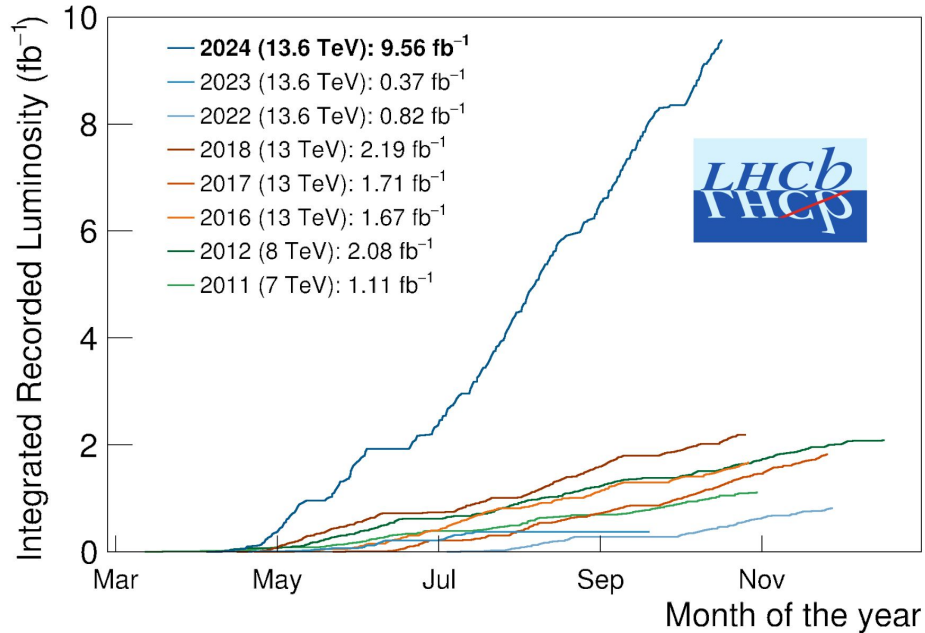


Journées LCG-France - LHCb input

Concezio Bozzi, Ben Couturier,
Jan van Eldik



Data taking in 2024



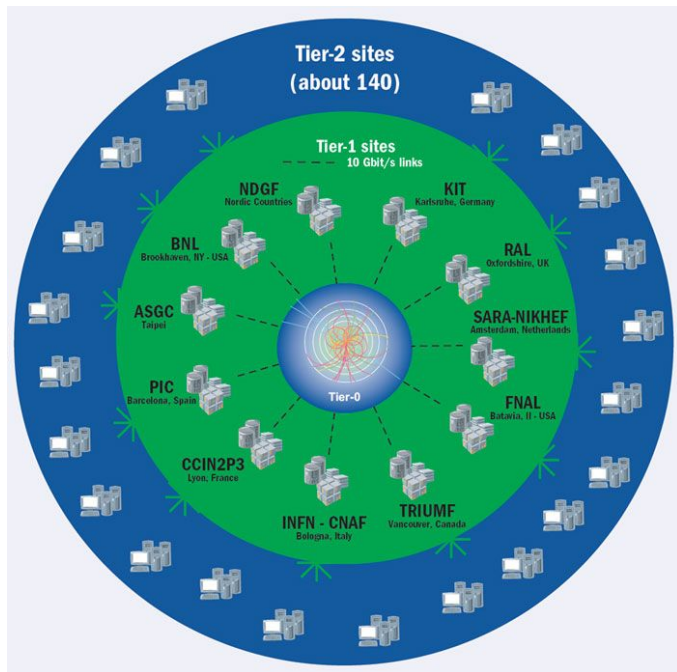
LHCb reached the full potential of the upgraded detector in 2024

Recorded more data than in Run1/Run2 together.

