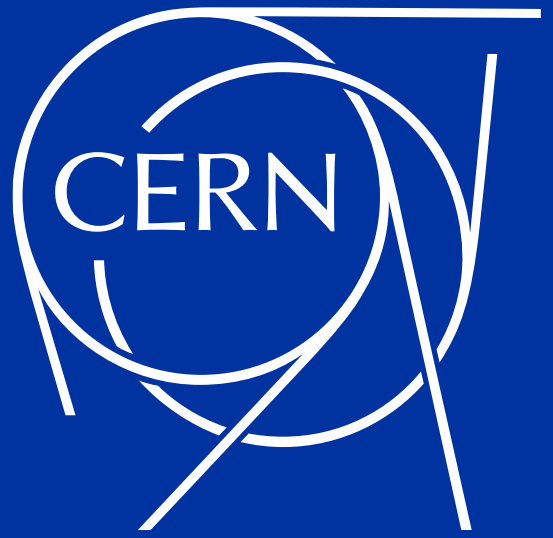
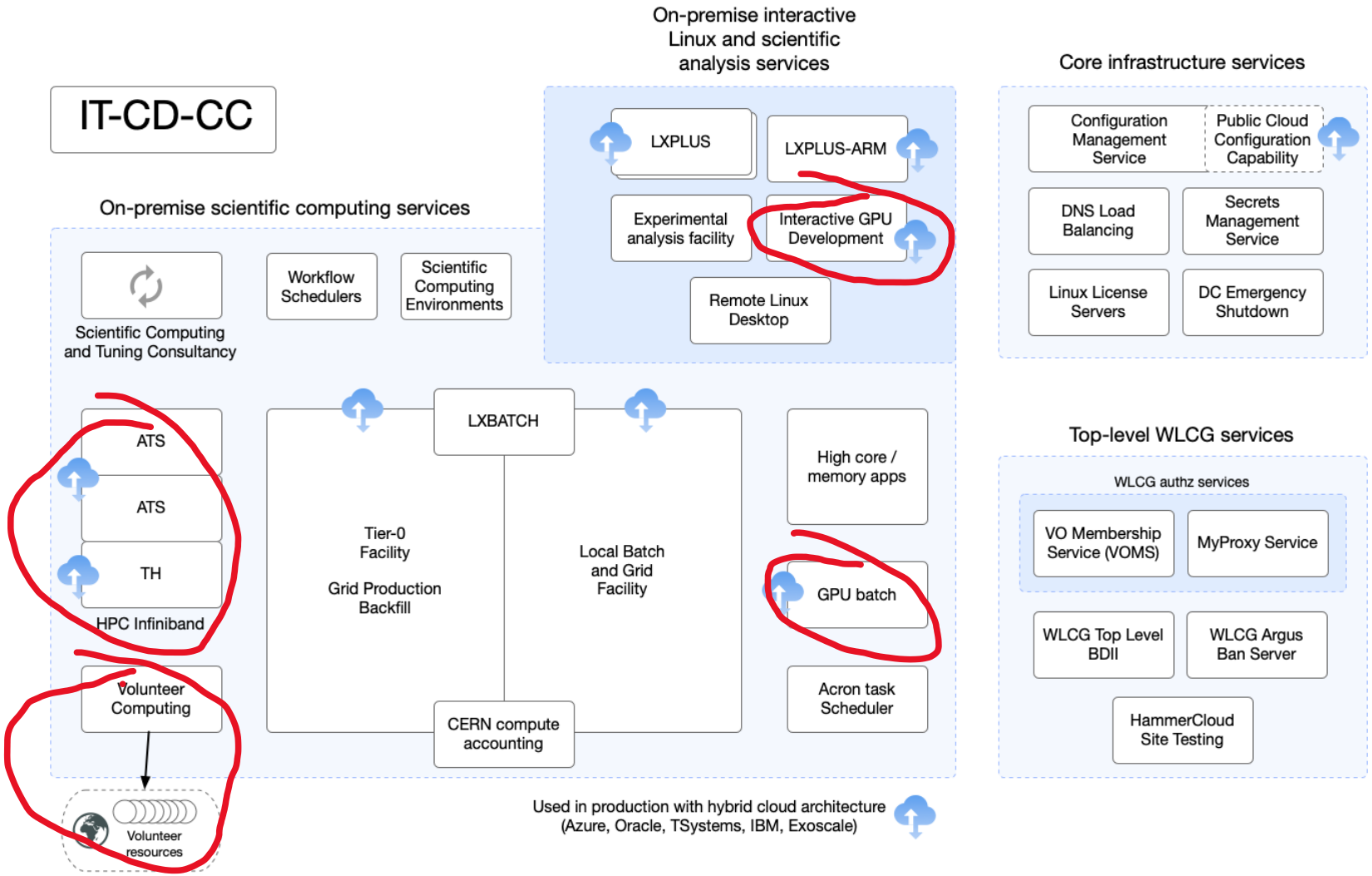

