CERN–RRB–2023-074
9 October 2023

Autumn 2023 Report of the Computing Resources Scrutiny Group

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1 Introduction

The Computing Resources Scrutiny Group (C-RSG) is charged with reviewing the requests of the four Large Hadron Collider collaborations, ALICE, ATLAS, CMS and LHCb, for computing resources provided by the Worldwide LHC Computing Grid (WLCG), and making recommendations to the WLCG Resource Review Board (WLCG RRB) on allocations of these resources given the approved physics programs of the experiments. This report summarizes the Autumn 2023 C-RSG review of the computing resources being used for 2023, pledged resources for 2024 and expected utilization and preliminary projections for the 2025 WLCG year. Unless otherwise noted, the start of each reporting period is 1 April.

The C-RSG arrived at its findings and recommendations using the information provided by the collaborations on current and planned utilisation during 2024, their preliminary projections for 2025 requirements, subsequent questions from the C-RSG to each collaboration and face-to-face discussions with collaboration representatives for clarifications. As has been the recent practice, the fall scrutiny was undertaken using virtual meetings.

In the following, the usual conventions for the WLCG computing model is used: T0 refers to the CERN computing resources, T1 refers to the Tier 1 facilities and T2 refers to the Tier 2 systems.

2 C-RSG Membership

The C-RSG welcomes formally two new members: Eric Fede is the new representative for France and Markus Schulz is the new representative for CERN. The member representing Italy has stepped down and INFN has nominated Domenico Elia, who was an observer in this scrutiny round. The chair thanks the outgoing C-RSG members for their contributions and the on-going members for their commitment and expert advice. The C-RSG thanks the experiment representatives for their collaboration with the C-RSG and this review process.

Finally, thanks are due to the CERN management for its support and to the C-RSG scientific secretary, Andrea Valassi for ensuring the smooth running of the group. The group also thanks Helge Meinhard for his additional assistance during this scrutiny.

3 Interactions with the Collaborations

The collaborations were asked to submit their reports by August 29th, 2023. The C-RSG thanks the experiments for the timely submission of their detailed documents [1–4]. The group acknowledges

the computing representatives of the experiments for their availability, their constructive responses to the questions raised by the C-RSG and subsequent requests for further information. The dedicated one-on-one meetings of the referee teams with experiment representatives were particularly helpful.

Specific sets of C-RSG referees were assigned to review the ALICE and LHCb requests. As usual, by agreement with ATLAS and CMS management, a single team of C-RSG referees scrutinized the ATLAS and CMS requests to ensure a consistent approach. The referees subsequently reported to the full C-RSG, which then jointly developed the recommendations contained in this report.

In anticipation of the Spring 2024 scrutiny, the C-RSG asks the experiments to submit their documents for the April 2024 WLCG RRB by February 13st, 2024. The C-RSG requests that as part of their submission the experiments respond to the general and experiment-specific recommendations, as has now become practice. According to decisions taken in 2017 about the scrutiny process, the review reported here is the first opportunity to discuss resource estimates for 2025, allowing for further in-depth discussion with the experiments and LHC Experiments Committee (LHCC) during winter 2023/2024. The C-RSG plans to make recommendations to the WLCG RRB on the 2025 resource allocations after the Spring 2024 scrutiny.

4 Background for Preliminary 2025 Requests

The C-RSG met with the experiments after the LHC schedule was revised resulting in a truncted 2023 pp run and plans for an extended 2023 heavy-ion run. Plans for 2024 running are consistent with the longer term LHC schedule, and specific running conditions for 2025 planning have been established by the LHC Programming Committee. The 2025 run, the last year of full-luminosity Run 3 data-taking, is expected to consist of a pp run followed by a PbPb run. The 2025 computing estimates for the four collaborations are based on these planning inputs.

Each collaboration is confident that the resources they have available in 2023 are sufficient to address their physics program, and that the pledged resources for 2024 remain appropriate given the expected 2024 data-taking.

The accounting of CPU resources is transitioning from the HEPSpec 2006 (HS06) benchmark units to the newly adopted HepScore 2023 (HS23) benchmark. The information compiled for previous scrutinies and pledges remain unchanged, under the assumption that these units are approximately equivalent. This situation will be monitored to ensure that there is a consistent framework for the C-RSG reports and recommendations.

