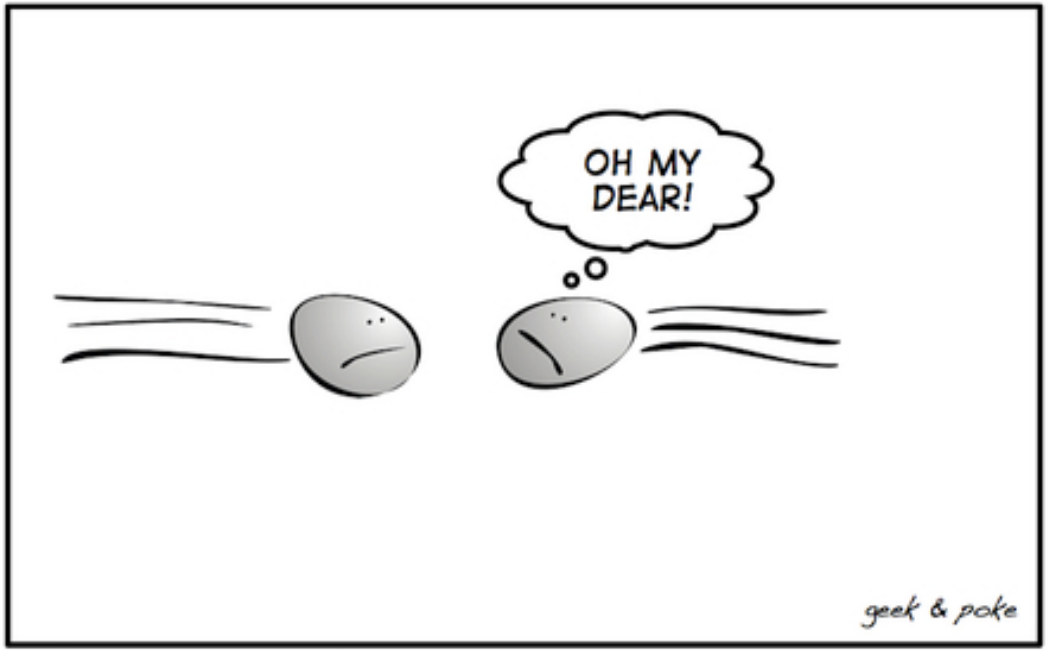
CERN

From Data to Knowledge

CERN Open Days
14 & 15 September 2019

Between LHC Particles Colliding …



LATELY INSIDE THE LHC:
2 PROTONS 0.00000000000000000001 SEC BEFORE THE COLLISION

… and the Presentation of Physics Results

