

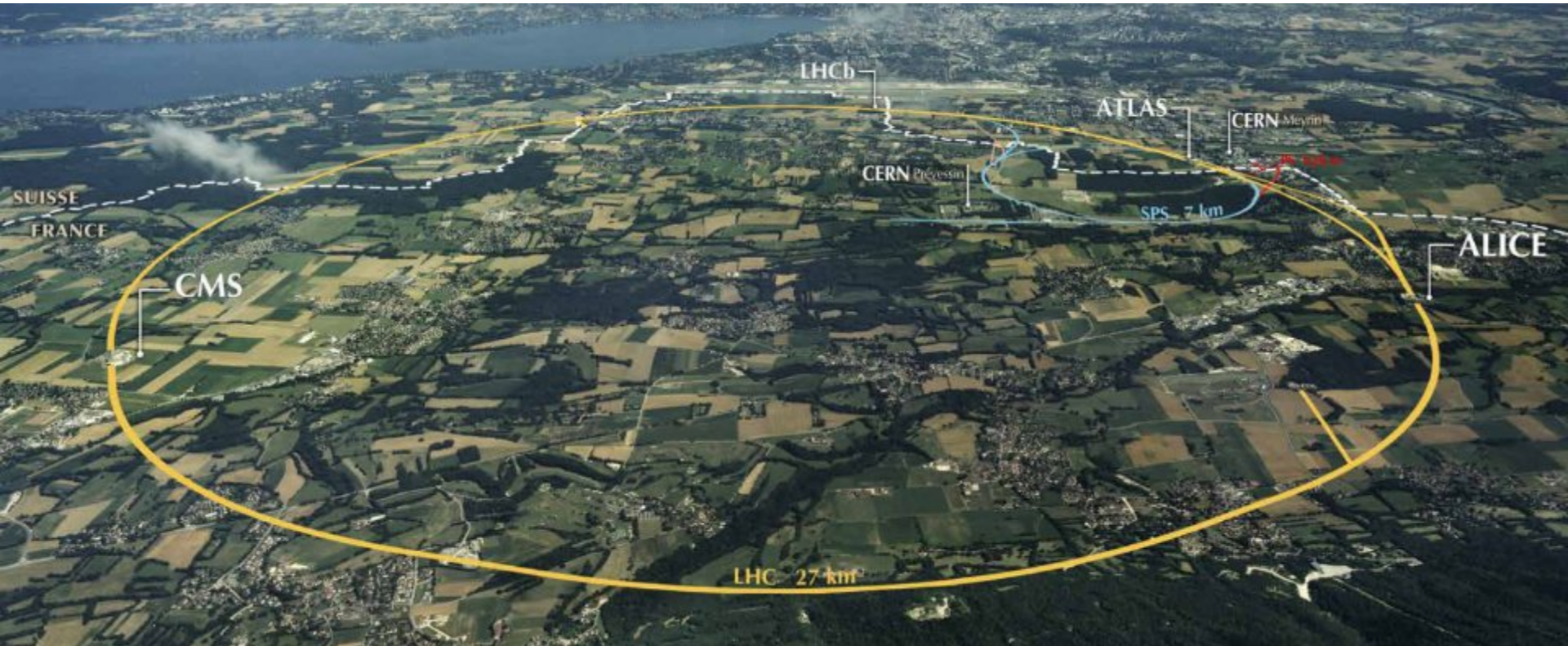
Computing at the LHC

and the Göttingen Tier-2 centre GoeGrid

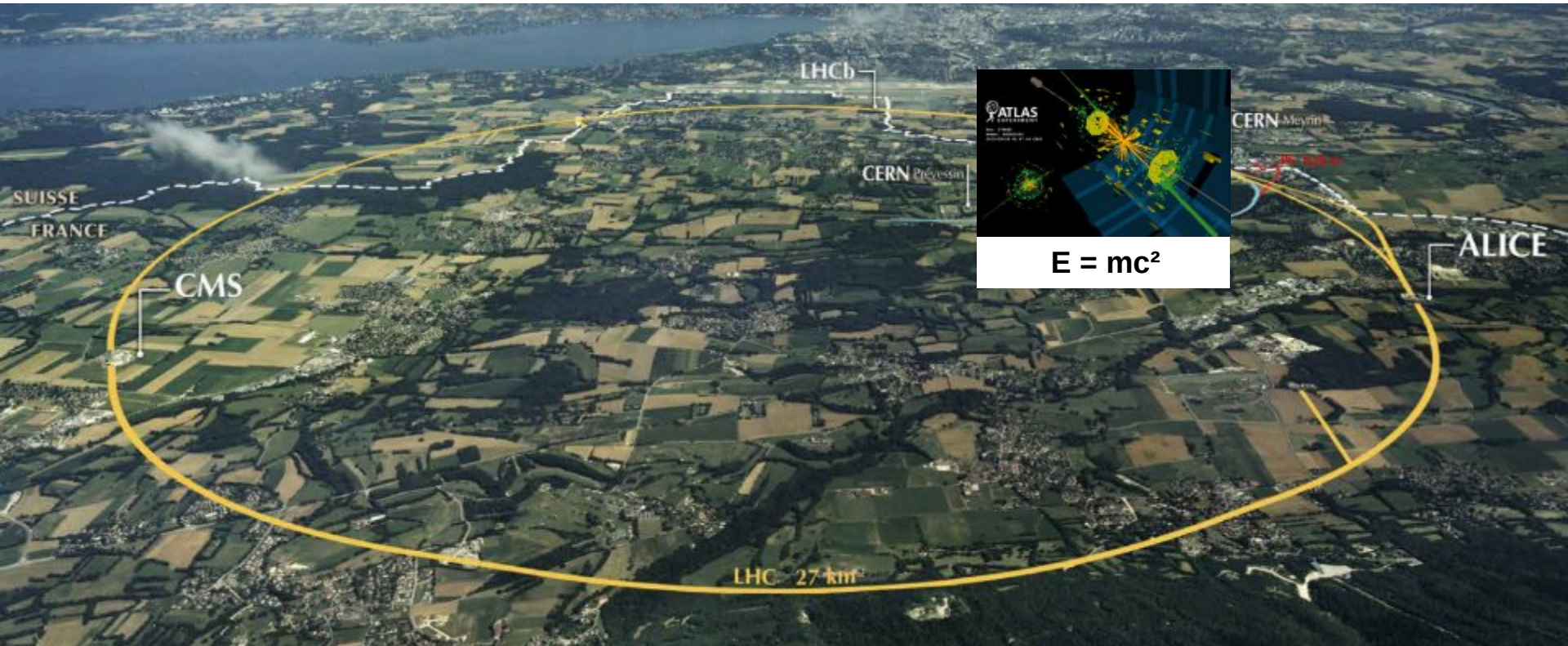
SEBASTIAN WOZNIEWSKI, II. INSTITUTE OF PHYSICS, AG QUADT

FDM@CAMPUS 2026 – GÖTTINGEN