CERN

Compute Services

Laurence Field

CERN IT ML Infrastructure Workshop 10/03/2023

Compute and Config



LxPlus [LinuX Public Login User Service]

- **Interactive linux login service for CERN**
- **What is it used for?**
  - Everything and Anything: general purpose computing facility
  - Batch (remote) submit node
  - Users whose primary desktop/laptop is mac or windows do their physics on lxplus
    - Examine subsets of data, prepare jobs, development, LaTeX
  - Remote desktop for graphical apps (vnc, fastx etc)
  - ansible control of their service, Jenkins CI, etc etc
  - Tunneling, email (mutt, alpine)
- **Reference build: people often ask for ”their own” lxplus**
  - ”contract” lxplus == batch worker node

LxPlus Current Status

Number of LxPlus 7 Nodes	Number of LxPlus 8 Nodes	Number of LxPlus 9 Nodes
106	18	9

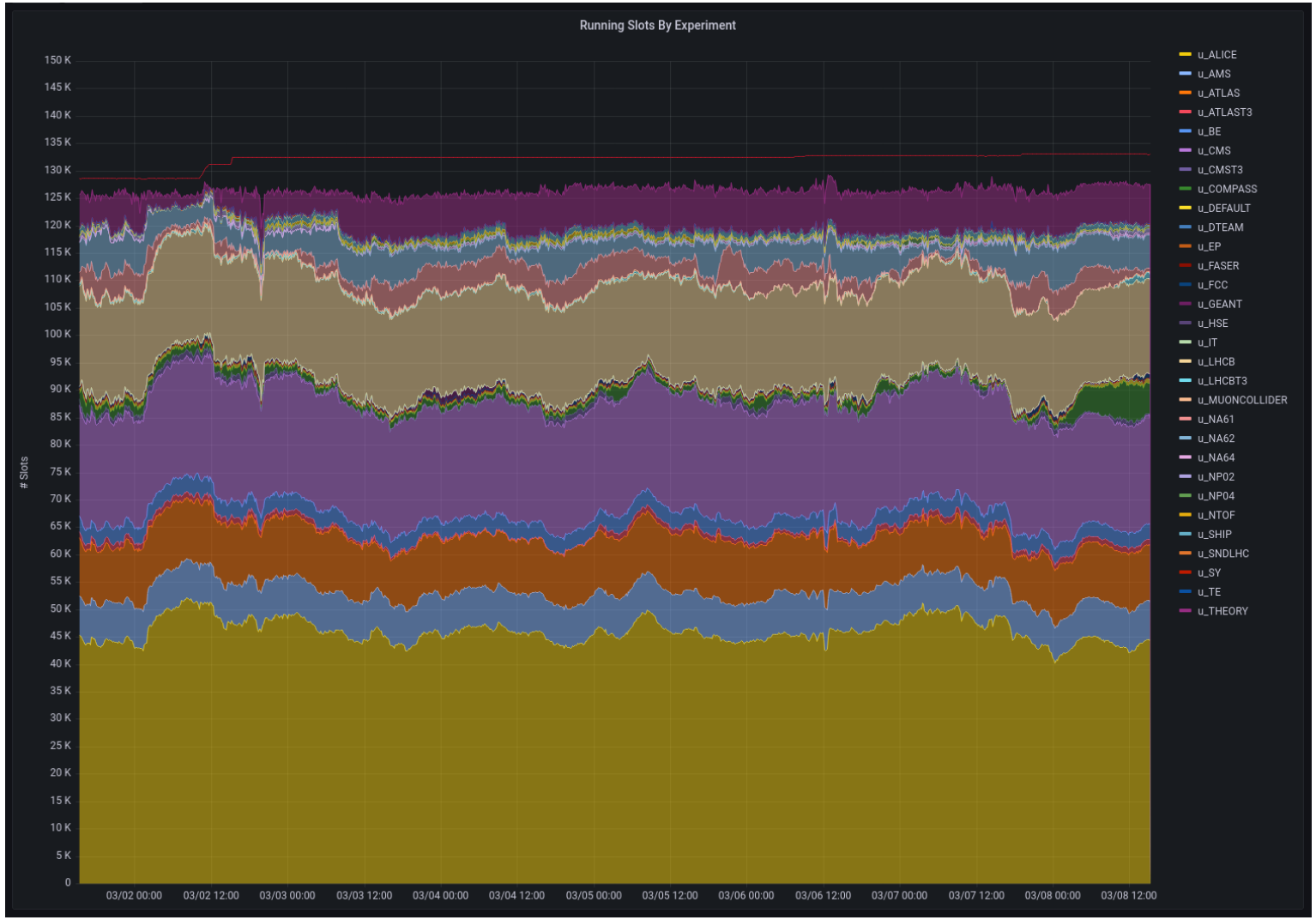
- lxplus7 (CERN CentOS7)
- lxplus8 (CentOS Stream 8)
- lxplus9 (CentOS Stream 9)
- lxplus.cern.ch alias -> lxplus7
- lxplus-gpu
  - 5 Nvidia T4 GPUs
- lxplus node =~ lxbatch node