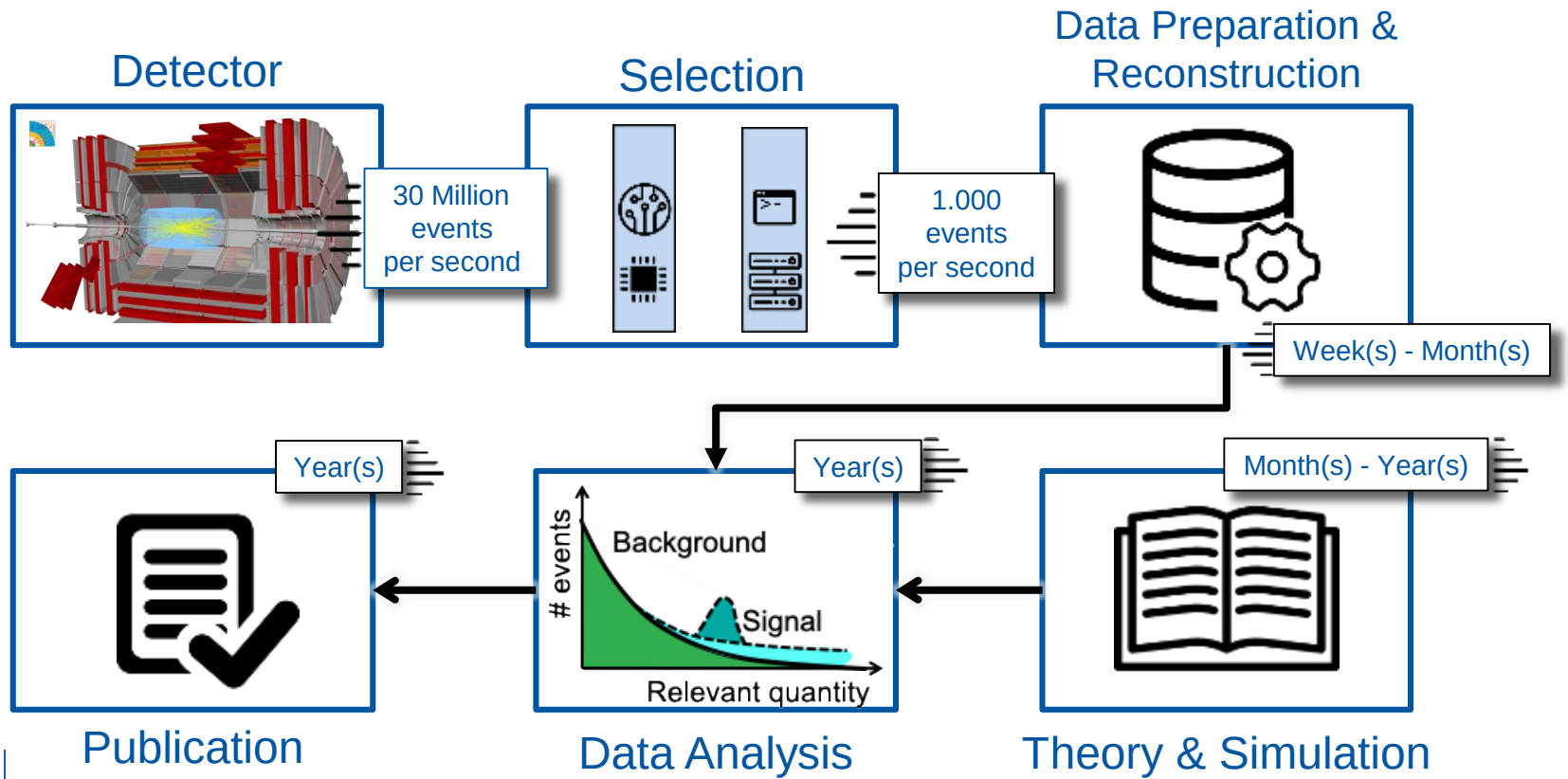
Press coverage of the CERN Seminar in July 2012 on the Higgs boson search results

Computing is Involved in All Stages

Definition: Event

”Observation of the collision of two particles and their subsequent production of new particles”

