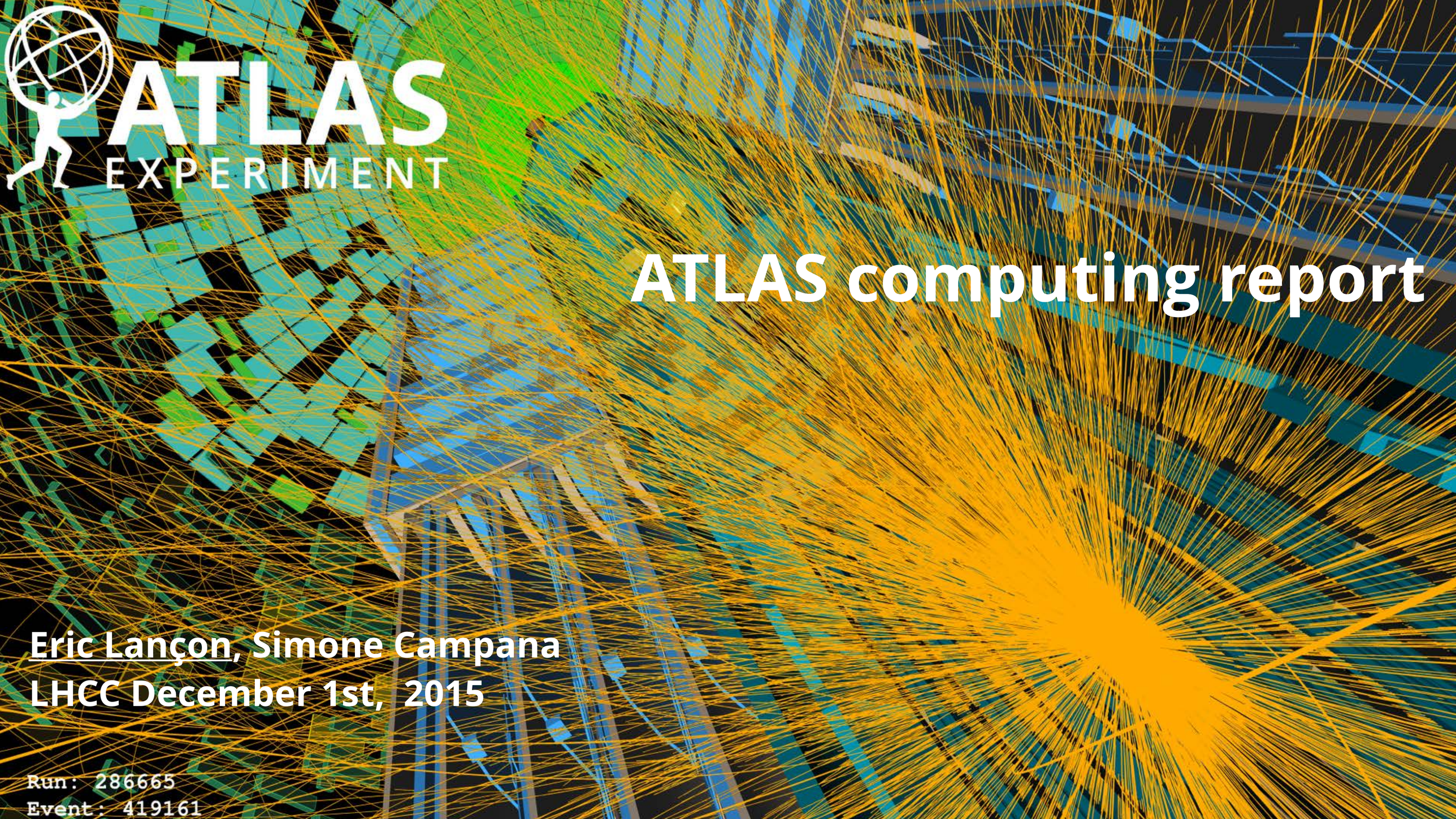


ATLAS computing report

Eric Lançon, Simone Campana

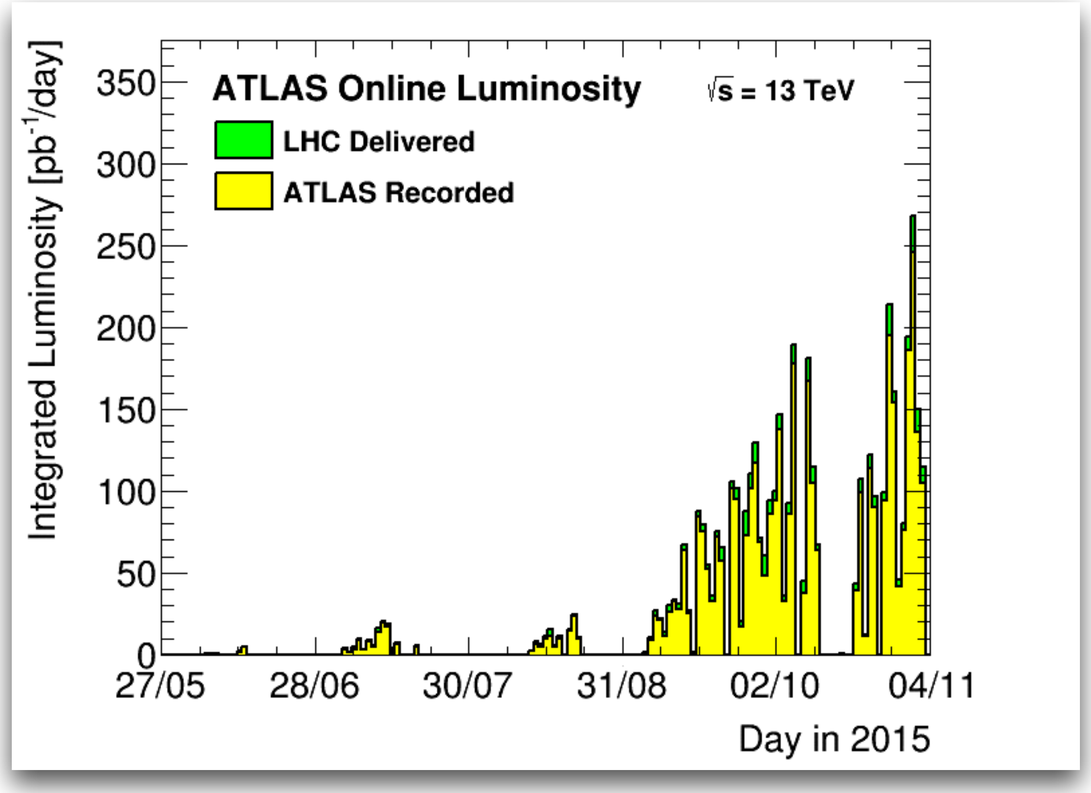
LHCC December 1st, 2015

Items of the day

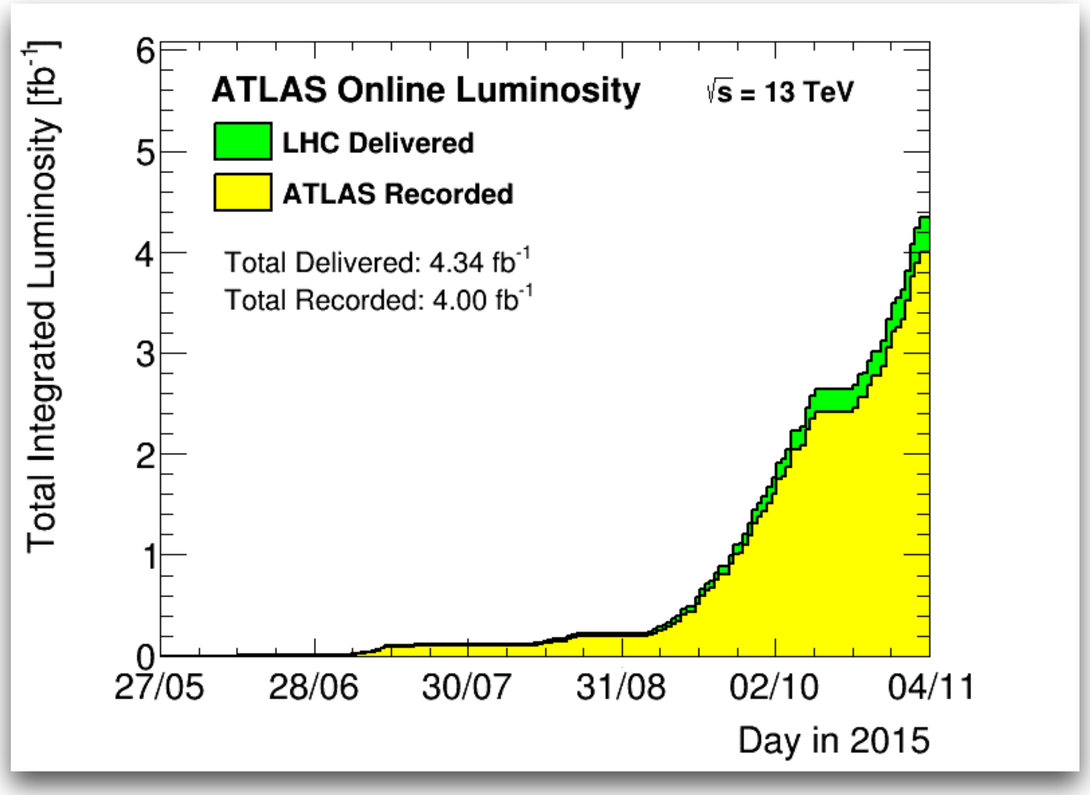
- Status of computing & software
- Recent and future events
- Paths for the future

2015 data taking

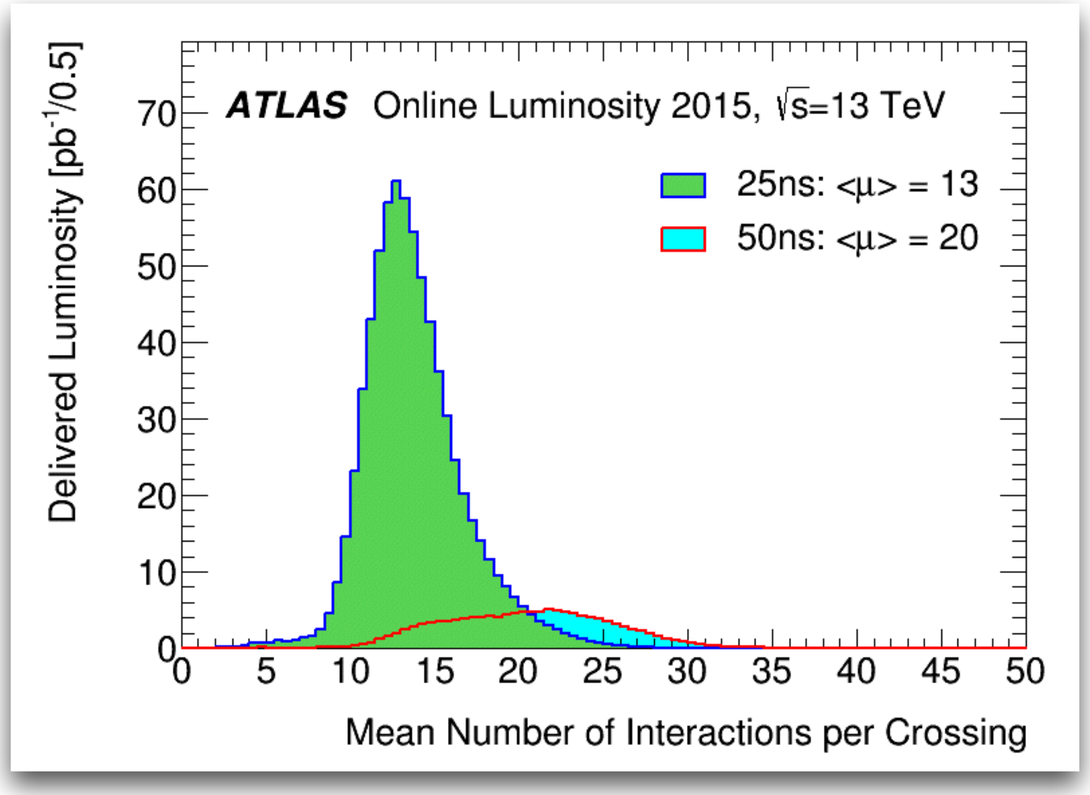
LHC in 2015 … after 2 years of technical stop



