

# KET Document

## “Perspective for Computing in the HL-LHC Era”

### Toward its Implementation



“Excellent IT infrastructure indispensable to transform data into knowledge”

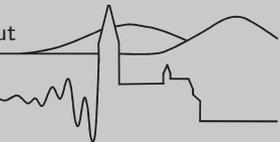
Albert-Ludwigs-Universität Freiburg

Markus Schumacher  
KET Annual Meeting  
Bad Honnef, 18 November 2022

Physikalisches Institut

Albert-Ludwigs-

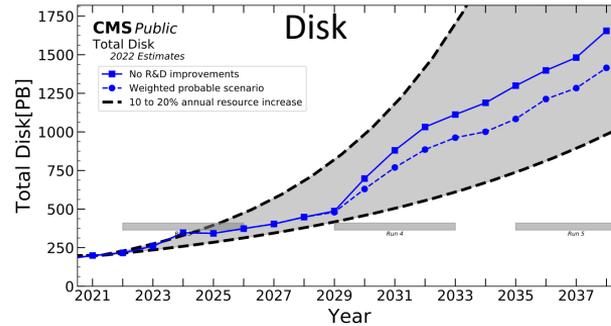
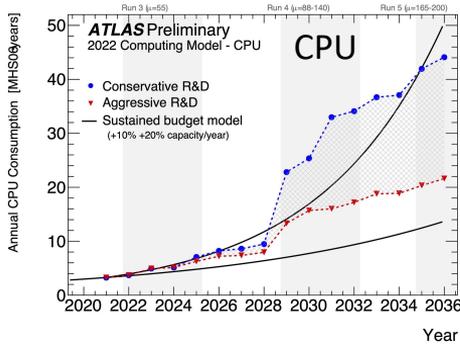
Universität Freiburg



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# Reminder: Motivation for „Perspective Document“

## Significant increase in requirements of resources for HL-LHC



Despite successful R&D for more efficient software, modified computing model and technological advancement in hardware flat budget probably not sufficient

Aspects of green IT - for very good and obvious reasons - get more important

## WLCG recommends for future provisioning of resources

- concentration of mass storage to fewer sites (less copies, better QoS, ..)
- common and simultaneous usage of HPC centres and other heterogeneous resources in science disciplines overarching effort

## → Transformation of provisioning of pledge-able resources in Germany to WLCG

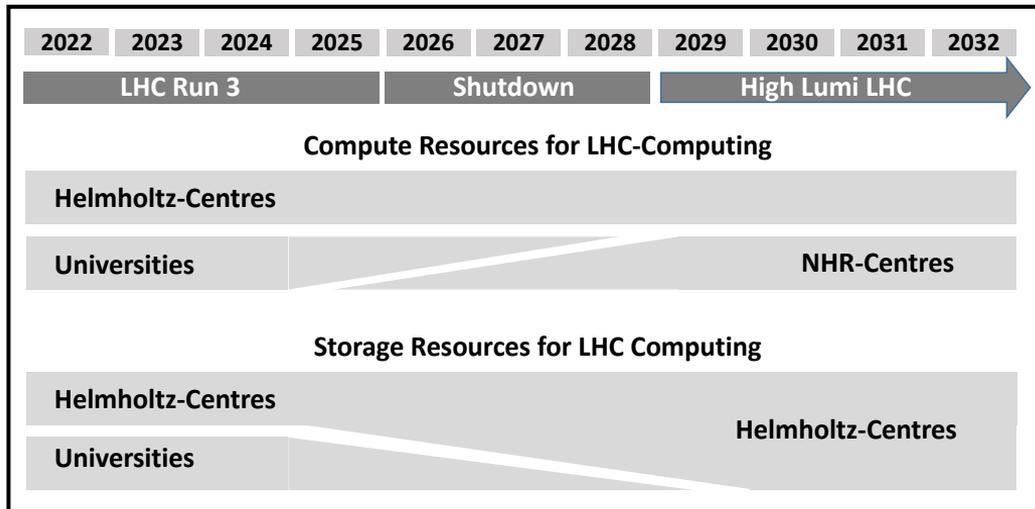
- increase resource and energy efficiency in new model for provisioning of resources
- foster new synergies between different science disciplines

