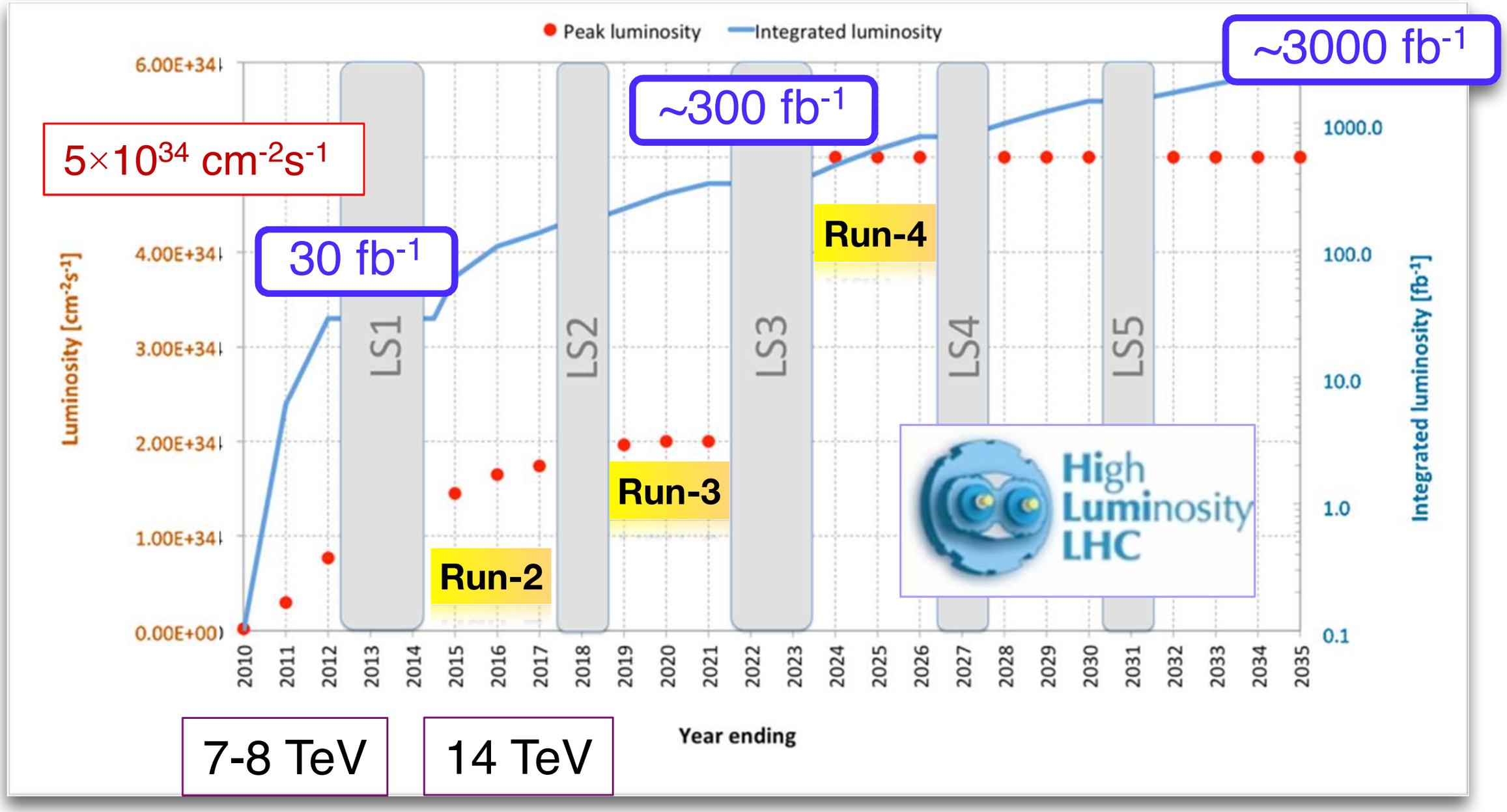
ATLAS computing model for Run2 and beyond

- The landscape
- Limitations of Current Model
- Responses to Run2 Challenges

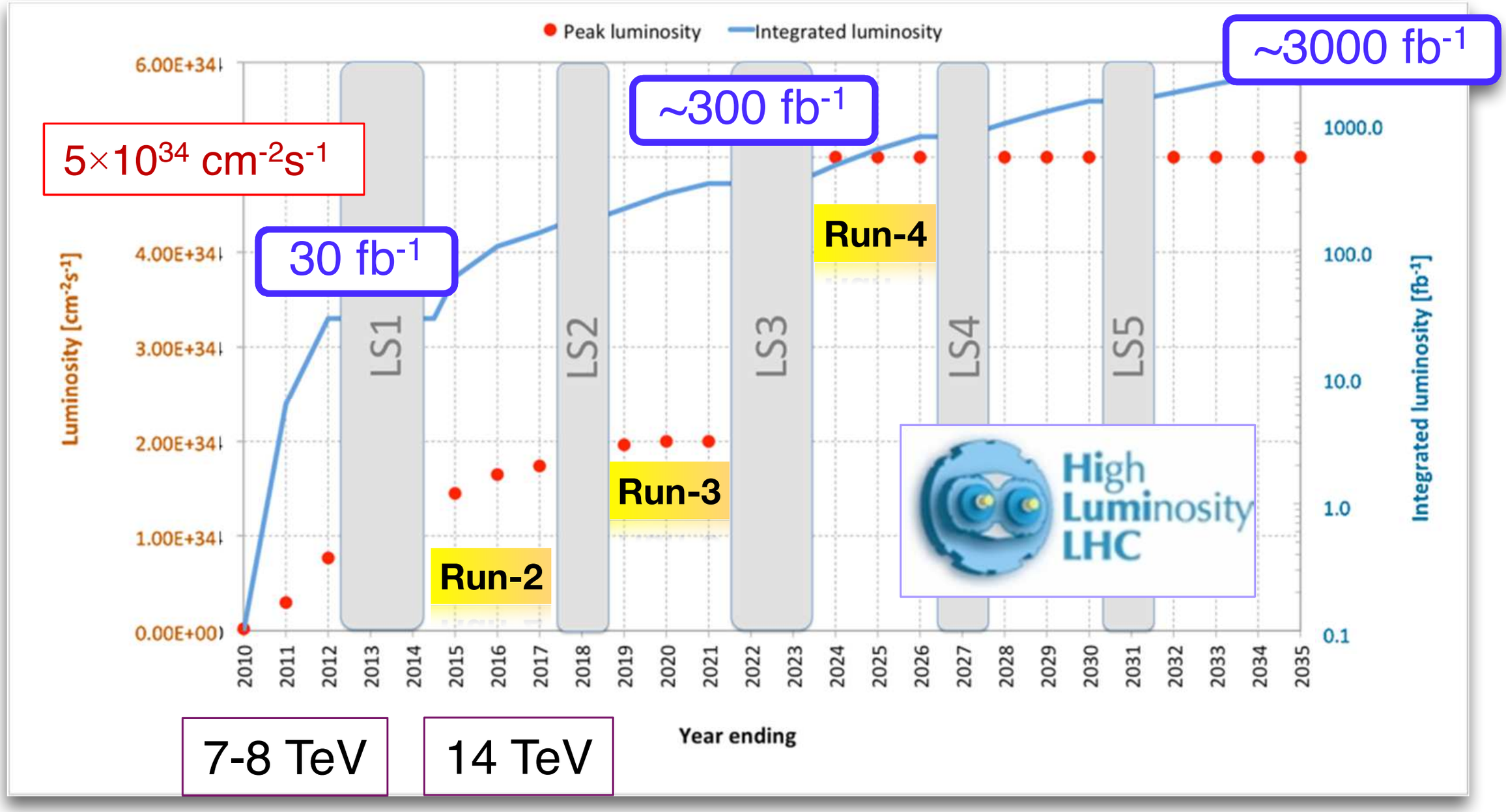
Eric Lançon on behalf of the ATLAS collaboration