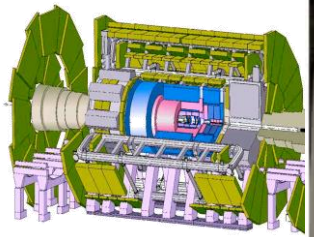
A Particle's Life

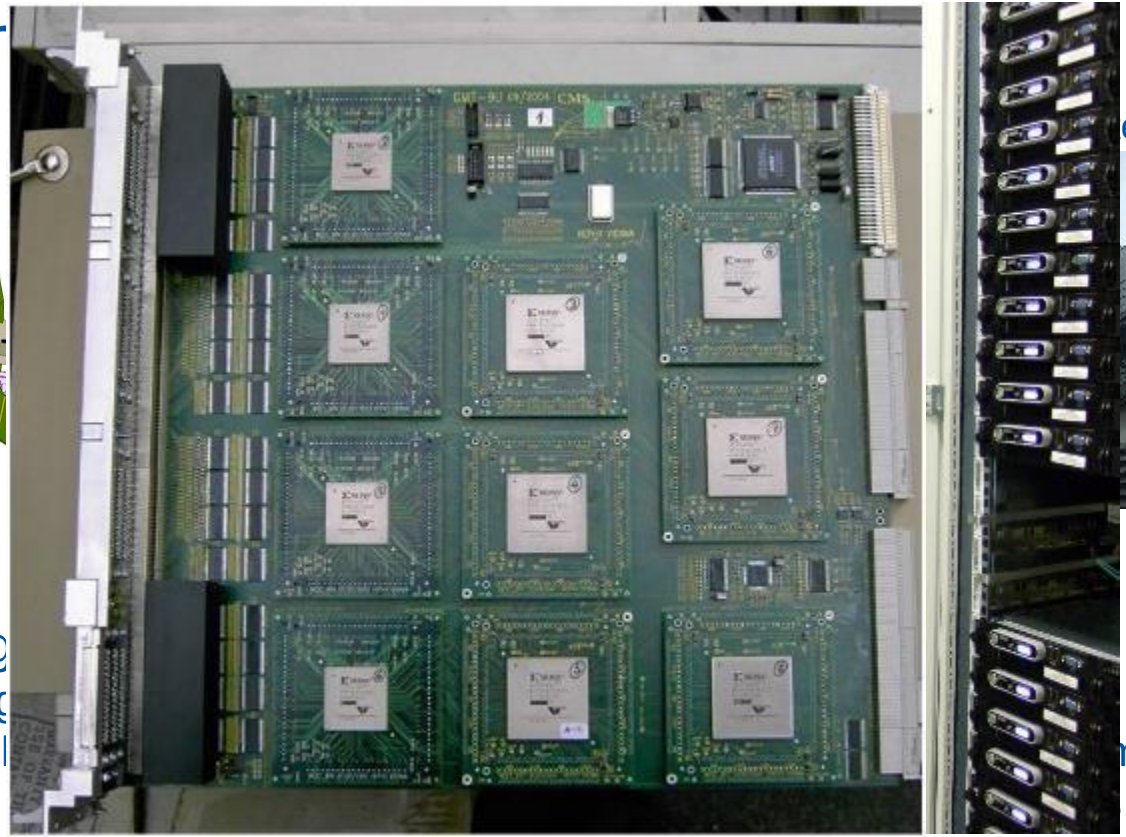


Selectior

er

Detector

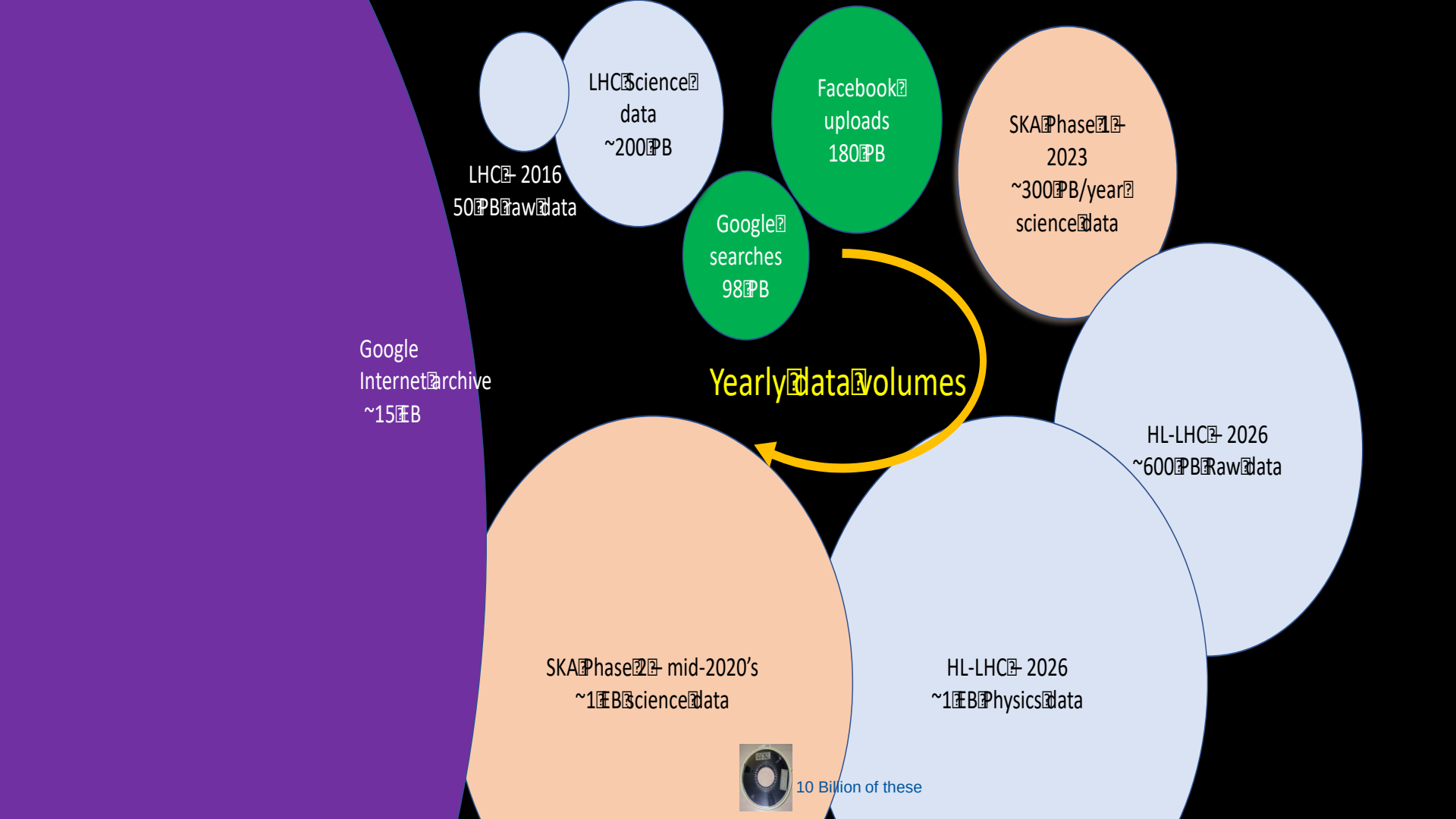




- Filtering stag LHC
  - Level 1 trig
  - High Level nputing cores
- Final filtered r and further worldwide for next processing stages