# Formation Process: from First Ideas to Approval by KET

- First presentation of basic concept and discussion in dedicated meeting in April 2021  
Participants: Resource Providers, FSP-Spokespersons, KET, KET-C&S-Panel, ....
- First version of document after several iterations in late summer/autumn 2021  
Including many comments from several smaller discussion sessions
- General public discussion at KET Annual Meeting in November 2021  
Subsequent significant revision of the document until February 2022  
w.r.t. structure and motivation but not concerning the basic idea and content
- Final textual adjustments until March 2021 (several iterations with many contributors)
  
- Document approved by KET on 21.3. 2022
- BMBF and PT-DESY have "unofficially" been informed
- Presented during RECFA visit on 1.4. 2022 by Michael Dührssen-Debling (for M.S.)
  
- Consensus reached after fruitful, long and wide discussion between all involved parties
- Cordial thanks to all contributors and in particular to Uli Uwer (former KET spokesperson and co-editor)

# Transformed Model for WLCG Resources in Germany

- Complete pledged WLCG mass storage to be provided by Helmholtz Centres (DESY, GSI, KIT) and MPP Helmholtz Centres to take over the pledges from university Tier-2 Centres
- CPU pledge from University Tier-2 Centres to be provided by NHR centres  
strong believe that NHR centres predestined for this task according to their mandate



- Experiment specific developments and operation of WLCG cloud by university groups at current Tier-2 Centres

Transition period 2025-2028:

- already available hardware will be operated at university sites
- new resources to be installed and provided at Helmholtz and NHR centres

*„The proposed transformation builds an important headstone for a furthermore powerful and concurrently even more energy- and resource-efficient LHC computing in Germany“*

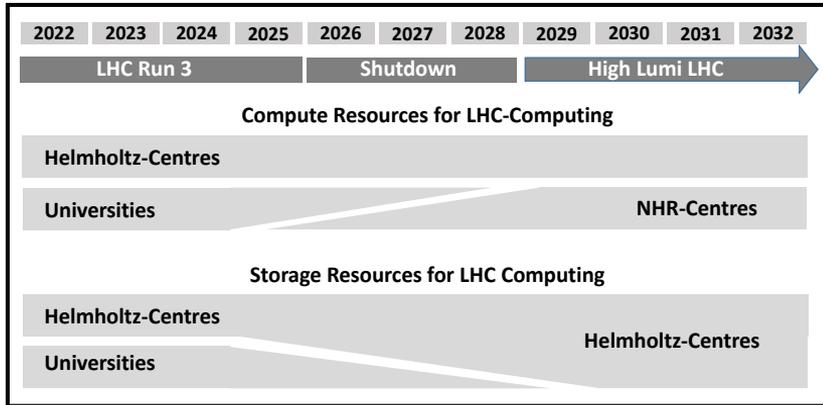
From strategy document by KET [https://www.ketweb.de/sites/site\\_ketweb/content/e199639/e312771/KET-Computing-Strategie-HL-LHC-final.pdf](https://www.ketweb.de/sites/site_ketweb/content/e199639/e312771/KET-Computing-Strategie-HL-LHC-final.pdf)

# Next Steps after Publication

- Informal phone calls with Chair of *NHR-Verein* C. Schütte (Zuse-Institut on 20.4.) and Chair of *NHR-Strategieausschuss* R. Krause (USI Lugano, 30.5.)
  - both were generally and unofficially very positive and welcomed the future usage of the NHR centres by our community / LHC experiments (my personal impression)
  - but obvious open/critical points (already described in KET document) were addressed immediately:
    - allocation of CPU time (project based for university groups vs „pledged“)
    - specific needs from our community (operation model, access rights, network, caches ,.. )
- Official distribution of „perspective document“ with individual accompanying letters on 1.6. to representatives of BMBF, Helmholtz Association and NHR-Committees  
With the plea to discuss next steps in bilateral or common meetings and in the letter to Mr. Dietz with the additional plea to support and accompany the process
- My conclusion from all three answers:
  - in general feedback positive and encouraging
  - problems have been recognized and are addressed clearly in answers
  - offer to follow-up and for detailed discussions in order to try to solve open issues

# Towards Complete Mass Storage at Helmholtz Centres (+MPP)

- Good fruitful online meeting with Herrn Wiestler on 14.9. 2022 (Lutz F. and M.S.)