- Active Users
  - ~1500(day)
  - ~1000(night)

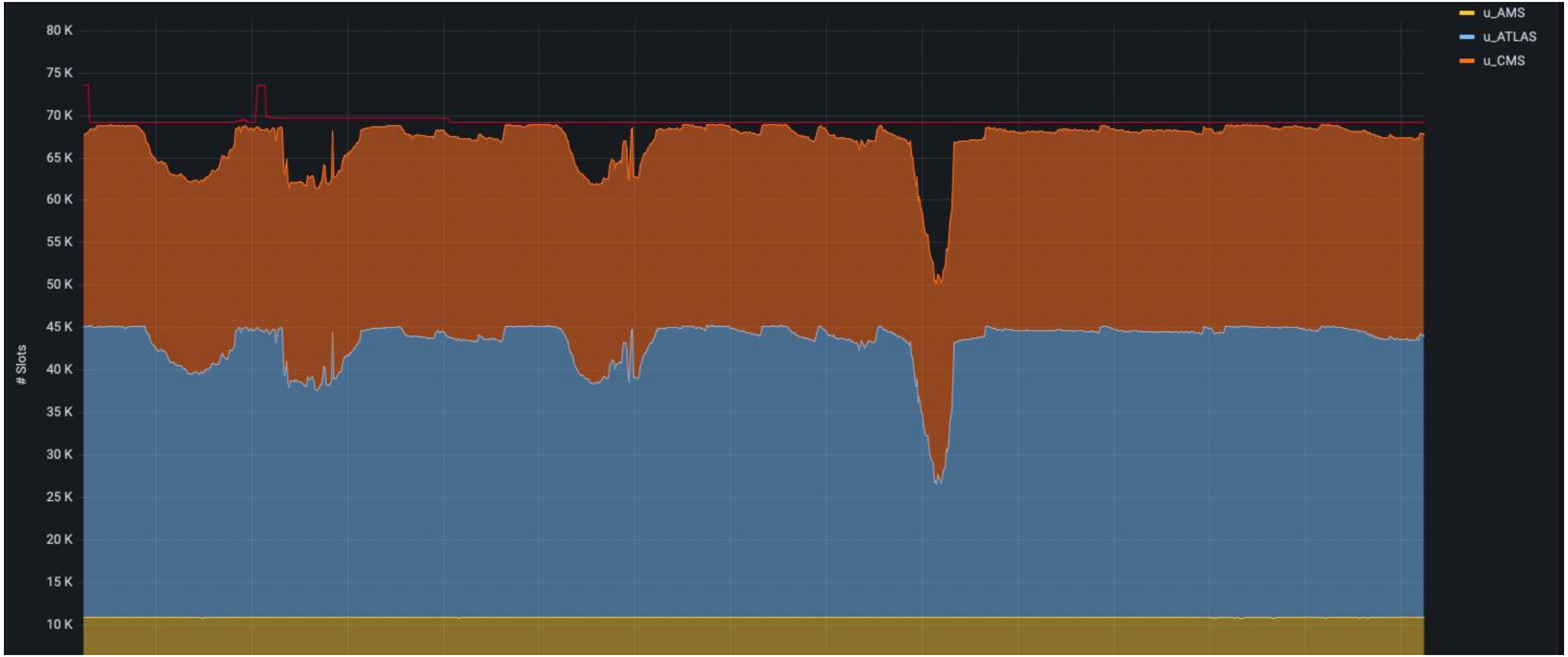
LxBatch

- **Current batch system HTCondor from CHTC Wisconsin**
- **Used for both Grid and ”Local” submission**
  - Grid means submitted to a ”Compute Element” (CE) which more or less means WLCG
  - ”Local” means any user submitting at CERN, authenticated with kerberos
- **High Throughput Computing**
  - “Embarrassingly parallel” or “pleasently parallel” as HTC would like it to be termed
  - Primary platform for a batch process that can fit on one computer
- **Non-homogeneous resource types**
  - BigMem and BigMCore
  - GPUs
    - 55 A100
    - 23 V100
    - 2-20 T4

