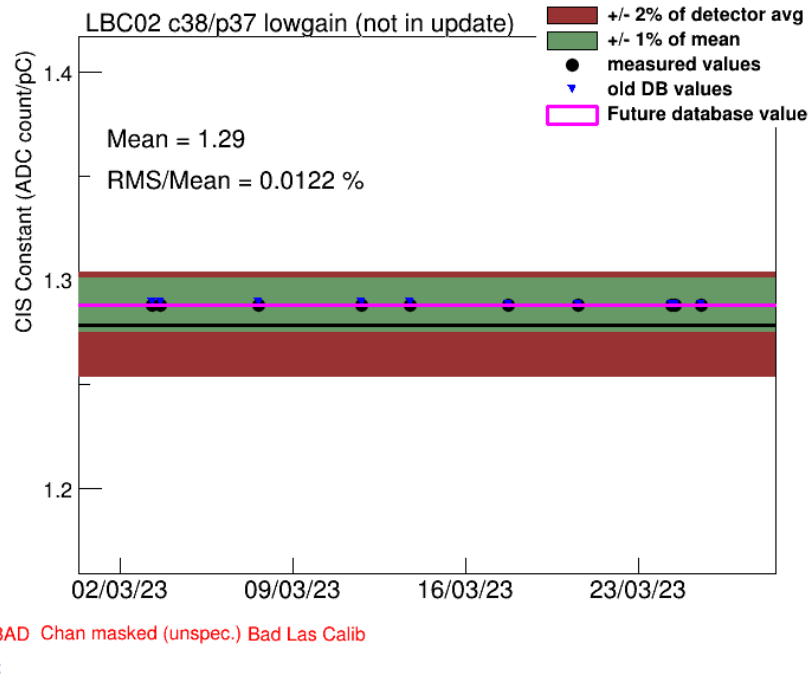


Figure: Good CIS status in LBC02 Channel 38 LG after Cs flag updates

Cesium Flag Changes

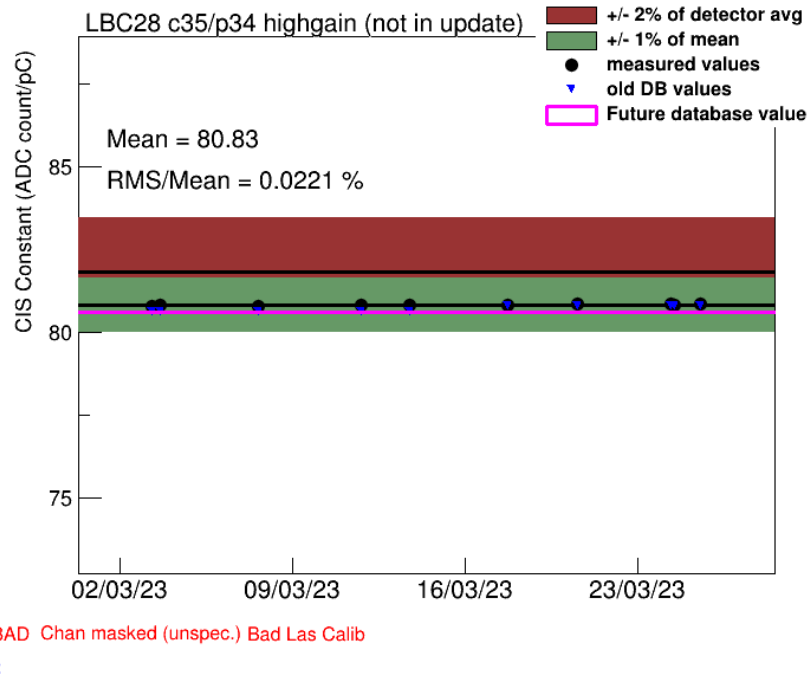


Figure: Good CIS status in LBC28 Channel 35 HG after Cs flag updates

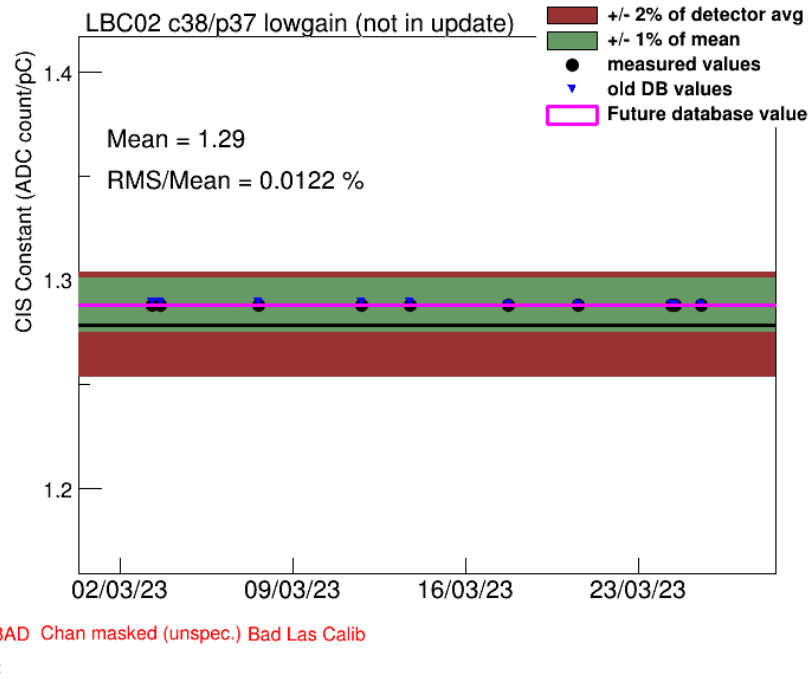