Collected data



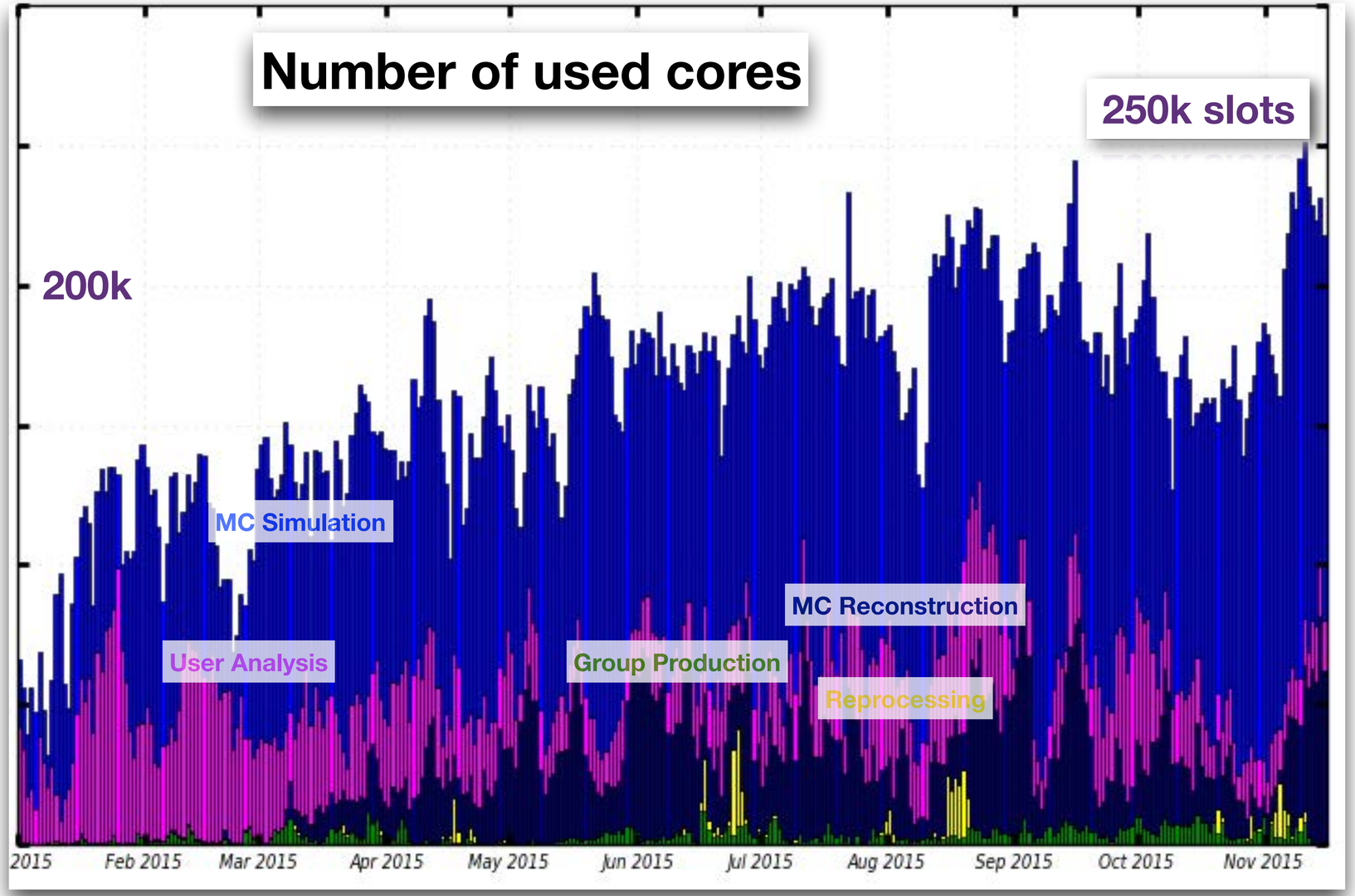
2016 : 10+ x 2015



2016 : 3+ x 2015

ATLAS activities on the grid

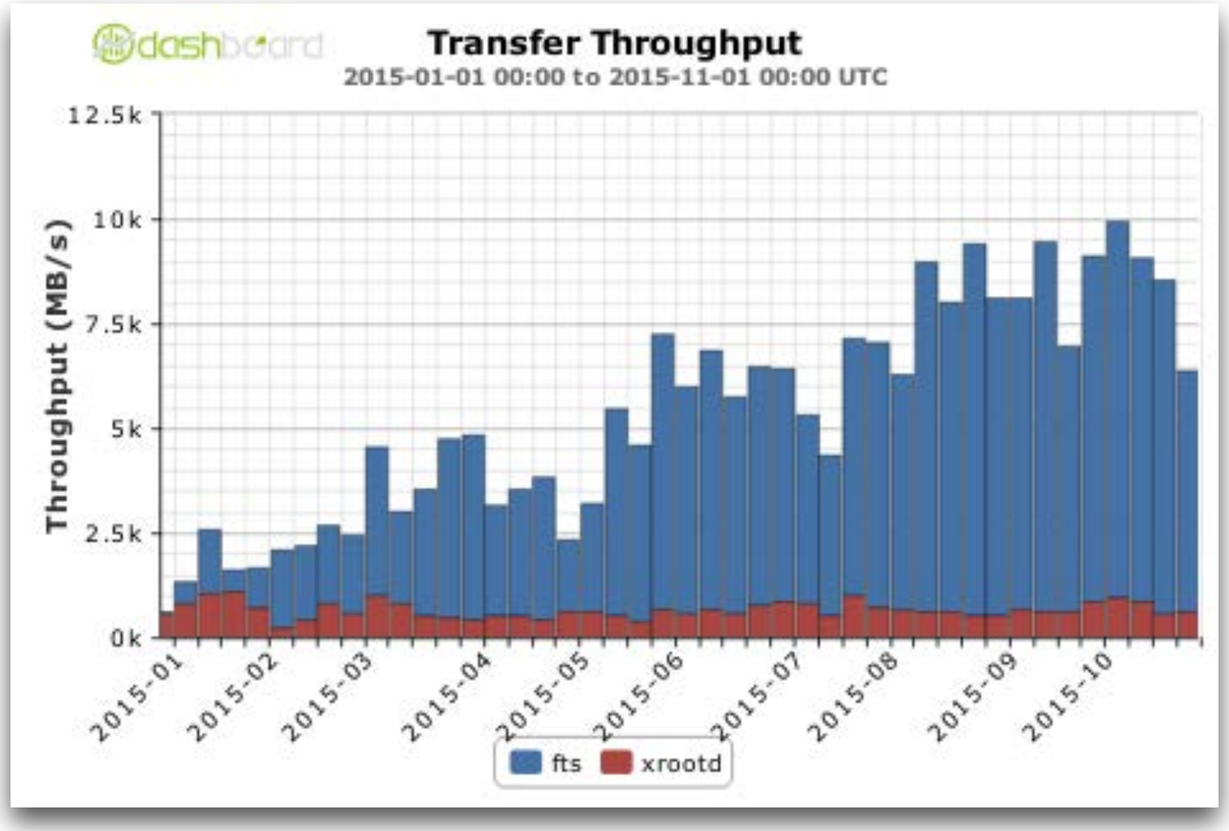
ATLAS activities on the grid in 2015



Record level of activity
Thanks to new production and data management systems and WLCG sites!

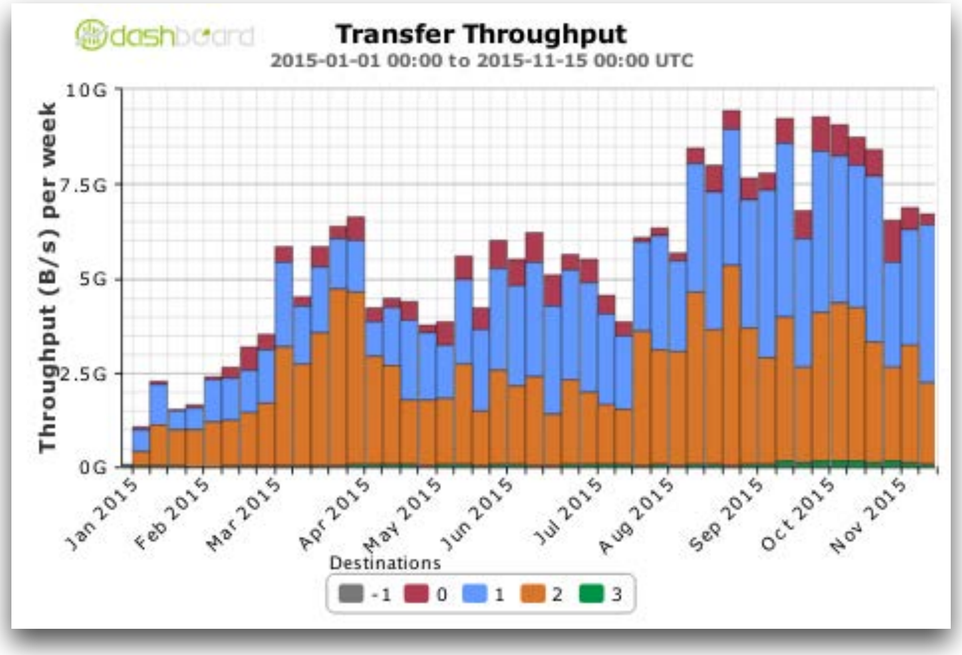
Data Transfers

- Global network activity increased over year
- Last months :
  - ~100 Gb/s bandwidth occupancy
  - 20M files transferred per week
- Xrootd : 12%

