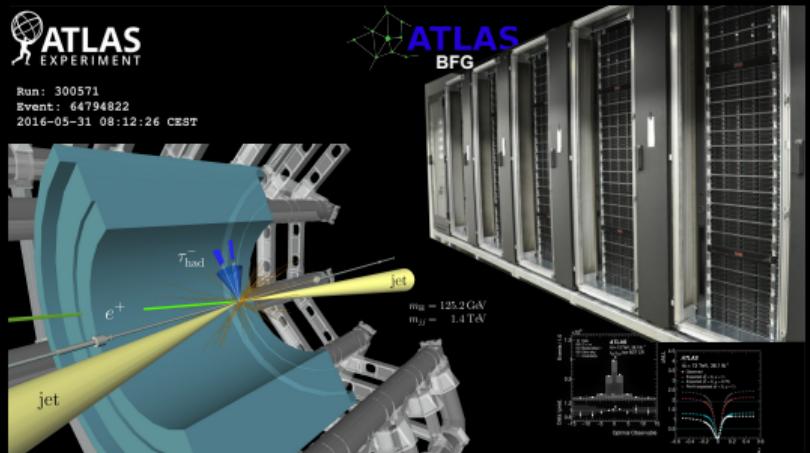


Annual Meeting of the BMBF-funded Research Compound - “Föderiertes Computing für die ATLAS- und CMS-Experimente am Large Hadron Collider in Run-3”

Weiterentwicklung und Optimierung des föderierten Computing für das ATLAS-Experiment am LHC

February 27th 2023
Michael Böhler



UNI
FREIBURG

Tasks and Manpower

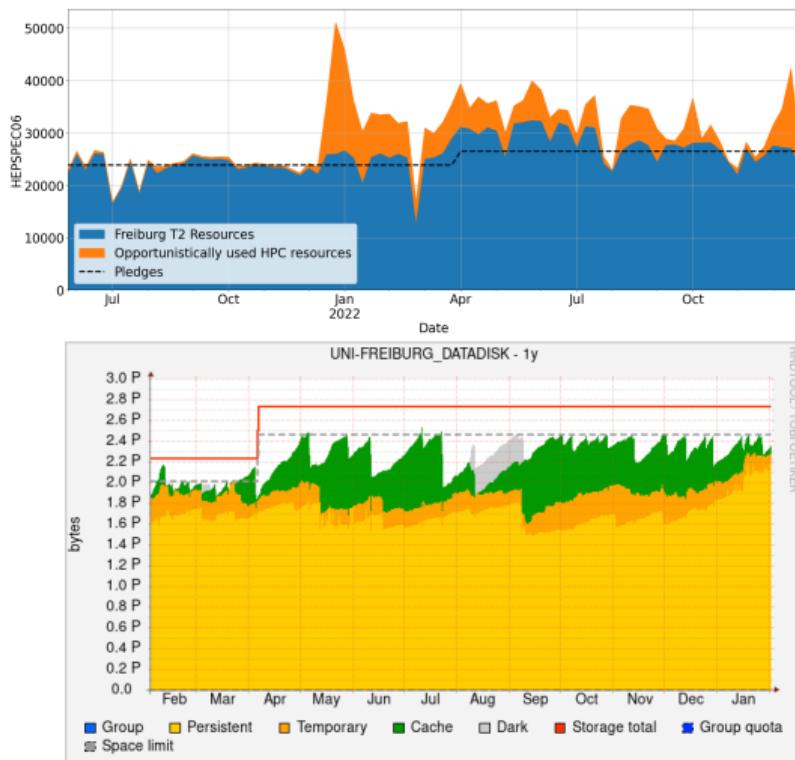
Planned contributions are broken down as follows:

- ▶ **GridBasis:** Expansion and base operations of the ATLAS Tier-2 centre in Freiburg
- ▶ **GridCloud:** ATLAS specific tasks at the local Tier-2 center and in the *GridKa* cloud
- ▶ **HC Devel.** : Further development of the HammerCloud(HC) framework