*„KET supports the proposal for the entry of “Upgrade Tier Centres for HL-LHC” in the Helmholtz-FIS-Roadmap emphatically”*

Originally entry on roadmap foreseen for 2025

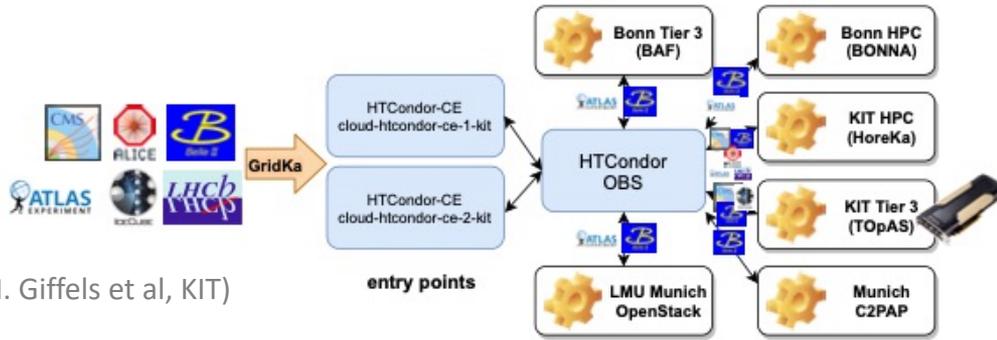
- KET expressed wish, that a definite statement from the Helmholtz Association by spring 2023 (before BMBF call) stating support of the KET strategy and confirmation of providing the additional resources would be desirable
- Timeline in proposal for roadmap entry has been shifted by two years i.e. start now in 2027
- Meeting of *Helmholtz-Forschungsbereichsplattform “Matter”* on 4.11. in BMBF
  - “Upgrade Tier Centres for HL-LHC” is the only entry from field “Matter” for FIS-Roadmap in 2027
- Even if roadmap entry will finally be approved a gap in funding for 2025 and 2026 may exist
- ➔ use the offer for a follow-up meeting with Herrn Bohnet (Chief Research Manager “Matter”)

# Towards Usage of CPU Resources at NHR Centres

- Presentation of strategy document in Meeting of GridKa Overview Board on 29.4  
Chair of NHR@KIT / HoreKa Martin Frank has been invited as guest  
Positive and supportive feedback with hints to known open questions
- KET Software and Computing asked (14. July) to provide feedback / advice on
  - Requirement in network, caches and CPU power for transferring university pledges to NHR centres
  - Development of a detailed operation model for integration of  $n$  NHR centres in the WLCG workflow
- Preparation of „Requirements and Operational Model for the Usage of NHR-Centres“ document“
  - First meeting of KET C&S panel on 16.9. presenting proposed concept and collecting ideas f
  - First version (editors: G. Duckeck and T. Kuhr) circulated to KET-C&S panel on 24.10.
  - Detailed discussion in KET-C&S panel 15. November discussed in KET-C&S panel
  - Next (final?) version by end of November and then discussion and approval in KET  
will provide important input for further discussions with representatives from NHR
- Presentation of “KET Perspective Document” and some indisputable items from “Requirements and Operational Model Document at “NHR Computational Physics Symposium” (8.11.)

