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Status of the operations of CALET for 7.5 years on the International Space Station PCRD0-13

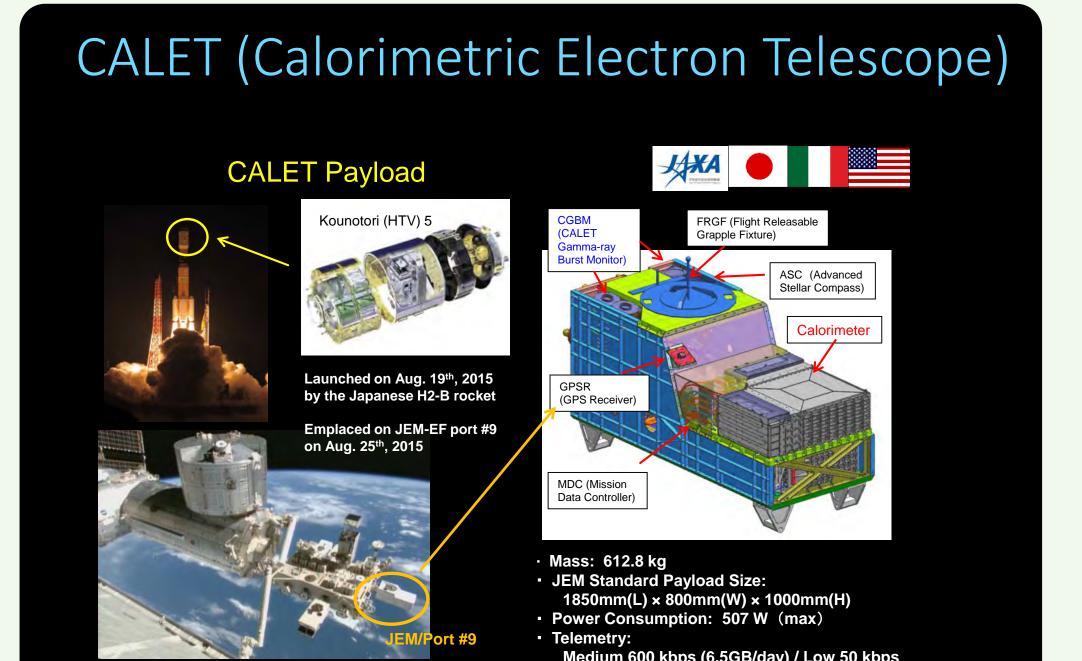
T. Tamura¹, Y. Akaike^{2, 3}, K. Kobayashi^{2, 3} for CALET collaboration

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2) WISE, Waseda University, Japan

3) JEM Utilization Center, JAXA, Japan

The 38th International Cosmic Ray Conference (ICRC2023), Nagoya, Japan, Jul 26 – Aug 3, 2023



Operations for CALET

- Launch date of CALET : Aug. 19, 2015
- ◆ Start of data acquisition : Oct. 13, 2015

Normal Operations

 \succ Update of schedule files

• Uplink of a file to the ISS and update around UT 3:00 on every Monday, Wednesday, Friday Shift for the CALET status check

Check of the CALET status every day by a web site of WCOC (Waseda CALET Operations Center) on data qualities and instruments status

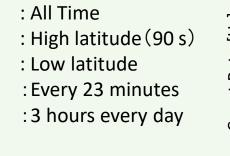
Special Operations

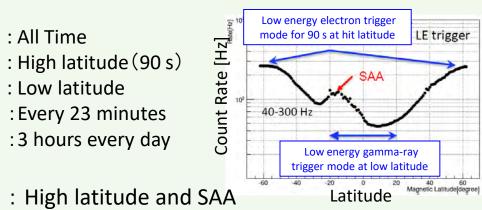
 \succ Countermeasures related to ISS operations such as reboost, PDAM, power reduction request, out gas of other equipment etc. \succ Corrective actions for known events such as MDC auto-reboot by SEU etc.