LHC in the next years



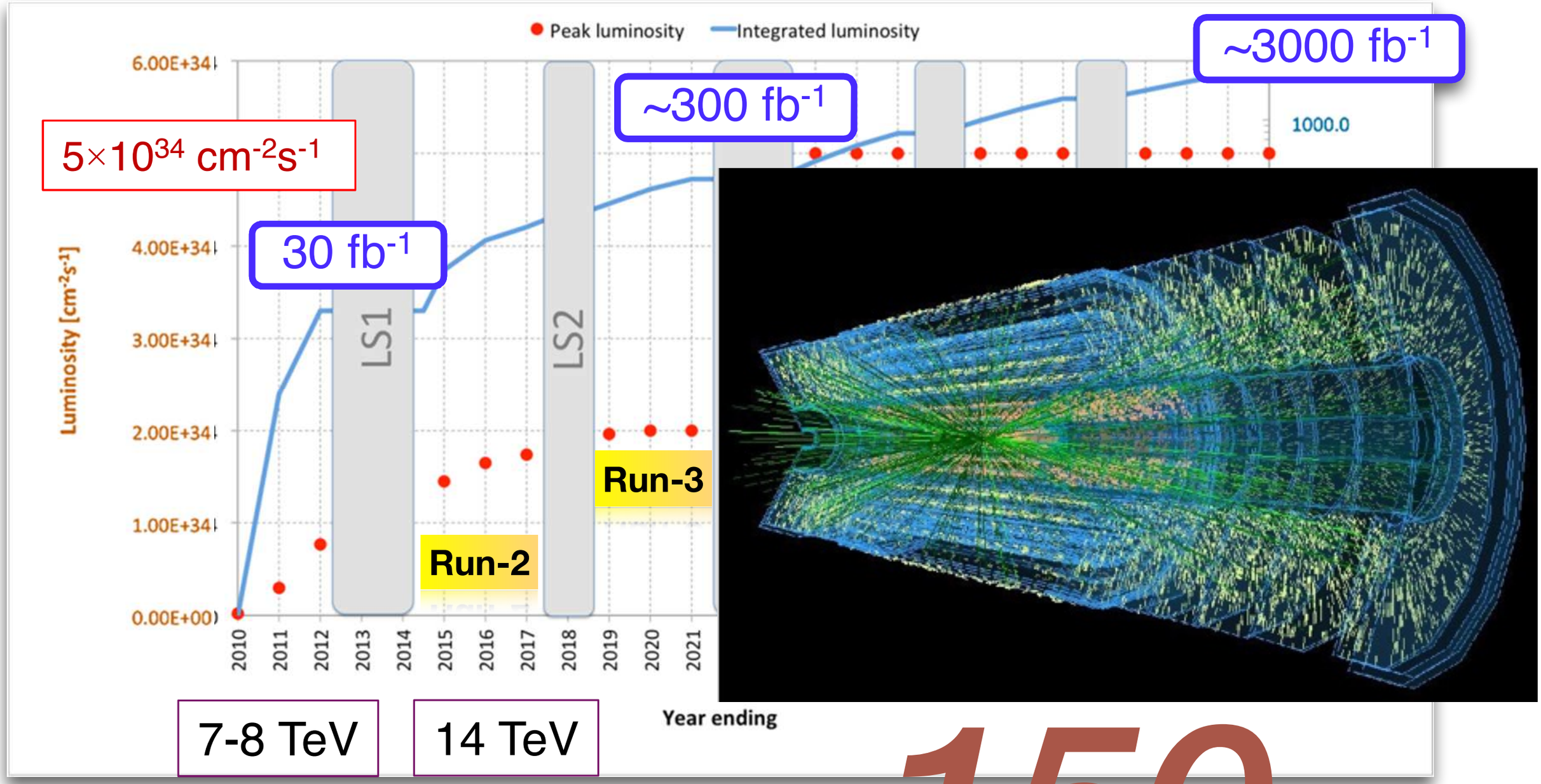
~25 *~40* *Pile-up*

LHC in the next years



~25 *~40 ~ 70* ***Pile-up***

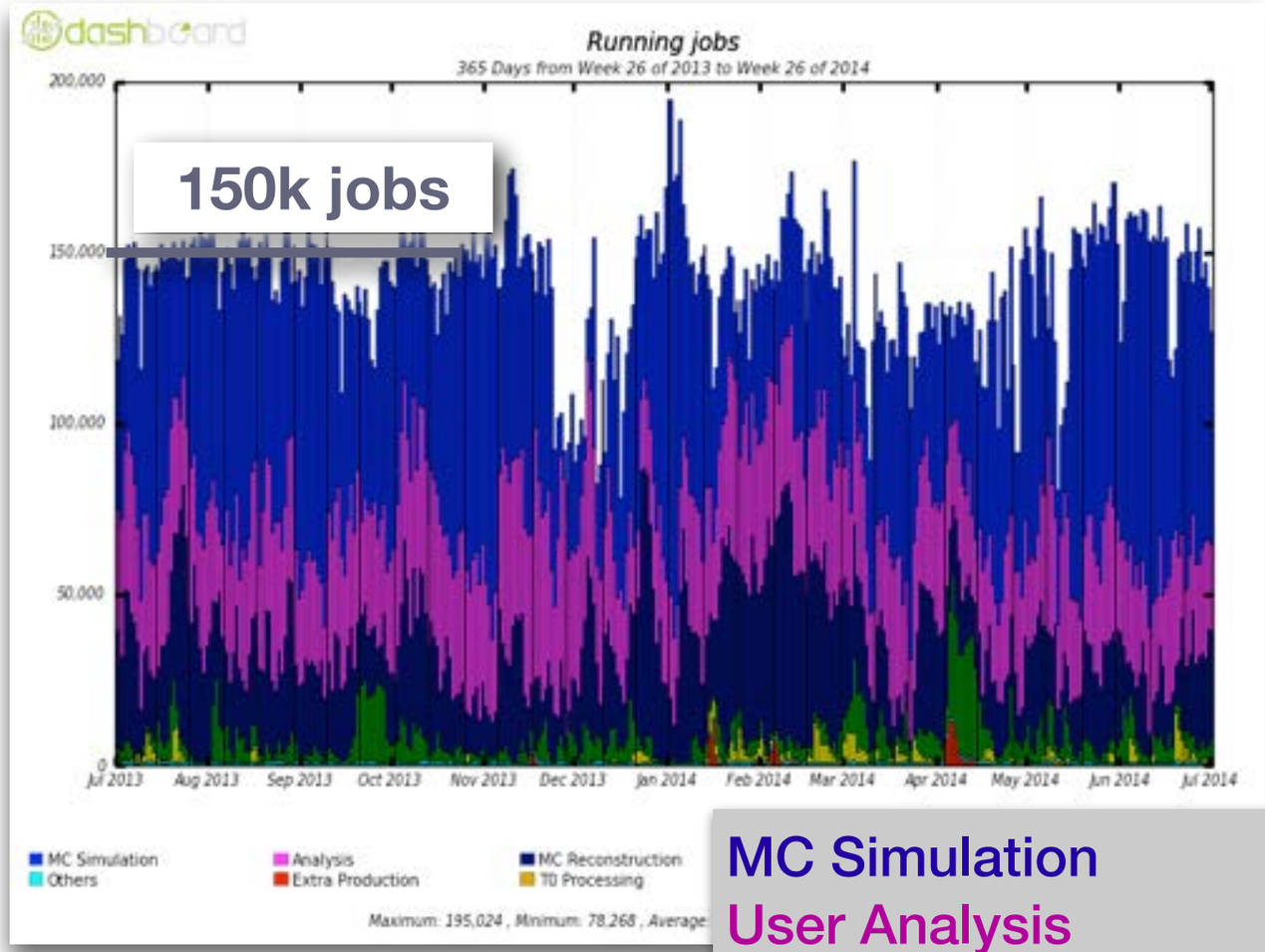
LHC in the next years



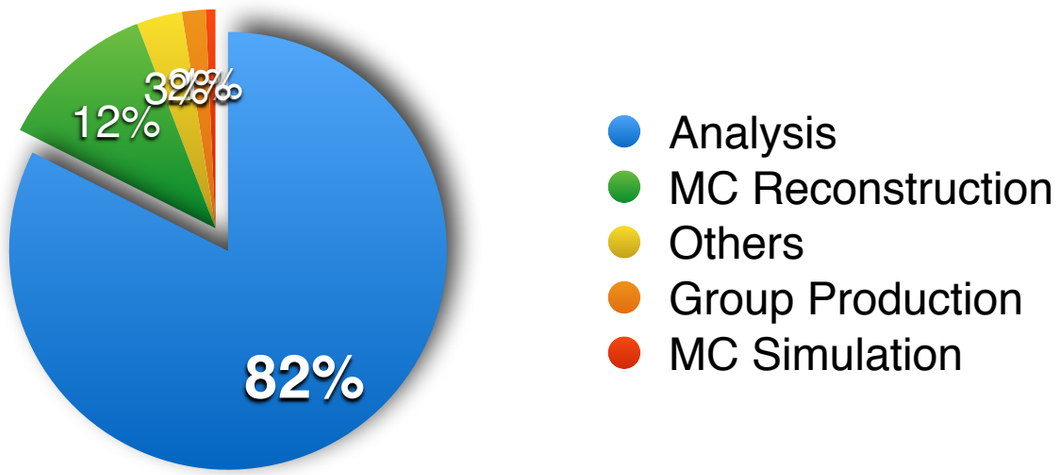
ATLAS Grid activity

- ~150K concurrent jobs running
- 350M jobs completed in 2013
  - Analysis: >50% of the jobs
- **1.2 EB** of data read-in by ATLAS grid jobs in 2013
  - 82% by analysis jobs
- **Analysis** is the main driver of storage & network I/O capacity