LHC – Large Hadron Collider



LHC – Large Hadron Collider

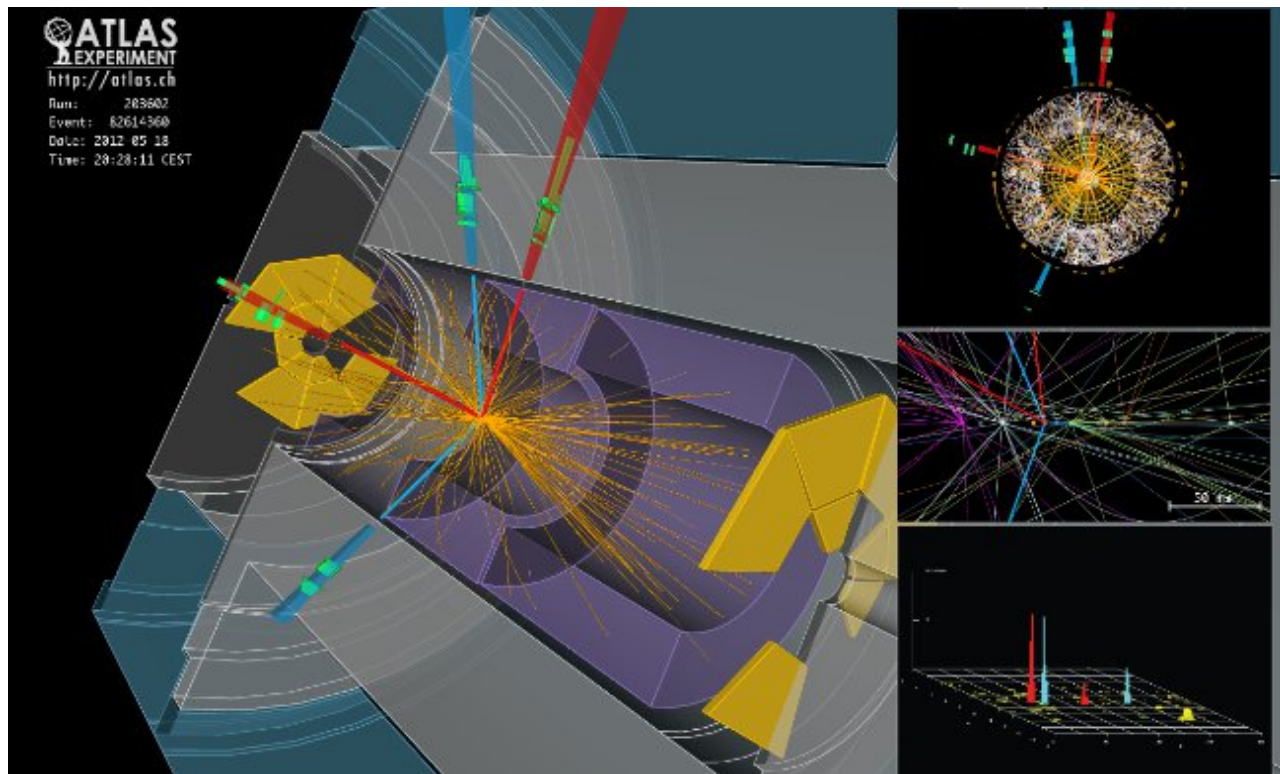


Many detector layers, e.g. inner tracker with 100 Mio. pixels

40 Mio. collision events per second

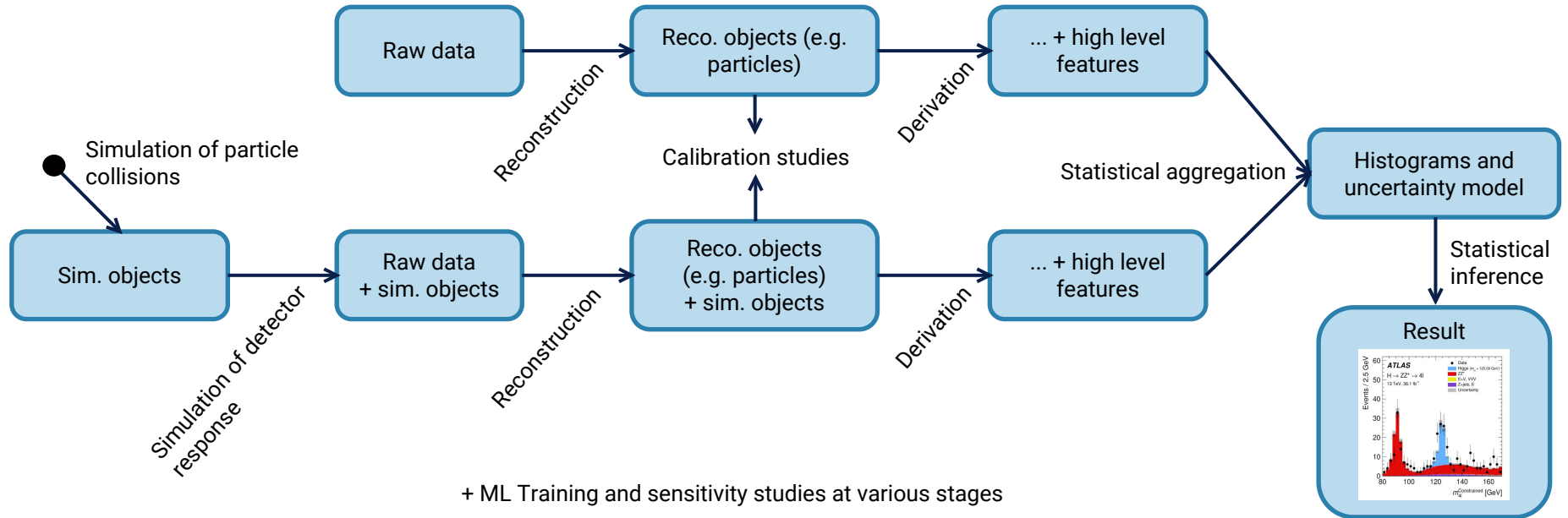
