# Software, Computing, Databases

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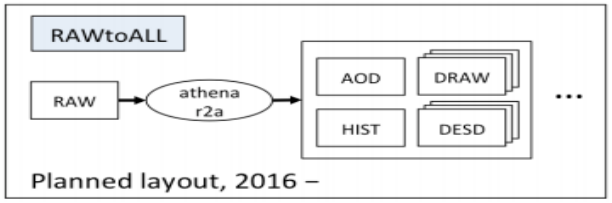
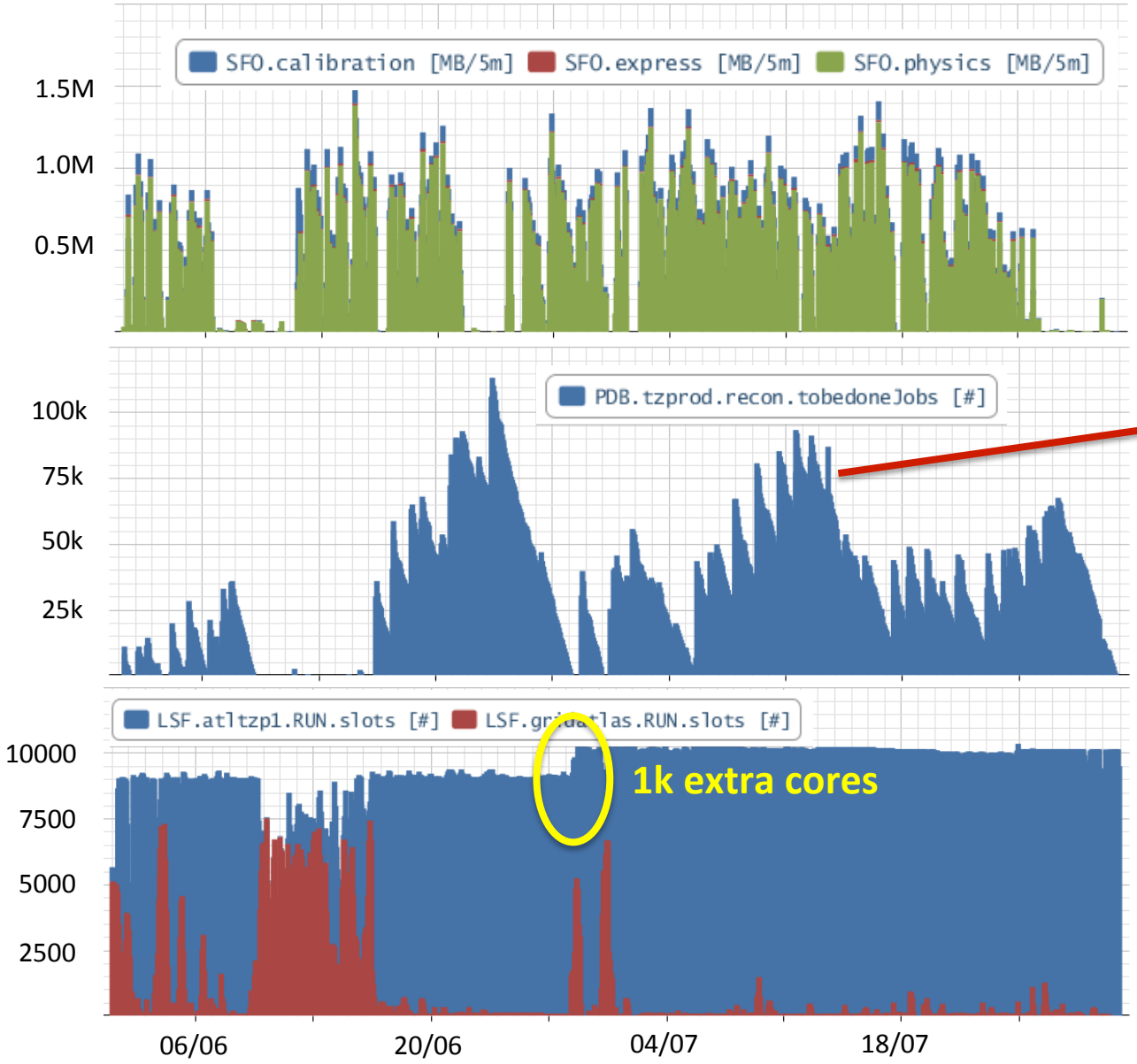
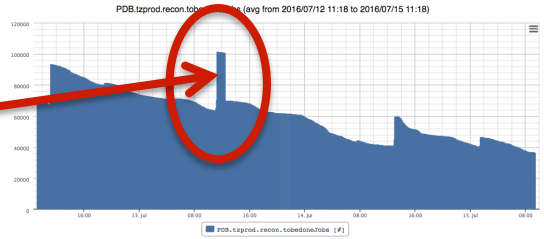
# 2016 data: Tier-0 performance