# Integration of HPC Resources: Technical Aspects

- The technical realisation of the integration of multiple HPC centres in WLCG workflow has already been proven impressively and successfully



(M. Giffels et al, KIT)

But pilot runs and temporary opportunistic usage not equivalent to continuous large scale operation

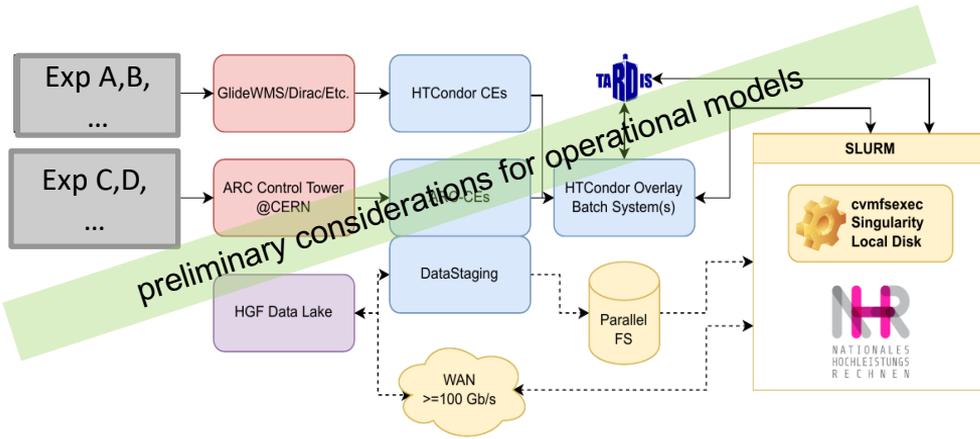
Future continuous R&D work at least at current level indispensable

- These are results of past and ongoing R&D efforts funded within the BMBF program ErUM-Data (FP19-21: IDT-UM Chair T. Kuhr, FP21-24 FIDIUM Chair A. Schmidt)
  - development and optimisation of job orchestration on heterogenous resources operation
  - development and optimisation of caching solutions for operation of sites w/o mass storage
  - development of monitoring and accounting frameworks



and other tools like “Compute-Site-in-a-Box”, “Disk-Caching-on-the-Fly”

# Towards Model for „Integration“ of NHR centres in WLCG



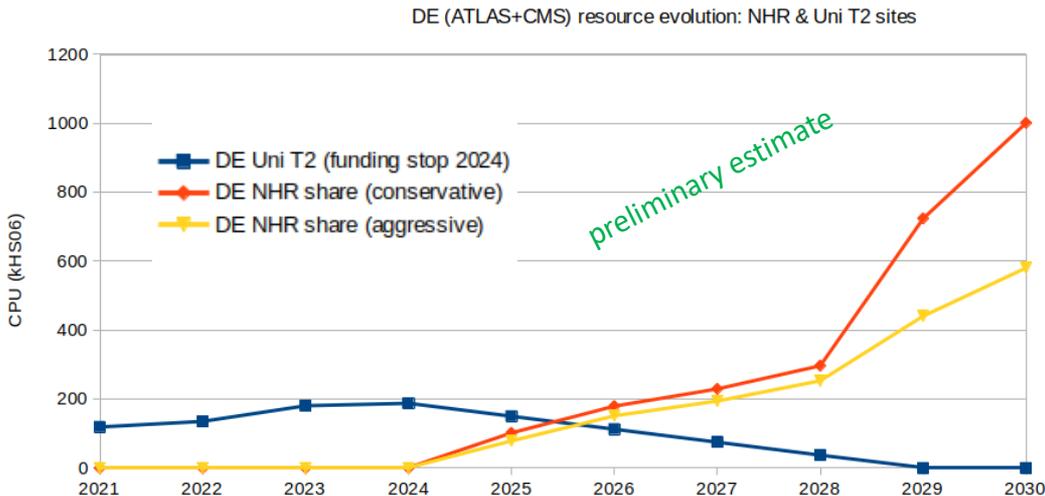
## Requirements at NHR centres (prel. examples)

- support of container solutions
- implementation of specific edge services and software stacks
- in- and outgoing internet access of sufficient bandwidth on compute nodes
- eventually small fast caches at NHR sites
- .....