The C-RSG has been following the utilization of disk space and the collaborations have provided information on how they allocate disk space and for what use. The group has found this information valuable in developing a better understanding of this important resource. The group notes that some T1 sites allocate tape buffering space to collaborations as part of their pledged resources while others choose to treat these buffers as part of the system infrastructure. The scrutiny group does not recommend a single accounting strategy for this disk space. Rather, it will continue to track the disk space that is under the control of the collaborations and continue to treat that as the pledged disk space.

The C-RSG summarizes in the following sections the current computing plans and reports on the preliminary estimates for 2025, along with a number of findings and recommendations.

5 Preliminary Resource Requests: ALICE

The C-RSG report is based on the usage and resource requests provided by the ALICE Collaboration [1], a written set of responses to C-RSG scrutiny questions and a remote meeting with the

ALICE Collaboration computing coordinators. The C-RSG thanks the ALICE team members for providing detailed responses to the C-RSG recommendations from the Spring 2023 scrutiny report and for their timely responses to questions from the C-RSG in this scrutiny. In particular, the C-RSG thanks the ALICE Collaboration for the reduction in the length of the report for the Autumn scrutiny and its greater focus on the justification for the requests for future computing resources. The C-RSG encourages the ALICE Collaboration to continue this trend.

The ALICE report reflects the cancelling of the heavy-ion run in 2022 and a planned extended heavy-ion run planned for 2023, 2024 and 2025. The objective of these runs is to achieve a total integrated luminosity of 3.25 nb^{-1} for PbPb collisions in 2024 and 2025. This results in two possible data taking scenarios for 2024 and 2025: 5 weeks of PbPb data in 2024 and 3 weeks of pPb data in 2025 (scenario A), or 4 weeks of PbPb in 2024 and 1 week of PbPb plus 3 weeks of pPb collisions in 2025 (scenario B). These scenarios result in comparable resource requirements, with 116.8 PB of Compressed Time Frame (CTF) data for scenario A and 114.5 PB of CTF data for scenario B, and 3.67×10^{13} HS23-s and 3.56×10^{13} HS23-s of CPU resources for scenario A and scenario B, respectively.

Processing of the 2022 pp data was completed in 2023. This revealed that three calibration passes were not sufficient for calibration of the Time-Projection Chamber (TPC) space-charge distortion effects. This led to the need for a fourth asynchronous pass for the pp data, which substantially improved tracking resolution and efficiency. Substantial improvements in the calibration have been made through the development of a new TPC space-charge distortion calibration method. Given this, it is expected that pp processing of the 2023 data will require a single pass to be skimmed.

The ALICE Collaboration's computing configurations (or payloads) have displayed, on CPUs which are not fully saturated, that more resources are utilized than are accounted for. This can lead to situations where fractions of the system calls are not accounted for, leading to a de facto increase in the resource share. This problem was recognized by the ALICE Collaboration and CPU pinning techniques and changes in scheduling have mitigated this problem. The overall impact is estimated by the ALICE Collaboration to be on the order of 5%.

The CTF pp data is compressed using a "skimming" procedure whereby only the relevant physics event data are stored. The original 2022 skimming was, however, found to be suboptimal because the reconstructed events after skimming did not match the original CTF data. This was caused by changes in TPC tracking combinatorics. To overcome this issue, neighbouring bunch crossings had to be included in a more conservative skimming procedure. This initially led to an estimate of a 9% compression factor rather than the original goal of 1.5%. This estimate has subsequently been revised to 6%. This skimming was based on a physics event selection of 0.1% of all events. Tightening this selection to 0.04% will result in a compression factor of 3% for the 2023, 2024 and 2025 pp data, while ensuring data reproducibility.

Over the last year, 7.2×10^{9} pp MC events have been generated with 55% generated for general purpose productions and 45% based on Physics Working Group requirements. Monte Carlo (MC) generation to analyze the 2022 pilot beam data have been completed together with the creation of MC datasets for the 2022 PbPb data at 5.36 TeV center-of-mass energy per nucleon pair. Physics Working Group MC productions are underway with the injection of prompt and non-prompt J/ψ, heavy flavors, multi-strange hadron, nuclei and jets into minimum-bias pp events.

The current and estimated ALICE computing resources are summarized in Table 1. Resource requirements for 2024 remain unchanged from the RRB-approved levels. For 2025, ALICE estimates a growth of +15% for CPU (across all tiers), and +16% for disk (divided 16%, 15% and 16% across T0, T1 and T2, respectively). Archiving of the CTF files requires a +25% growth in tape (divided 25% and 26% across T0 and T1, respectively). This would result in 2165 HS23-years of CPU, 238.5 PB of disk and 361 PB of tape across all tiers.