Software Trigger Selection

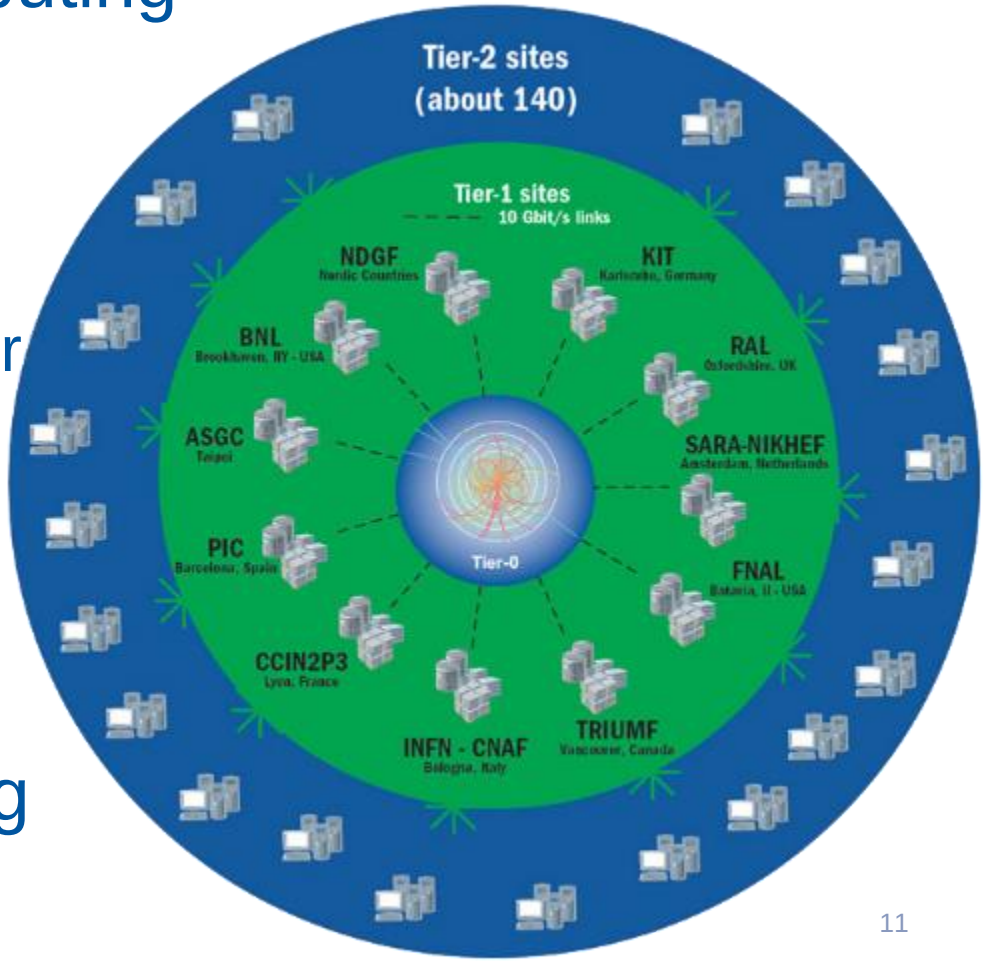
(every dot represents 1.000 events)


LHC - 2016
50 PB raw data
LHC Science data
~200 PB
Facebook uploads
180 PB
Google searches
98 PB
SKA Phase 1 - 2023
~300 PB/year science data
Google Internet archive
~15 EB
Yearly Data Volumes
HL-LHC - 2026
~600 PB Raw data
SKA Phase 2 - mid-2020's
~1 EB Science data
HL-LHC - 2026
~1 EB Physics data
10 Billion of these

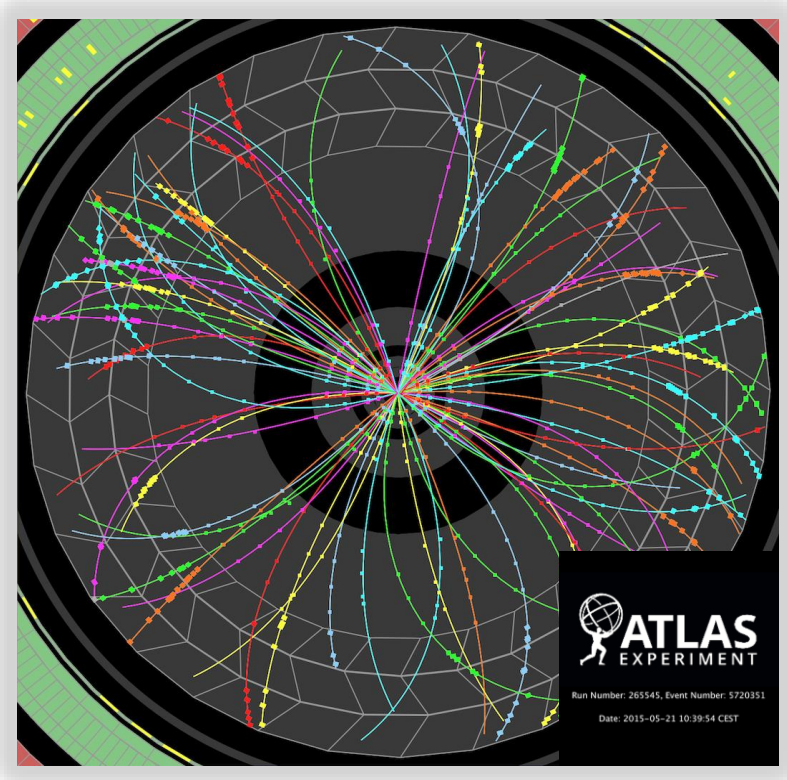
The Worldwide LHC Computing Grid (WLCG)