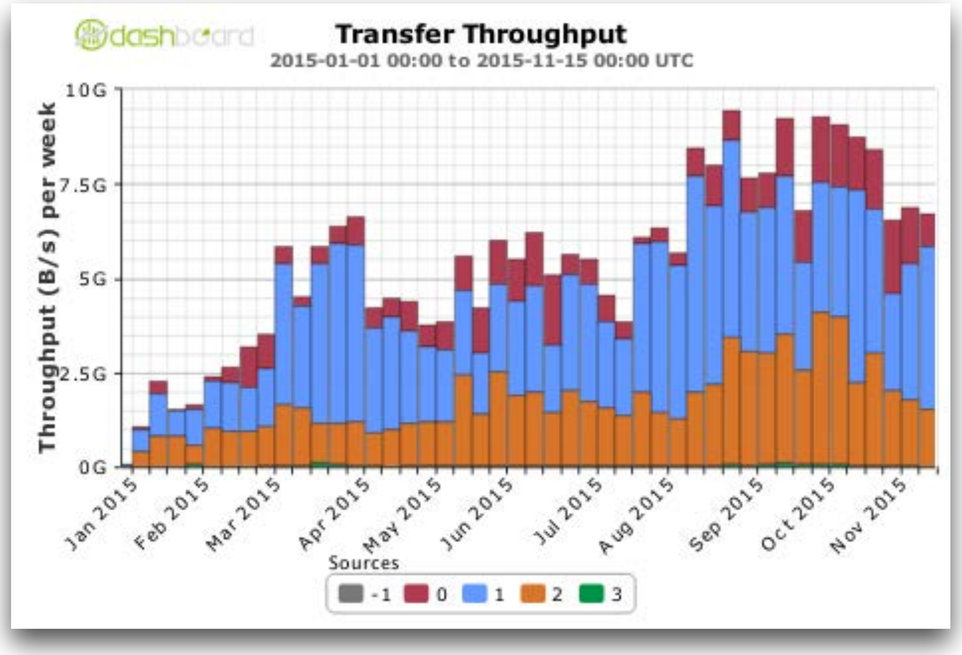


Transfer by origin & destination

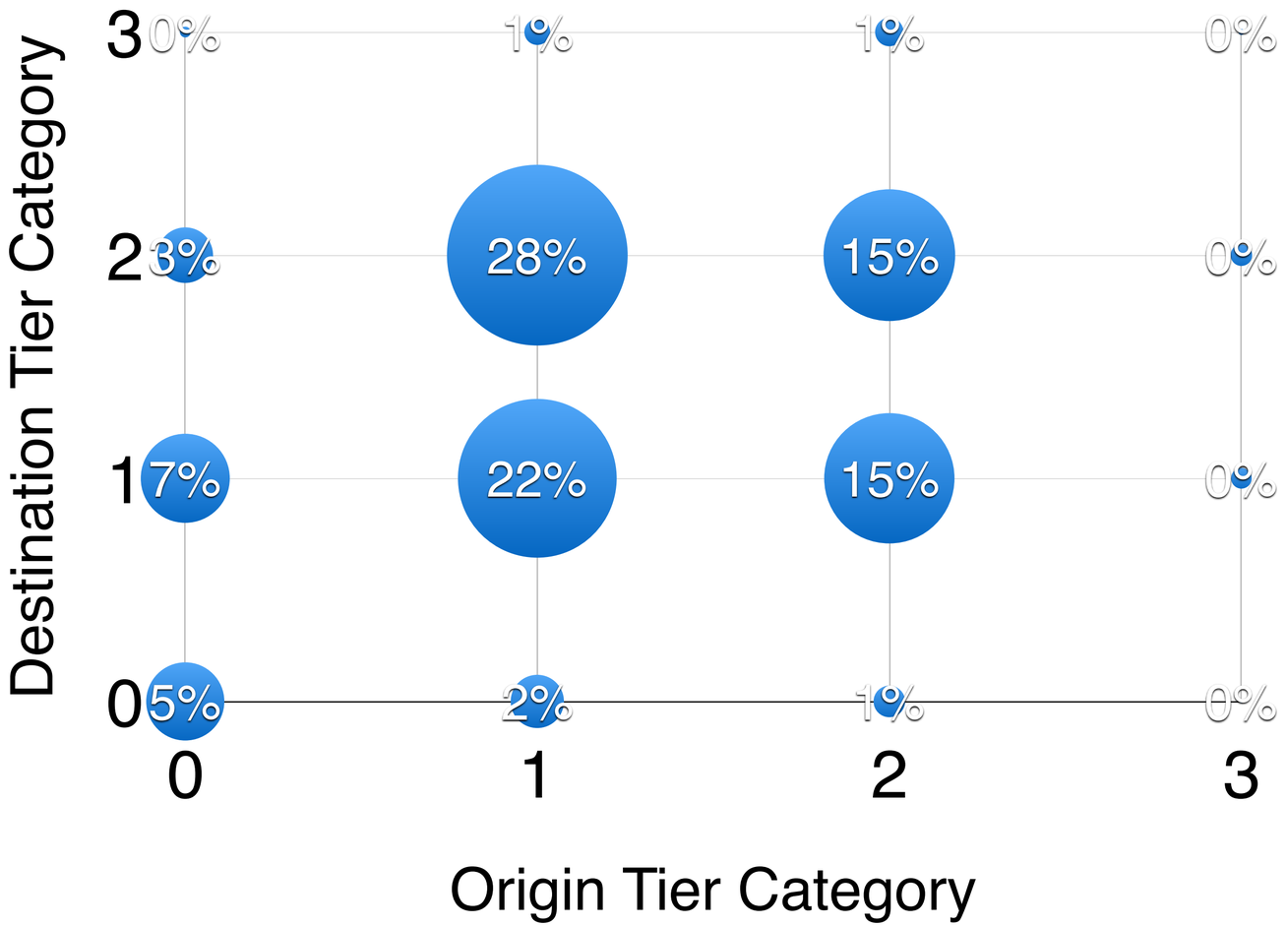
Transfers by destination



Transfers by origin

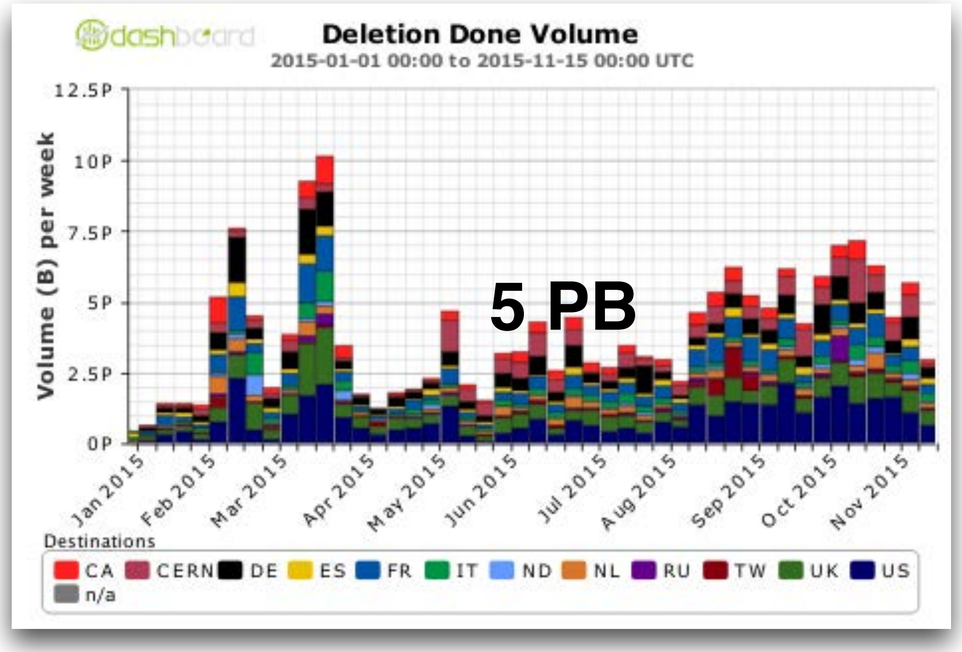


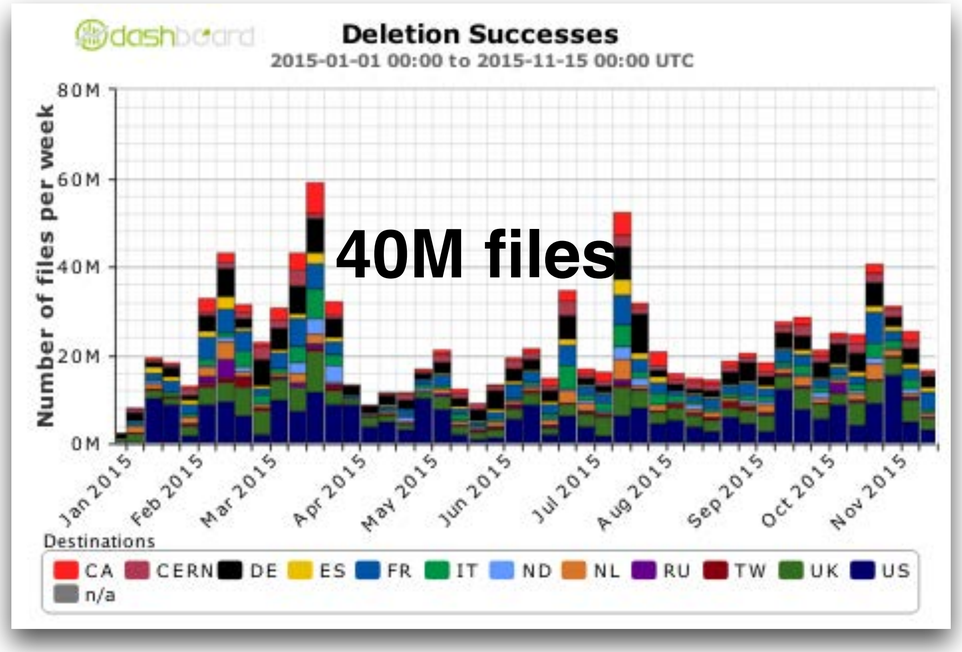
Transfer matrix (data volume)