- Major improvements in T0 throughput commissioned in 2016
  - Tuning and configuration of dedicated T0 hardware for ATLAS use case
  - Lightweight metadata handling and I/O improvements
  - RAWtoALL workflow




| | 2015 (mu =14) | 2016 (mu=14) | 2016 RAWtoALL (mu=14) | 2016 (mu=33) | 2016 RAWtoALL (mu=33) |
|---|---|---|---|---|---|
| Athena Release | 20.1 | 20.7 | 20.7 | 20.7 | 20.7 |
| Avg PSS - no MP (GB) | 3.2 | 3.6 | 4.9 | 3.2 | 3.9 |
| CPU/Wall time efficiency | 49% | 91% | 93% | 95% | 98% |
| Wall-Clock Time (s) | 39.0 | 11.5 | 7.5 | 19 | 17.7 |
| Wall-Clock Time (HS06s) | 323 | 184 | 120 | 304 | 283 |



**RAW Recording**

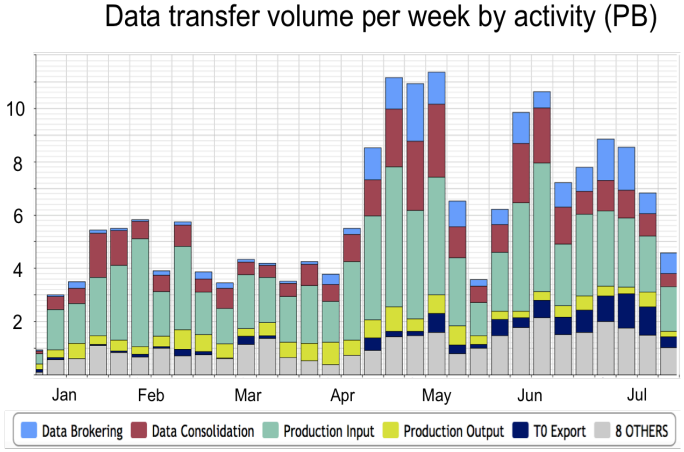
**Tier-0 Processing Backlog and Spillover**

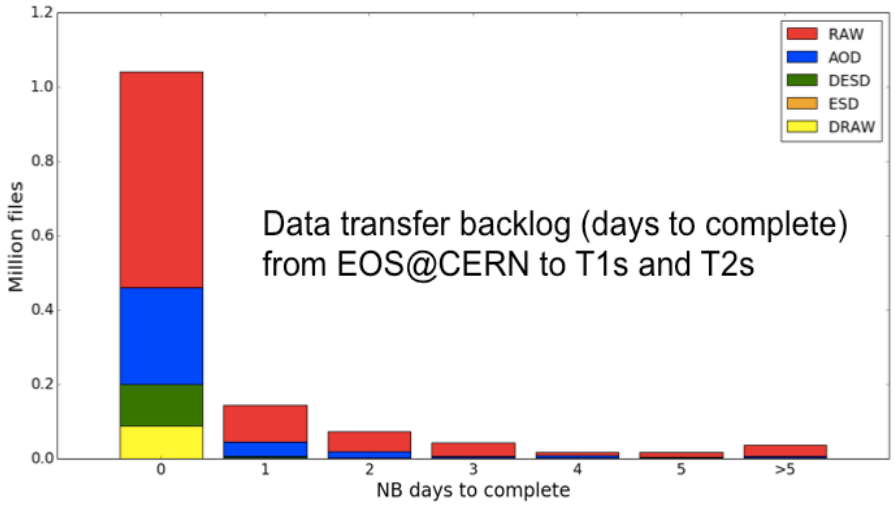
**Processing at Tier-0 Grid jobs backfill rare available slots**