The 2025 disk estimates are driven by the pass 1 processing of 40% of the 2024 PbPb data, pass 2 processing of the full 2024 PbPb data, together with processing of the low field, full field and reference

ALICE		2023		2024			2025	
		C-RSG recomm.	Pledged	Request	2024 req. / 2023 C-RSG	C-RSG recomm.	Prelim Request	2025 req. / 2024 C-RSG
CPU	Tier-0	541	541	600	111%	600	690	115%
	Tier-1	572	506	630	110%	630	725	115%
	Tier-2	592	567	650	110%	650	750	115%
	HLT	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total	**1705**	**1614**	**1880**	**110%**	**1880**	**2165**	**115%**
	Others							
Disk	Tier-0	58.5	58.5	67.5	115%	67.5	78.5	116%
	Tier-1	63.5	57.6	82.5	130%	71.5	82.5	115%
	Tier-2	57.5	60.4	77.5	135%	66.5	77.5	117%
	Total	**179.5**	**176.5**	**238.5**	**133%**	**205.5**	**238.5**	**116%**
	Others							
Tape	Tier-0	131.0	131.0	181.0	138%	181.0	226.0	125%
	Tier-1	82.0	87.7	107.0	130%	107.0	135.0	126%
	Total	**213.0**	**218.7**	**288.0**	**135%**	**288.0**	**361.0**	**125%**
	Others							

Table 1 ALICE resource requests and C-RSG recommendations for 2023 and 2024. The ALICE Collaborations estimates for 2025 and the increases relative to the C-RSG recommendatons for 2024 are shown.

pp data. This results in a need for 17 PB of disk storage for the PbPb data and 13 PB for the pp data. The initial processing of pPb data collected in 2025 will require an additional 3 PB of storage. For tape, 52 PB of CTF data are expected to be generated during the pPb and pp data collection. ALICE requires the archiving of 2 copies of pp data to ensure data integrity given that the aggressive event selection is only ∼1% of the pp data. The increase in event selection from 1.5% to 6% for the pp data from 2022 and the expected increase of 3% for the 2023 and 2024 pp data has resulted in an additional request of 14 PB of tape (across T0 and T1). The size of this additional request is 3 PB smaller than described in the ALICE report due to an improvement in the event selection since the report was written and this change is not reflected in Figure 1. The need for the increase in the event selection will be reviewed by ALICE for the next scrutiny and the resource allocations updated appropriately.

CPU resources at T0, T1 and T2 will be allocated to support reconstruction, and simulations for the PbPb, pPb and pp data. Approximately 35% of the total CPU resources are expected to be devoted to analysis over the course of 2025. The fraction of CPU resources committed to the calibration, reconstruction and MC generation will vary throughout the year. About 20% of T0, T1 and T2 resources will initially be devoted to the second pass of the 2024 pp low-field reconstruction. Associated MC simulations of the low and full field pp data will require 20% of CPU resources. MC for the PbPb data from 2024 will require 25% of the CPU resources from early-2025 with an additional 5% required for MC for pp reference run. The second calibration pass of the PbPb data from 2024 and the associated reference pp run will require 20% of CPU resources from mid-2025 and will be run at the T0 and T1 sites. In early 2026, CPU resources will transition to the simulation of the 2025 pPb data, which will require about 50% of CPU capacity with 15% devoted to pp MC production.

The ALICE Collaboration remains concerned about access to sufficient resources for data processing and storage if the International Cooperation Agreements (ICAs) with Russia and JINR are suspended. The C-RSG requests that the ALICE Collaboration continue its efforts to mitigate this and to provide updates on the possible consequences in future scrutiny reports.

ATLAS		2023		2024			2025	
		C-RSG recomm.	Pledged	Request	2024 req. / 2023 C-RSG	C-RSG recomm.	Prelim Request	2025 req. / 2024 C-RSG
CPU	Tier-0	740	740	936	126%	936	1100	118%
	Tier-1	1430	1520	1516	106%	1516	1661	110%
	Tier-2	1747	1841	1852	106%	1852	2030	110%
	HLT	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total	**3917**	**4101**	**4304**	**110%**	**4304**	**4791**	**111%**
	Others							
Disk	Tier-0	40.0	40.0	49.0	123%	49.0	56.0	114%
	Tier-1	136.0	150.5	163.0	120%	163.0	186.0	114%
	Tier-2	168.0	160.0	200.0	119%	200.0	227.0	114%
	Total	**344.0**	**350.5**	**412.0**	**120%**	**412.0**	**469.0**	**114%**
Tape	Tier-0	174.0	174.0	207.0	119%	207.0	264.0	128%
	Tier-1	353.0	360.3	452.0	128%	452.0	567.0	125%
	Total	**527.0**	**534.3**	**659.0**	**125%**	**659.0**	**831.0**	**126%**

Table 2 ATLAS resource requests and C-RSG recommendations for 2023 and 2024. The ATLAS 2025 estimates and the increase from the C-RSG recommended levels in 2024 are also shown.