- 170 computing sites in 42 countries providing
  - Up to 900.000 computer cores
  - ~ 1 exa-byte of disk and tape storage

→ Used for all later remaining data processing



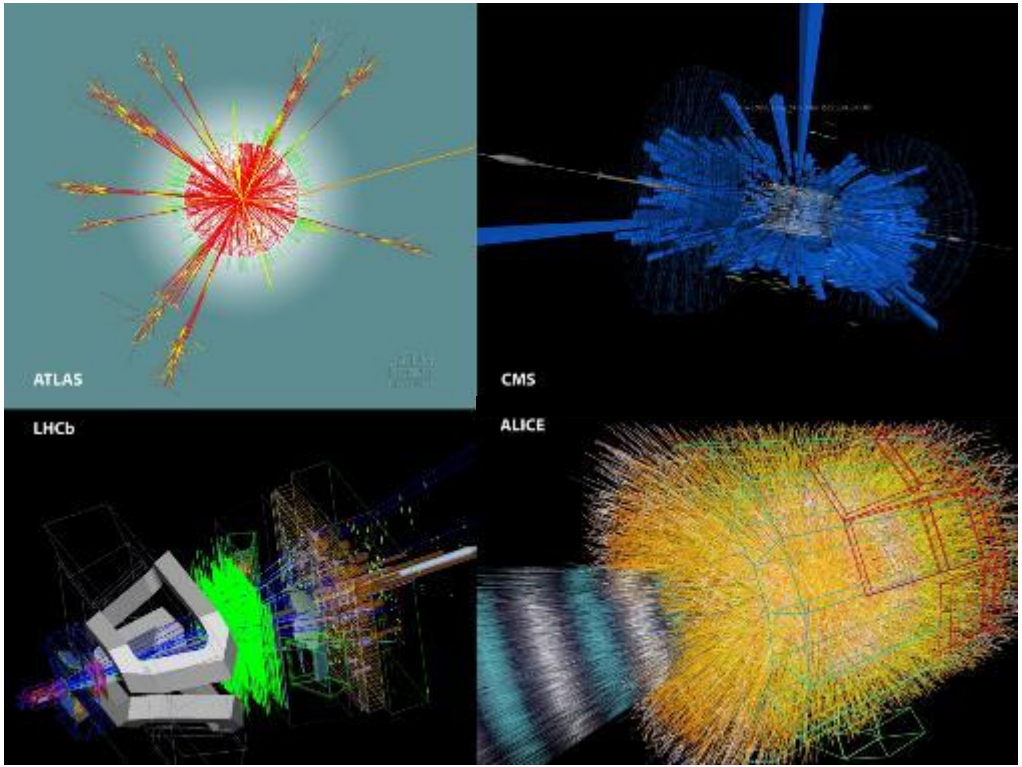
Data Reconstruction



Convert measured data points by the detector and energy into “tracks” and particles