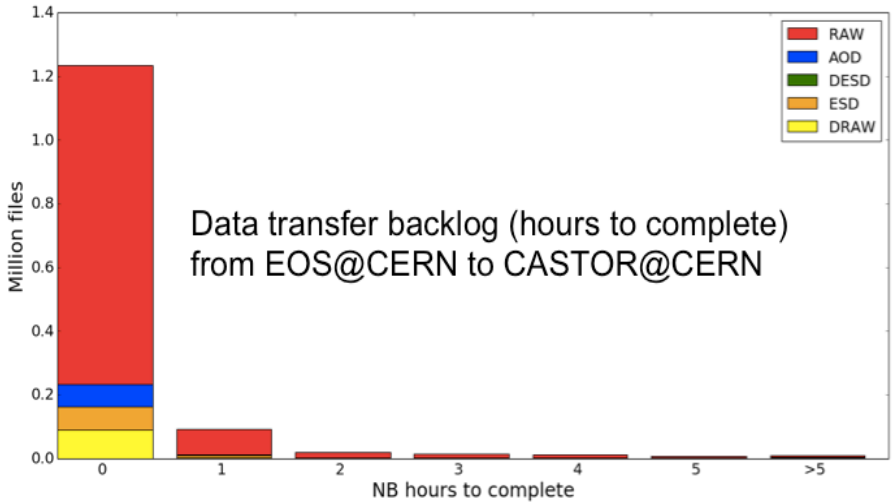
# Data Handling

**The ATLAS data management systems performed above expectations: e.g. > 10PB of data transferred/ day worldwide**

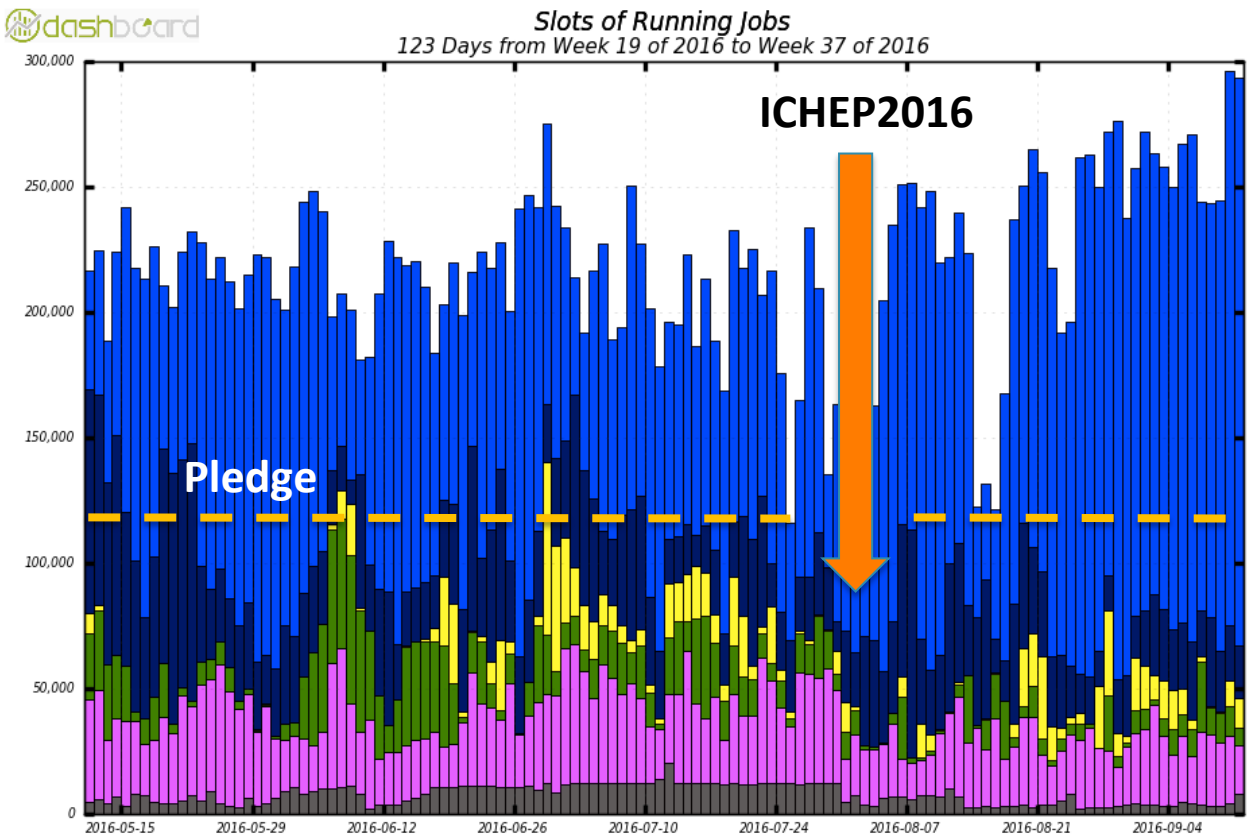
**CERN storage facility worked very well. T0 to Grid traffic generally fine, but with some hotspot e.g. CERN to RAL link. 10Gb/s not sufficient**