Arbeitspaket	2021 2. HJ	2022		2023		2024 1. HJ
		1. HJ	2. HJ	1. HJ	2. HJ	
GridBasis	0,0 (0,45)	0,0 (0,45)	0,0 (0,45)	0,0 (0,45)	0,0 (0,45)	0,0 (0,45)
GridCloud	0,7 (0,35)	0,7 (0,35)	0,7 (0,35)	0,7 (0,35)	0,7 (0,35)	0,7 (0,35)
HamCloudEnt.	0,3 (0,20)	0,3 (0,20)	0,3 (0,20)	0,3 (0,20)	0,3 (0,20)	0,3 (0,20)
Summe	1,0 (1,00)	1,0 (1,00)	1,0 (1,00)	1,0 (1,00)	1,0 (1,00)	1,0 (1,00)

- ▶ 1 FTE requested, 1 FTE in brackets employees funded by “Landesmittel”

Operation of ATLAS Tier2 Center at Freiburg



Compute:

- ▶ Stable Operation of Tier2 in 2021/22
 - pledges fulfilled
- ▶ Puppet version upgrade: 3.8 → 6.14
- ▶ Scheduler upgrade: Slurm 17.11 → 21.08

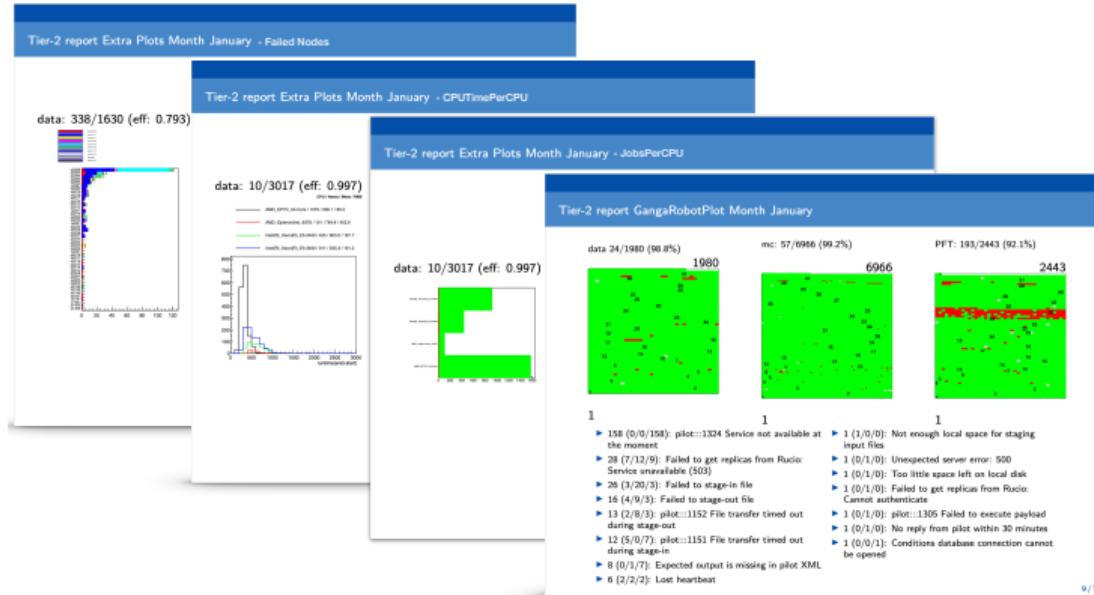
Storage:

- ▶ New Hardware deployed
- ▶ Smooth operation
- ▶ dCache upgrade: 5.2 → 6.2.47

Space Token

	Disk [TB]
UNI-FREIBURG_SCRATCHDISK	60
UNI-FREIBURG_DATADISK	2740
UNI-FREIBURG_LOCALGROUPDISK	650
Total	3450

ATLAS tasks around the Tier1 centre GridKa



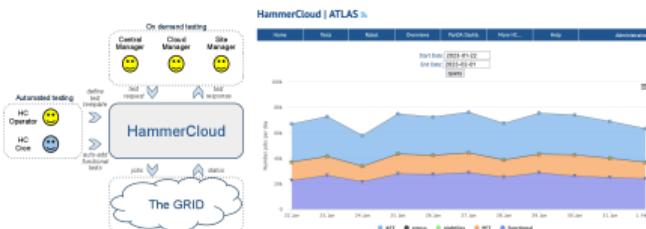
0 / 76

- ▶ Member of GridKa Squad (weekly/monthly meeting - presenting Tier-2 Report)
- ▶ Member of GridKa Technical Advisory Board - ATLAS Collaboration (2022-06 - today)

HammerCloud Infrastructure Migration and Containerization

HammerCloud(HC) in a Nutshell

- ▶ HC is testing and benchmarking framework used in ATLAS & CMS
- ▶ central service: submits thousands of test jobs per day to all WLCG grid sites



Python2 → Python 3 migration

- ▶ HC written in Django/Python
- ▶ both need to be upgraded:
 - ▶ Django: 1.7 → 4.1
 - ▶ Python 2.7 → 3.8

Will be presented @CHEP 2023: Bringing the ATLAS HammerCloud setup to the next level with containerization

Containerization of HC infrastructure

- ▶ HC release deployment based on rpms
- ▶ code base is in CERN gitlab
- ▶ more agile code deployment and CI requires transformation to docker containers
- ▶ (web server) development much faster:
 - can be done via docker on any laptop

The figure shows a screenshot of a browser window displaying the HammerCloud interface. The address bar shows 'HammerCloud | ATLAS' and 'localhost:4243'. The page content is identical to the one shown in the first figure, indicating it's running within a Docker container.

State	M	Host	Schedule	Start (Europe/Zurich)	End (Europe/Zurich)	Sites	submit (min/avg/max)	run (min/avg/max)	fail (min/avg/max)	exit (min/avg/max)
running	20252624	hammercloud-al-74	1184-AFT-mc11-Size of 21.0.15.FC	21/Nov/7 13:22	22/Nov/5 10:00	ATLAS_7953_ATLAS_01_Swiftlet_147	102 90 5890 1273 17 7355			
running	20252627	hammercloud-al-74	9512-AFT_Event21_Step1_Avaly	21/Nov/8 16	22/Nov/7 23	ATLAS_7957_ATLAS_01_Swiftlet_147	76 22 8460 1018 11 9576			
running	20252618	hammercloud-al-74	1192-AFT_mc21_Sim_tf_23.0.7.5	21/Nov/15 14:14	22/Nov/14 13	ATLAS_7958_ATLAS_01_Swiftlet_147	52 18 3963 333 14 3434			
running	20252640	hammercloud-al-78	1013-AFT_AirDerivation_21.2.33.0	21/Nov/16 44	22/Nov/17 23:00	ATLAS_7955_ATLAS_01_Swiftlet_147	46 51 2358 186 7 2643			
running	20252645	hammercloud-al-74	1149-GPU Container GPU Available + Vector Multiplication	23/Nov/0:58	23/Nov/0:58	ATLAS_7956_ATLAS_01_Swiftlet_147	1 3 6 7 41 17			
running	20252646	hammercloud-al-77	BET-AFT_Plottingleibspalte_ExampleCode	22/Nov/0:46	23/Nov/2:09	ATLAS_7957_ATLAS_01_Swiftlet_147	65 27 341 14 4 347			