Conclusions and Recommendations

ALICE-1 The C-RSG requests that for future scrutinies, when multiple run scenarios are possible, the ALICE Collaboration provide a high-level summary of the total amount of disk, tape and CPU for each scenario. This will allow the C-RSG to better understand the resource requirements for each scenario and how they map to long term resource needs.

ALICE-2 When new processing, calibration or MC generation campaigns are undertaken by ALICE (i.e., campaigns that were not planned for in the previous scrutiny such as the PbPb MC for 2018 data) the C-RSG requests that the ALICE Collaboration provide an assessment of the CPU, disk and tape costs associated with these campaigns.

ALICE-3 The C-RSG requests that for the next scrutiny report the ALICE Collaboration provide an estimate of the contingency that the experiment holds when calculating its resource requests (e.g., the amount of disk, tape and CPU) and the assumptions that are used to define these contingencies.

6 Preliminary Resource Requests: ATLAS

The ATLAS report is based on the information provided by the ATLAS Collaboration [2], written responses to questions by the C-RSG, and a virtual face-to-face meeting with the ATLAS computing coordinators.

As in previous years, the ATLAS Collaboration has made effective use of opportunistic HPC resources. However, the Collaboration expects in the near future that some HPC sites will provide CPU resources as pledged contributions. However, the Collaboration expects that some HPC sites will provide CPU resources as pledged contributions in the near future. Recognizing that some workloads are unable

to run on the HPC facilities, the ATLAS Collaboration will need to ensure that the total computing workload will be accommodated on the mix of pledged resources.

The ATLAS Collaboration expects 2025 to be a full data-taking year with 6×10^6 s for pp and 1.7×10^6 s for PbPb collisions, with average and peak pileup of 62 and 65 collisions/crossing, respectively.

ATLAS computing requests for 2025 are driven by the following planned computing activities:

- Run 3 Data processing: Processing and reprocessing of the Run 3 data taken in 2024 and 2025 using the newest release.
- Simulation: Simulation of MC samples for 2025 (campaign starting in 2024).
- Production Processing: Production of derived formats for data and MC (DAOD_PHYS and its skims as well as DAODs made directly from AOD).
- Analysis: User analysis on Run 2 and Run 3 data and MC samples.
- Physics Studies: Continuation of physics studies for the HL-LHC phase.
- Heavy-Ion Production: Processing heavy-ion data and associated MC samples.

The ATLAS Collaboration reported to the C-RSG an increase of 20% in the raw data event size. Two factors have resulted in this increase. First, the commissioning of the L1Calo trigger system took longer than expected and has increased the total data volume. Second, a correction had be made to the estimates of the effects of pileup at $\mu = 62$ collisions/crossing. Those corrections were determined based on the data collected in 2023. This raw event size increase affects the level of T0 resources.

Based on the activities listed above, the experiment is asking for increases from 2024 levels of 11% for CPU (+487 kHS23-years), 14% for disk (+57 PB) and 26% for tape (+172 PB).

Conclusions and Recommendations

ATLAS-1 The C-RSG recommends that ATLAS continue increasing the adoption and usage monitoring of the more compact DAOD_PHYS and DAOD_PHYSLITE data formats for its physics data analyses.

ATLAS-2 The C-RSG is concerned by the 20% increase in RAW data event size. It encourages the ATLAS Collaboration to explore strategies to mitigate this increase.

7 Preliminary Resource Requests: CMS

The CMS report is based on the information provided by CMS [3], written responses to questions by C-RSG and a hybrid face-to-face meeting with the CMS computing coordinators. The current and estimated 2025 CMS computing resources are summarized in Table 3.

As in previous years, CMS plans to increase its physics potential by complementing the standard, promptly reconstructed primary dataset with two additional data-taking modes, known as data parking and data scouting.