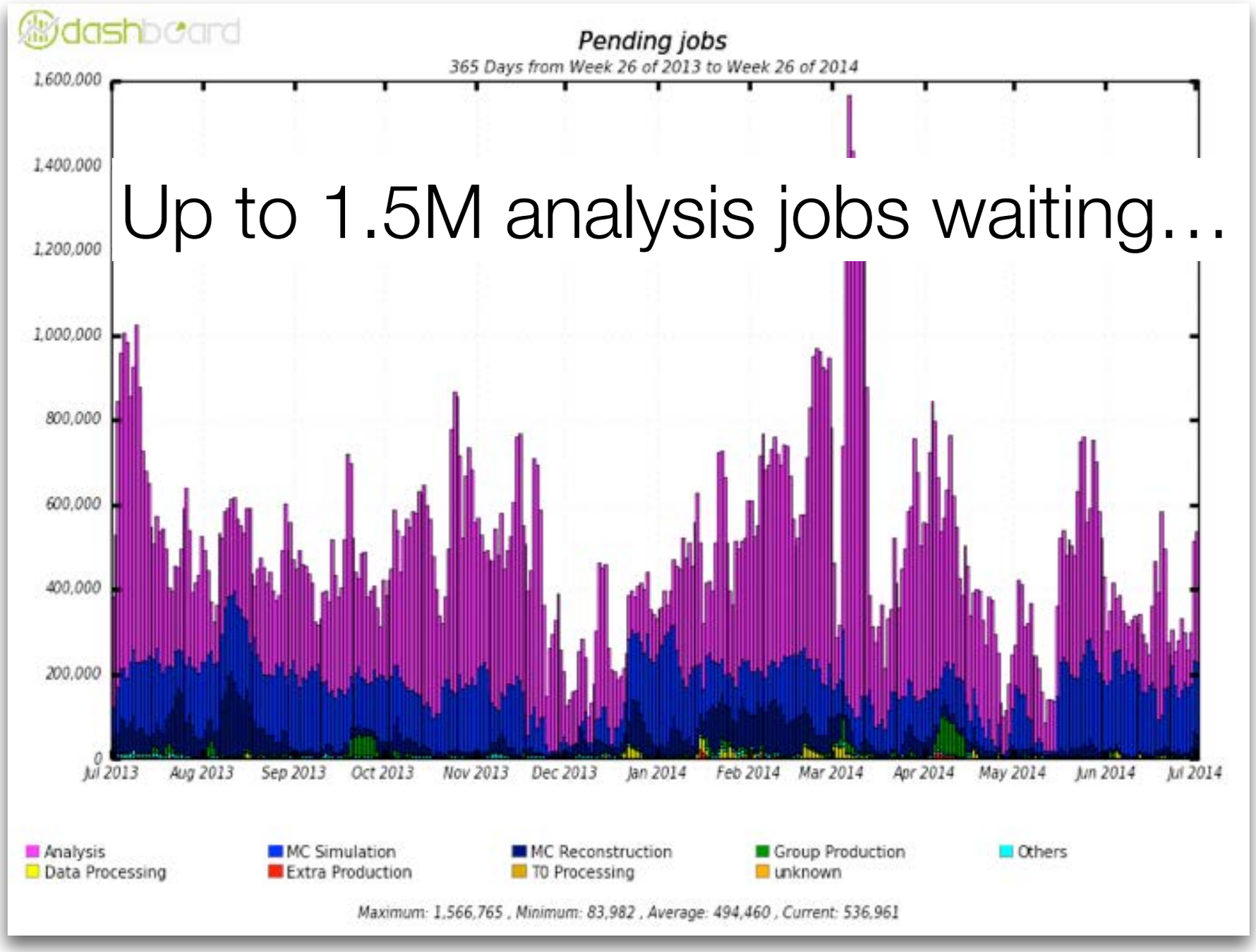
Running jobs on ATLAS T0+T1+T2 sites [Jul. 2013-Jun. 2013]