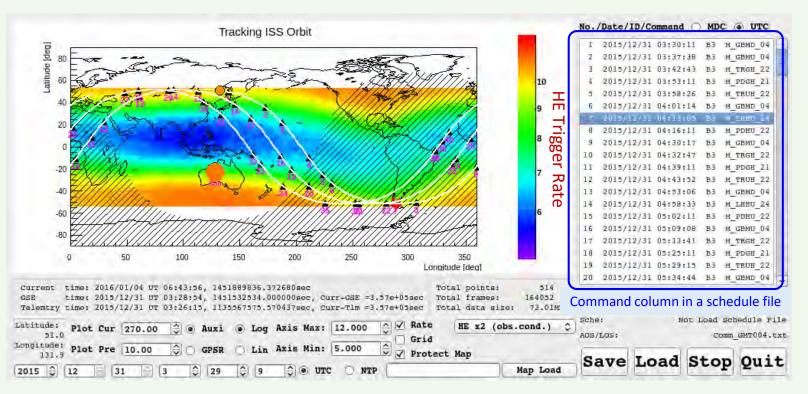
CALET: Observation Schedule

CAL Observation Mode

□ High Energy Trigger (HE) □ Low Energy Electron Trigger (LE-ele) Low Energy gamma-ray Trigger (LE-y) Pedestal Trigger □ Single Trigger (p, He) Detector (CGBM) protection **CGBM HV On/Off**