→ unfiltered ~ 1PB of data per second

**After online data selection and
together with simulation etc.:
~90 PB per year permanently stored!**

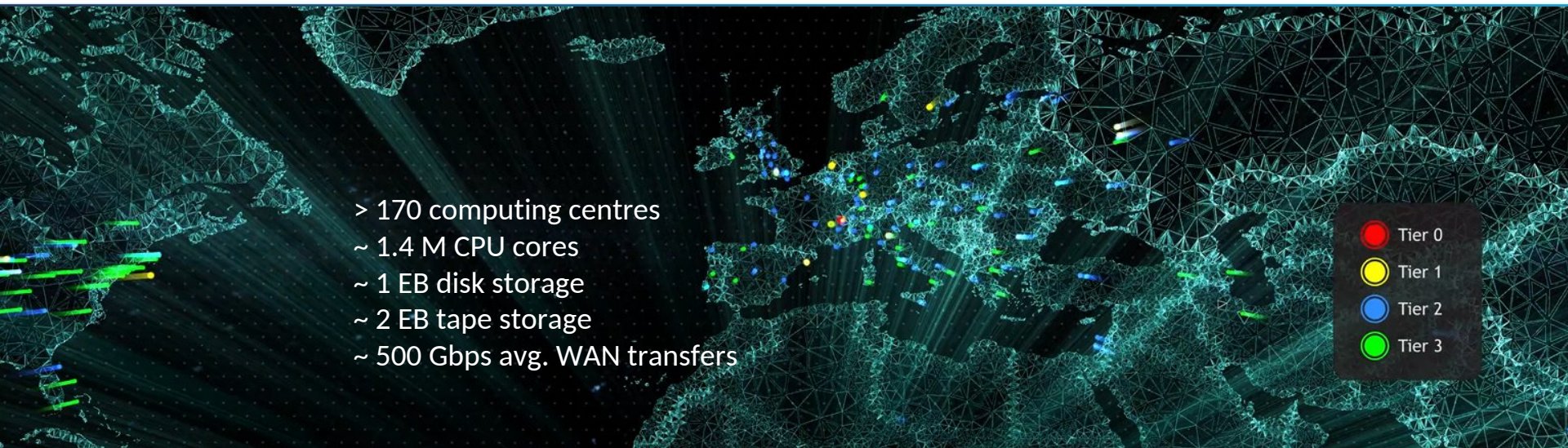


Raw data corresponds to detector response (tracker hits, energy deposits...)