# Distributed processing: data and MC




Many partial data reprocessing

Analysis trains

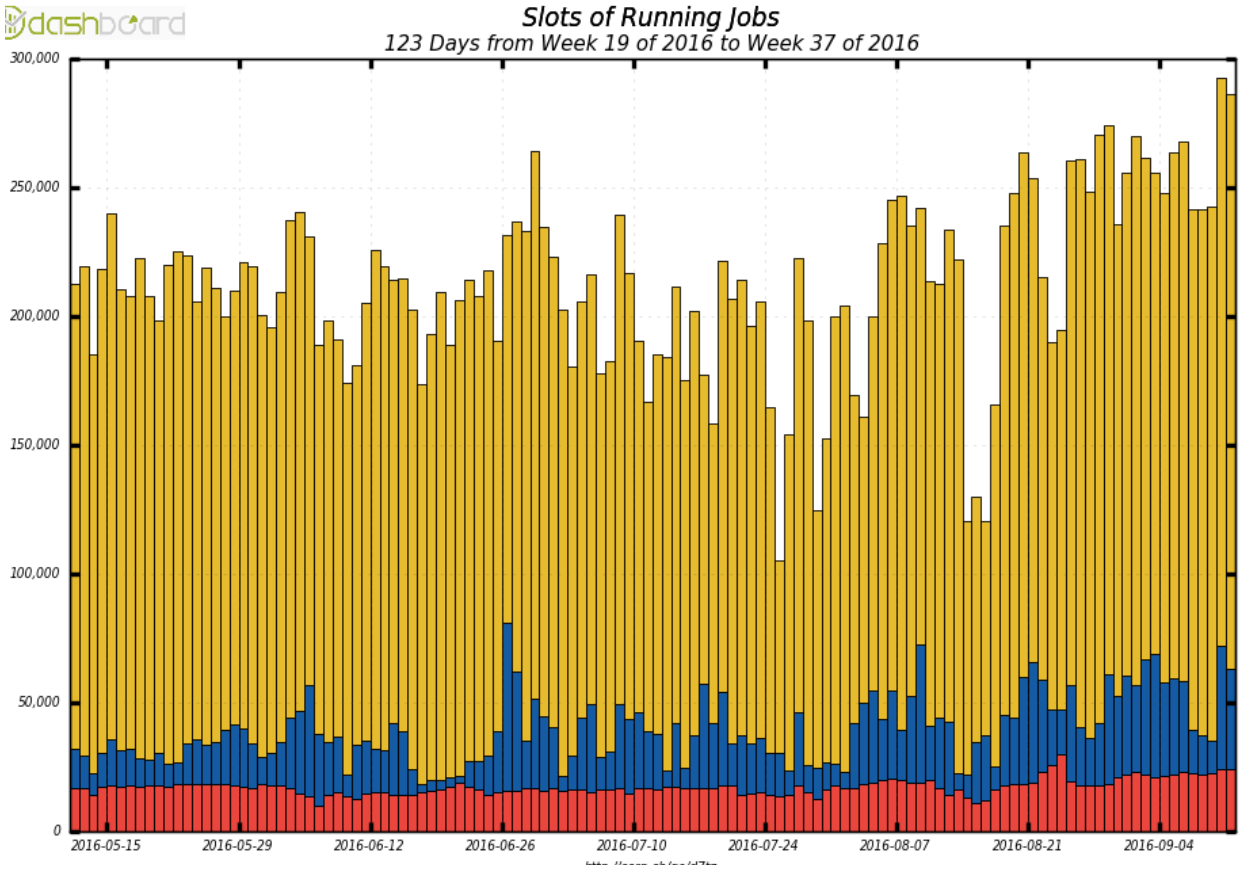
MC reconstruction

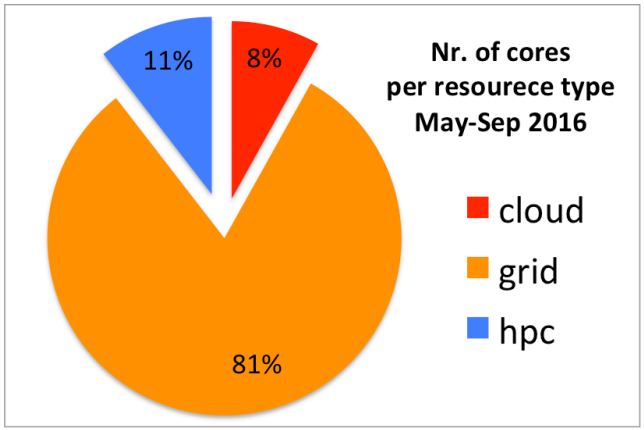
MC simulation and event generation

User Analysis

**We fully use all our pledge resources all the time**
**We try to leverage any extra resource available to