Data management

Rucio at work





Disk Space Usage

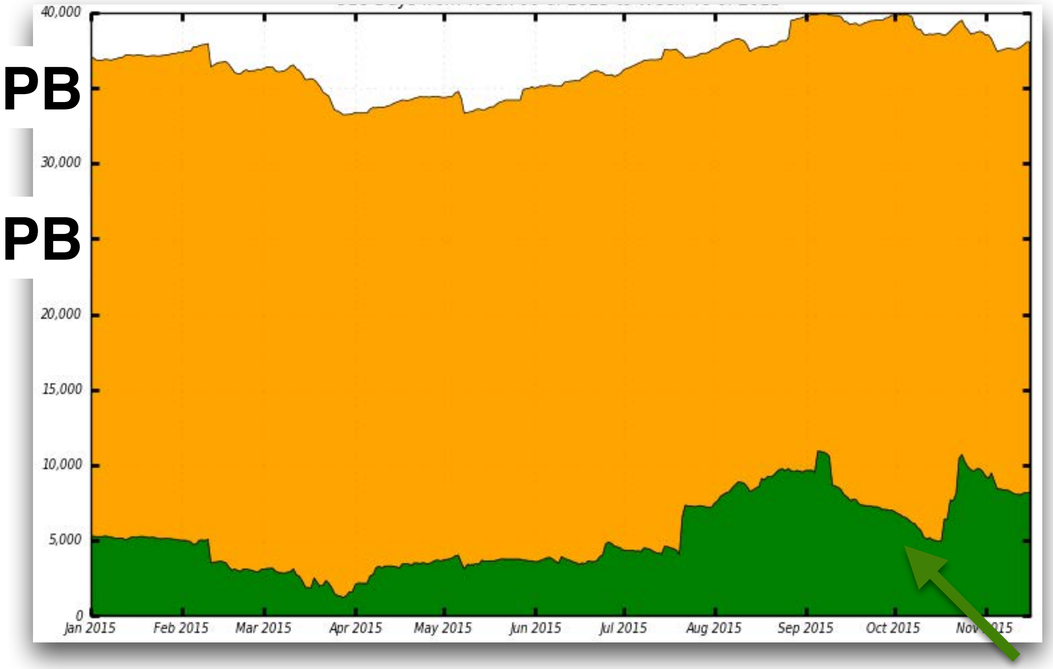
Tier 1s still ~full

Still some difficulties to efficiently use T2 disk space

Tier 1s

35PB

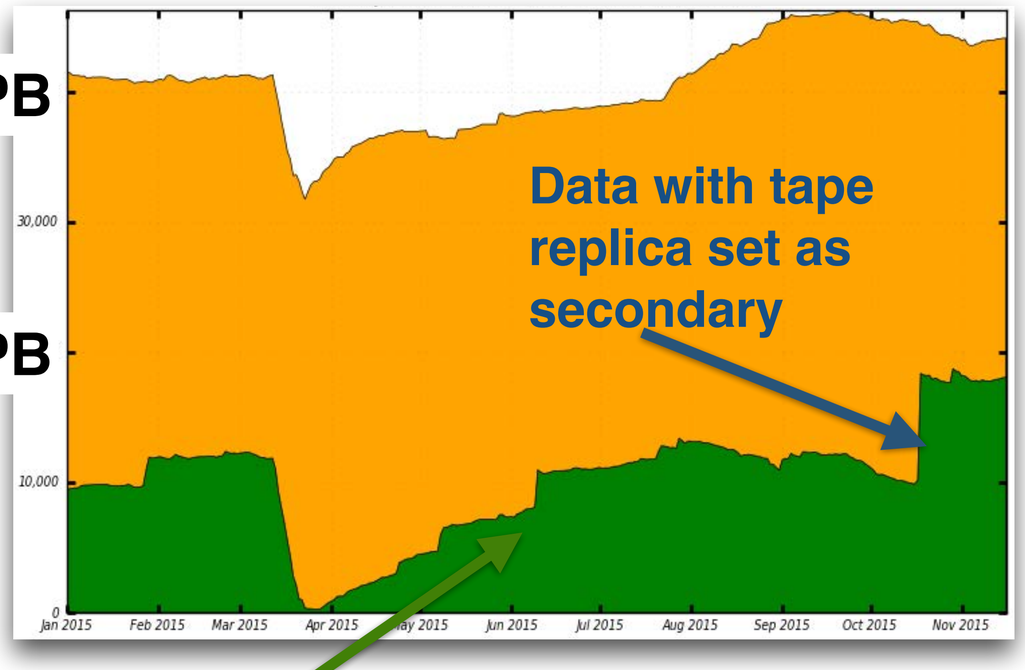
25PB



Tier 2s

40PB

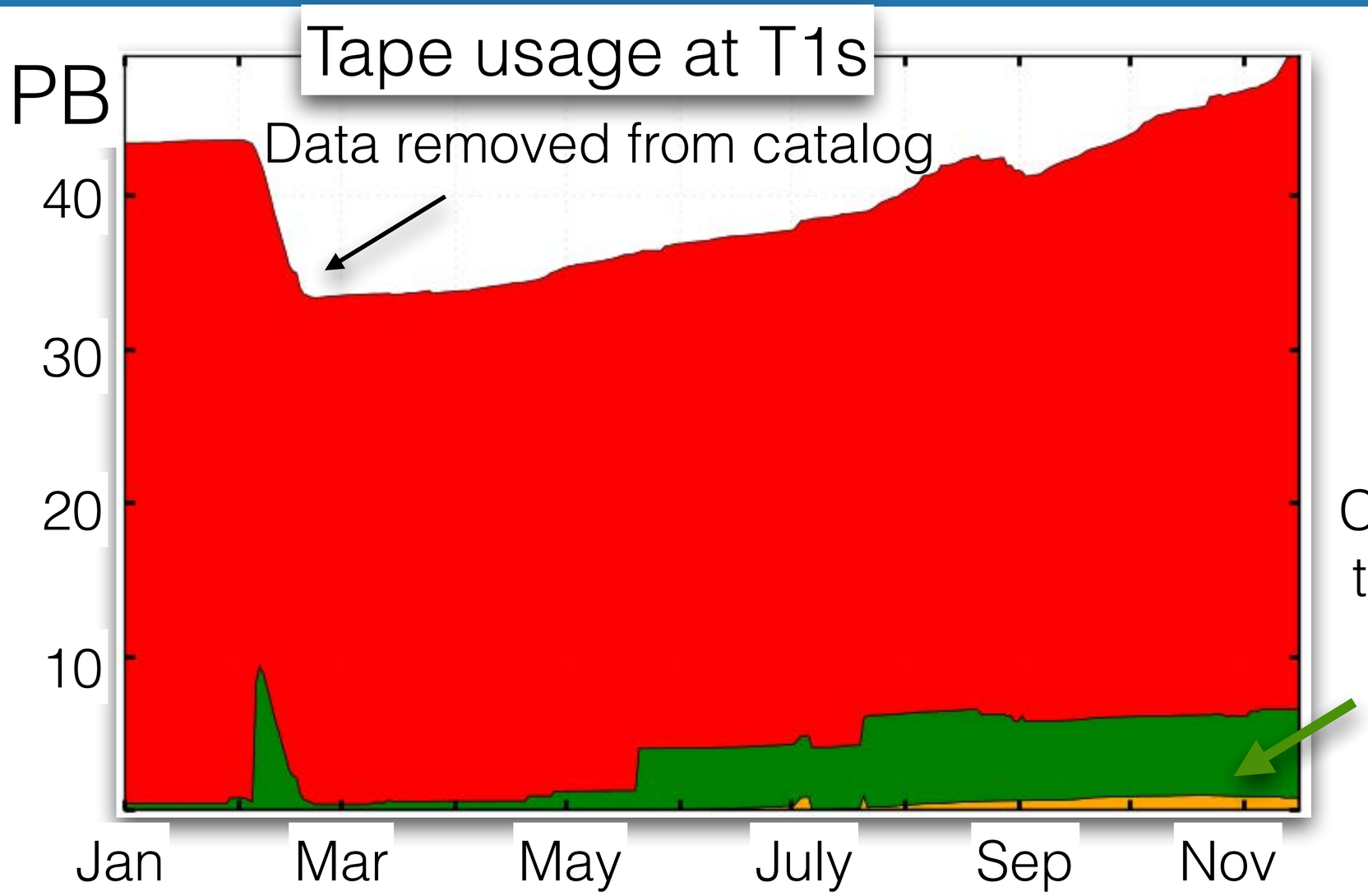
20PB



Data with tape replica set as secondary

Secondary copies = Buffers (can be deleted)

Tape usage : lifetime model in practice



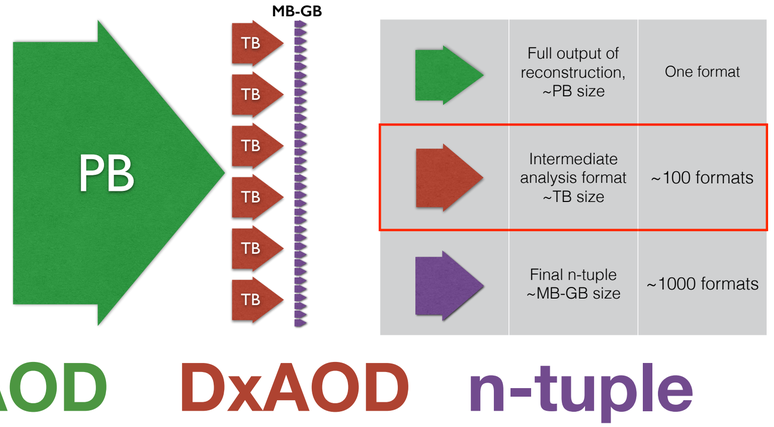
Deleted space recoverable at next tape repacking or next generation of device … months

Candidate data to be removed from catalog

Derivation Framework

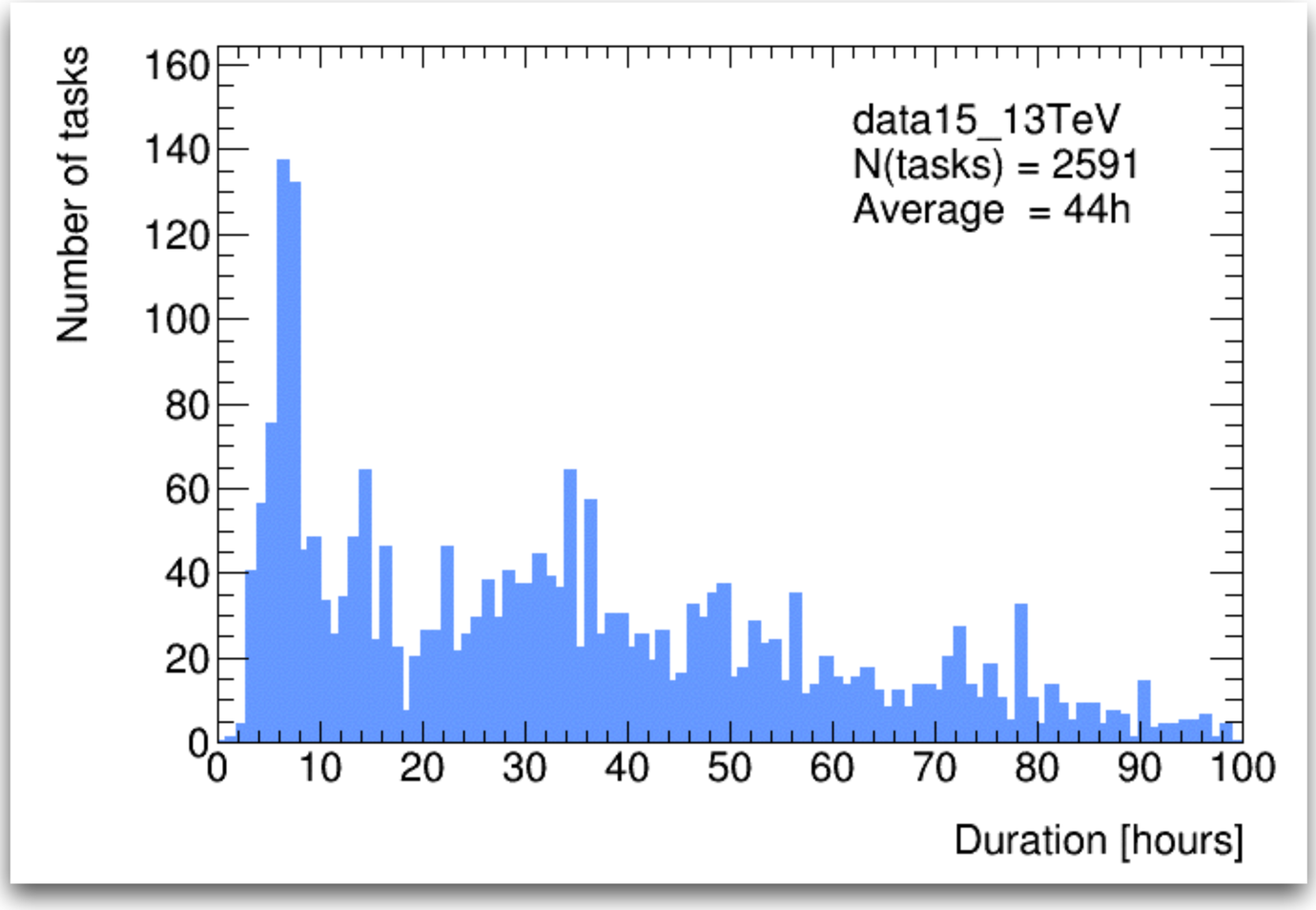
Derivation framework

- New analysis model for Run 2: group data format **DxAOD** made using a train model
- Production of 84 **DxAOD** species by 19 trains on the grid
  - 24h after data reconstruction at Tier-0
  - Working!
  - Vital for quick turn around and robustness of analyses
- 2015 ATLAS results based on **DxAODs**!