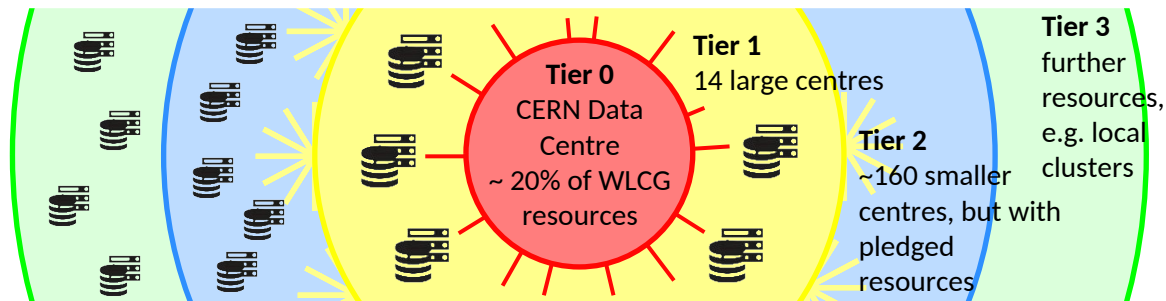
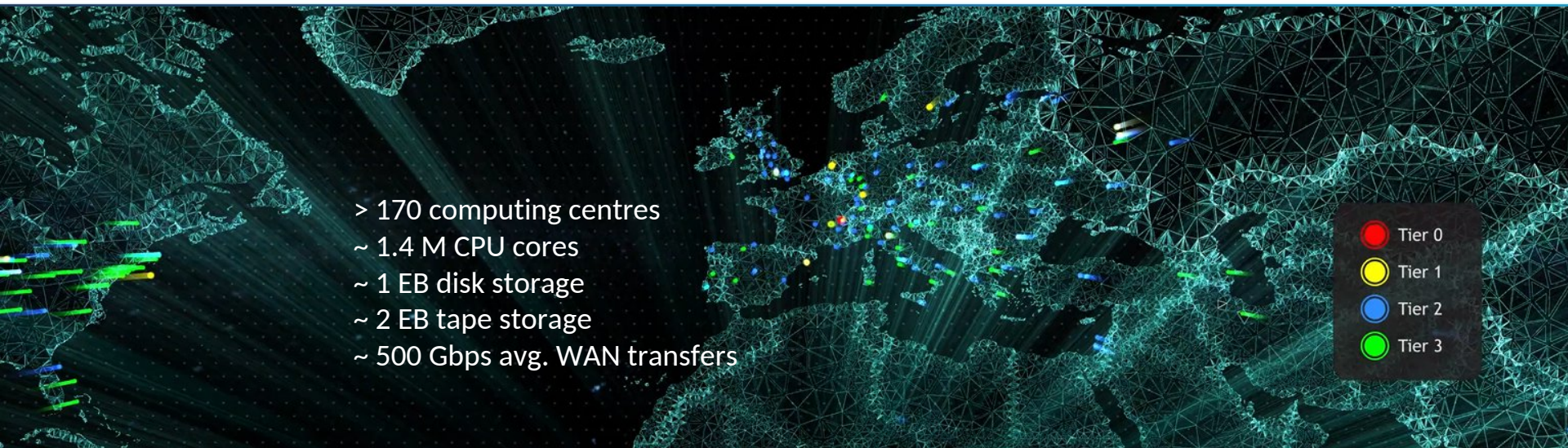
Multiple processing steps towards research result:



Worldwide LHC Computing Grid (WLCG)