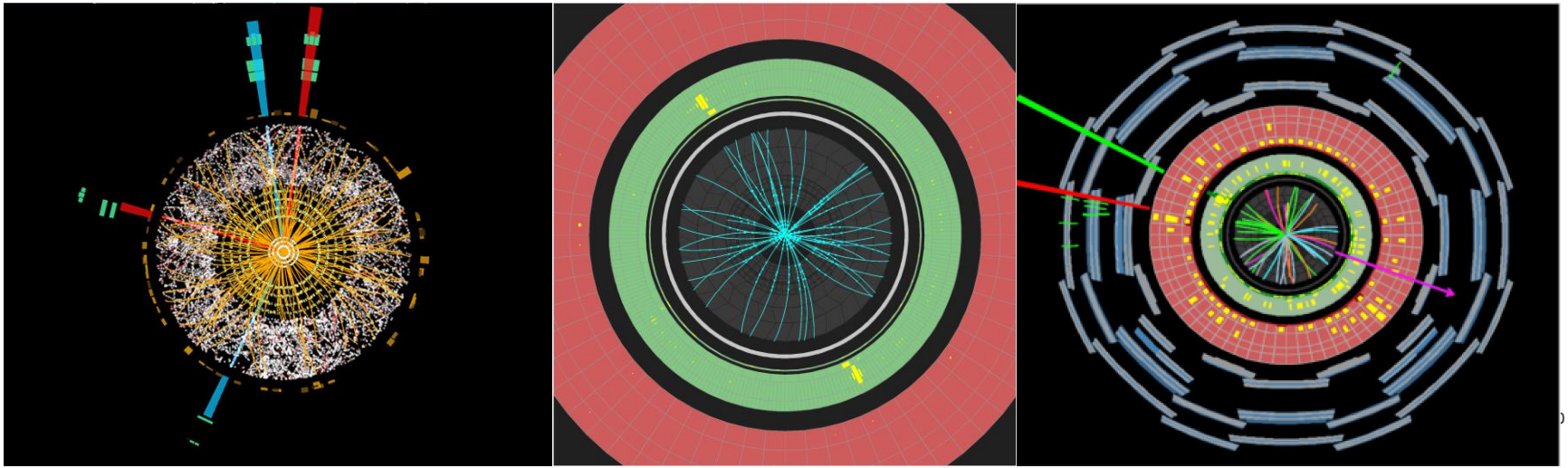
→ Physics data ready for analysis

Simulation



- Particle collision and detector response simulated with computer programs
- Simulation is essential for data analysis and design of new detectors
- Majority of WLCG resources needed for simulation

Data Analysis



Physicists analyze the reconstructed data with statistical methods to verify or falsify theoretical predictions