Medium 600 kbps (6.5GB/day) / Low 50 kbps

Permanent failure after launch

1400 Lings 1200

<u>ණ</u>1000

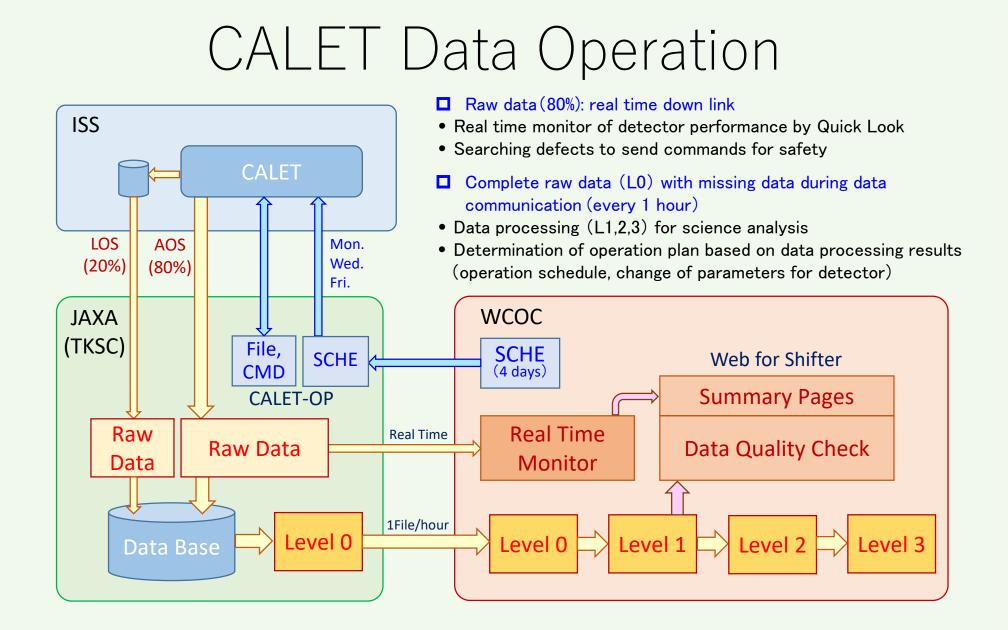
High 600

400

200

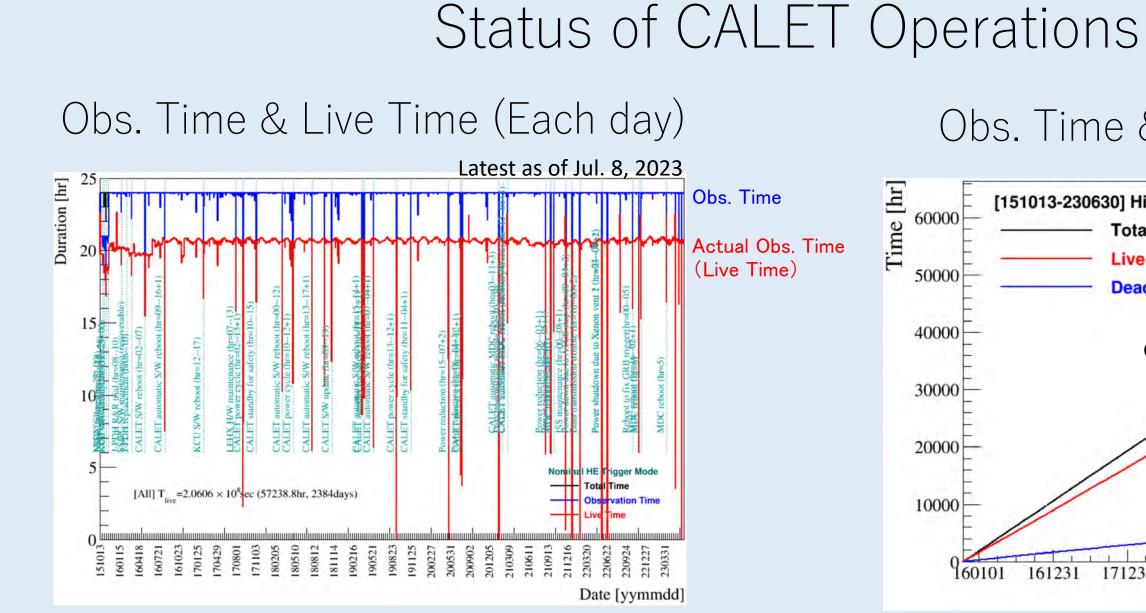
>IMC (7168 ch) : one ch (+ one ch of gain reduction)