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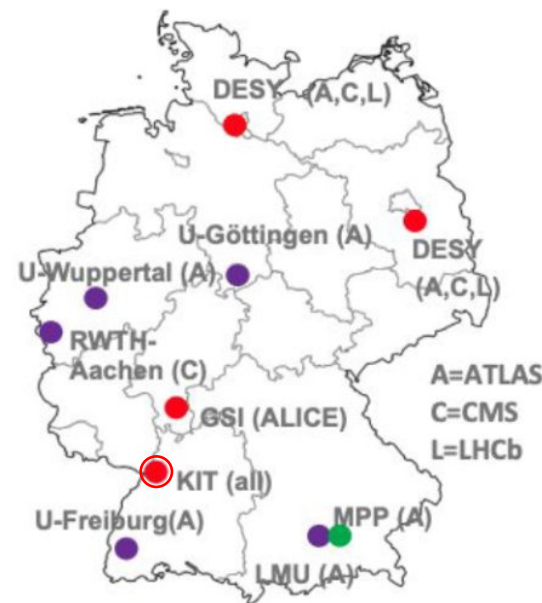
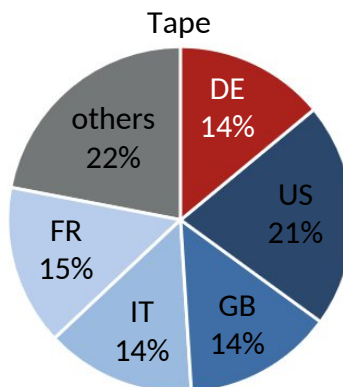
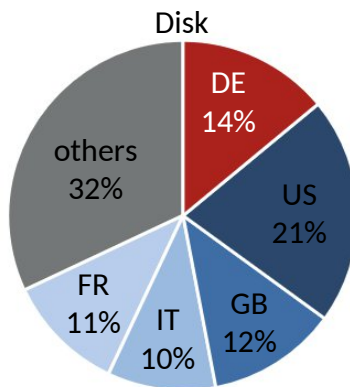
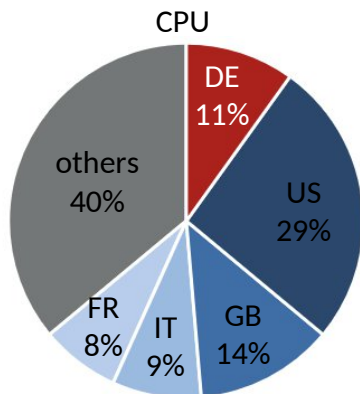


German Tier 1 centre „GridKa“ at KIT

Tier 2 centres at DESY, GSI, MPP and universities

WLCG resources by country within last year:

(excluding Tier-0)



Helmholtz Centres
Max-Planck-Institute
Universities

GoeGrid – The WLCG Tier-2 in Göttingen

~22,000 logical CPU cores

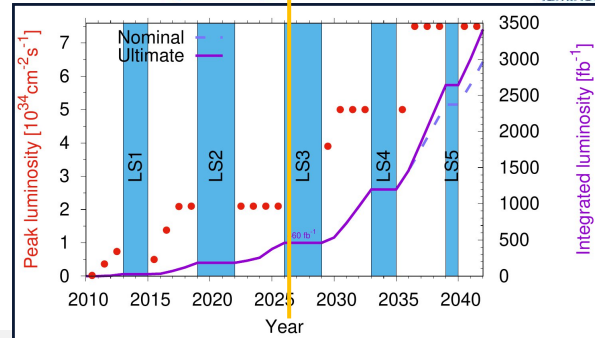
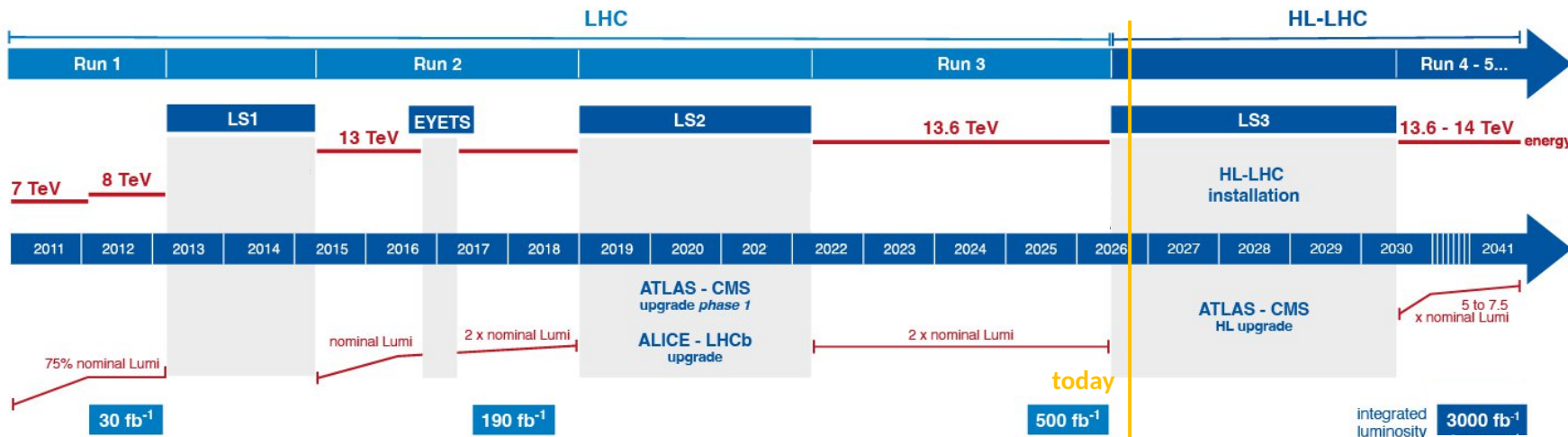
3.6 PB permanent disk storage

Running ~20% of the German data processing for the ATLAS collaboration, involving an increasing contribution from NHR@Göttingen aka Emmy...