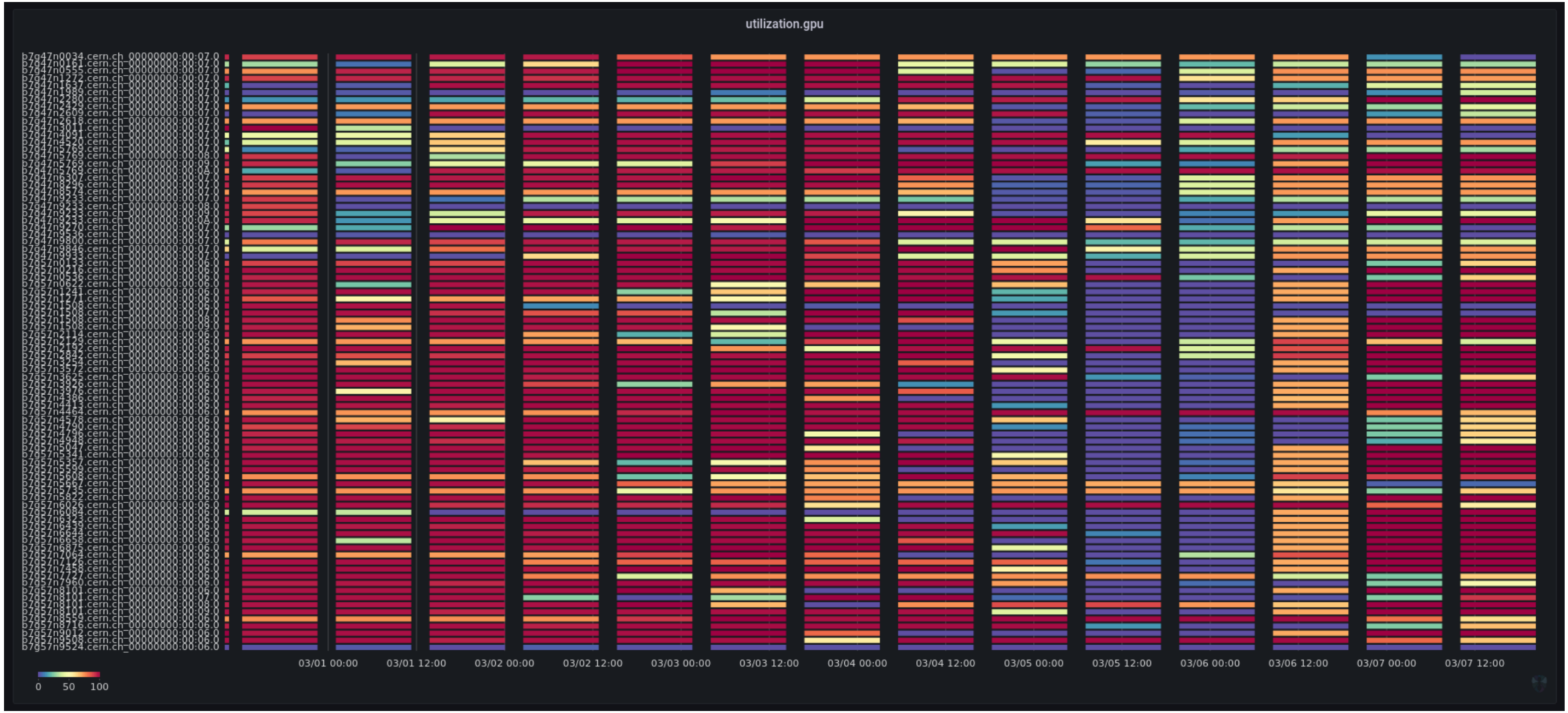
Usage (shared)