Train #	Data stream	Carriages
1	physics	EGAM1,EGAM2,EGAM3,EGAM4
2	physics	EXOT0,EXOT1,EXOT5,EXOT6,E
3	physics	EXOT2
4	physics	EXOT3,JETM1,JETM8,JETM9
5	physics	EXOT4,EXOT7,EXOT11,EXOT1
6	physics	EXOT16
7	physics	FTAG1,FTAG2,FTAG3,FTAG4
8	physics	HIGG1D1,HIGG1D2,HIGG2D1,H
9	physics	HIGG2D4,HIGG5D1,HIGG5D2,H
10	physics	HIGG4D1,HIGG4D2,HIGG4D3,H
11	physics	JETM2,JETM3,JETM4,JETM6,JE
12	ZeroBias	JETM5
13	physics	MUON0,MUON1,MUON2,MUON3
14	physics	STDM2,STDM3,STDM4,STDM5
15	physics	SUSY1,SUSY4,SUSY5,SUSY9,S
16	physics	SUSY2,SUSY3,SUSY6,SUSY7,S
17	physics	TAUP1,TAUP3
18	physics	TCAL1

Task durations for data derivations

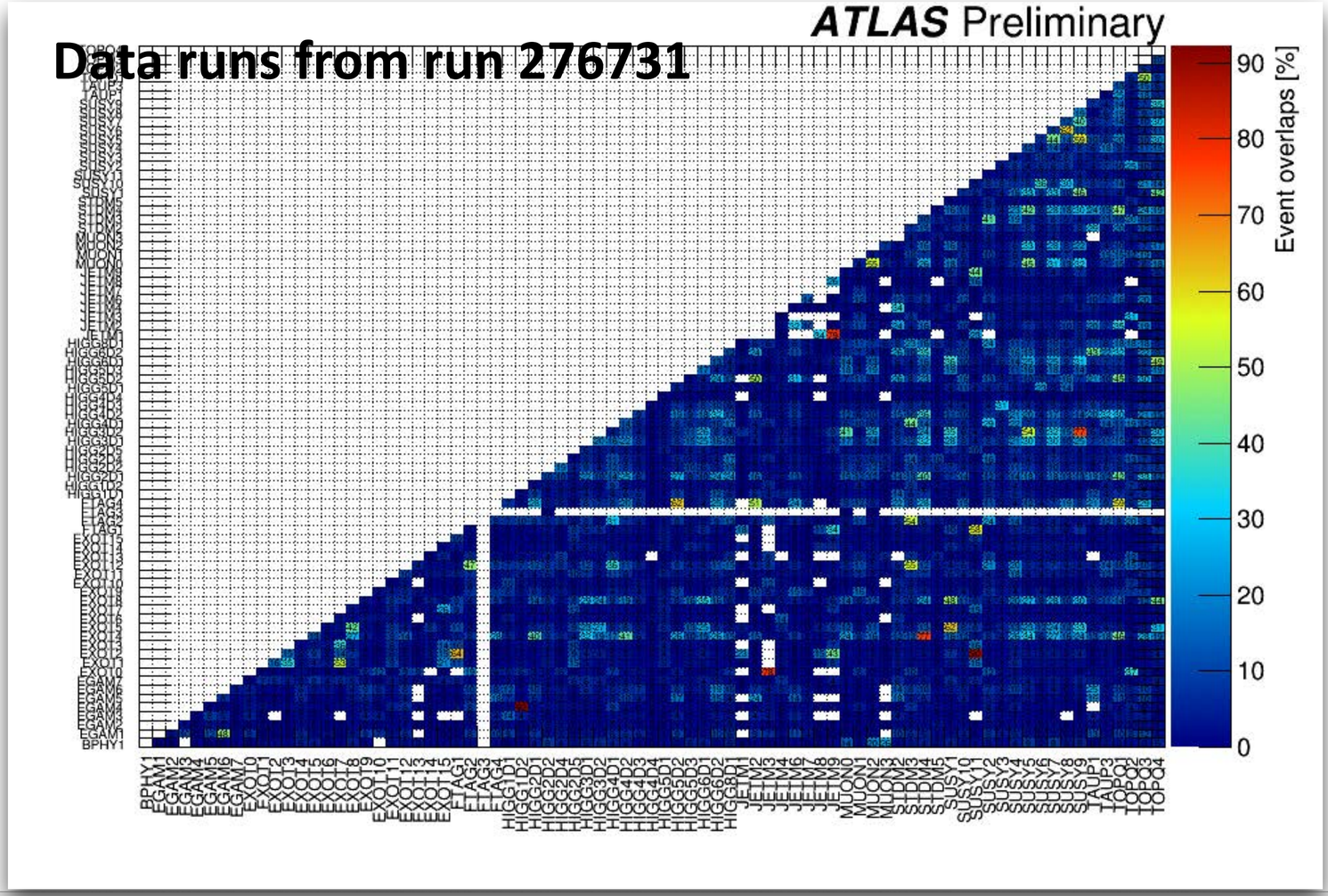


- 48h calibration loop after end of run
- 36-48h for Tier-0 reconstruction
- 3-4h for Tier-0 AOD merging

40% of the tasks complete after 24h
70% of the tasks complete after 48h
~6 days turnaround after end of run