Reached the target luminosity ($\mu 5.3$) with all sub-detectors operational

Produced ~50 PB Raw data, to be stored and processed on the Grid

The LHCb Grid today



<https://cerncourier.com/a/the-lhcs-worldwide-computer/>
(list not exhaustive nor up-to-date)

- Tier 0: CERN
 - Data recording
 - CPU + disk + tape
- 8 Tier 1s:
 - CPU + disk + tape
- 22 Tier 2s:
 - CPU
- + 11 Tier 2Ds:
 - CPU + disk

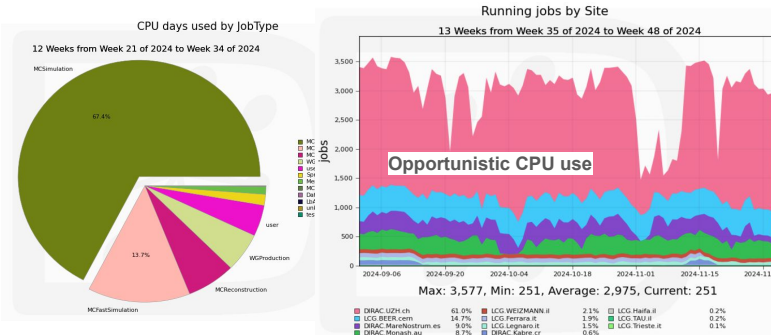
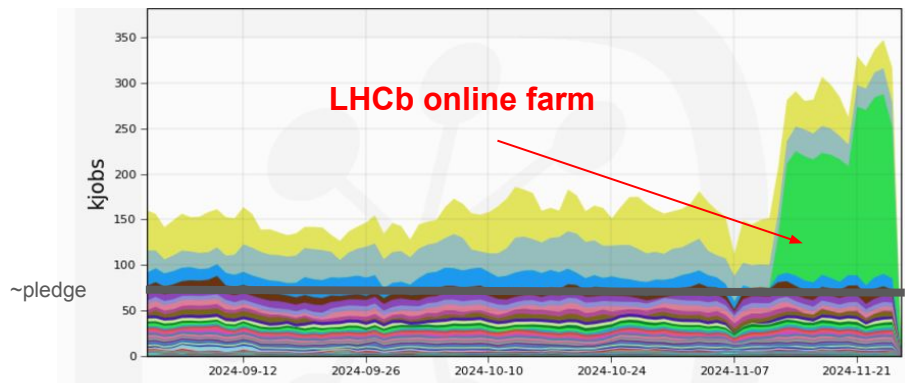
Plus opportunistic resources

LHCb Tier 1s

- IT-INFN-CNAF
- UK-T1-RAL
- CN-IHEP-T1
- FR-CCIN2P3
- DE-KIT
- ES-PIC
- PL-T1-NCBJ
- NL-T1

WLCG provide services to facilitate LHCb data processing (e.g. security infrastructure, information services, software deployment, service testing, helpdesk, accounting, ...)