The CMS Collaboration expects 2025 to be a full data-taking year with 6×10^6 s for pp and 1.7×10^6 s for PbPb collisions, with average and peak pileup of 62 and 65 collisions/crossing, respectively. The heavy-ion run impacts only the requested T0 tape resource as all other storage needs are treated separately, as has been the case for the CMS Collaborations since Run 1. The C-RSG noted that the

CMS		2023		2024			2025	
		C-RSG recomm.	Pledged	Request	2024 req. / 2023 C-RSG	C-RSG recomm.	Prelim Request	2025 req. / 2024 C-RSG
CPU	Tier-0	720	720	980	136%	980	1180	120%
	Tier-1	800	916	930	116%	930	1100	118%
	Tier-2	1350	1313	1600	119%	1600	1900	119%
	HLT	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Total	**2870**	**2949**	**3510**	**122%**	**3510**	**4180**	**119%**
	Others							
Disk	Tier-0	45.0	45.0	54.0	120%	54.0	64.0	119%
	Tier-1	98.0	96.8	122.0	124%	122.0	142.0	116%
	Tier-2	117.0	109.7	149.0	127%	149.0	175.0	117%
	Total	**260.0**	**251.5**	**325.0**	**125%**	**325.0**	**381.0**	**117%**
Tape	Tier-0	228.0	228.0	320.0	140%	320.0	420.0	131%
	Tier-1	316.0	303.7	380.0	120%	380.0	452.0	119%
	Total	**544.0**	**531.7**	**700.0**	**129%**	**700.0**	**872.0**	**125%**

Table 3 CMS resource requests and C-RSG recommendations for 2023 and 2024. The 2025 estimates and the increase relative to the levels recommended by the C-RSG for 2024 are also shown.

CMS Collaboration provided a detailed analysis of the relatively low CPU efficiency and the group appreciated the effort involved in that analysis. The group urges the Collaboration to continue its efforts to further improve CPU utilization.

The CMS Collaboration foresees the following processing activities in 2025:

- Run 3 data taking: The data collected during the beginning of the 2025 run will be reprocessed during the summer, while a full reprocessing will take place after final detector calibrations are derived.
- Run 3 Monte Carlo production: A first round of sample production will take place to support detector studies and the development of reconstruction software, followed by a more substantial Monte Carlo simulation for analysis.
- HL-LHC Monte Carlo production: The preparation for Phase-2 will continue during 2025 and its needs in terms of samples will have to be addressed.
- Data analysis: Data analysis activities during 2025 will be focused on the data acquired during Run 3 at that point.

The experiment is estimating increases of 19% for CPU (+670 kHS23-years), 17% for disk (+56 PB) and 25% for tape (+172 PB) relative to the 2024 approved resources.

Conclusions and Recommendations

CMS-1 The C-RSG requests that the CMS Collaboration continue reporting on efforts to pinpoint and reduce the causes behind the relatively low CPU efficiency.

CMS-2 The C-RSG recommends that CMS continue increasing the adoption and usage monitoring of the more compact NanoAOD data format for its physics data analyses.

LHCb		2023		2024			2025	
		C-RSG recomm.	Pledged	Request	2024 req. / 2023 C-RSG	C-RSG recomm.	Prelim Request	2025 req. / 2024 C-RSG
CPU	Tier-0	215	215	174	81%	174	283	163%
	Tier-1	707	598	572	81%	572	928	162%
	Tier-2	391	434	319	82%	319	518	162%
	HLT	50	50	50	100%	50	50	n/a
	Total	**1363**	**1297**	**1115**	82%	**1115**	**1779**	**160%**
	Others			50			50	
Disk	Tier-0	30.3	30.3	30.6	101%	30.6	49.2	161%
	Tier-1	60.5	54.7	61.2	101%	61.2	98.5	161%
	Tier-2	11.6	7.9	11.8	102%	11.8	19.0	161%
	Total	**102.4**	**92.9**	**103.6**	101%	**103.6**	**166.7**	**161%**
Tape	Tier-0	91.0	91.0	117.1	129%	117.1	189.3	162%
	Tier-1	157.0	133.7	133.3	85%	133.3	208.1	156%
	Total	**248.0**	**224.7**	**250.4**	101%	**250.4**	**397.4**	**159%**

Table 4 LHCb resource requests and C-RSG recommendations for 2023 and 2024, and estimates of computing resources for 2025

8 Preliminary Resource Requests: LHCb

The assessment of the preliminary LHCb computing resource requests for 2025 is based on the documentation provided by the experiment [4] and discussions between the C-RSG and LHCb computing management.