us**

# Heterogeneous Resources




**20% of data processing happens today on non grid resources**

**Integration of non Grid resources in ATLAS is a big investment with a big return**

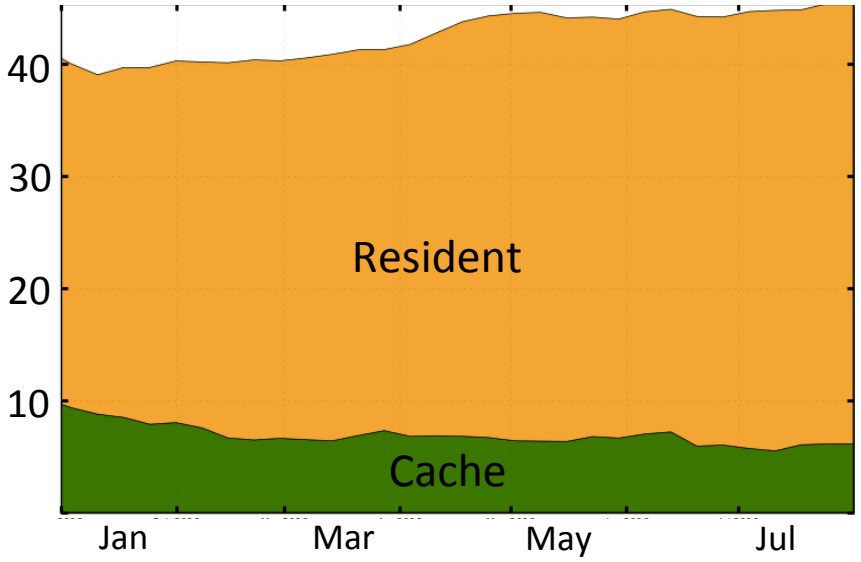
**Automation is the key**

# Distributed Data Management

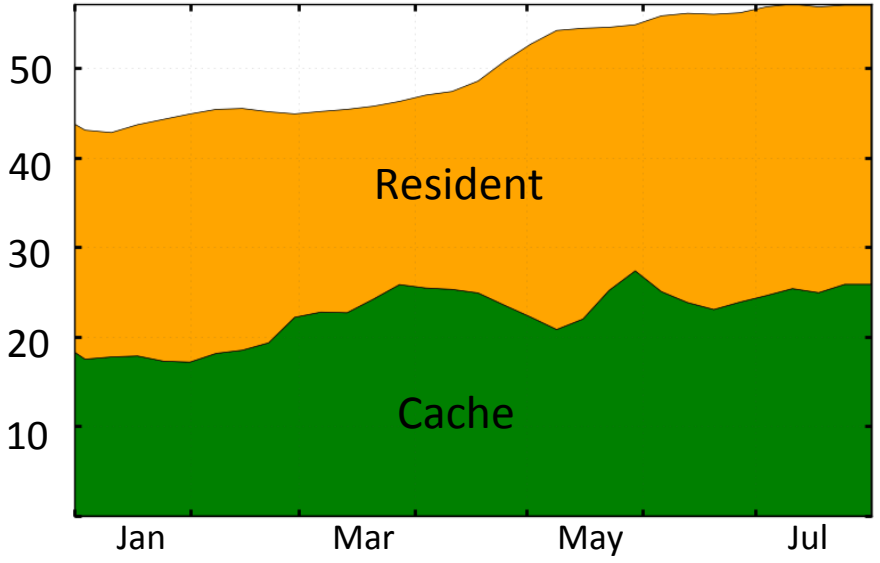