Utilization of LHCb Grid resources

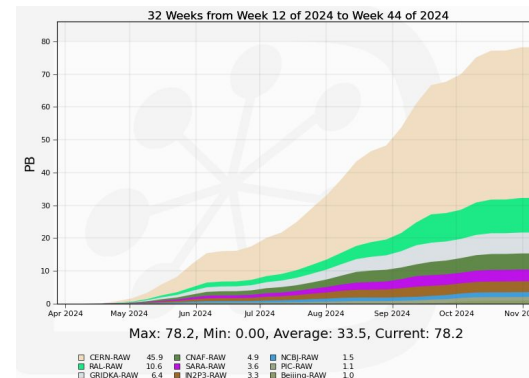


More than 110k jobs running at any time

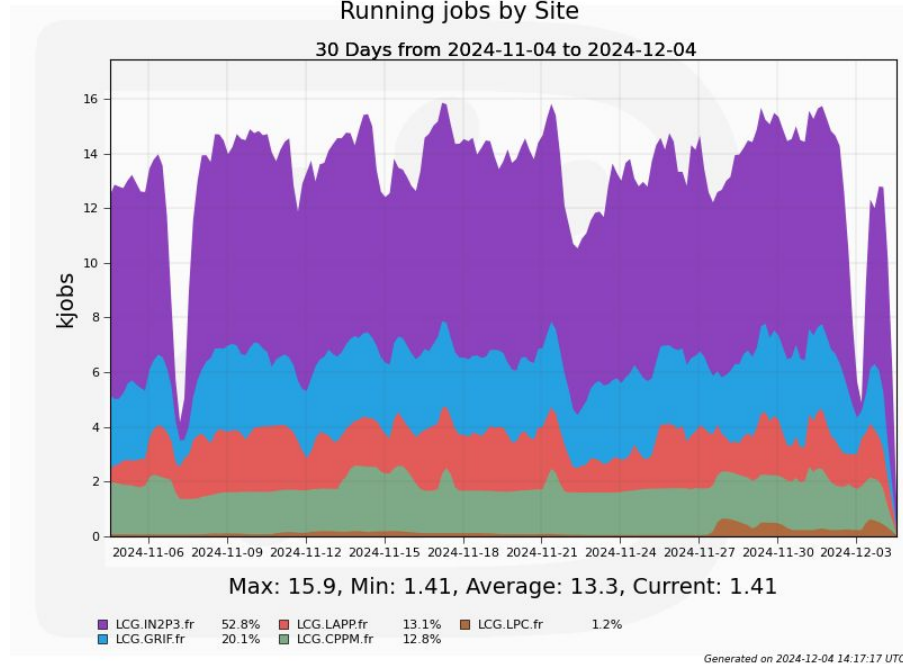
- 87% of CPU used for simulation
- using opportunistic resources at a few % level

Data stored currently:

- ~80 PB of disk
 - 41 PB Run3, 16 PB Run1+2, 13 PB of Simulation, 4 PB User data, ...
- ~200 PB of tape



Jobs at the French sites



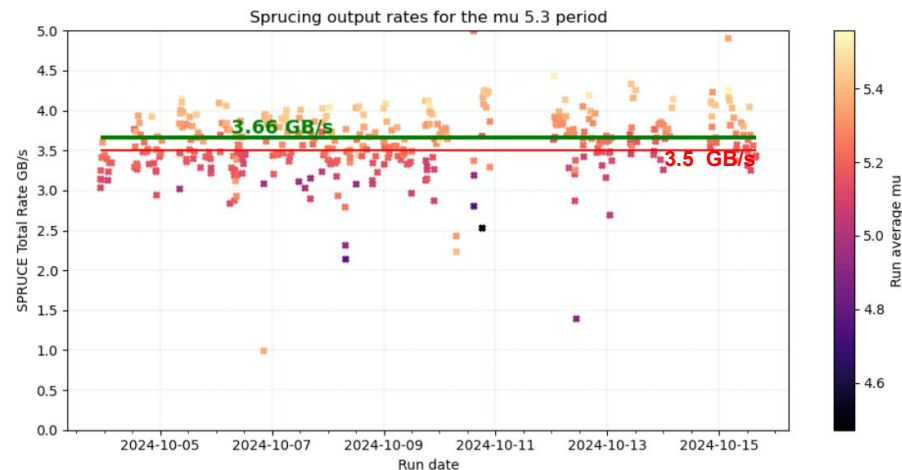
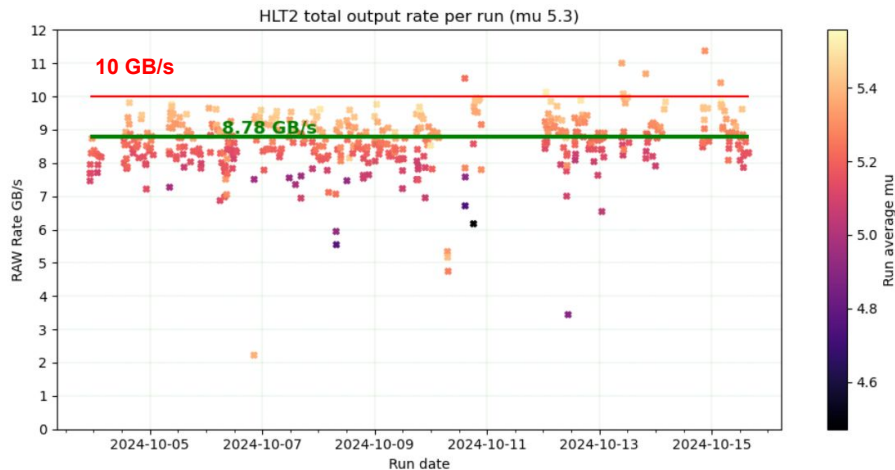
2024 rates and preparation for 2025