Data volume processed in 2013



But at the same time



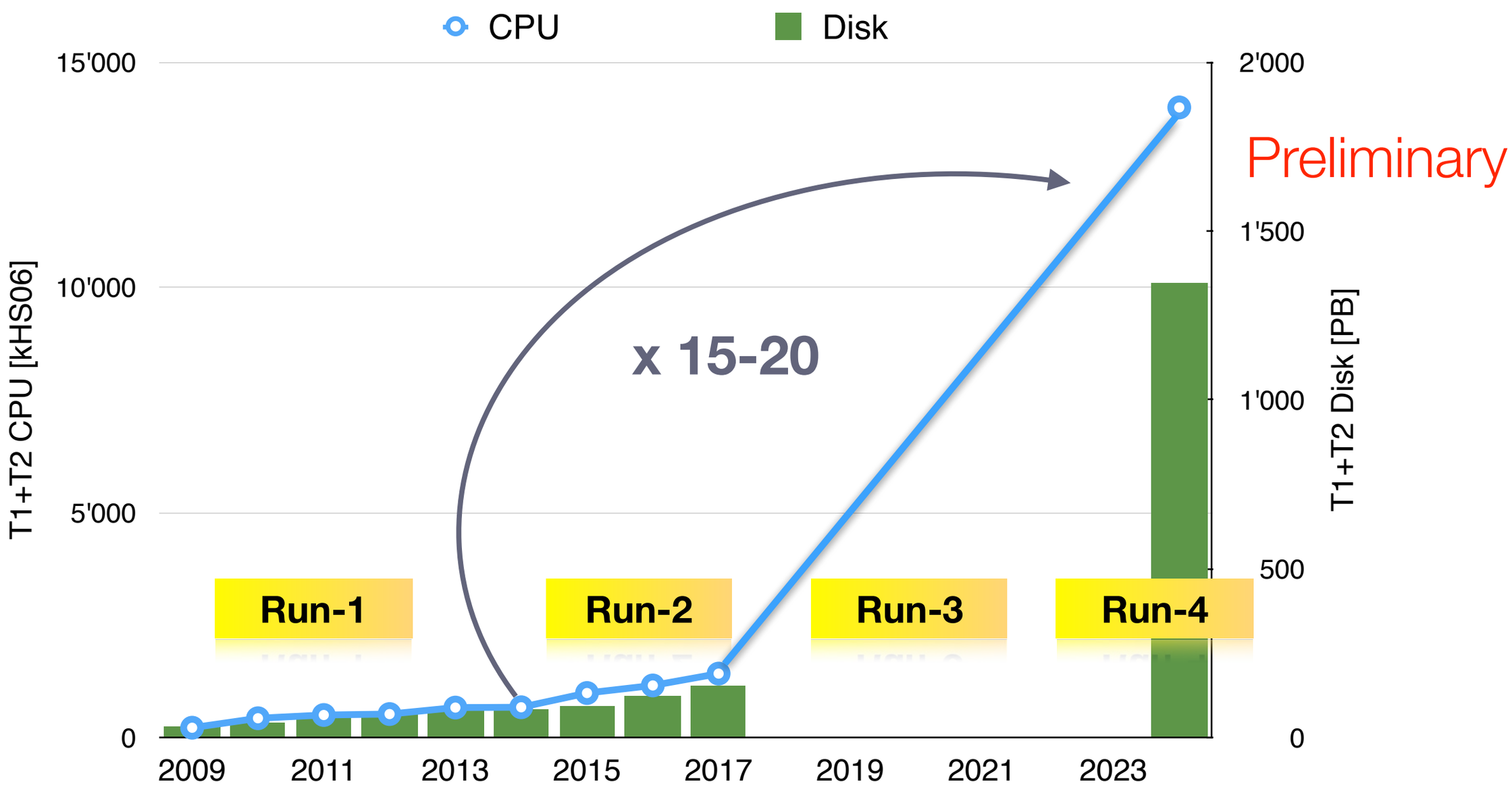
Up to 1.5M analysis jobs waiting…

Improvements needed for Run2

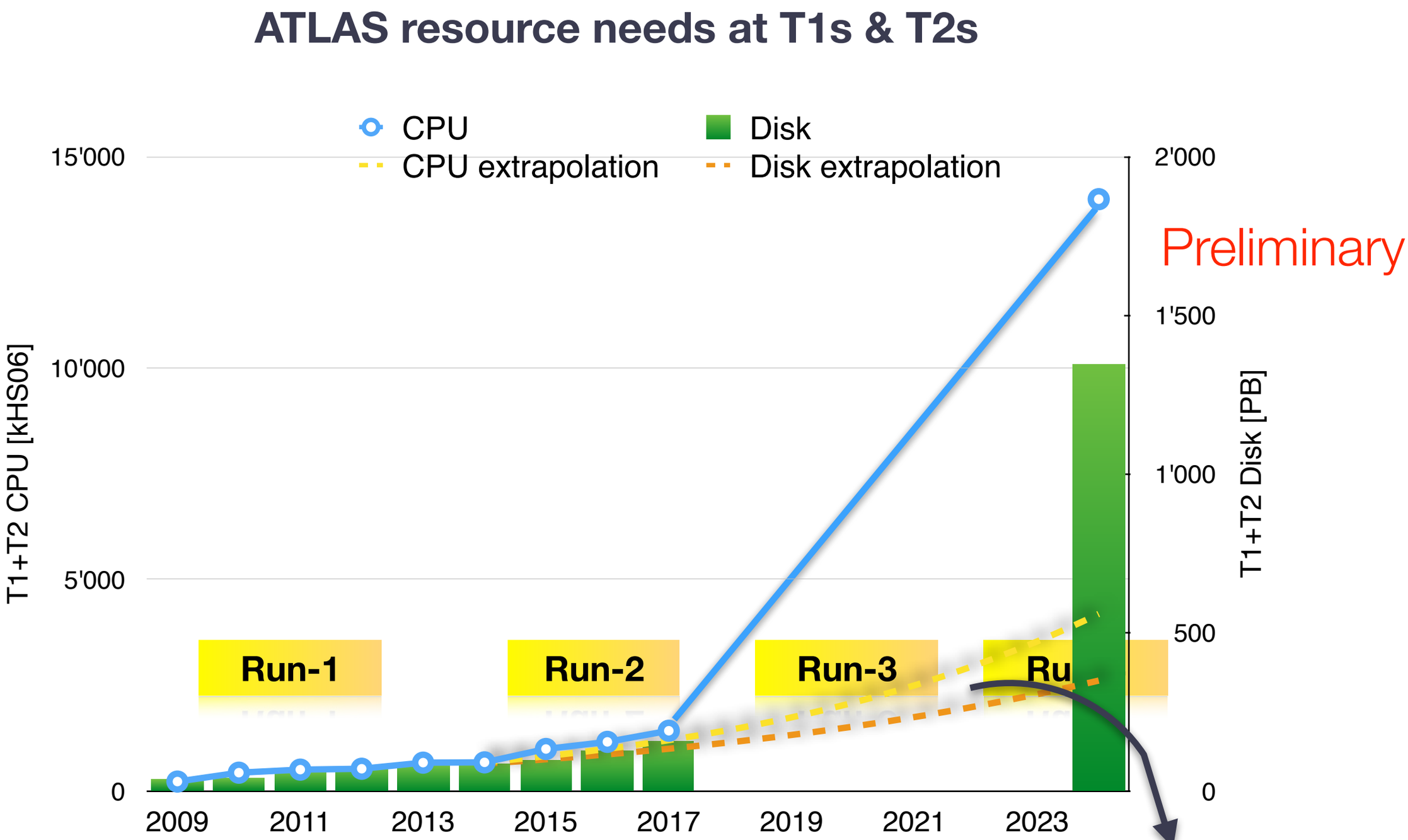
Run2 and beyond…

Run-4 (with 2014 performances)

How to simulate 150 pileup events?



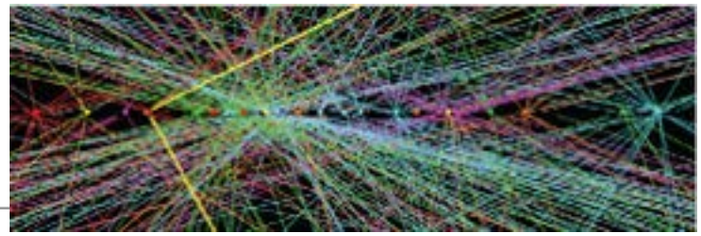
Run-4 (with 2014 performances)



Extrapolation from 2014 (Moore law)

Let’s concentrate on Run2…

The Challenges of Run2



- **Constraints of ‘flat budget’**
  - Both for hardware and for operation and development
  - Hardware increase from Moore’s law gain, estimated at factors of 1.2/year for CPU and 1.15/year for disk
- **Data from Run1**
- **LHC operation**

Run1

  - Trigger rate 1 kHz (~400)
  - Pile-up up above 30 (~20)
  - 25 ns bunch spacing (~50)
  - Centre-of-mass energy x ~2
- **~new detector**

Some limitations of current model & tools

- Partitioning of resources
  - User analysis vs Central Production
  - T1s vs T2s
- Difficulties of current Data Distribution Management & production systems to accommodate new use cases and technologies
- Memory increase of MC pile-up digitisation & reconstruction
- Full reprocessing once a year only
- Multitude of data formats for analysis

Optimisation is needed everywhere

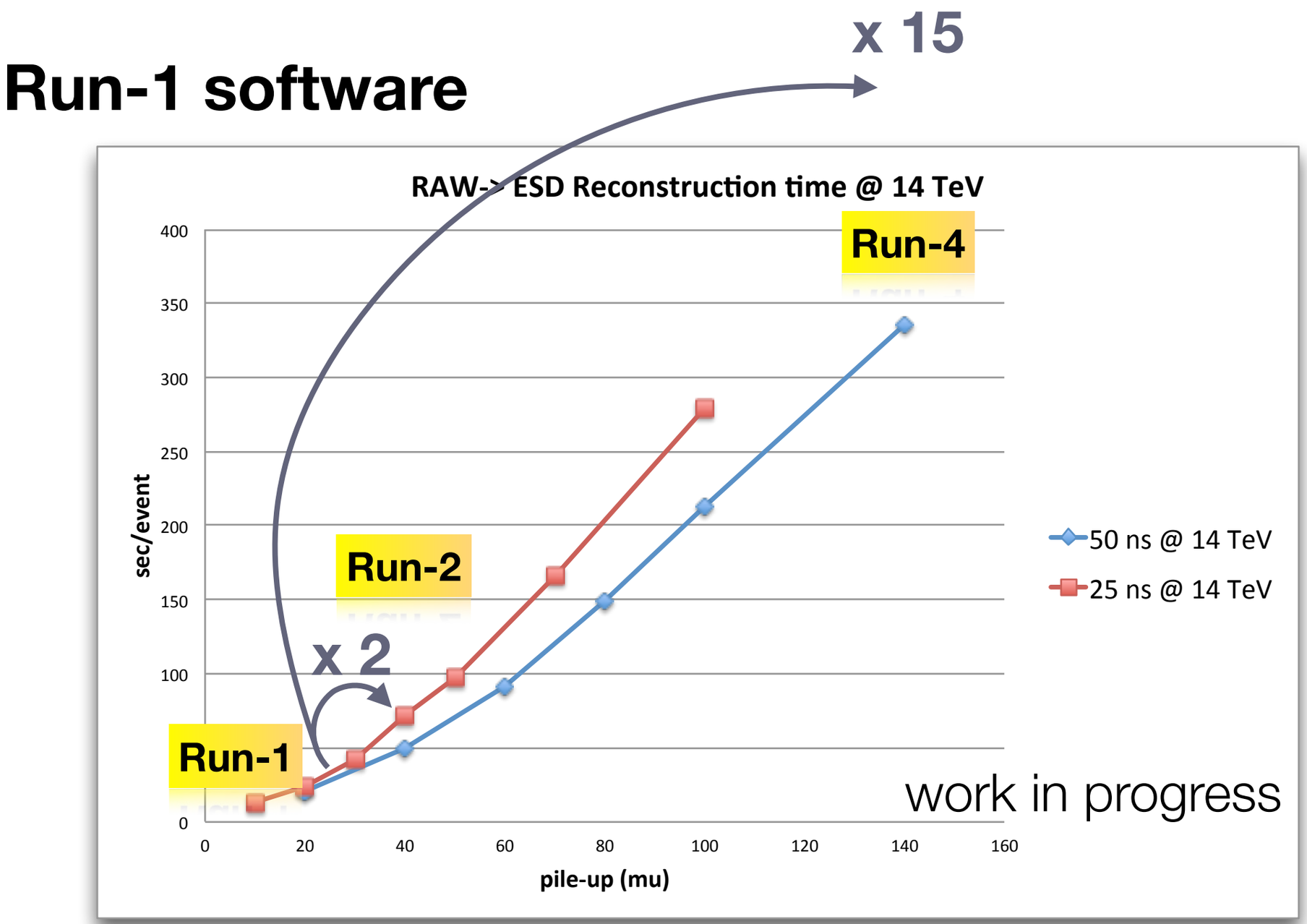
- **Simulation** : CPU
- **Reconstruction** : CPU, memory
- **Analysis** : Data formats, Disk space, CPU

With shrinking manpower (-10% in 2013)