**Distributed Computing evolved the data processing and data management model flattening the Tier structure between T1s and T2s.**

**Data caching and dynamic management allow to fully exploit T1 and T2 storage**

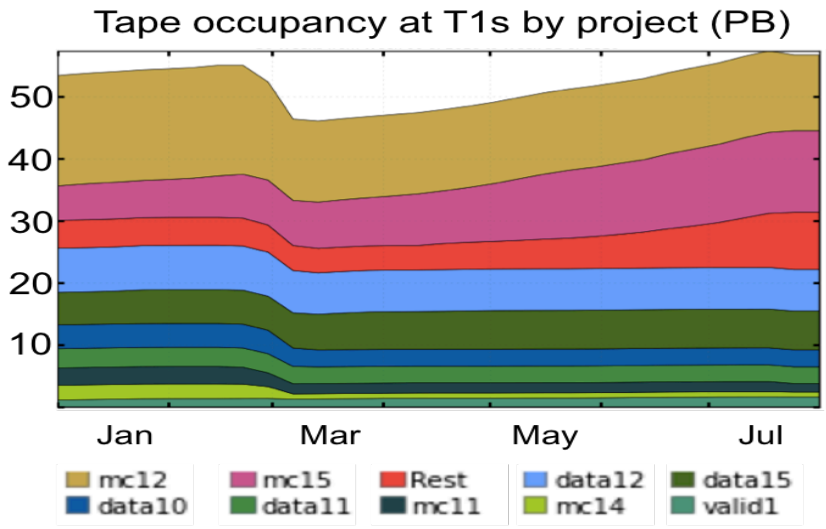
Resident vs Cache data at T1s (PB)

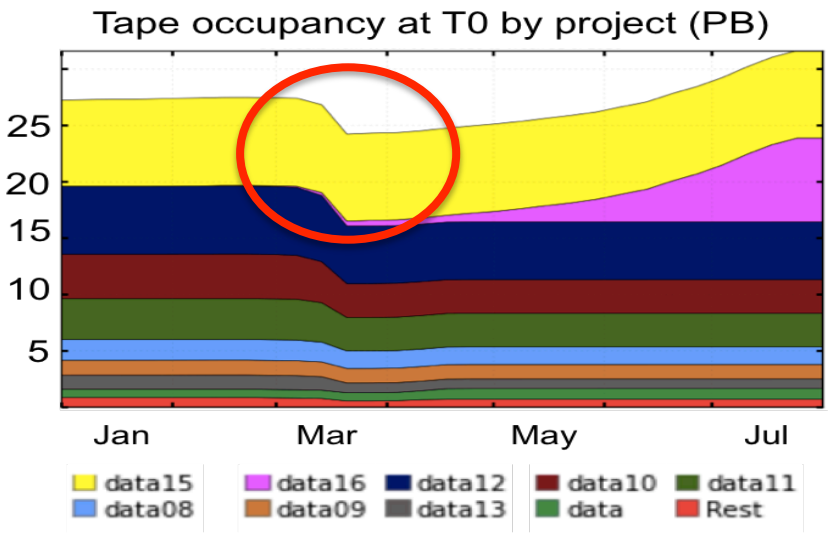



Resident vs Cache data at T2s (PB)