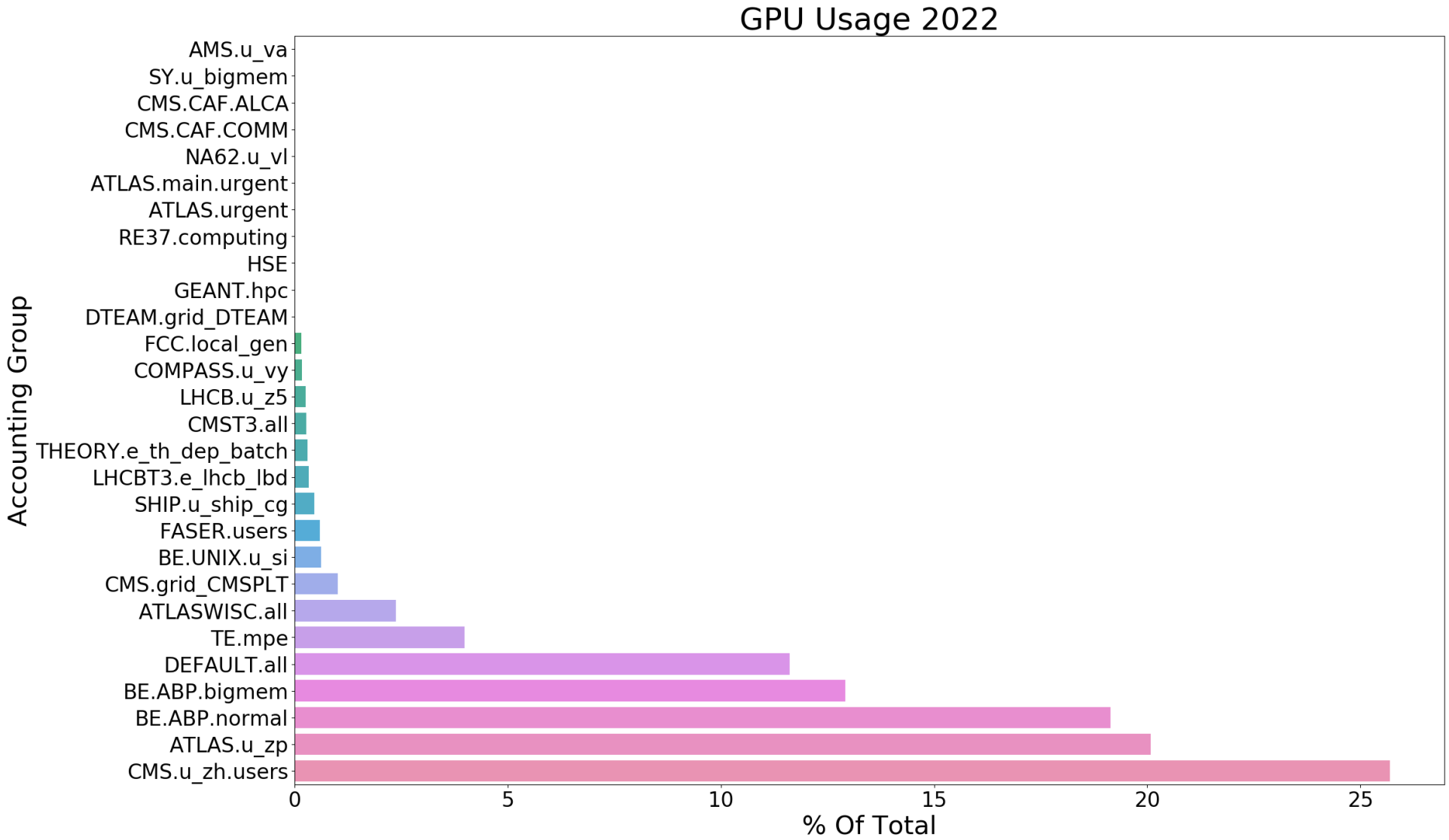
Usage (dedicated)



Usage GPUs


utilization.gpu
03/01 00:00
03/01 12:00
03/02 00:00
03/02 12:00
03/03 00:00
03/03 12:00
03/04 00:00
03/04 12:00
03/05 00:00
03/05 12:00
03/06 00:00
03/06 12:00
03/07 00:00
03/07 12:00
0
50
100

GPU Users


GPU Usage 2022
Accounting Group
AMS.u_va
SY.u_bigmem
CMS.CAF.ALCA
CMS.CAF.COMM
NA62.u_vl
ATLAS.main.urgent
ATLAS.urgent
RE37.computing
HSE
GEANT.hpc
DTEAM.grid_DTEAM
FCC.local_gen
COMPASS.u_vy
LHCB.u_z5
CMST3.all
THEORY.e_th_dep_batch
LHCBT3.e_lhcb_lbd
SHIP.u_ship_cg
FASER.users
BE.UNIX.u_si
CMS.grid_CMSPLT
ATLASWISC.all
TE.mpe
DEFAULT.all
BE.ABP.bigmem
BE.ABP.normal
ATLAS.u_zp
CMS.u_zh.users
0
5
10
15
20
25
% Of Total

High Performance Computing (HPC)

~8000 cores for HPC
~300 000 cores for batch

- Use cases that do not fit the standard batch HTC model
  - Parallel MPI applications
  - 32-2304+ cores for a single job

- Batch HPC facility using Slurm scheduler to run jobs on 4 Infiniband clusters, on different Slurm partitions:
  - 2x72 nodes with 2 x Xeon(R) CPU E5-2630/20 cores (partitions “inf-short” and “inf-long”)
  - 72 nodes with 2x AMD EPYC 7302 32 cores (partition “photon”)
  - 72 nodes 2 x Xeon(R) CPU E5-2630/16 cores (“qcd” partition)