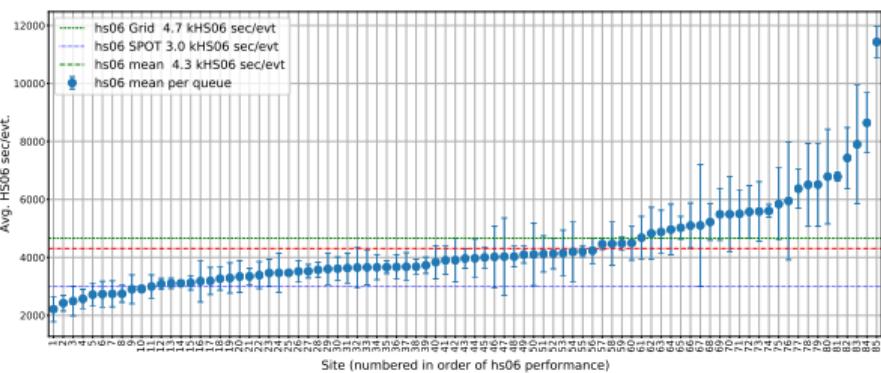
HC overview page running in local browser

Comparison HEPSPEC benchmark of ATLAS Grid-Sites vs ideal conditions

Objective

- ▶ Understand discrepancy of ideal conditions (SPOT) and performance on WLCG sites
 - ▶ SPOT measures (2020): **3 kHS06 sec/ event**
 - ▶ Average ATLAS jobs on WLCG (2020): **4.7 kHS06 sec / event**

Results



Method

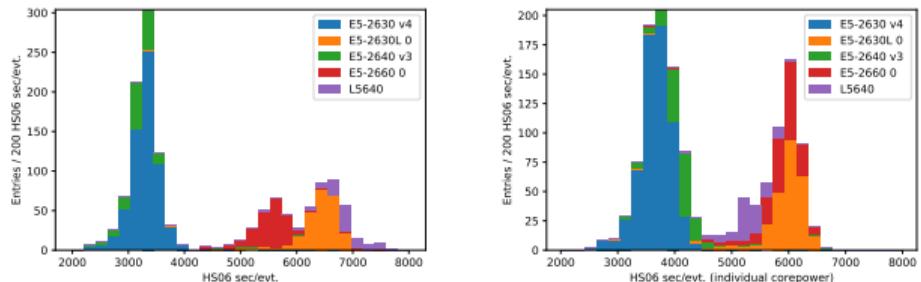
- ▶ Run **hundreds of identical simulation jobs** with HammerCloud (HC)

Cut	Jobs	Sites	CPU types
0 total	102066	96	154
1 exclude TEST queues	98196	89	154
2 (nJobs per CPU & site) >= 25	96805	86	125
3 (total nJobs per site) >= 50	96757	85	125

$$\text{hs06} = \frac{t_{\text{walltime}} \times n_{\text{cores}} \times \text{corepower}}{n_{\text{events}}}$$

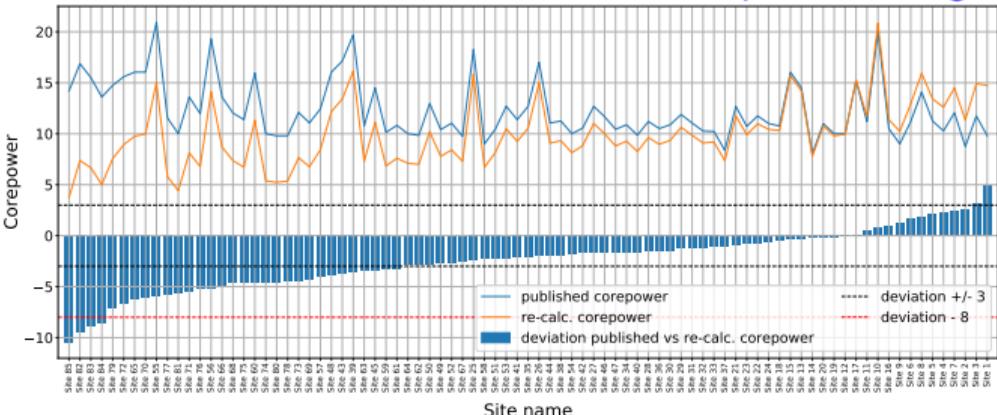
- ▶ Both SPOT and Grid values reproduced
- ▶ Major discrepancies:
unpledged resources and jobs in bad state
- ▶ Heterogeneous hw and single/out-dated core-power values additional discrepancy