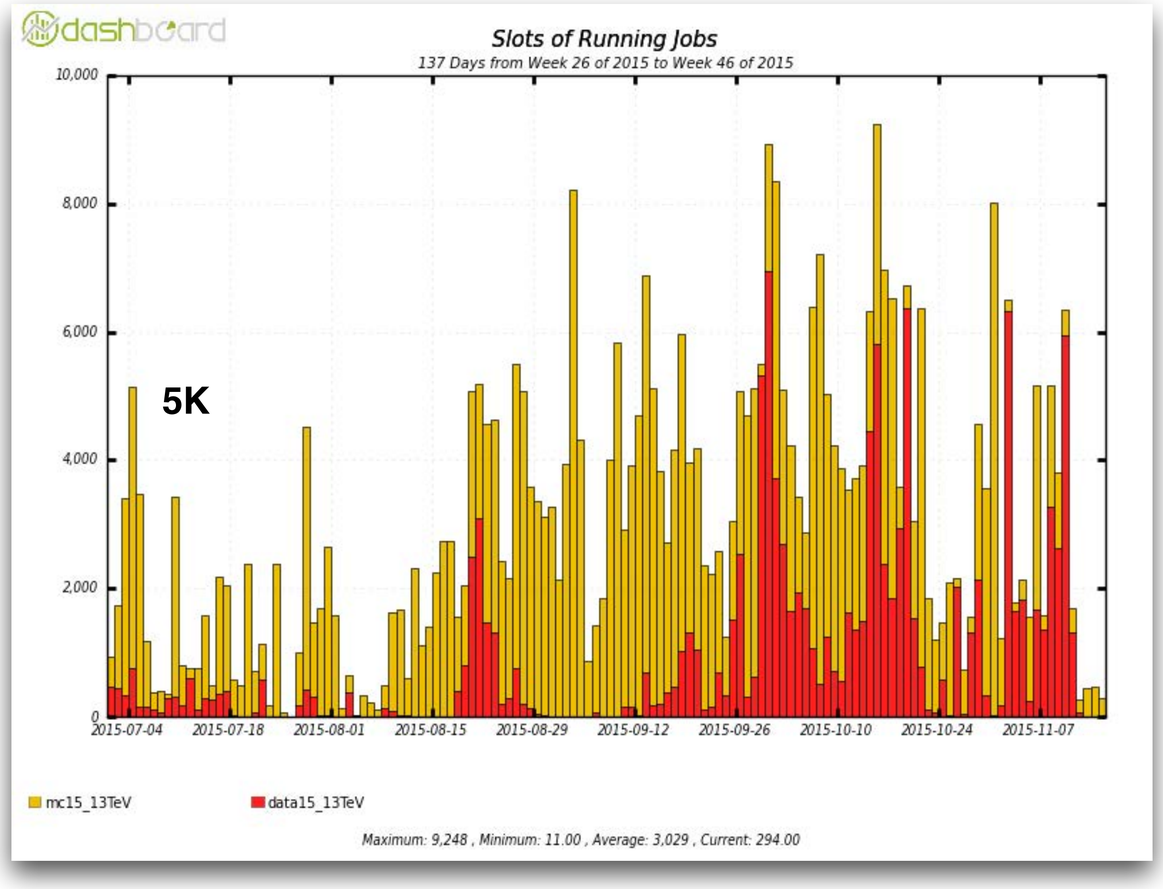
Event Overlaps in Derivations

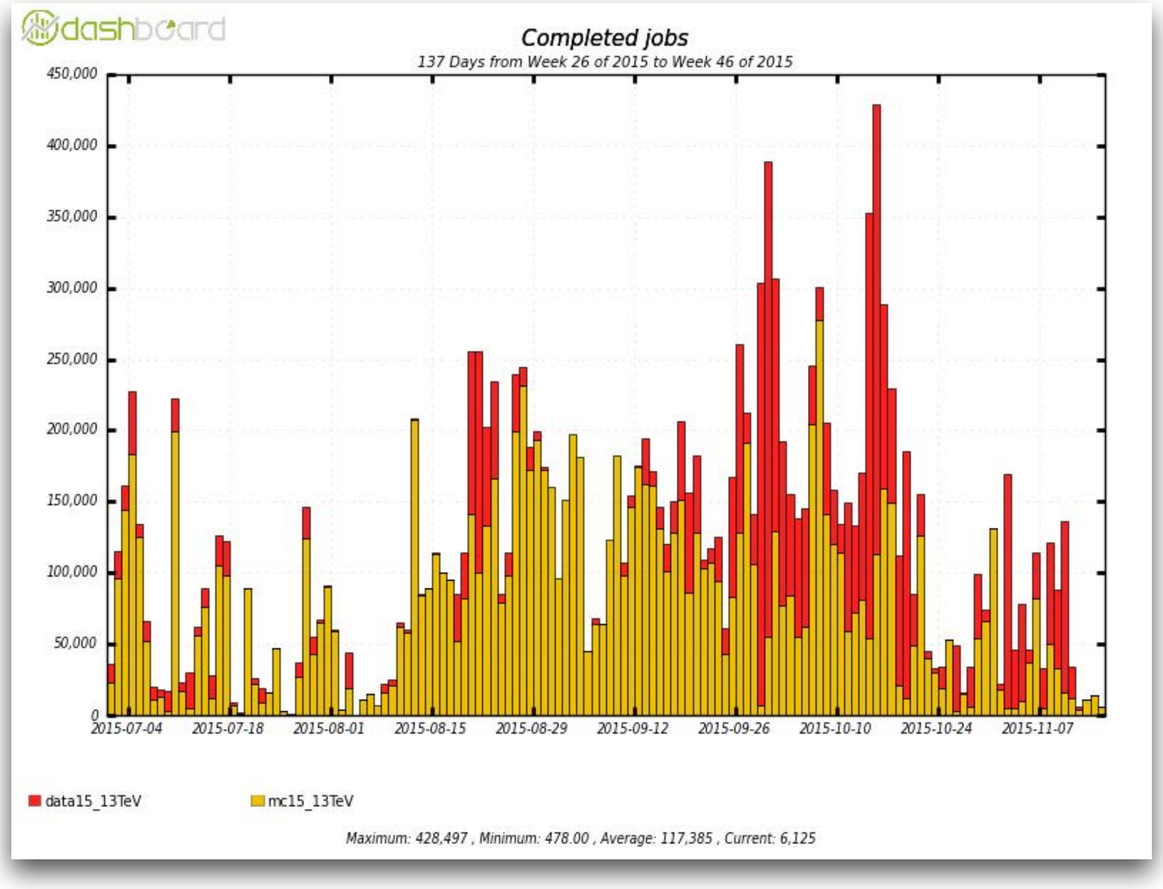
No derivations overlapping > 70% so no need on merging of any derivations



Derivation framework load on the grid

16M finished jobs

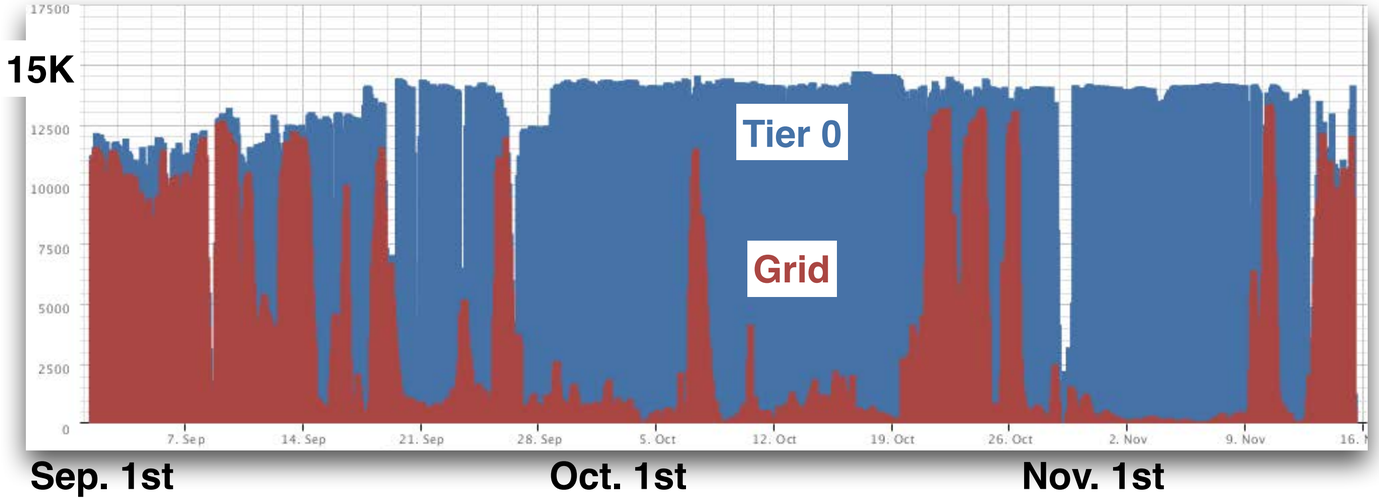




Tier 0

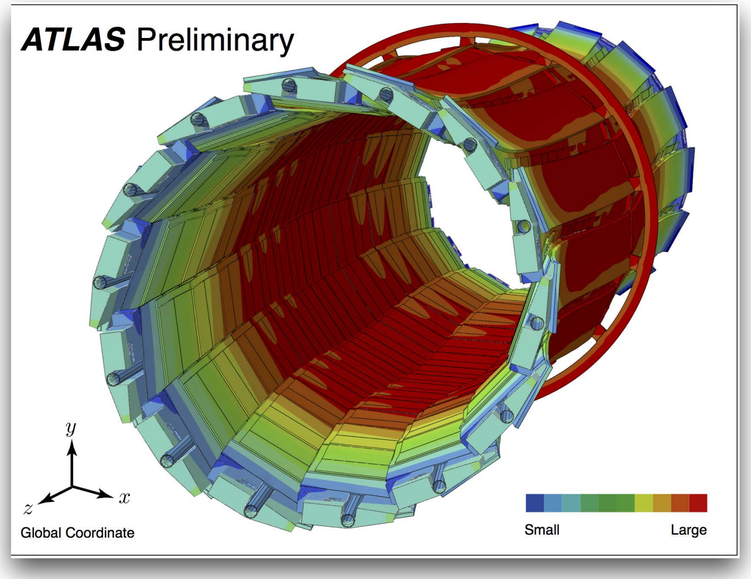
Activity at the Tier 0

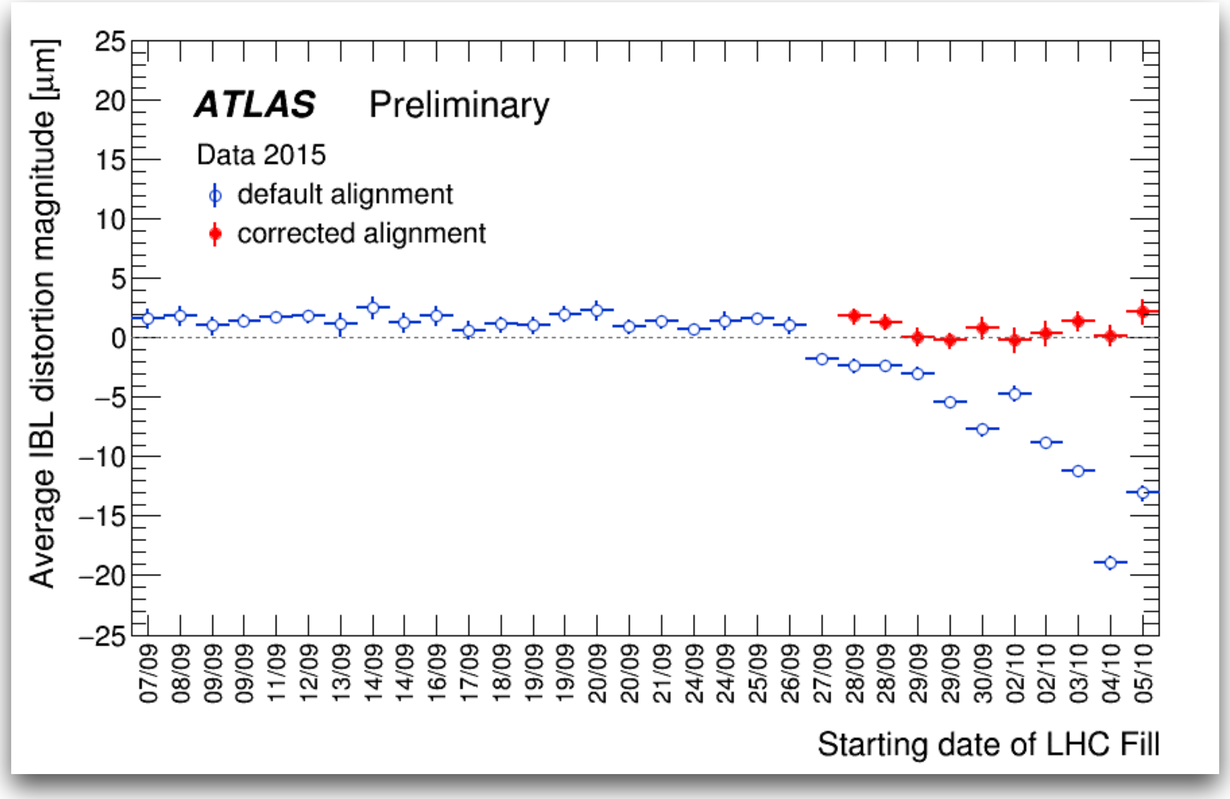
- Tier 0 farm used for grid processing when no data processing activity
- Tier 0 ressources saturating end of 2015 pp period for high LHC luminosity/efficiency
  - Backlog of reconstruction jobs
- 2016 Tier 0 resources :
  - Increase by ~10%, might not be enough
  - ATLAS share : 30% CERN Tier 0
  - Investigating ATLAS needs for 2016.



More workloads on Tier 0

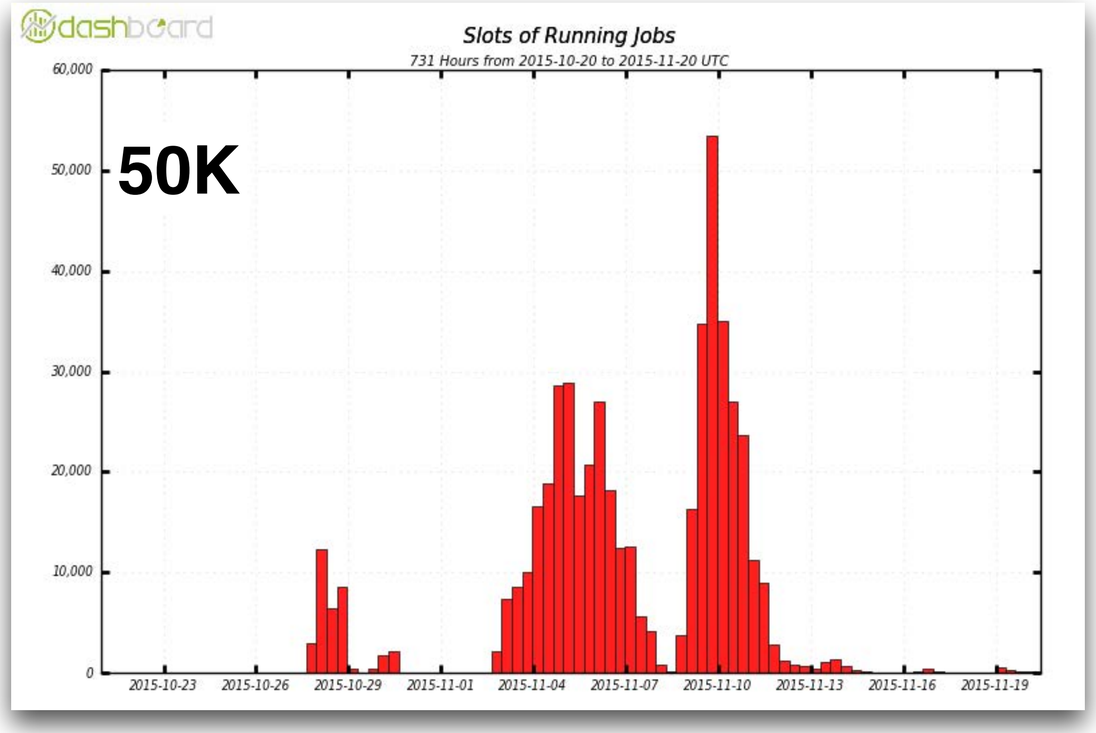
- Fill / Fill alignment of tracking devices on Tier 0
- Distorsion of IBL because of an increase of the power consumption of the IBL modules, which is correlated with the increasing integrated luminosity per LHC fill