Run2 computing model is an extrapolation and extension of end of Run-1 framework

More details in presentations by Alessandro & Simone

Reconstruction time vs Pile-up

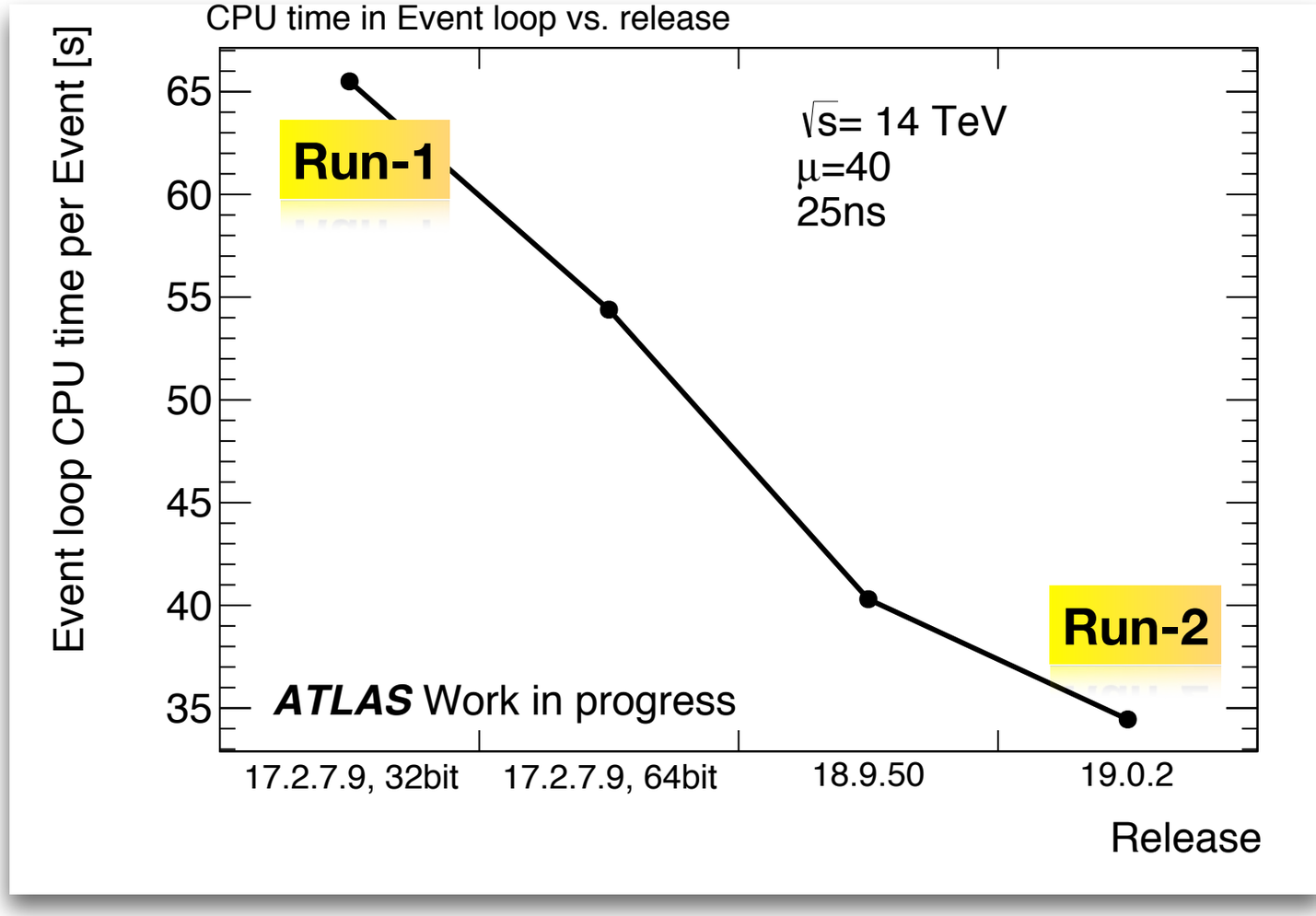


A factor of ~2 speedup in reconstruction time required for Run2

Reconstruction speedup

ATLAS software ~6M lines of code

- **Factor 2 achieved**
- Large-scale software cleanup and optimisation
- Replacement of algebra library CLHEP by Eigen, …
- New Event Data Model (>1000 packages modified)
- Optimisation still ongoing…



ATLAS software is SL6 64 bits

Resources for Run2

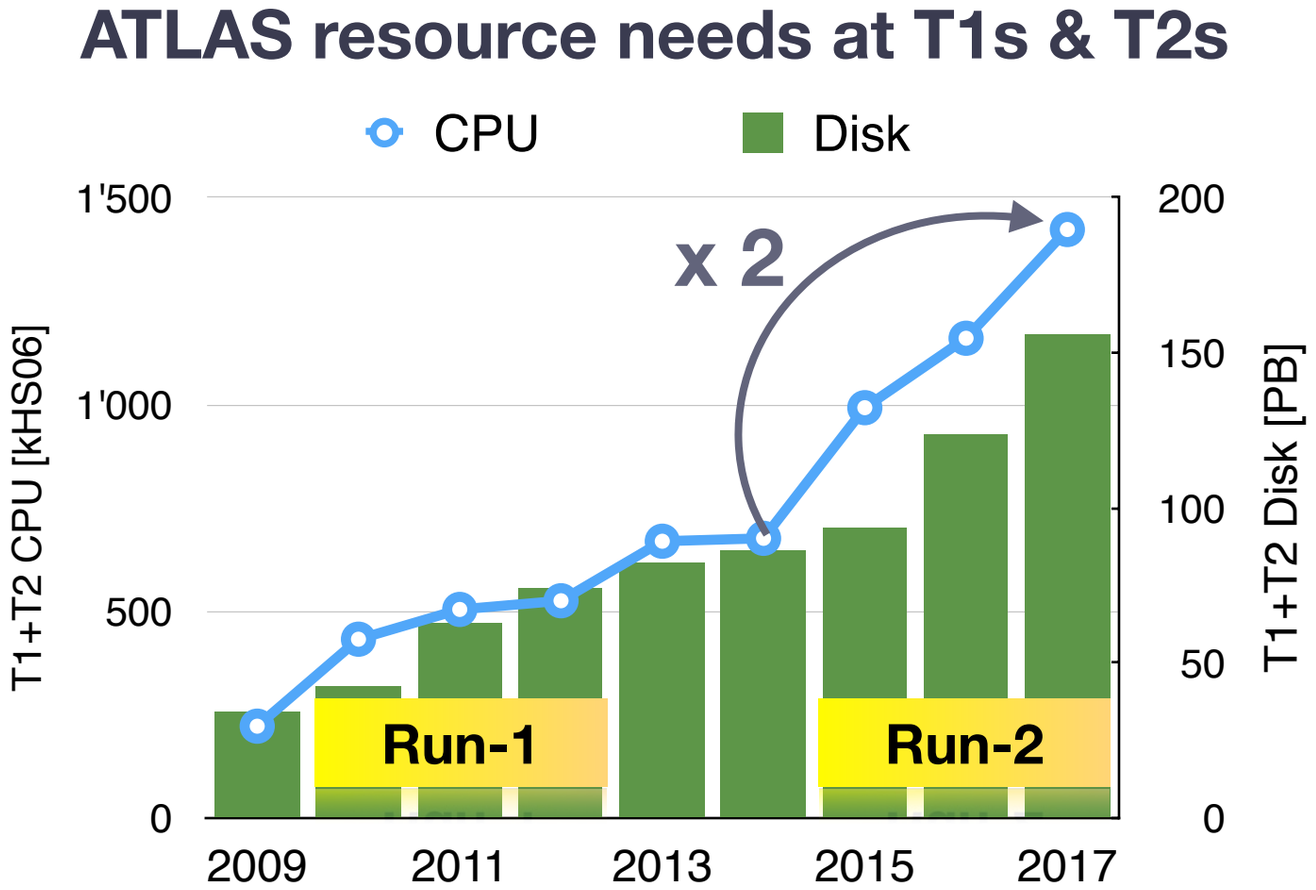
Resource estimates for 2016 & 2017 are still preliminary

- Profile of hardware replacement not taken into account in ‘flat budget’ hypothesis yet