# Lifetime Model




**Lifetime Model allows to reduce the unused (useless) data retained on disk AND TAPES**
**Tuning the lifetimes parameters buys some contingency for disk and tape.**
**Such contingency proved being crucial to handle the unexpected volume of data in 2016**

# Final remarks on the 2016 data taking

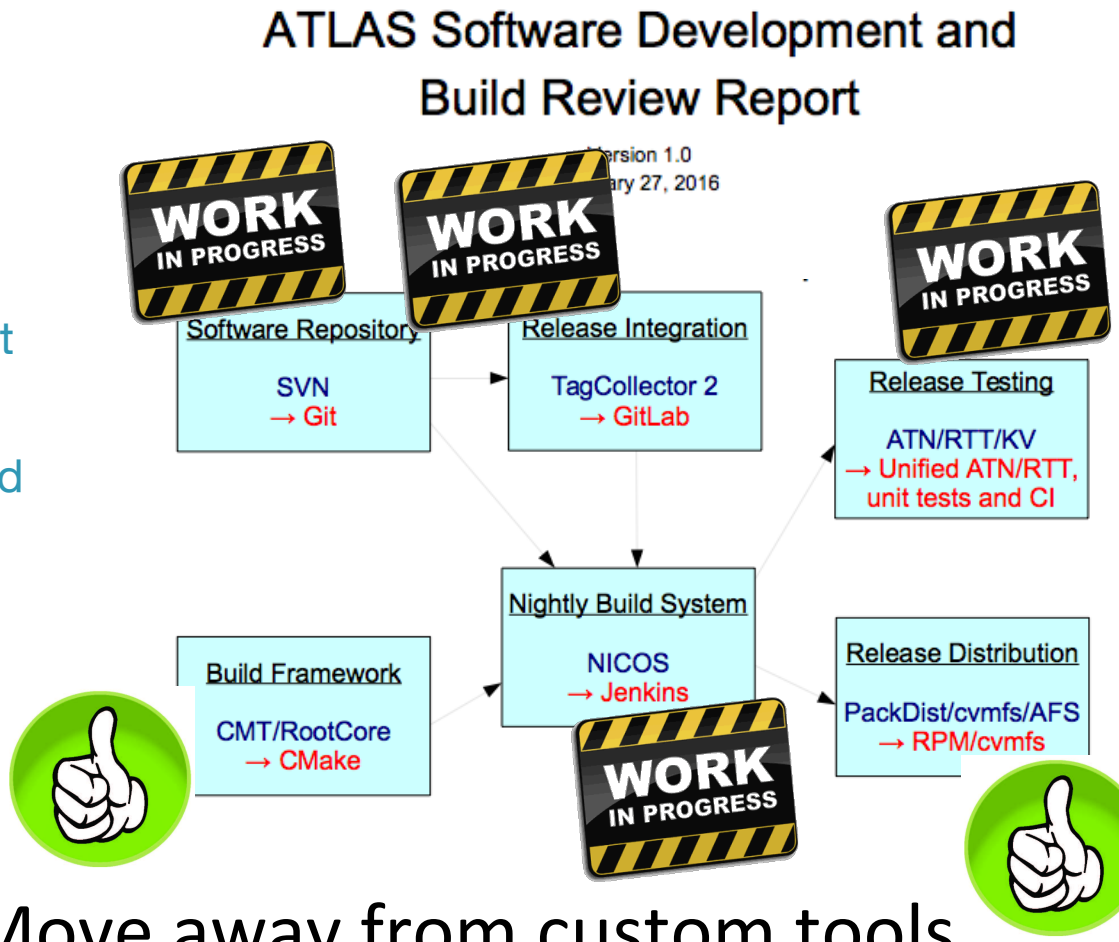
- Despite the unexpected volume of data, ATLAS computing delivered the requested samples (MC and data) to physicists for ICHEP 2016
- ICHEP analyses included data collected up to 2 weeks before the conference
  - calibration -> bulk processing -> data distribution -> analysis trains -> user analysis -> physics results
  - .. plus the approval process of the results, all in 14 days is a major success
- 70% of the presented results based on 2015+2016 data (15.2 $fb^{-1}$)
  - 45 conference notes on 2015+2016 data, 10 papers and 5 notes on 2015 or Run-1 data, 5 performance notes
- Some activities were postponed later in the year and freed up precious resources on the Grid. CERN plays a very central role, so we can be less flexible there: good that it worked very well and contingency was planned
- Non negligible cost in terms of manpower, sustainable only for a short period of time