Figure: Good CIS status in LBC28 Channel 35 LG after Cs flag updates

Cesium Flag Changes

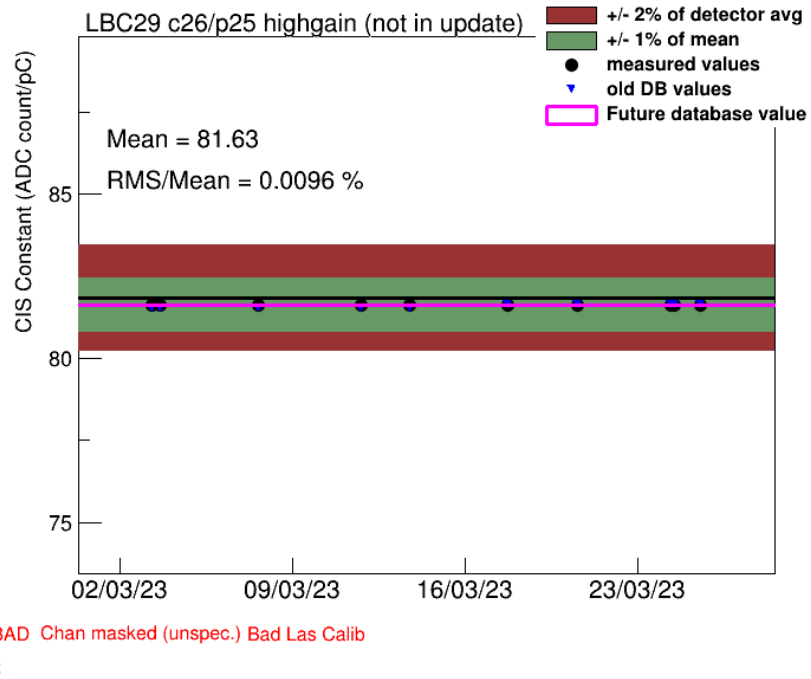


Figure: Good CIS status in LBC29 Channel 26 HG after Cs flag updates

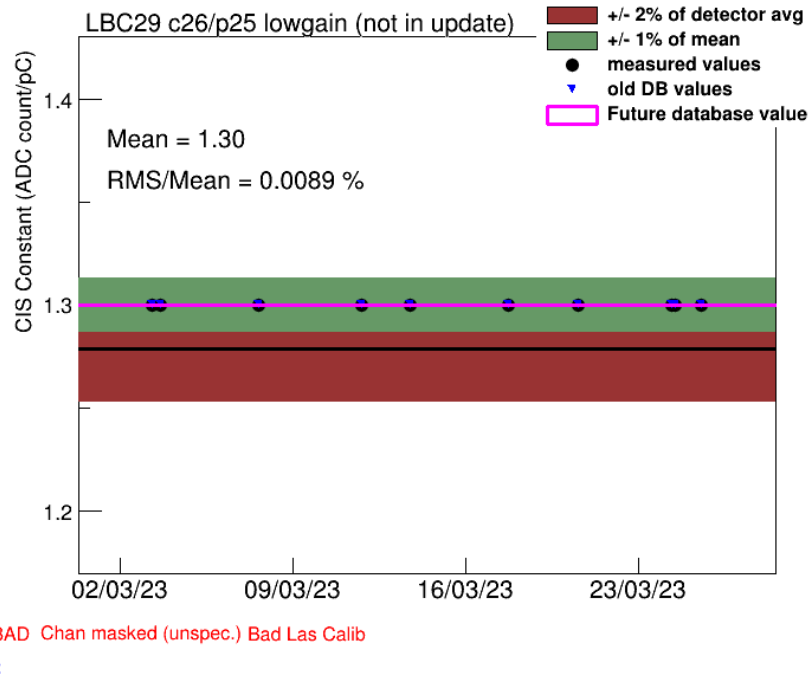