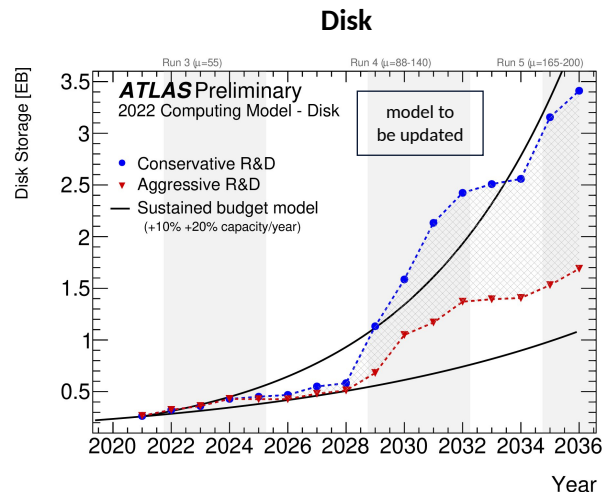
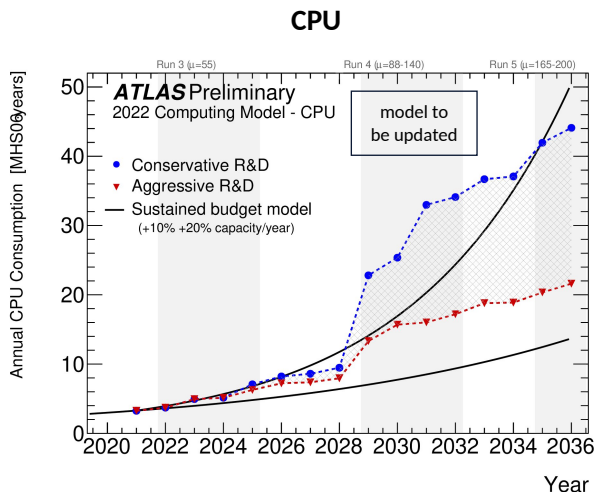
LHC / HL-LHC Plan

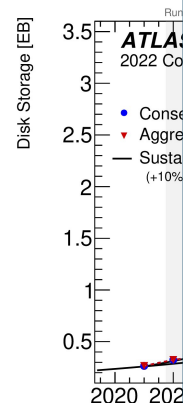
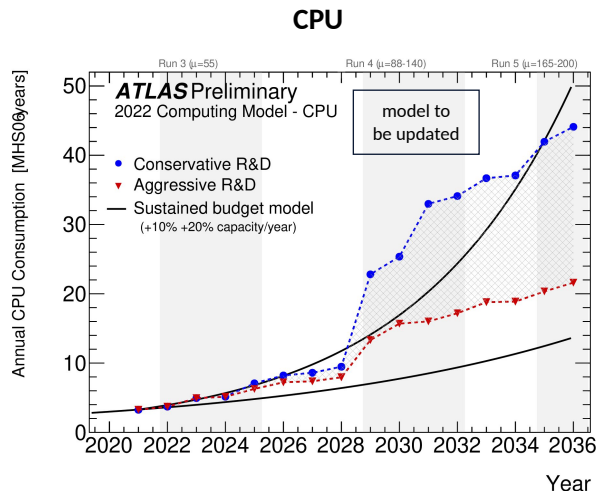


Challenging trigger rate and event complexity!

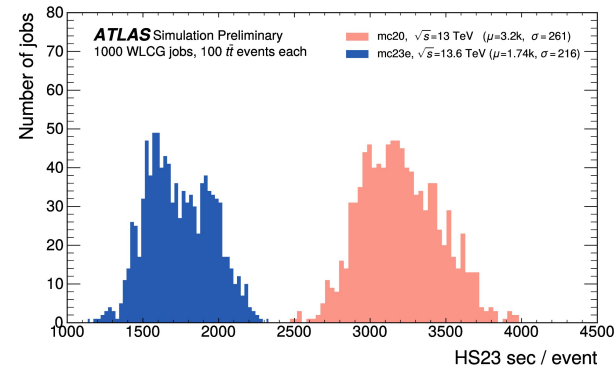
90% of integrated luminosity yet to come!