( from Requirements and Operation Model Document compiled by KET C&S Panel)

- Operation of WLCG and experiment specific services to be provided and continuous R&D for needed tools (orchestration, caching, monitoring, accounting, ..) to be performed by university groups currently operating WLCG Tier-2 centres
- R&D work and expertise in operation by university groups should be beneficial for *NHR-Verein* → foster new synergies and cooperation between different science fields

# „Required“ Pledge-able CPU Resources at NHR Centres



G. Duceck, KET-Computing&Software-Panel (preliminary)

- 1 today's logical core typical ~ 10 HS06  
moderns cores up to 20 HS06
- amount of CPU resources at "typical"  
NHR centre  $\geq$  60 000 logical cores

CPU amount did not shatter representatives  
from NHR-Verein during NHR symposium

## Different way of granting CPU resources is (hopefully) the largest open issue

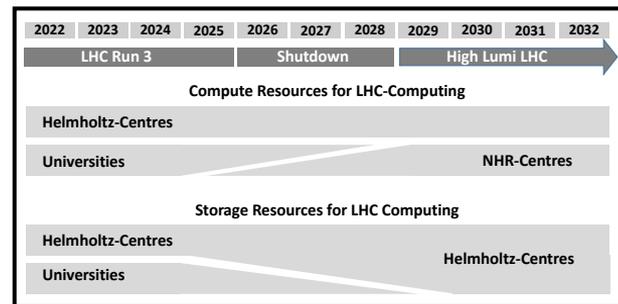
- NHR: university groups apply for amount of CPU hours for specific research project
  - WLCG: university sites pledge a constant amount of CPU resources for next year
- ➔ desirable to find a common solution to allow delivering of NHR resources to WLCG

NHR-Strategieausschuss will meet on 21. 11. and will provide some first feedback afterwards

# Conclusions

KET community has developed a vision for a transformed provisioning of compute resources in the HL-LHC era

- mass storage at Helmholtz centres and MPP
- CPU resources at Helmholtz centres, MPP and NHR centres (replacing contribution of universities)



Design of an operation model for usage of NHR centres in good progress (at least from KET side)

Technical challenges are demanding but solvable with continuous successful R&D work

Significant progress made in ErUM-Data funded R&D compounds IDT-UM and FIDIUM

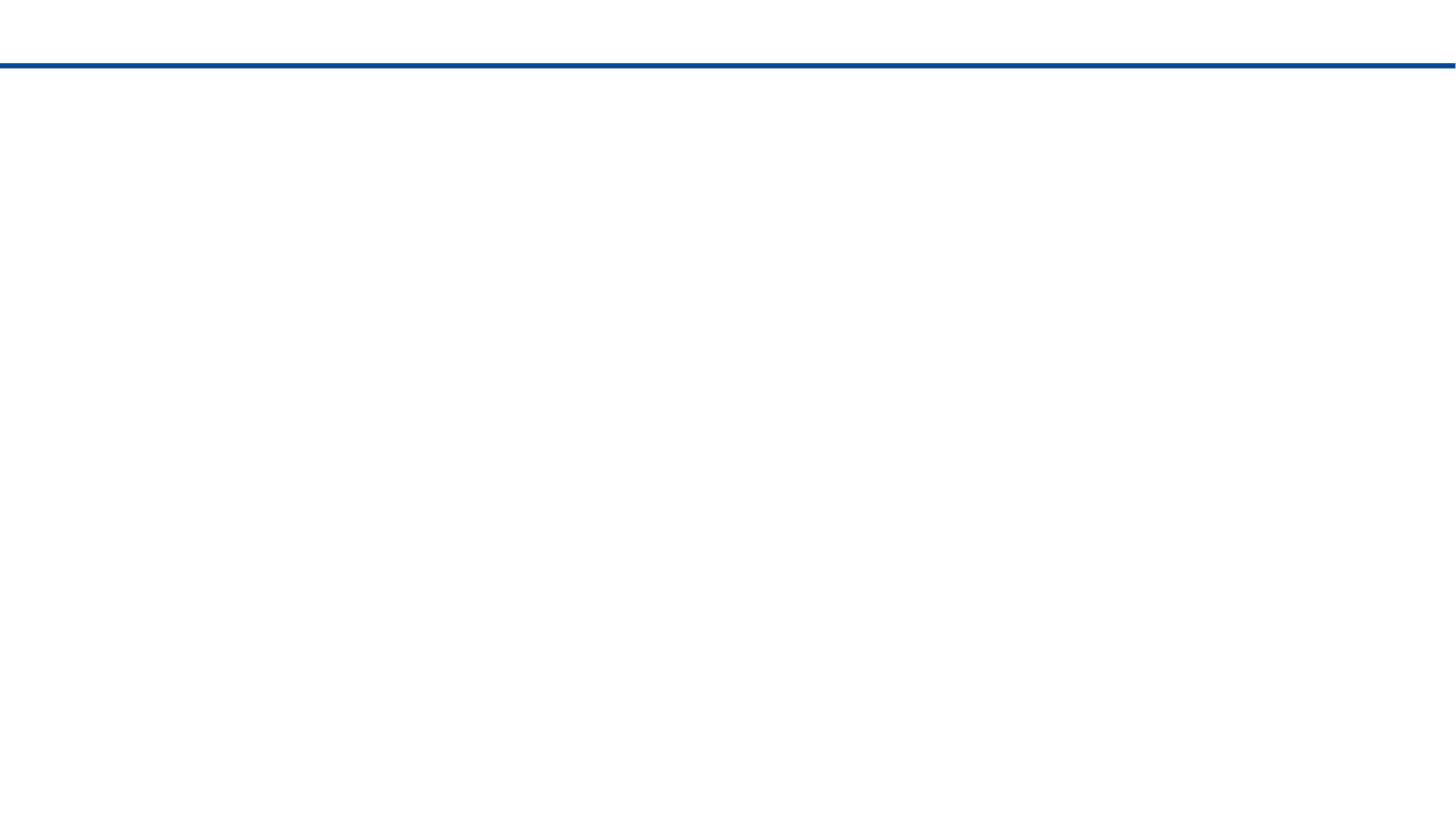
This activities need to be sustained beyond 2024