>CHD (28 ch) and TASC (736 ch for PWO 192 logs): no deficit

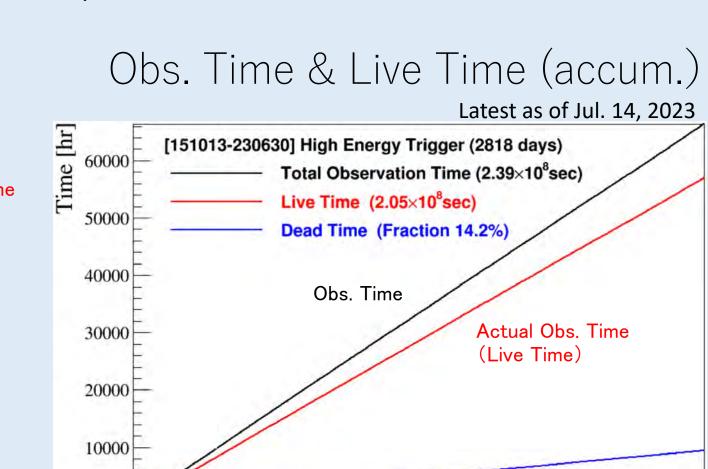


CALET WCOC Web Tool

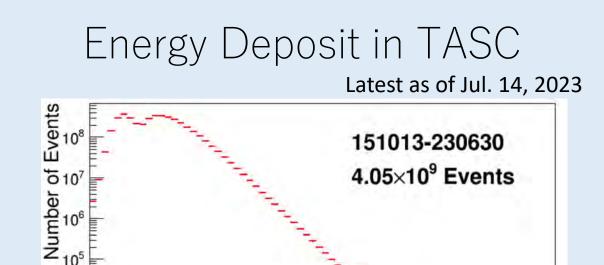
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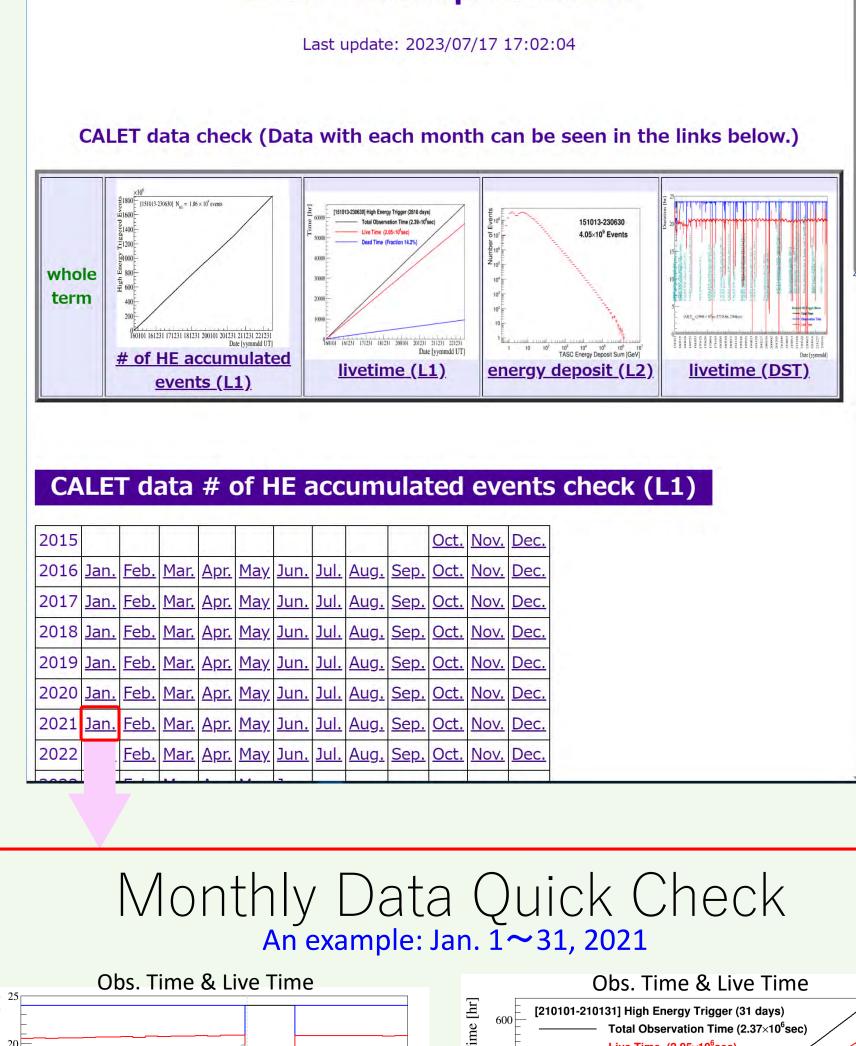


Accumulated Number of High Energy Trigger Events Latest as of Jul. 14, 2023 ¥1800 -[151013-230630] N_{LIE} = 1.86×10^9 events **ы́1600**



161231 171231 181231 200101 201231 211231 221231 Date [yymmdd UT]





		Spe	cial operati	on	s f	(
Malfunctions of the detctor	Ping no response	ART table full	5			
	MDC auto reboot	SEU	2	9		
	Telemetry stop	SEU	1	9		
	Misc.		1			
Tasks related to ISS operations	Reboost/Deboost	ISS altitude change	20	32		
	PDAM	Debris avoidance	7			
	Power reduction requests	EVA, Docking	3			
	Gas leakage	Other instruments	2			

for 2 years (2021-2022)

- neray Deposit Sum [GeV]
- Total observation time by HE trigger: 2818 days (Oct. 13, 2015 Jun. 30, 2023)

Date [yymmdd UT]

• Exposure of HE trigger: $S\Omega T \sim 248 \text{ m}^2 \text{sr day}$

160101 161231 171231 181231 200101 201231 211231 221231

• Live time fraction (Actual Obs. Time / Obs. Time) > 85%

HE Trigger (DAQ) Rate: 8.7 Hz

• Total data obtained by High Energy Trigger: 1.86 × 10⁹ events (Total data: 4.05 × 10⁹ events)

- Handling works against malfunctions of the detector were done 9 times for 2 years.
 - Three of them were caused by SEU. We expected such SEU caused by radiation of kRAD in high altitudes or SAA may occur once or twice in one year.
- Tasks related to ISS operations were needed 32 times for 2 years.
 - ISS track changes by reboost including PDAM were done 27 times for 2 years.
 - CALET have to be put into the standby mode against power reduction requests.
 - We have to turn off HV against gas leakage out of other instruments.