Different Hardware Generations do not scale linearly



- ▶ WLCG accounting based on one corepower value per queue
→ cannot correct for different CPUs
- ▶ individual corepower values shows double peak
→ do not correct hs06 properly

HammerCloud benchmarks can be used to spot misconfiguration



- ▶ Extract corepower value from HC jobs with fixed reference hs06 value (3kHS06)
- ▶ Calculated **optimal** corepower can be compared with **published** value (blue bars show deviation)

Presented @ACAT 2022: A comparison of HEPSPEC benchmark performance on ATLAS Grid-Sites versus ideal conditions

Conclusion

- ▶ Efficient and successful operation of ATLAS Tier2 centre in Freiburg
- ▶ Important contribution to ATLAS GridKa Cloud Operations
- ▶ Innovative developments to the HammerCloud Framework
 - ▶ "A comparison of HEPSPEC benchmark performance on ATLAS Grid-Sites versus ideal conditions" presented at the ACAT¹ conference
 - ▶ "Bringing the ATLAS HammerCloud setup to the next level with containerization" will be presented at the CHEP² conference

¹21st International Workshop on Advanced Computing and Analysis Techniques in Physics Research, 24-28th October, 2022, Bari, Italy

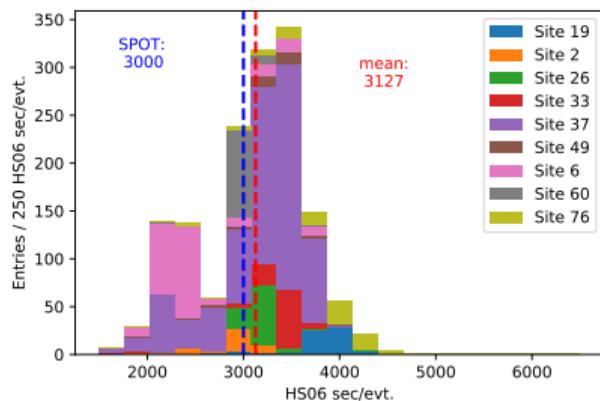
²26th International Conference on Computing in High Energy and Nuclear Physics, 8-12th May, 2023, Norfolk VA, USA

Back-up

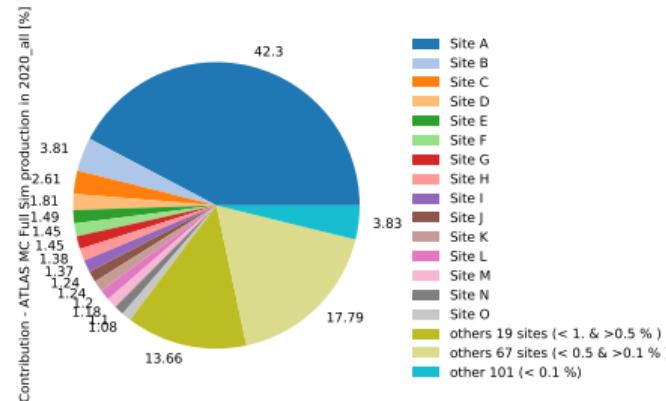
Comparison HEPSPEC benchmark of ATLAS Grid-Sites vs ideal conditions

Closure

SPOT ⇌ HC



HC ⇌ Grid Production



- HC jobs on identical hardware used by SPOT team show nice agreement

- Weight queues according to contribution to 2020 prod
→ values from HC tests agree with 2020 prod

Resources	ATLAS grid prod. 2020	HC benchmarks tot. frac	hs06 w	rel dev [%]
all resources	4127	80.3	3906	5.4
Grid & Cloud	3987	90.5	3921	1.6
Grid	3244	83.3	3263	-0.6