So far feedback from Helmholtz Association and NHR Committees positive and encouraging

Definite and timely statements by both bodies to take over the pledges from universities appreciated

Ongoing discussion shall hopefully reach this goal before applications for new funding period

KET is grateful for and appreciates the past, current and future support and guidance by BMBF in the process of realizing the “KET perspective for computing in the HL-LHC era”



# Provisioning of WLCG-Resources in Germany (status)

## WLCG: World Wide LHC Computing Grid

- Approx. 170 federated sites worldwide with tiered structure
- Very successful operation for almost two decades with very high availability and reliability
- Resources are pledged and available 24/7
- German share corresponding to fraction of authors between 10 and 25% depending on experiment
- Involvement of universities important for education and recruitment of young scientists in the area of federated HPC and HTC computing

## In Germany 10 Sites and 3 Funding Agencies

### Helmholtz Centres DESY, GSI, KIT

Tier-1 centre GridKa at KIT (100% Tier1-D)

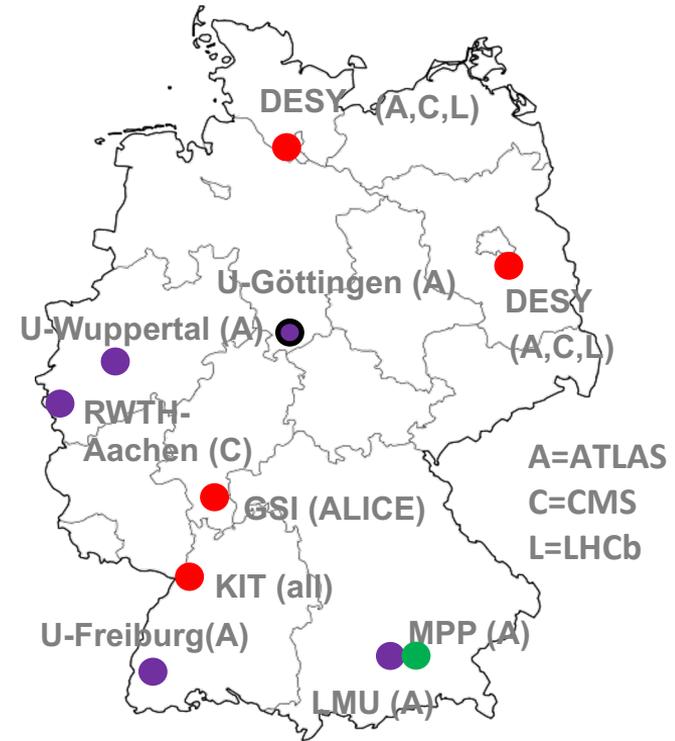
Tier-2 centres at DESY and GSI (58% Tier2-D)