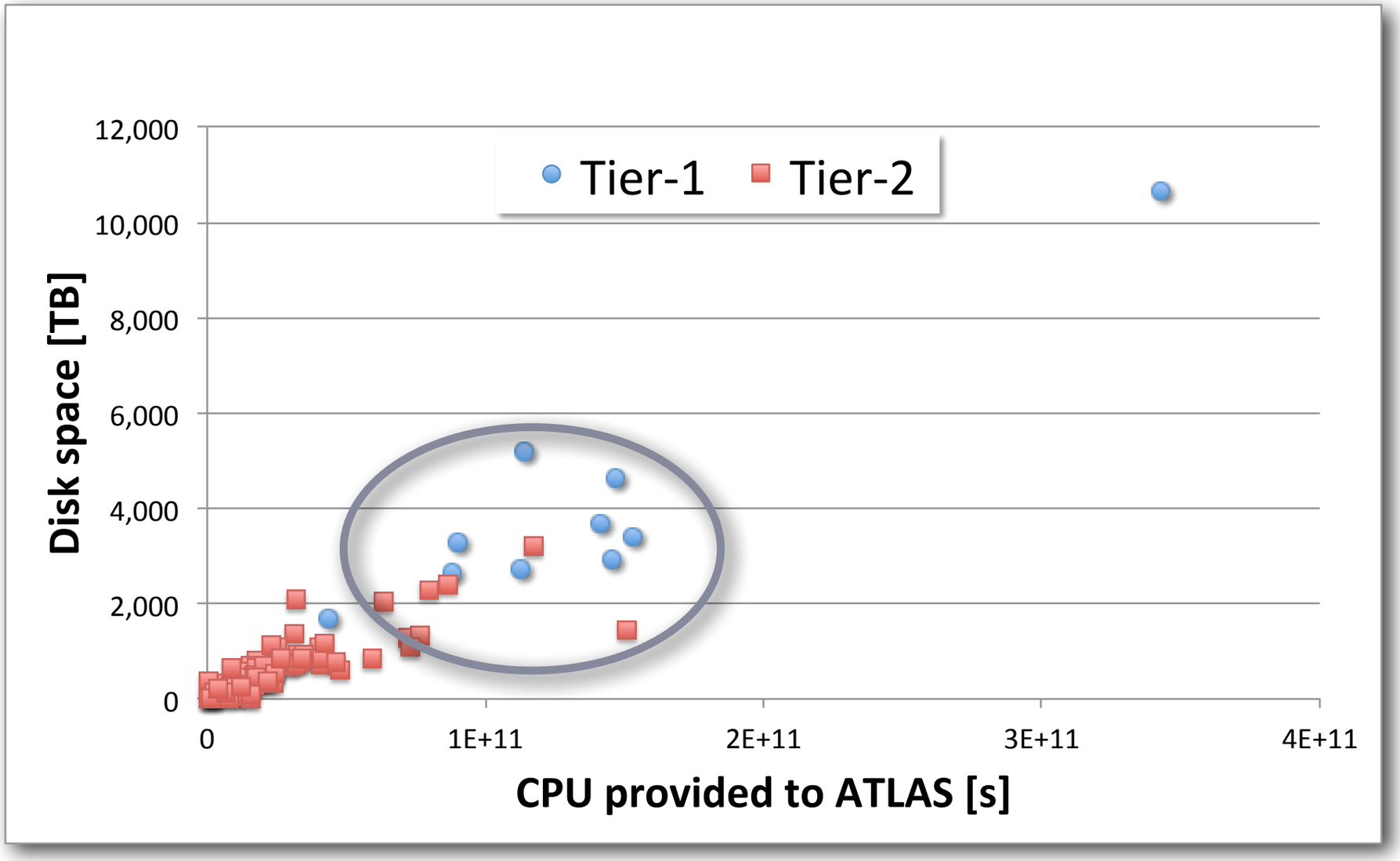
- Introduction of dataset lifetime both on disk and tape : more tape I/O and possibly more tape volume needed

- Balance of disks between T1s & T2s to be optimised

- Optimistic use of fast simulation?