Tier 0 spill-over to Tier 1s

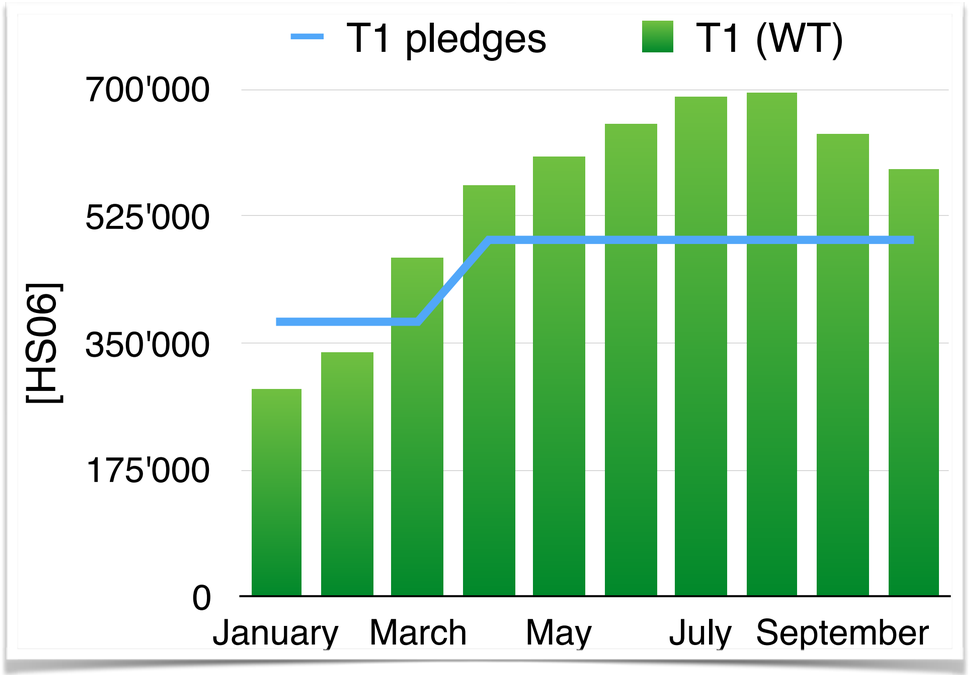
- Bulk reconstruction on Tier 1s has been experienced and validated
  - Technically challenging (delays, Data Quality run at Tier 0, other activities at Tier 1s, …)
- Might be used in case of Tier 0 saturation during 2015 Heavy Ion run
- Not foreseen as standard procedure for 2016 data taking

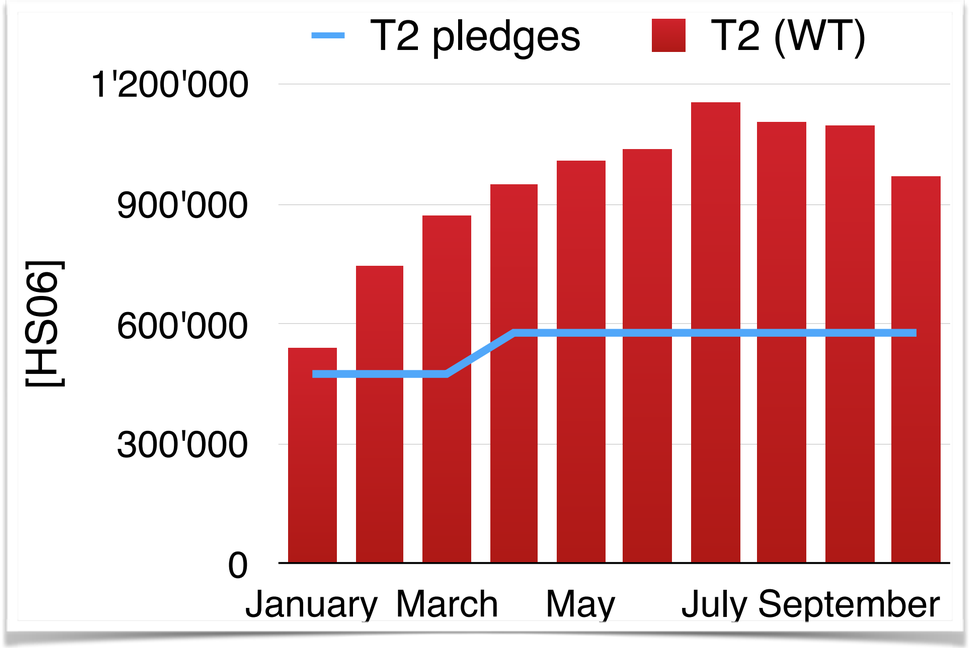


CPU utilisation

CPU usage

Consumption continues to be above pledges at T1s and T2s

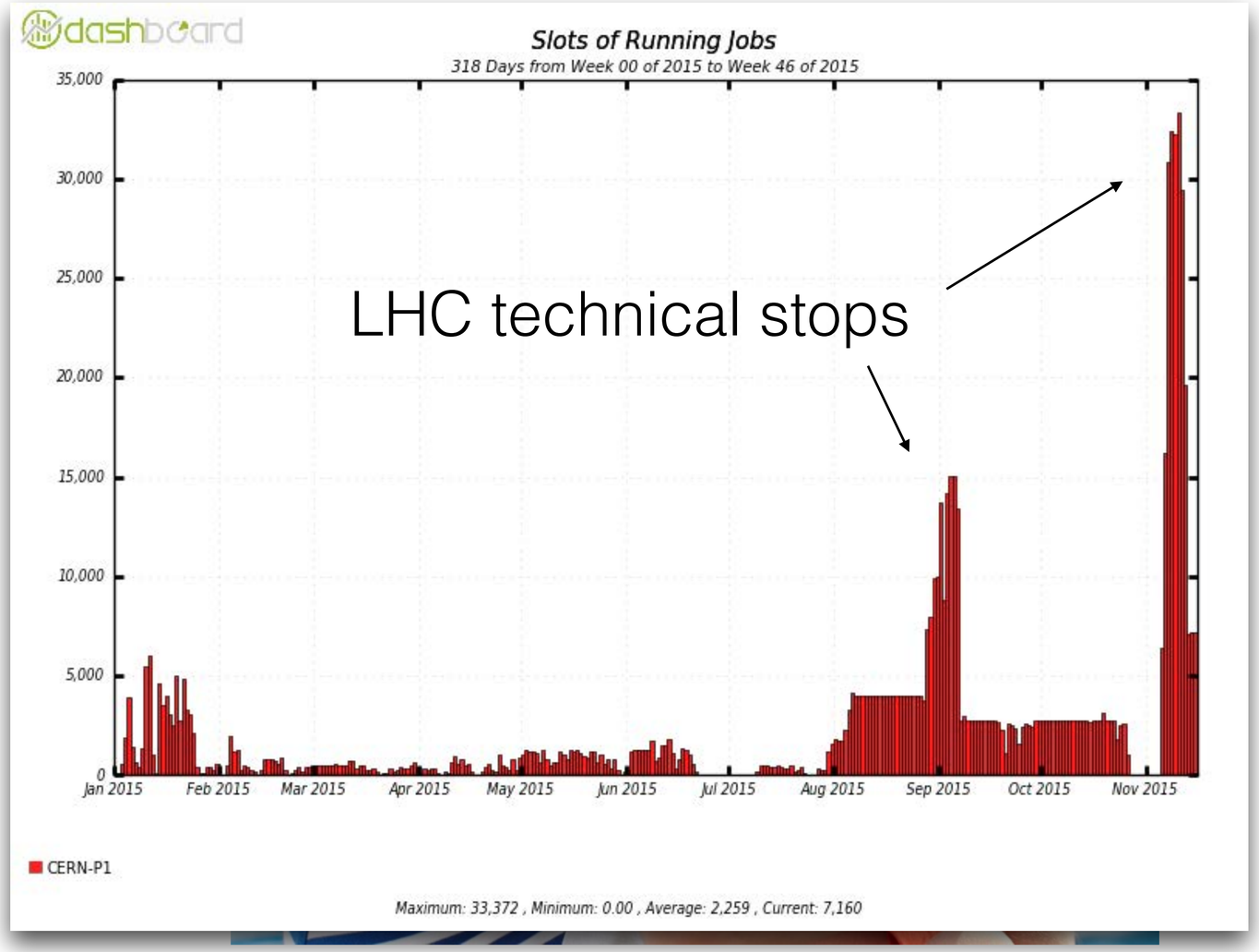




Non Tier 1 & Tier 2 sites : ~7% extra CPU

Usage of HLT farm

- Used during LHC technical stops in second part of 2015
- Might be used in 2016 during machine development periods or unscheduled LHC stops if no data taking ongoing



Past & future events

Past events

- ATLAS software long term planning document
  - In circulation within ATLAS since July 2015
  - A reference document for evolutions in ATLAS software & computing
- Software workshop in Berkeley (mid. November)
  - ~50 people from ATLAS, CMS, LHCb, ROOT, …
  - Foundation of **AthenaMT** the Athena Multi-Threaded framework based on GaudiHive

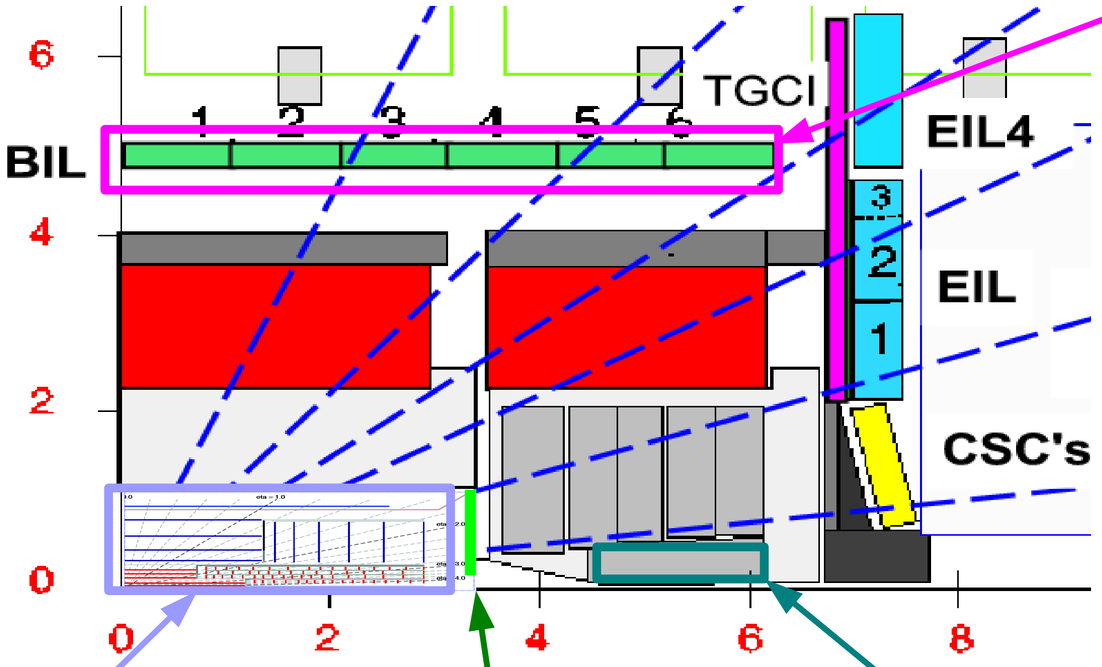
Coming events

- ADC workshop in Sitges (Dec. 2-4)
- Yearly jamboree with WLCG sites supporting ATLAS (Jan. 27-29)