### Max Planck Institute for Physics Munich (MPP)

Tier-2 centre integrated in MPCDF (7% Tier2-D)

**Universities:** 5 Tier-2 centres (35% Tier2-D)

Aachen, Freiburg, Göttingen, Munich (LMU), Wuppertal



5 Universities provide 34% (57%) of German Tier-2 resources for CMS (ATLAS) experiments

# Zentrale Aussagen im KET-Computing-Perspektivpapier

***Die Teilchenphysiker:innen in Deutschland unterstützen den Eintrag des „Upgrade Tier Centres for HL-LHC“ in die Helmholtz-FIS-Roadmap und den entsprechenden Antrag mit Nachdruck und hoffen auf die Unterstützung durch die Helmholtz-Gemeinschaft.***

***Der gesamte von Deutschland zugesagte Beitrag zum WLCG-Massenspeicher sollte in der HL-LHC-Phase von den drei Helmholtz-Zentren DESY, GSI und KIT bereitgestellt werden.***

***Die Helmholtz-Gemeinschaft und die Geldgeber beim Bund werden gebeten, den Dialog über die Bereitstellung des WLCG-Massenspeichers an den Helmholtz-Zentren aufzunehmen und mögliche Finanzierungsmodelle vorzuschlagen.***

***Die NHR-Zentren sollen die universitären WLCG-Tier2-Standorte bei der Bereitstellung der Rechen-Ressourcen ablösen und deren Rechenleistung für das LHC-Computing ab dem Jahr 2029 im Rahmen des WLCG bereitstellen.***

***Die Teilchenphysiker:innen bitten das BMBF, ihre Anliegen im Hinblick auf IT-Infrastruktur und Vergabe von Rechenzeit in den Diskussionen mit den NHR-Zentren und mit deren Strategieausschuss mit Nachdruck zu unterstützen und den notwendigen Diskussionsprozess zu begleiten.***

***Die Teilchenphysiker:innen bitten das BMBF um die nachhaltige Begleitung und Unterstützung des skizzierten dynamischen Transformationsprozess für das zukünftige LHC-Computing.***

# Zusammenfassung und Schlusssatz

## Zusammenfassung der vorgeschlagenen Transformation des Computingmodells für den HL-LHC:

- Die Helmholtz-Zentren DESY, GSI, KIT übernehmen bei der Bereitstellung der WLCG-Ressourcen die zentrale Rolle, im Besonderen soll durch sie der gesamte Massenspeicher bereitgestellt werden.
- Die NHR-Zentren unterstützen den Transformationsprozess im Bereich der rechenintensiven Aufgaben durch Übernahme des Beitrags zu den Rechen-Ressourcen von den universitären WLCG-Tier2-Zentren.
- Den universitären Gruppen an den derzeitigen universitären WLCG-Tier2-Standorten kommt bei der Umsetzung der Transformation eine zentrale Rolle zu, sowohl bei den notwendigen F&E-Arbeiten, als auch beim WLCG- und experimentspezifischen Betrieb und der Nutzerbetreuung.

Der zeitliche Verlauf der Transformation in der Bereitstellung der Ressourcen ist in der Abbildung qualitativ dargestellt.<sup>6</sup>

Die vorgeschlagene Transformation bildet einen wichtigen Grundstein für ein weiterhin leistungsfähiges und gleichzeitig noch energieeffizienteres und ressourcenschonenderes LHC-Computing in Deutschland.