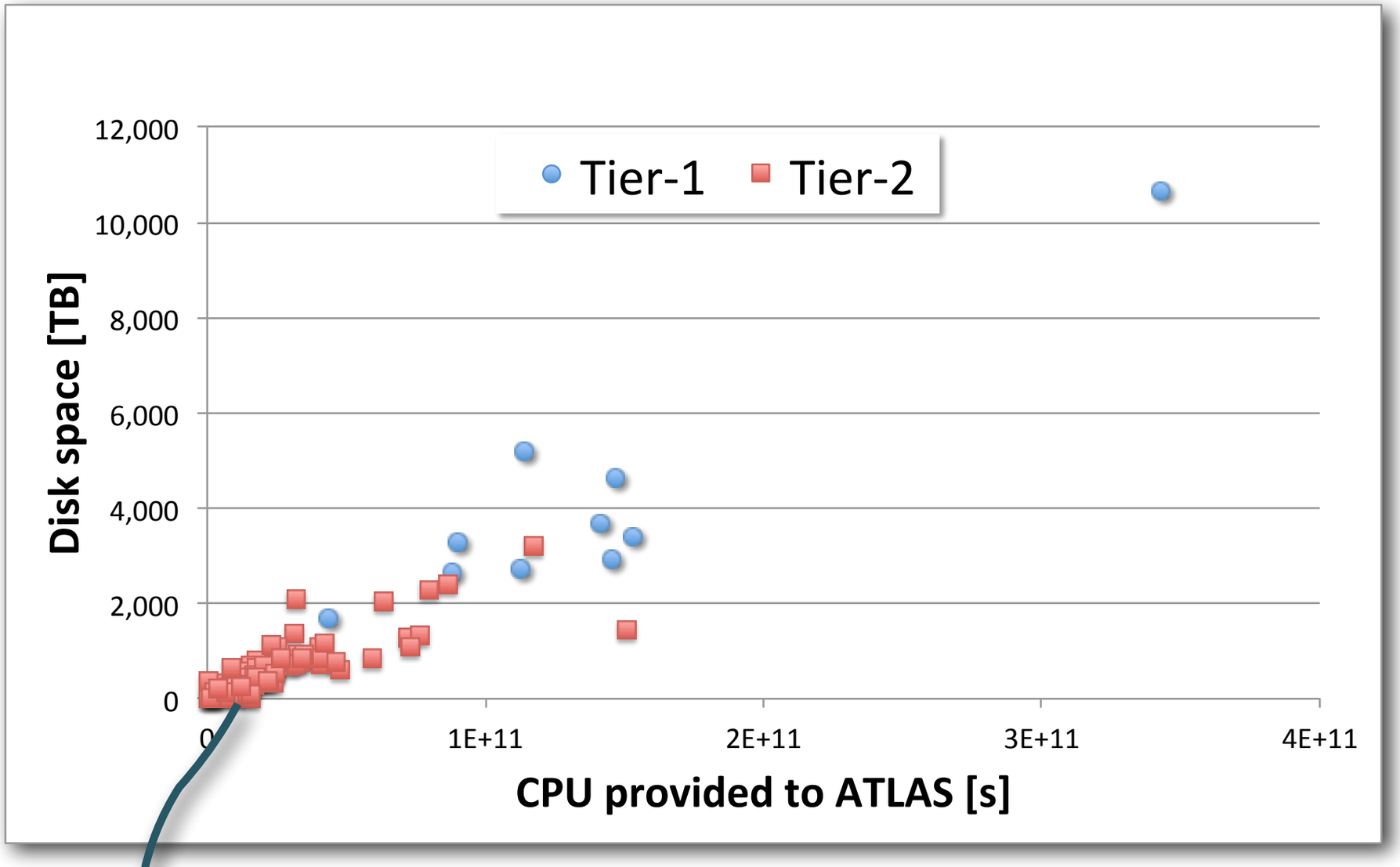


Data processing : Flexibility



Some T2s are equivalent to T1s in term of disk storage & CPU power

Data processing : Operational load



Operational load of many 'small' sites
Less and larger sites would be better

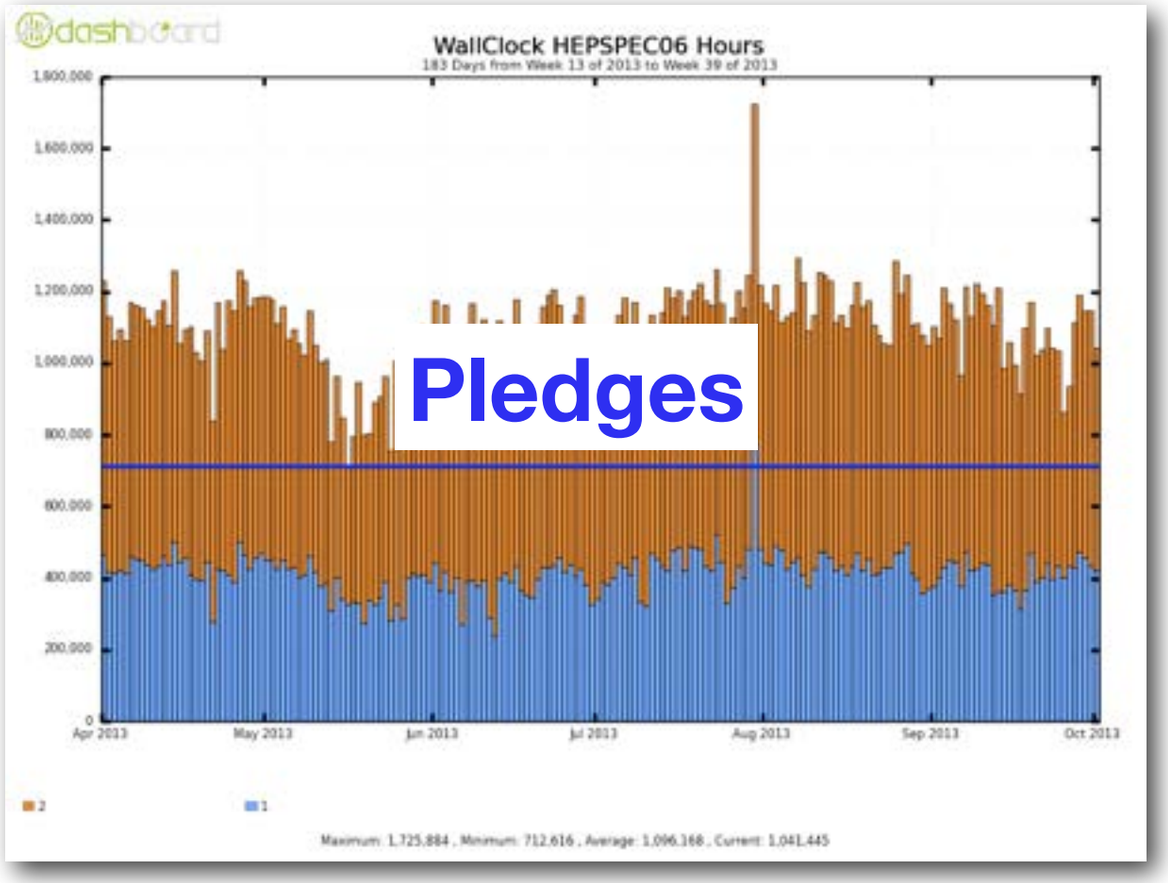
Opportunistic resources

At Run1 : quality of physics results and physics throughput benefited a lot from these additional resources!

Need for **additional** solutions beyond pledges :

- HLT farm at P1
- Cloud computing
- HPC (High Performance Computing) centres
- Volunteer computing: ATLAS@home, also useful for T3 sites

CPU consumption above pledges both at T1s and T2s



Opportunistic resources

Variety of resources = Manpower cost

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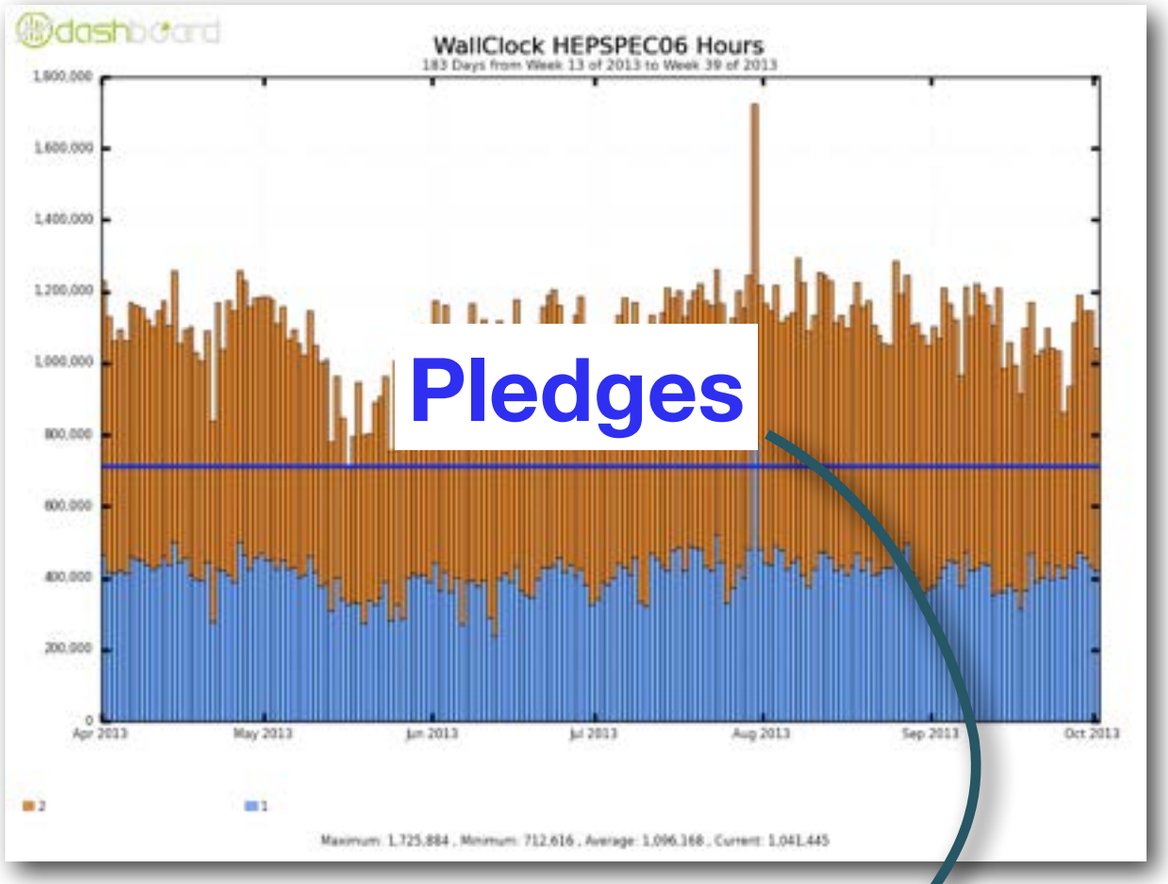


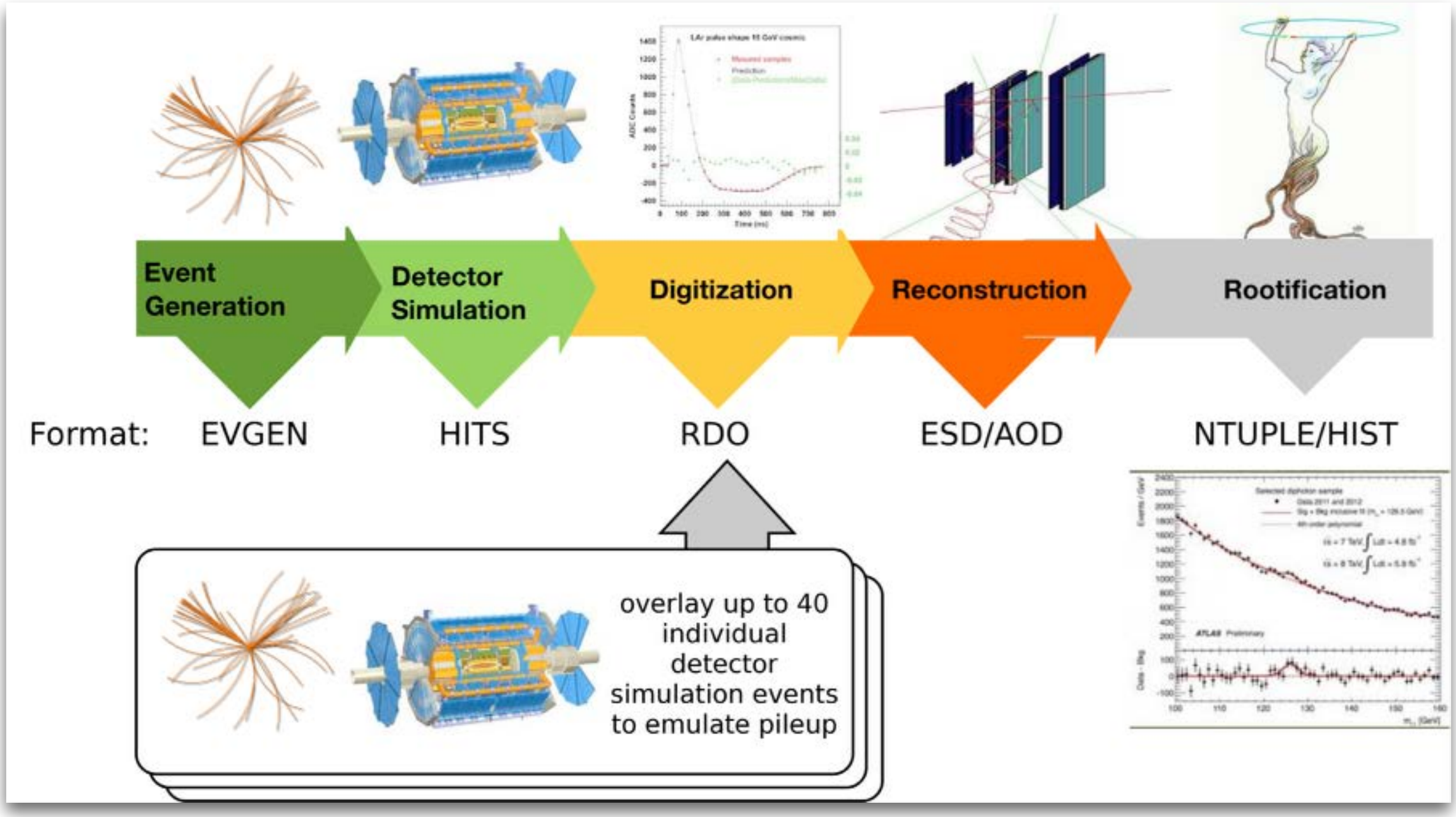
ATLAS sites availability/usability will be used to understand how many pledged resources are effectively available for us