You can help to process LHC data at home …

http://lhcathome.web.cern.ch/

Demonstrator in the restaurant on the other side of the road

http://lhcathome.web.cern.ch/

Acknowledgements

- Many thanks to Anna Sfyrla (U. Geneva) for sharing her summer student lecture slides !!!
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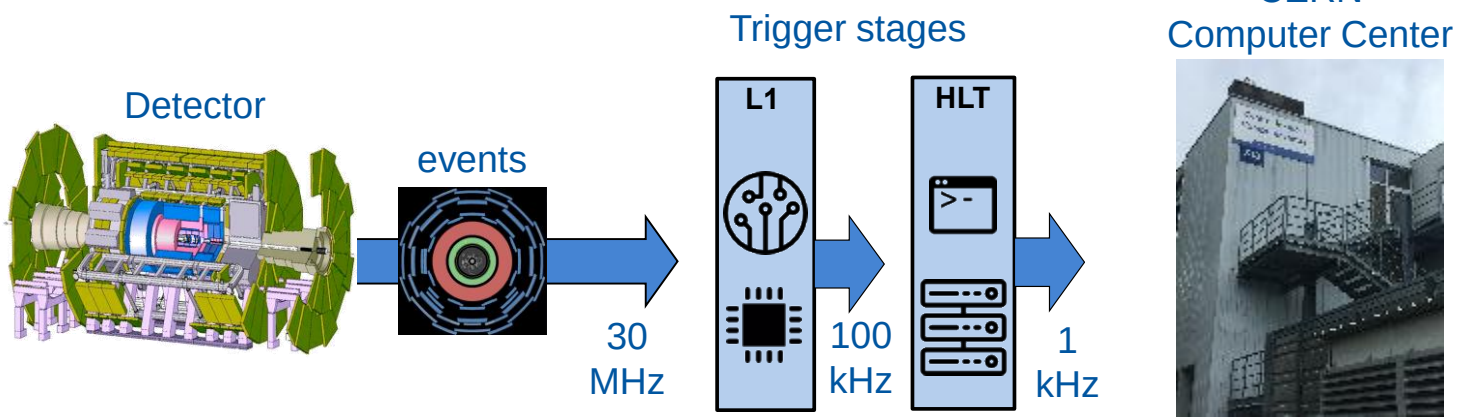
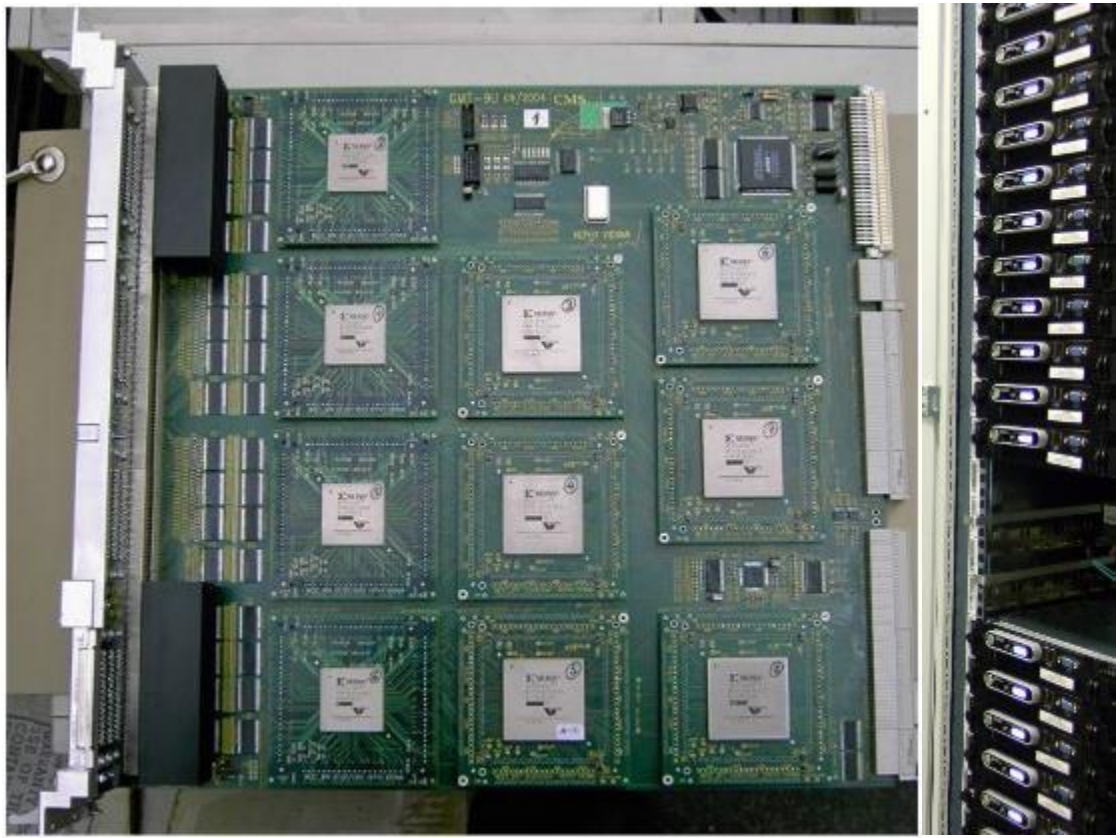
- Translation of slides by Julien Collet, Herve Rousseau, Nicole Cremel, Catherine Delamare, Melissa Gaillard

www.cern.ch

Backup

Selection of events (Trigger)



- Filtering stages installed in the experimental areas around the LHC
  - Level 1 trigger implemented in hardware
  - High Level Trigger (HLT) running on farms of several 10 thousand computing cores
- Final filtered collisions then exported to CERN computer center and further worldwide for next processing stages