- Applications that scale well with parallelisation
  - MPI application performance requires fast interconnects with low latency between nodes in a cluster
  - Stability of OS and environment critical
  - Applications typically require fast access to a shared filesystem

User Community and Applicaitons

- Login to submit node: “hpc-batch.cern.ch”
  - Users' home and scratch directories on /hpcscratch file system (CephFS)
  - AFS and EOS available, similar to lxplus
  - Applications on AFS or CVMS, (also local or EOS...)
  - EOS for data copy and project storage

BE
- Plasma simulations for Linac 4
- Beam simulations for LHC, CLIC, FCC…
- Xtrack, PyOrbit etc

TH
- Lattice QCD simulations

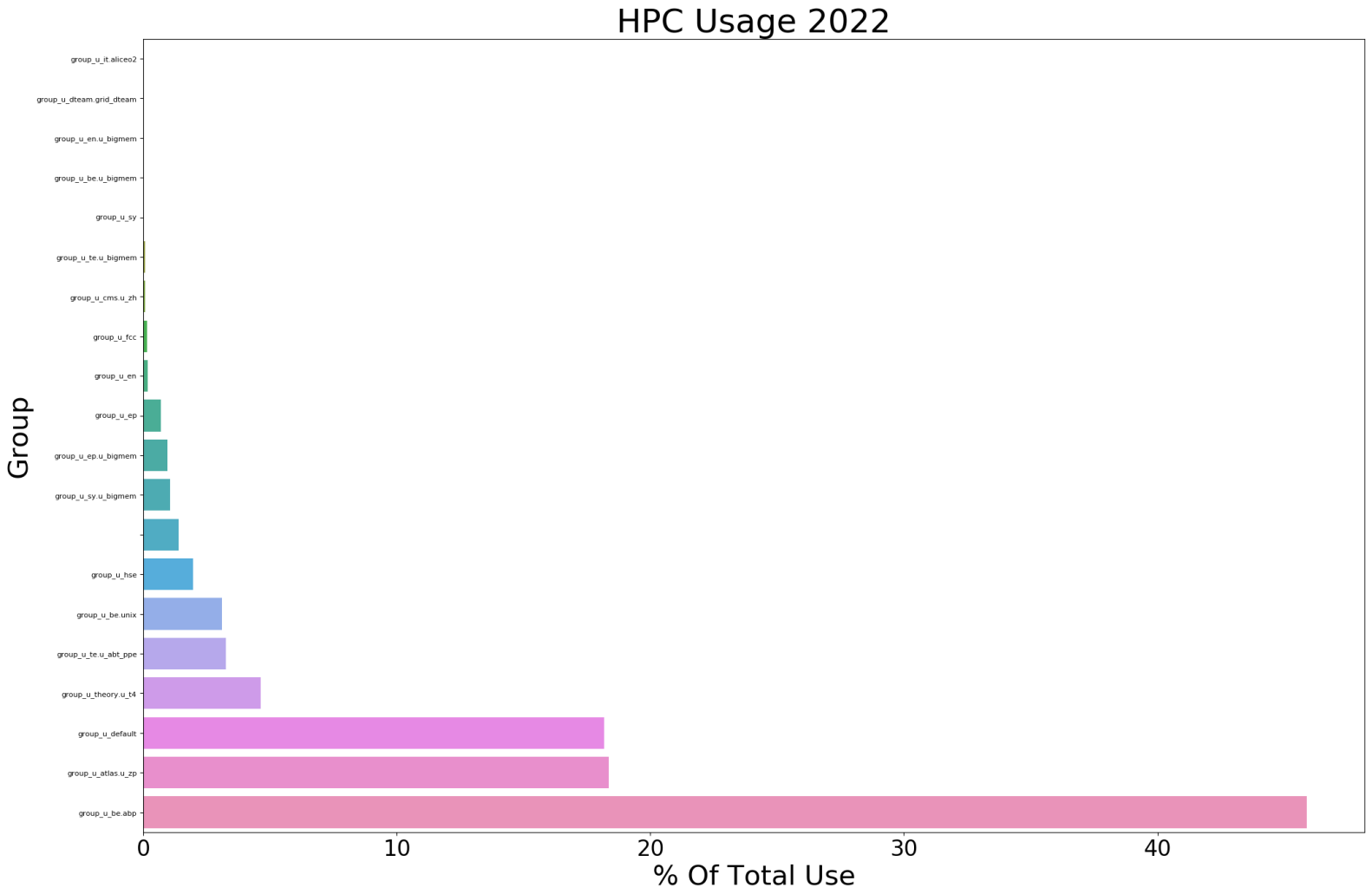
HSE
- Safety/fire simulations (FDS, OpenFOAM)

SY
- Gdfdl (field calculations for RF cavities)
- Field calculations (CST...)