2024 was the first full data taking year with UT included and velo fully closed

⇒ validated the sub-detectors with various configurations and various values of μ throughout the year

⇒ *terminated the p - p run with μ 5.3, reaching the design luminosity and validating the configuration for 2025*

At this working point, we measured a bandwidth to tape of ~ 8.8 GB/s and ~ 3.7 GB/s to disk on the period (Oct 3rd to 15th)



The LHCb compute resources for 2025

Tier	CPU [kHS23]	Disk [TB]	Tape [TB]
0	283000	54900	170400
1	928000	89900	194800
2	518000	17400	
Total	1729000	162200	365200

Resource requests

Federation	Tier	CPU [kHS23]	Disk [TB]	Tape [TB]
FR-CCIN2P3	1	92800	9350	20454
FR-GRIF	2	26022	1272	
FR-IN2P3-LAPP	2	20000	0	
FR-IN2P3-CPPM	2	12000	600	
FR-IN2P3-LPC	2	4000	0	

French contribution to the pledges

- Total pledged resources for 2025 are very close to the request
 - Many thanks!
- The French federations contribute 10% of the Tier-1 and Tier-2 resources
 - Merci beaucoup!
- The LHC schedule has changed significantly since these requests and pledges were made...

Outlook for 2025 - 2026

Updated LHC schedule for 2025 and 2026

- LHC final schedule for 2025 and 2026 will be finalized soon
- 2025 will be longer than assumed at the time the resource requests were made
 - We expected 2025 p-p to be $5.1e6$ s ($=6.3e6$ s - 4 weeks)
 - *We are likely to have 138 days ($\sim 6e6$ s) + 29 days of Pb + O runs...*
- 2026 data taking will be half of 2025 data taking
 - *$\sim 3e6$ s p-p run duration and 21 days of ions*
- We are currently studying the implications and possible mitigations
 - Tight control of data rates, optimizing resource utilization, etc

We already know we will be short of offline resources in 2025 (at least disk)

[Q1] What will be the programme between now and LS3?

[Q2] Impact of extending Run3?

- In 2025 and 2026, LHCb will execute the same workflows as in 2024
 - Data distribution, Sprucing, Analysis production, Simulation, User analysis, ...
 - Technology improvements will continue (DiracX, token transition, ...)
- At rates and volumes allowed by available resources
 - **Storing the data on tape will be most important**
- **Preliminary** observations
 - 2025: CPU and tape should be OK, disk will be short
 - 2026: was not planned to have data taking...
 - Mitigations to be implemented already during the YETS
- Precise numbers are being calculated
 - Preliminary requests assumed 2 scenarios for 2026, both superseded
 - Final 2026 request will be submitted to C-RSG in February

“LHCb Computing resources: preliminary 2026 requests”

- Preliminary request submitted in Sept 2024
 - Details in table on the right
- The preliminary request describes “2026 as LS3” and “2026 as data-taking” scenarios
- “Final scenario will be halfway in between”
- The final resource request for 2026 will be submitted to the C-RSG in February 2025

CPU Power (kHepScore23)	2025	2026 as LS3	2026 as data-taking
Tier 0	283	251	454
Tier 1	928	823	1487
Tier 2	518	459	830
Total WLCG	1729	1533	2771
HLT farm	50	500	50
Opportunistic	50	100	100
Total non-WLCG	100	600	150
Grand total	1829	2133	2921

Table 6-1: CPU power requested at the different Tier levels in 2026. The 2025 requests (endorsed at the April 2024 RRB) are also shown.