Summary & Outlook

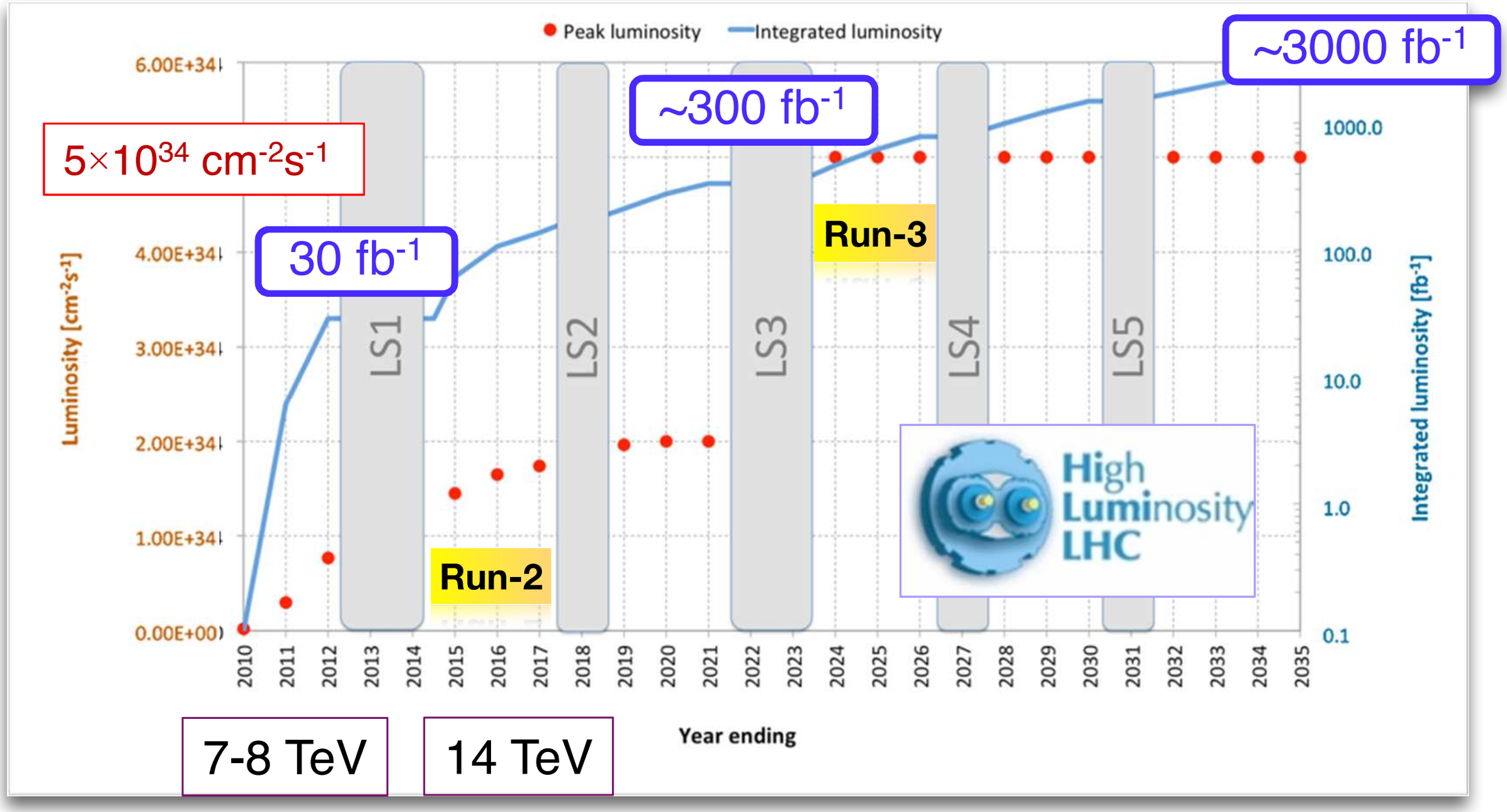
- A lot of experience acquired in 3 years of LHC data taking
- Run2 will put high pressure on hardware and human resources
- Solutions under development and manpower is critical
- New computing model and its components will be tested during 2014 data challenge (DC14)

spares

Simulation workflow

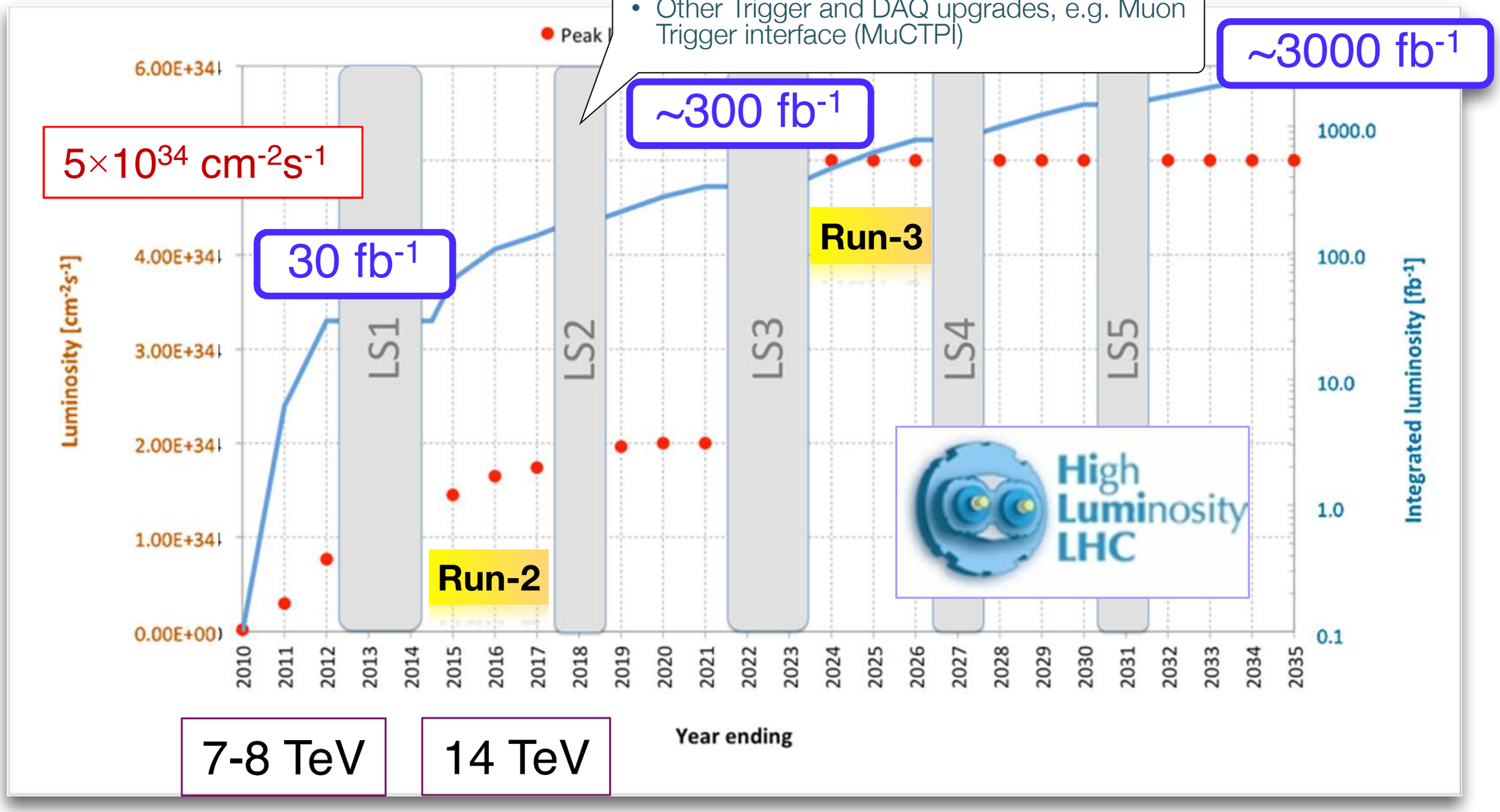


ATLAS in the next years



ATLAS in the next

- New Small Wheel (NSW) for the forward muon Spectrometer
- High Precision Calorimeter Trigger at Level-1
- Fast TracKing (FTK) for the Level-2 trigger
- Topological Level-1 trigger processors
- Other Trigger and DAQ upgrades, e.g. Muon Trigger interface (MuCTPI)



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  Trigger interfa

- New Tracking Detector
- Calorimeter electronics upgrades
- Upgrade muon trigger system
- …