TE
- Picmc
- Engineering (Ansys and Comsol)

EN
- CFD (Ansys-Fluent, OpenFOAM)
- Structural analysis (Ansys, LS-Dyna...)

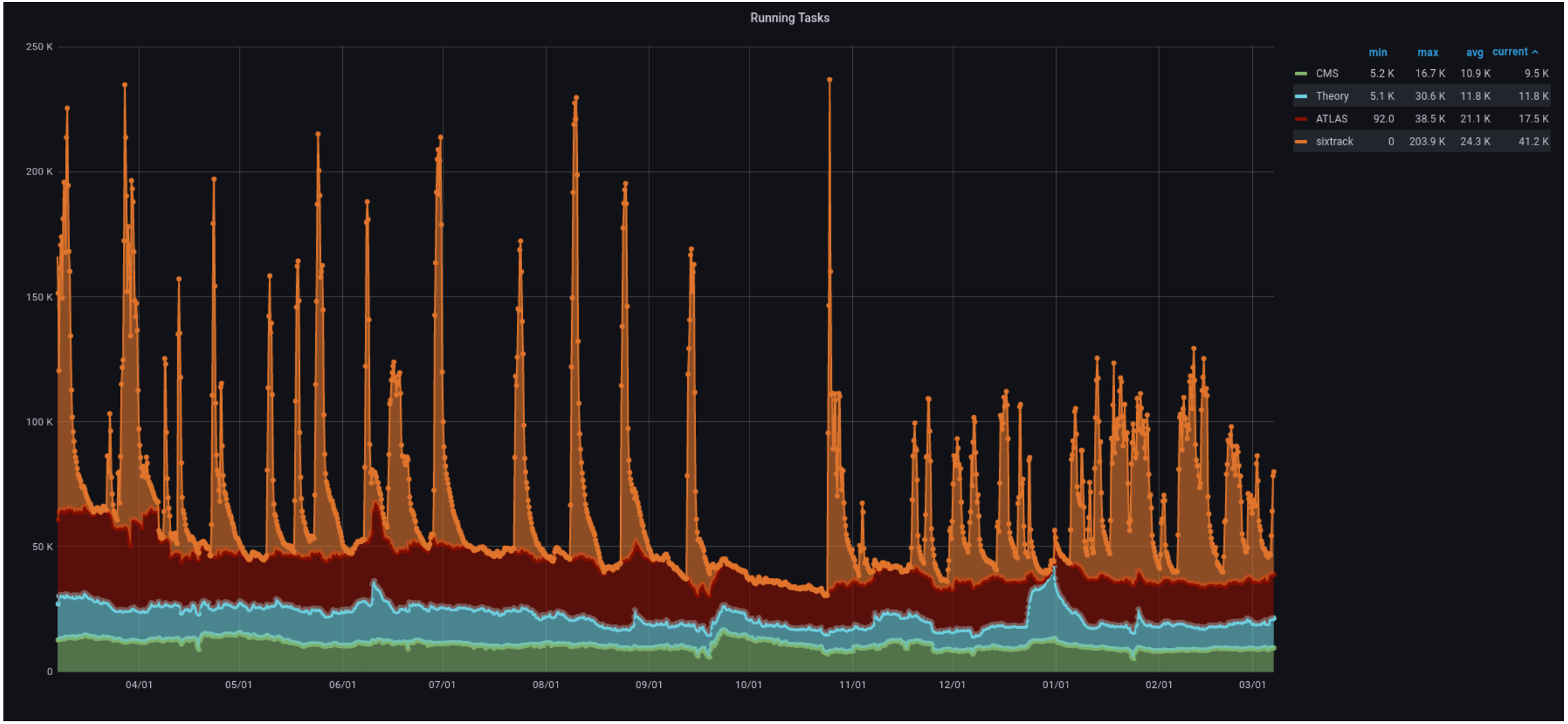
HPC Usage


HPC Usage 2022
Group
group_u_it.aliceo2
group_u_dteam.grid_dteam
group_u_en.u_bigmem
group_u_be.u_bigmem
group_u_sy
group_u_te.u_bigmem
group_u_cms.u_zh
group_u_fcc
group_u_en
group_u_ep
group_u_ep.u_bigmem
group_u_sy.u_bigmem
group_u_hse
group_u_be.unix
group_u_te.u_abt_ppe
group_u_theory.u_t4
group_u_default
group_u_atlas.u_zp
group_u_be.abp
0
10
20
30
40
% Of Total Use