Figure: Good CIS status in LBC29 Channel 26 LG after Cs flag updates

Cesium Flag Changes

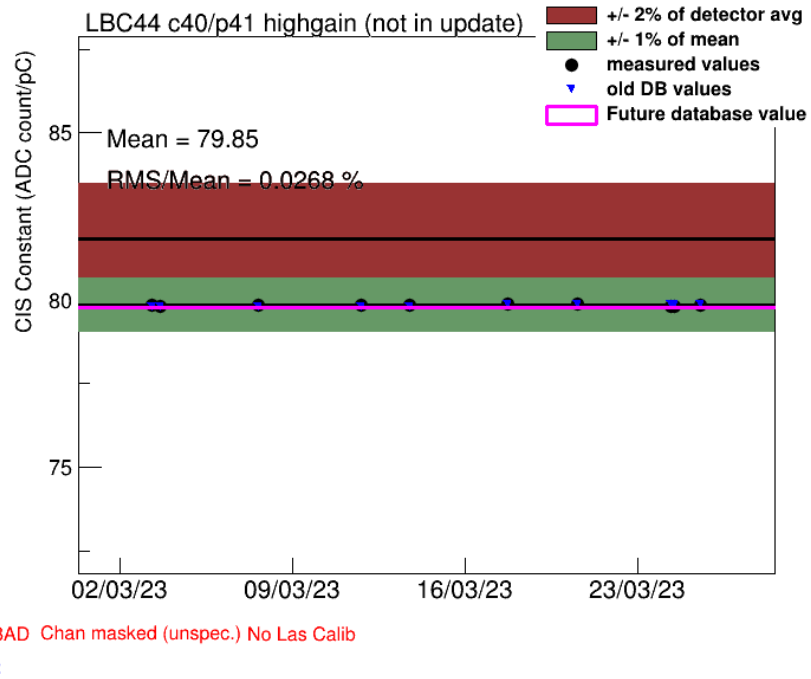


Figure: Good CIS status in LBC44 Channel 40 HG after Cs flag updates

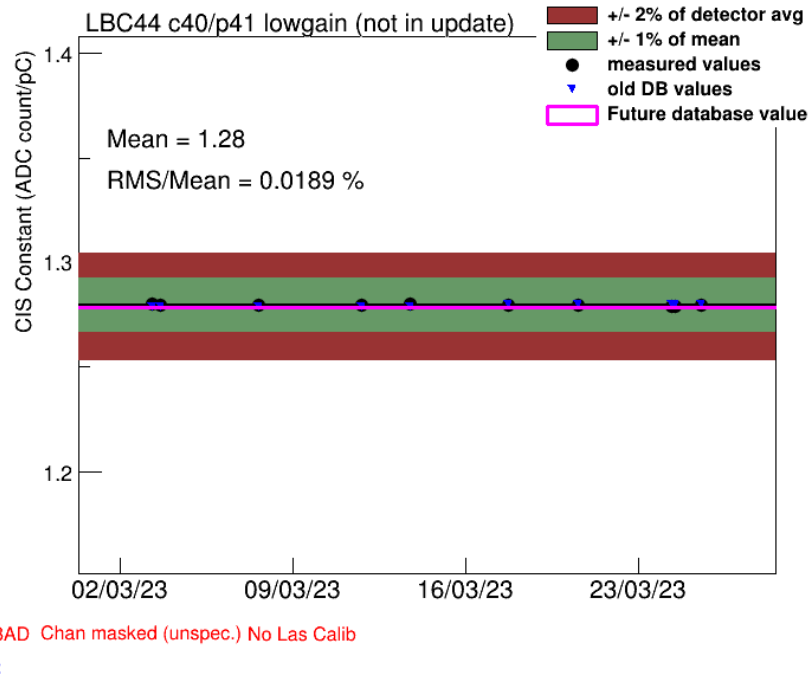


Figure: Good CIS status in LBC44 Channel 40 LG after Cs flag updates