Disk (PB)	2025	2026 as LS3	2026 as data-taking
Tier0	54.9	54.8	77.3
Tier1	89.9	89.9	126.7
Tier2	17.4	17.4	24.5
Total	162.2	162.1	228.5

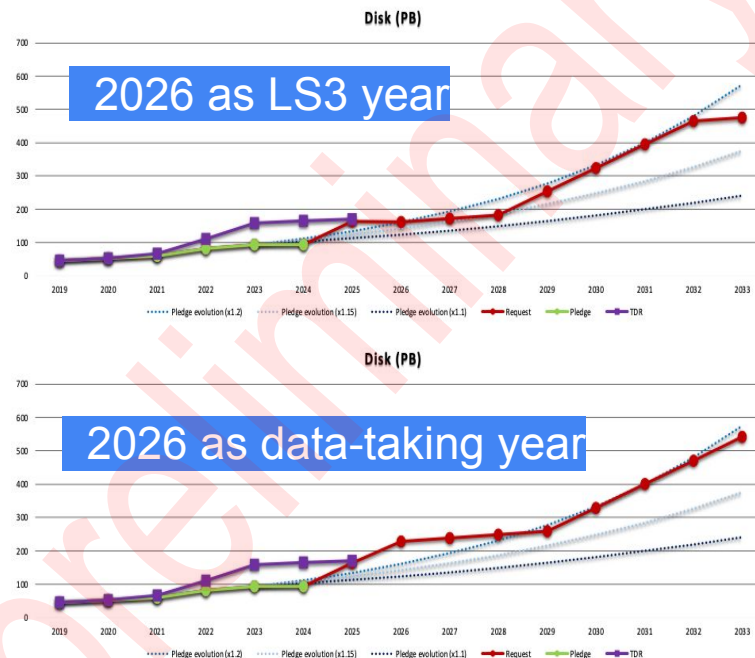
Table 6-2: LHCb Disk request for each Tier level 2026. The 2025 requests (endorsed at the April 20 RRB) are also shown. For countries hosting a Tier1, the Tier2 contribution could also be provided Tier1.

Tape (PB)	2025	2026 as LS3	2026 as data-taking
Tier0	170	173	244
Tier1	195	198	272
Total	365	371	516

Table 6-3: LHCb Tape request for each Tier level in 2026. The 2025 requests (endorsed at the April RRB) are also shown.

“LHCb Computing resources: preliminary 2026 requests”

- Preliminary request submitted in Sept 2024
 - Details in table on the right
- The preliminary request describes “2026 as LS3” and “2026 as data-taking” scenarios
- “Final scenario will be halfway in between”
- The final resource request for 2026 will be submitted to the C-RSG in February 2025




[Q3] Technological developments (ARM, GPU, HPC, ...)

- ARM resources on the Grid could be used for Simulation
 - LHCb software needs to be validated for general productions
 - But some Upgrade-II samples could already be produced on ARM
- Use of GPUs in Simulation
 - AdePT being integrated in Gaussino, Exploring ways to trace optical photons (Opticks, Mitsuba)
 - Production use still some way off
- HPCs
 - 3 Centers integrated in DIRAC production system
 - Contributing to simulation at the level of a few percent
 - Integrating HPC centers often difficult

Thank you!

Backup information

Experiment Site Name 	RC Site 	State 	Tier level 
 LCG.IN2P3.fr	IN2P3-CC	ACTIVE	1
 LCG.GRIF.fr	GRIF	ACTIVE	2
 LCG.LAPP.fr	IN2P3-LAPP	ACTIVE	2
 LCG.CPPM.fr	IN2P3-CPPM	ACTIVE	2
 LCG.LPC.fr	IN2P3-LPC	ACTIVE	2