Overview and history

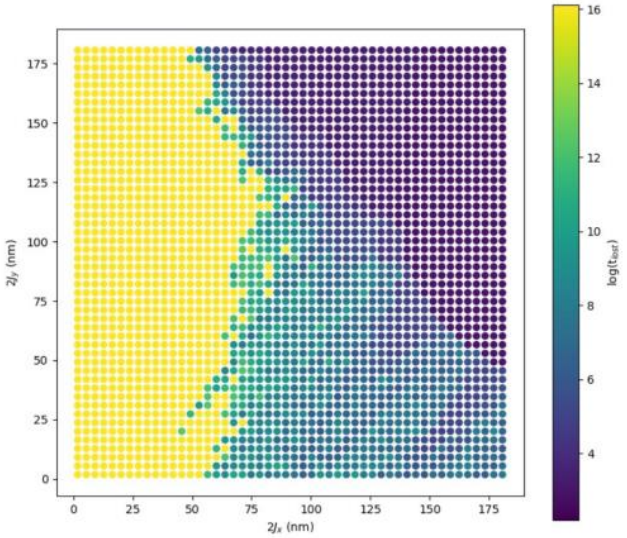
- LHC@home
  - Started in 2004 for the 50th anniversary of CERN. Running the Sixtrack application for beam simulations of the stability of proton orbits in the LHC accelerator
  - From 2011 also physics event simulations (Theory) and later also LHC experiment applications running in a virtual machine (CernVM) on volunteers' computers

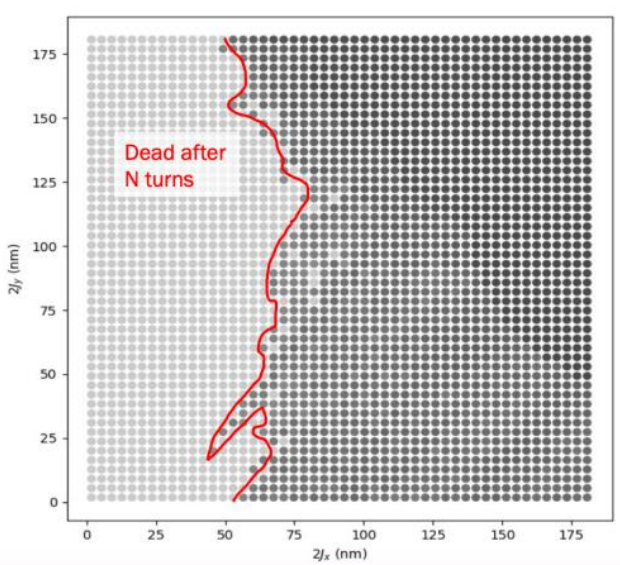
Usage and Opportunity

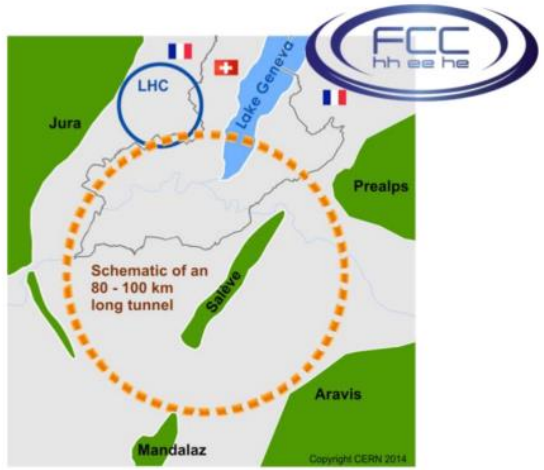


Xtrack on BOINC: Example study

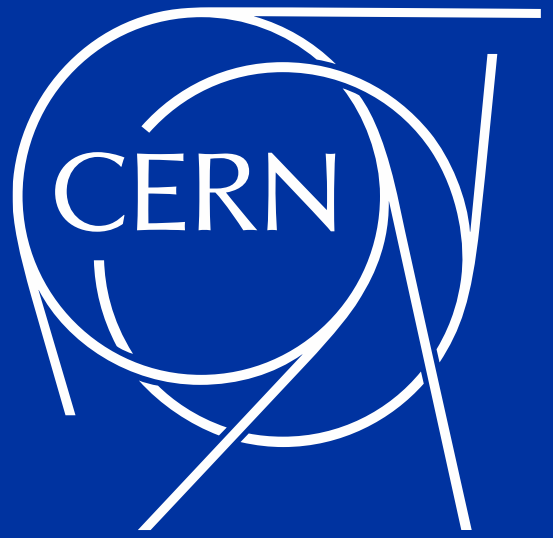
- **Currently, most people working on LHC simulations already moved to Xtrack** (explaining the drop in SixTrack jobs submitted to BOINC)
- **The tailoring of SixTrack BOINC to one type of study limited the amount users**
- **Very large-volume study in the pipeline: surrogate ML model for LHC and FCC** in collaboration with EPFL, SDSC (under the CHART project)







Study supported by CHART


CERN