Resource prospects for the HL-LHC





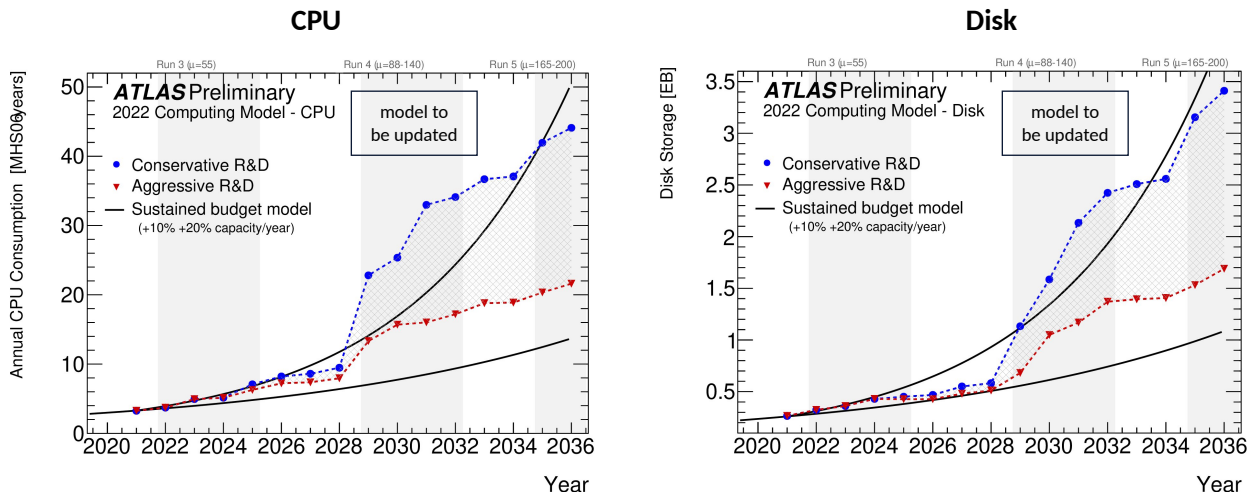
Example: ATLAS significantly improved simulation of particle interaction with detector



Serious improvements on resource efficiency required at all levels:

- Storage / CPU / GPU needs - data formats, algorithmic improvements

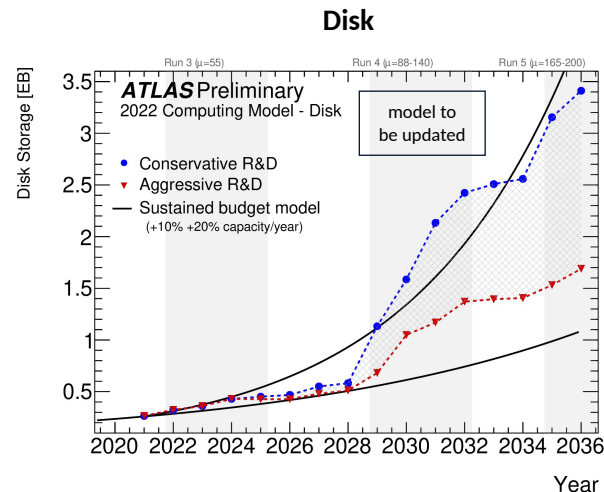
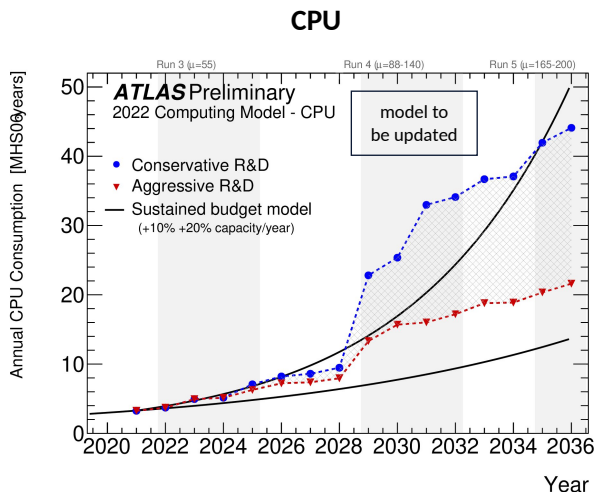
Resource prospects for the HL-LHC



Serious improvements on resource efficiency required at all levels:

- Storage / CPU / GPU needs - data formats, algorithmic improvements
- Power supply / usage (see also poster about SUSFECIT project)

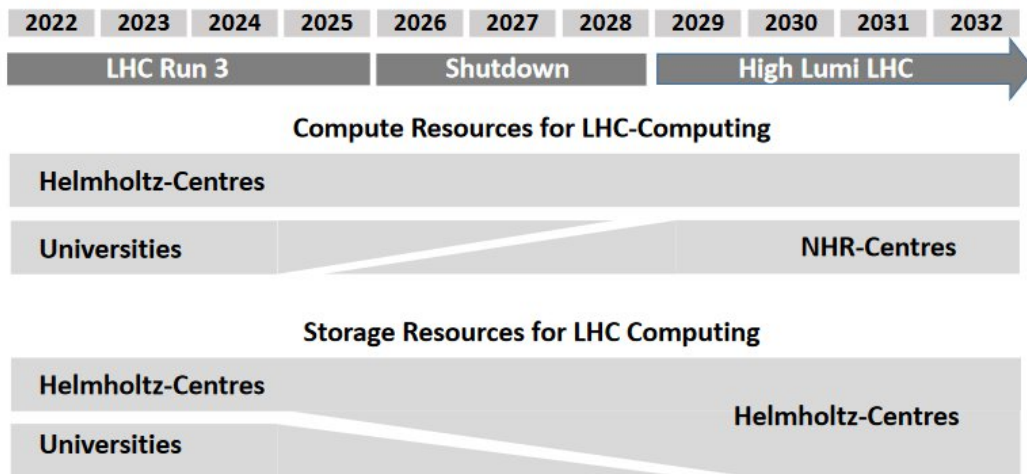
Resource prospects for the HL-LHC



Serious improvements on resource efficiency required at all levels:

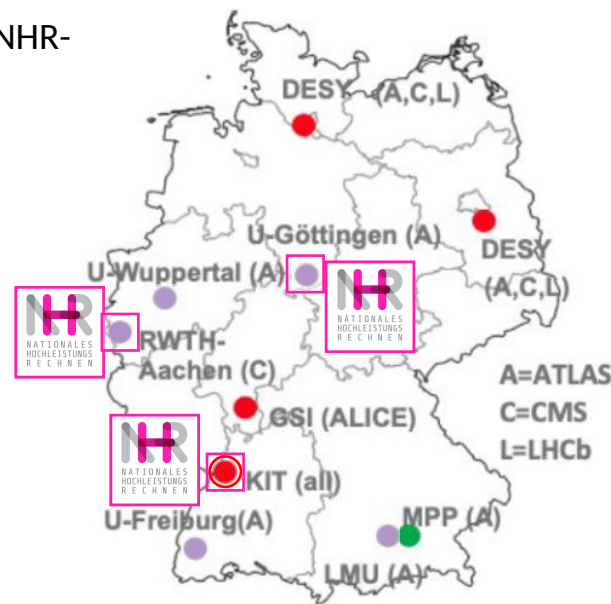
- Storage / CPU / GPU needs - data formats, algorithmic improvements
- Power supply / usage (*see also poster about SUSFECIT project*)
- Efficiency of data centres

Transition ongoing from university-based Tier-2 centres to Helmholtz- and NHR-Centres:



NHR-Centres at Göttingen and KIT take over CPU provisioning for ATLAS from four university-based Tier-2 centres, hence will provide respectively 50% of the total previous university contributions from 2030 on.

=> „Local“ transition in Göttingen with increasing responsibility!



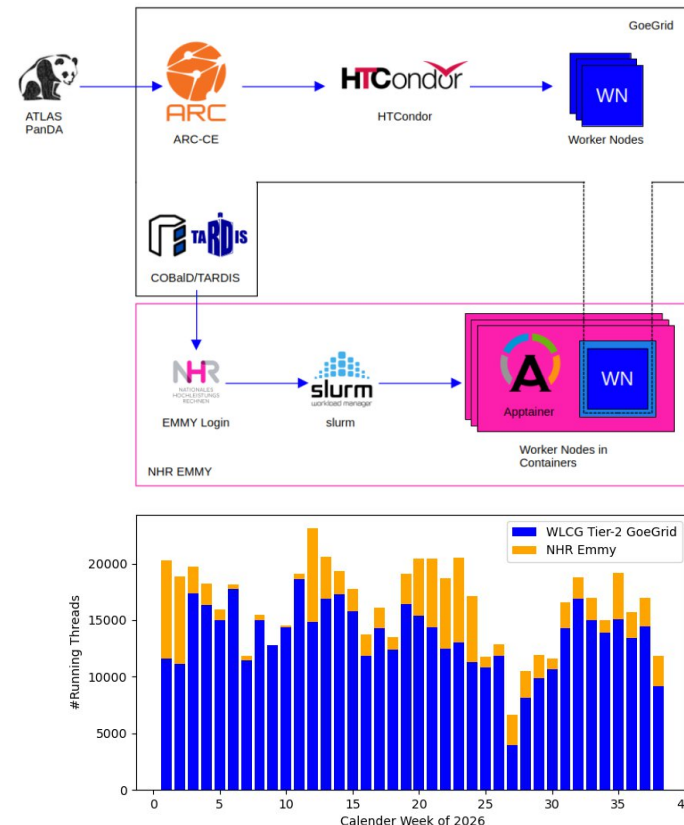
Helmholtz Centres
Max-Planck-Institute
Universities

Challenges and Synergies

- No standard use case for NHR centres:
 - Highly automatised workflows / workload distribution
 - Large data I/O between computing centres (*more on data transfers in next talk*)
 - Limited flexibility due to standardised methods within LHC collaborations and/or WLCG

Luckily, our local NHR&GWDG colleagues are very supportive and don't deny individual solutions where necessary!

- Concentration of many users and research fields in few efficient data centres (less overhead, large centralised procurement and operation)
- LHC collaborations provide workload 24/7 and utilise available resources



- Scientific computing at the Exabyte-Scale
- Efficiency at all levels highly important to meet resource limitations and output goals of HL-LHC
- In Germany: Transition from university-based Tier-2s to Helmholtz- and NHR-Centres ongoing
- Increasing responsibility of Göttingen in the provisioning of compute resources

Thank you for your attention!