# Offline Software

- Sherpa2.2 was validated for ATLAS event generation
  - A massive production campaign (> 1B events) started
- MC16 simulation under validation
  - Last major release for G4 of Run-2: major improvements in geometry, Geant4.10, multithreading
  - Will launch bulk simulation in 1 month
- R21 for reconstruction under validation
  - Plan to reconstruct MC16 Monte Carlo and 2015/2016 data in early 2017
  - Will be used at T0 in 2017 and for the rest of Run-2

# Software Infrastructure

- **Progressing with guidelines from the review last year**
  - C-Make migration: DONE (R21)
  - Preparatory work for Git migration was DONE. Actual migration planned in the next 6 to 12 months
  - Integration of Jenkins in Build System is ongoing




Move away from custom tools

# Software Infrastructure

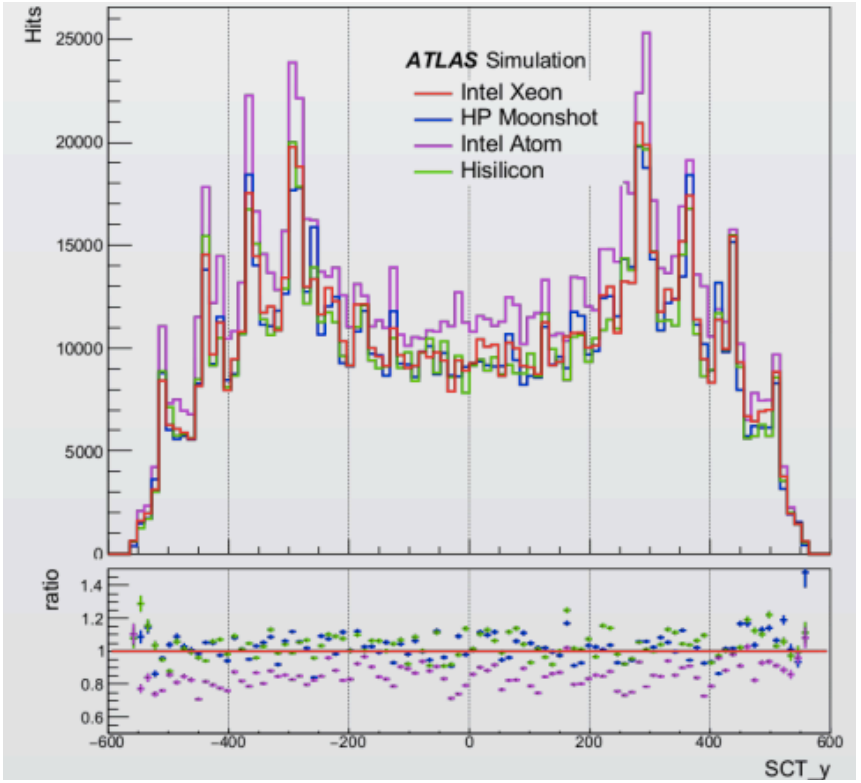
**The ATLAS simulation software was ported to ARM64 and validated for 2 different architectures**

**This is a subset of 350 packages needed to run ATLAS G4 simulation, streamlined for the purpose of simplifying the porting to different architectures. The full Athena release consists of 2500 packages**

**Performance measurements thanks to the CERN Openlab project**

⇒ with 1kWh on HiSilicon ARM64 machines we simulate 80 events; on a standard Xeon we simulate 40.

⇒ ARM64 is 1.6 times slower than Xeon



# Upgrade Phase-1 and Phase-2

- Two major software projects ongoing, targeting production in Run-3
  - Well advances multithreaded offline software AthenaMT. Continuous progress
  - New conditions database and service: a joint project with CMS, with the interest of LHCb and Belle-2. Recently started
- Computing resource estimates for HL-LHC driven by WLCG.
  - ATLAS major update will come with the Inner TracKer TDR: detector layout will dictate the reconstruction time.