[All] $T_{\text{live}} = 2.0652 \times 10^6 \text{sec} (573.7 \text{hr}, 23 \text{days})$

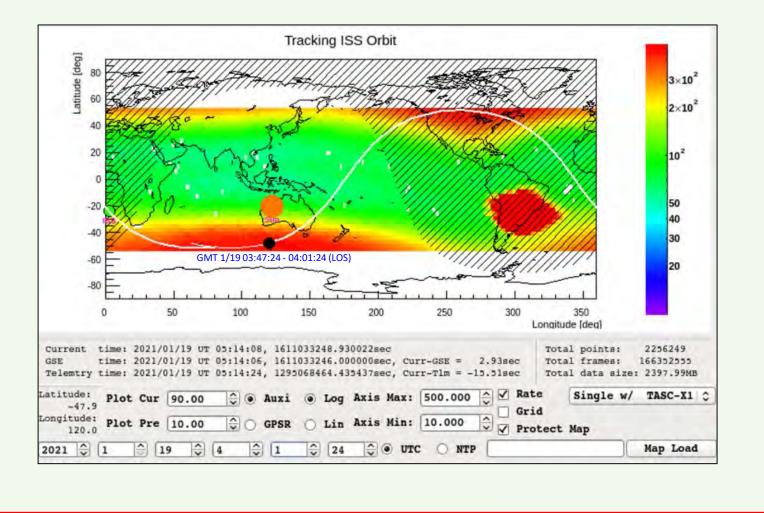
Date [yymmdd UT]

MDC auto-reboot

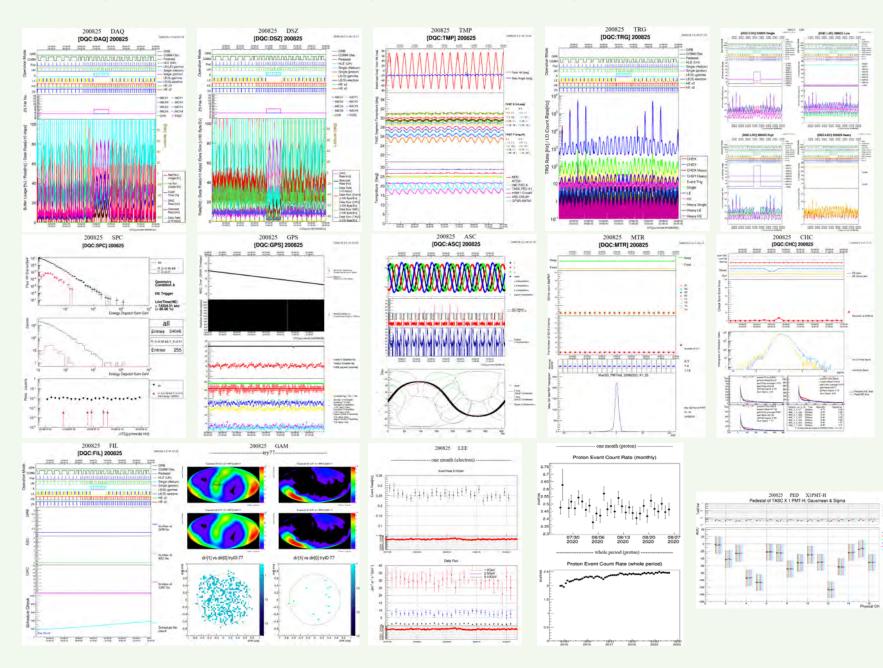
Auto-reboot of MDC on Jan. 19, 2021

Total Time
Observation Tim
Live Time

• Caused by a SEU at high latitude in south region • Such known incidents are recovered in next day (A recovery procedure was carried out on Jan. 22 due to some reason regarding an ISS laptop)



Daily Data Quality Check by wcoc-shifters



Summary

- CALET has been carrying out cosmic-ray observations on the space station for more than seven years while maintaining the expected instrument performance.
- Responses related to ISS operations, such as reboosting and power reduction requests, are being properly implemented in collaboration with JAXA.
- When malfunctions occur, they are identified by checking observation data, and measures are taken quickly to restore normal operation in cooperation with JAXA.