Coming activities

Major ATLAS upgrades for Run 4

Upcoming Major Design Decisions



Possible addition of RPC/sMDTs in inner muon barrel
- *decision not driven by further physics studies*

Most decisions scheduled for first half of 2016

Layout of ITk including possible extension up to η~4

Possible addition of high-precision timing detector

Possible replacement of FCal with sFCal

© B. Petersen

Major ATLAS upgrades for Run 4

Upcoming Major Design Decisions

3

	Q1	Q2	Q3	Q4
2016	ITK Layout TDAQ IDR	sFCAL dec. Muon BI dec. Muon IDR	LAr IDR Tile IDR	Strip TDR
2017		Muon TDR	LAr TDR Tile TDR	Pixel TDR TDAQ TDR

Many CPU intensive studies to be performed in the next 2 years!

Layout of ITk including possible extension up to η~4

Possible addition of high-precision timing detector

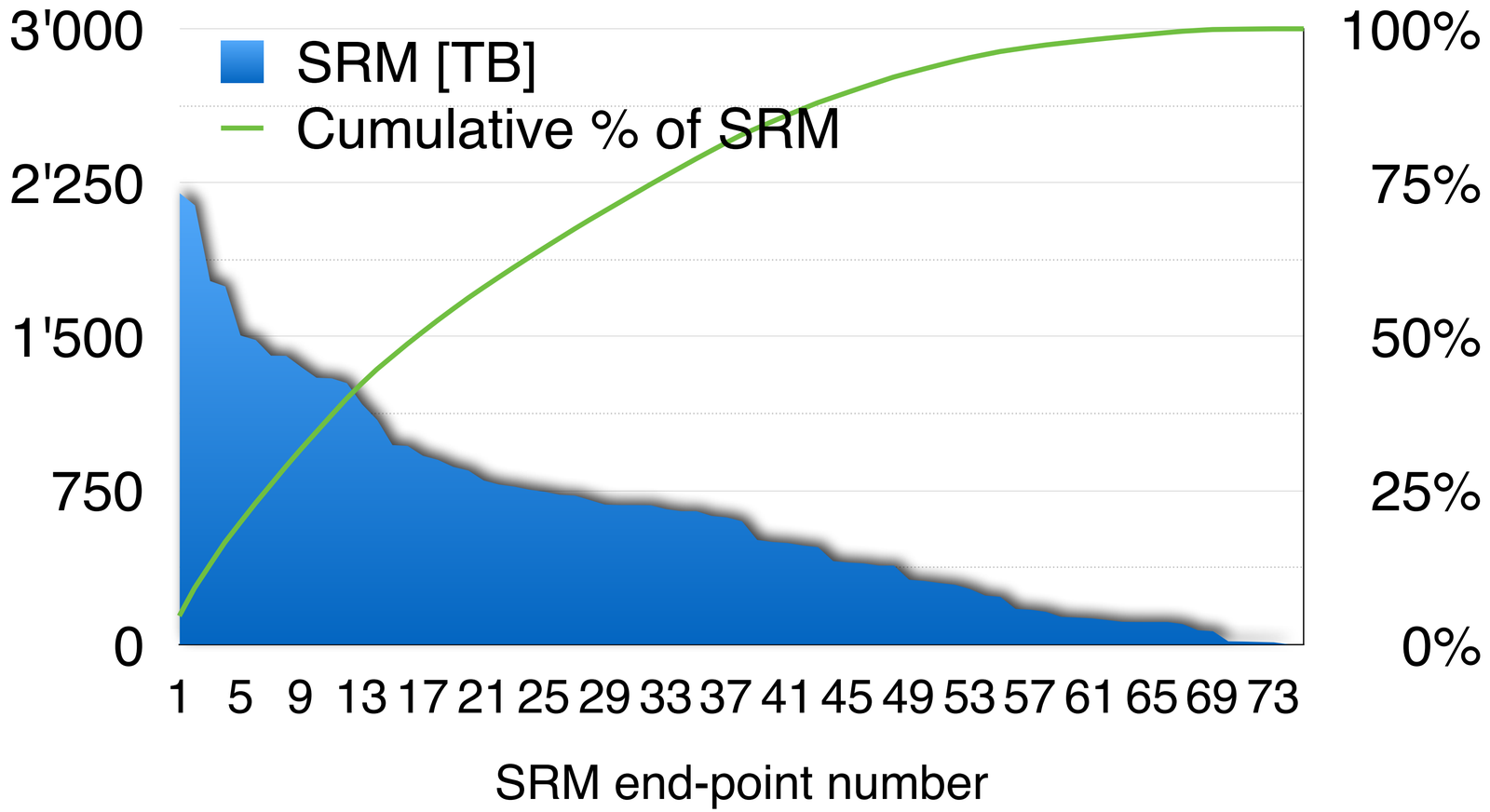
Possible replacement of FCal with sFCal

2017 request will be reevaluated for March 2016 RRB

Possible evolutions of computing model

(Too) many storage and computing end-points

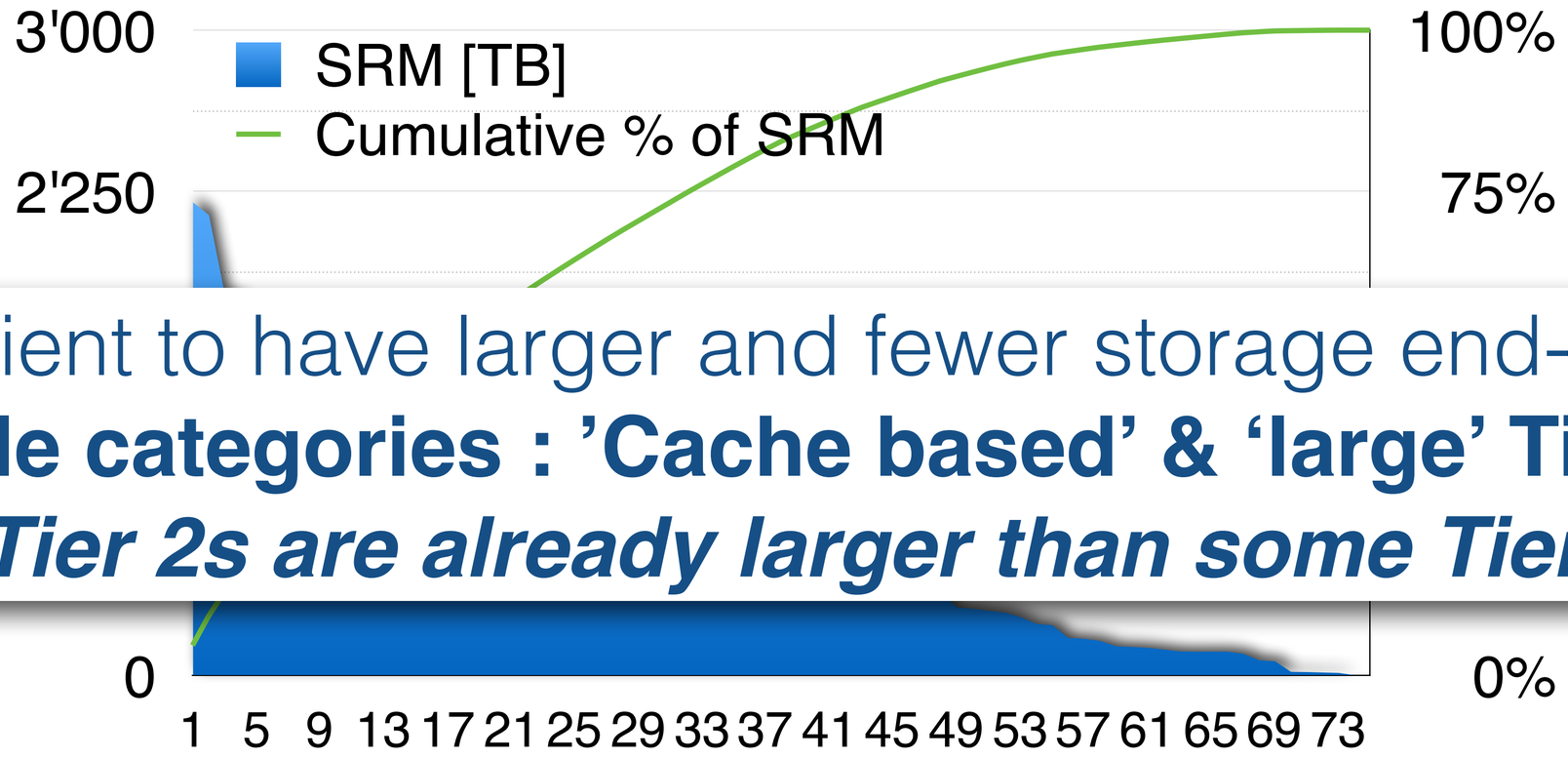
Available storage at Tier 2 sites



75% of Tier 2 available storage in ~30 sites

Large disparity in size of Tier 2s

Available storage at Tier 2 sites



More efficient to have larger and fewer storage end-points

2 possible categories : 'Cache based' & 'large' Tier 2s

Some Tier 2s are already larger than some Tier 1s

75% of Tier 2 available storage in ~30 sites

Large disparity in size of Tier 2s

Possible storage evolution

- Sizeable (TBD) regional centres
  - True federations
  - One storage entry point by centre
  - National & trans-national regional centres to match the scale
  - Technical solution to be worked out within WLCG
- Cache based (TBD) sites for those not part of a regional center

Possible Topological evolutions (Beg. Run3 timescale)

- Data centres typology
  - Several T1s seen as one
  - T1 + nearby T2s
  - Aggregation of several T2s
- CPUs :
  - use of cloud technology
  - Network ! + remote access
  - ‘Cache based’ T2s : limited buffering storage for CPU based sites
- Storage : concentration
  - Data centres & distributed storages
  - Fewer end points (both for T1s & T2s)

Summary

- 2015 data have been processed, distributed and analysed without major issue !!!
- Software for Run 3 and beyond under development
- Evolution of grid sites typology / topology within WLCG framework
- Sizeable computing resources will be needed for TDRs for ATLAS upgrades