Table 4 shows the LHCb resource projections for 2025, as well as the C-RSG recommendations for 2024, for 2023 and the pledged resources for 2023. The deficit of resources pledged for 2023 relative to the C-RSG recommended levels has not had a negative impact on the experiment since 2023 turned out to be primarily a year of data collection for detector commissioning. This deficit, however, is recurrent and a similar shortfall of pledged resources is anticipated for 2024. The computing activities of the experiment planned for 2024 and beyond might be compromised if this deficit persists.

LHCb requests a 60% increase in computing resources for 2025. This growth is in accordance with the LHCb computing model, and the additional resources will be used to store and process the experimental data to be recorded in 2025 and to fulfill the growing data simulation needs of the experiment. The large growth in 2025 follows a modest increase in 2023 (about 10%) and no increase in 2024. Moreover, during the LHC long shutdown 3 (2026-2028) no increase in resources is expected.

The CPU requirements are dominated by MC simulation for Run 3 data, consuming close to 75% of the total LHCb CPU budget. LHCb is expecting minimal additional requests to produce simulations for Run 1 and Run 2 conditions in 2024 and beyond. The fractions of events produced with full, fast and parametric simulations in 2025 are assumed to be the same as in previous years (i.e., 36%, 64% and 0%, respectively). Improvements in the performance of the Run 3 simulation would have a large impact on the reduction of the global CPU requirements. Therefore, the C-RSG recommends devoting efforts to speeding up the simulation.

The second contributor to the CPU budget is user analysis productions, accounting for about 17%. A centrally managed analysis production system has been deployed, significantly improving CPU efficiency. The central system validates user analysis code and optimizes its execution. The adoption of the new system by users is still low at about 7%. Most of the users analyzing Run 1 and Run 2 data

have not yet moved to the new system. LHCb expects that once the focus of the analysis is moved to Run 3 data, the bulk of the analysis will be done using the new analysis production system.

The projected increase in data storage capacity is driven by the integrated data volume expected to be recorded in 2025. For a projected pp run time of 6.3×10^6 s, about 50 PB of disk space will be required to keep on disk two replicas of the data in a reduced format for analysis. The required volume of tape space is 126 PB (two replicas of raw data).

The LHC schedule foresees a heavy ion run in 2025. The reconstruction of the heavy ion events will be done in the online farm, concurrently with data taking. If the CPU resources are not sufficient to keep up with the collection rate, the data will be buffered on disk and reconstructed during the end-of-year shutdown. The CPU work required to simulate heavy ion collisions is assumed to be 10% of that needed for the reconstruction of the real data counterpart, 93 kHS23-year. Resource capacities to process and simulate heavy ion data might be re-assessed in the next round of scrutiny in light of the experience gained in the 2023 heavy ion data taking.

Conclusions and Recommendations

LHCb-1 Considering that the CPU requirements are dominated by MC simulation for Run 3 data, the C-RSG encourages the LHCb Collaboration to explore strategies to reduce the simulation CPU footprint.

LHCb-2 A significant contributor to the CPU budget is user analysis. The C-RSG encourages the LHCb Collaboration to increase the utilization of the centrally managed analysis production system that has been shown to improve CPU efficiency.

LHCb-3 The physics data taken in 2023 during the pp and HI runs increase the storage requirements for 2025. These storage requests will need to be re-evaluated in the next scrutiny round in light of the actual physics data collected during 2023.

9 Summary

The C-RSG finds that the reports on current and near-term computing needs provide clear support for the resources currently approved and those pledged for 2024. The resource estimates for 2025 are also helpful as they allow the scrutiny group and the collaborations to identify issues prior to the spring 2024 scrutiny round, at which time the C-RSG is expected to make recommendations for pledged resources in 2025.

The C-RSG thanks the collaborations for their collegial discussions with the C-RSG and the comprehensive information provided to assess their 2025 computing plans.

References

[1] ALICE Collaboration. ALICE Summary Status of Run 3 Data Processing and Computing Resources Estimates for 2025, submitted 29-Aug-2023.

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[3] CMS Collaboration. Fall 2023 Scrutiny – CMS Preliminary Resource Request for 2025 - CMS Offline Software and Computing, submitted 30-Aug-2022.

[4] LHCb Collaboration. LHCb Computing Resources: preliminary 2025 requests. *LHCb-PUB-2023-003*, submitted 29-Aug-2023.