

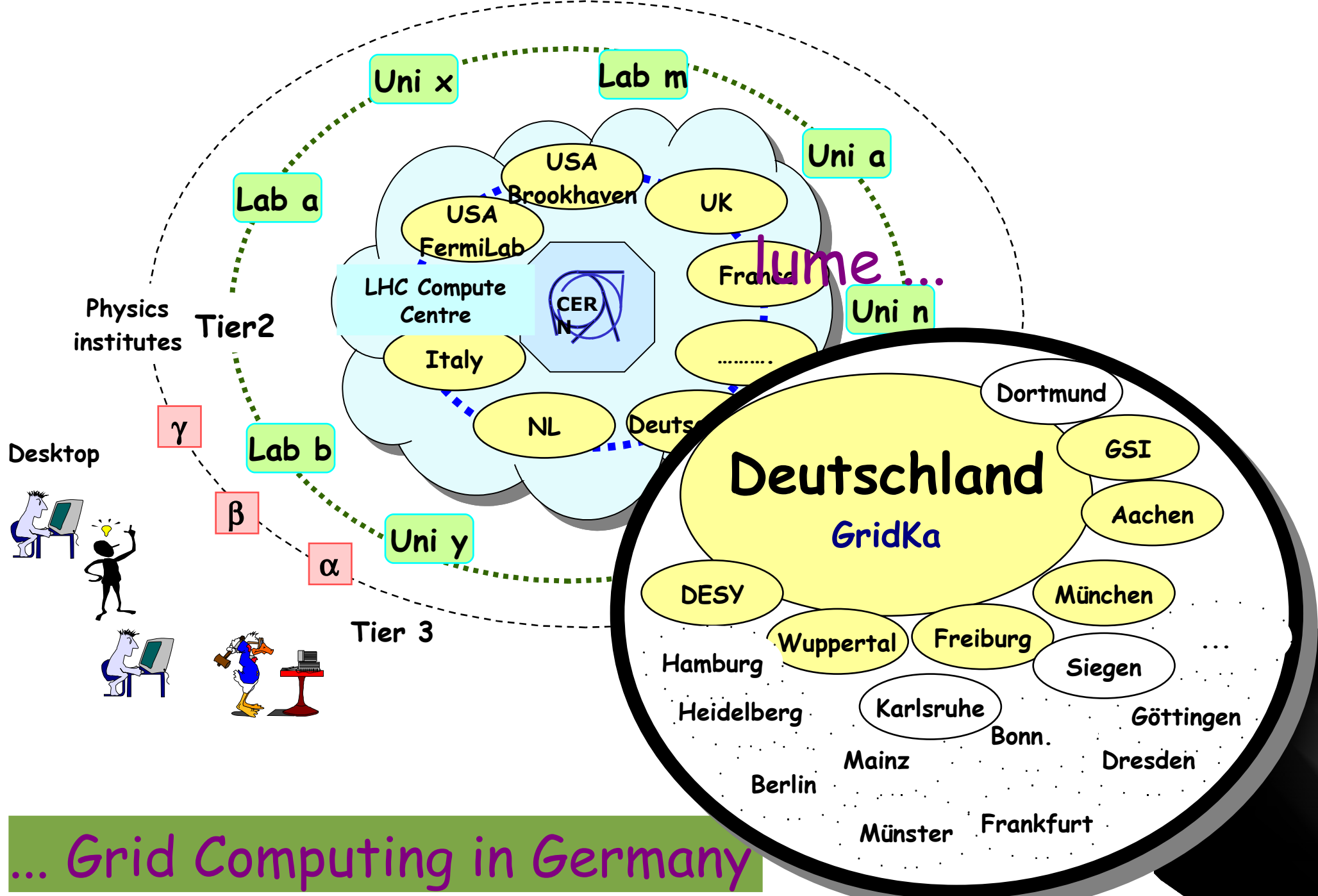


Computing for LHC in Germany

Günter Quast
Universität Karlsruhe (TH)

Meeting with RECFA
Berlin, October 5th 2007

- WLCG Tier1 & Tier2
- Additional resources for data analysis
 - HGF "Physics at the Terascale"
 - D-Grid
- Grid Computing for HEP in Germany





PHYSICS AT THE TERASCALE
Strategic Helmholtz Alliance



Together building a performant Grid Structure for LHC Data Analysis

- Tier1 / Tier2 / Tier3 (=Institute clusters)
 - embedded within the international LHC-Grid
 - Participation in data and service challenges
- **Grid sites:** FZK, DESY, GSI, MPI and installations at (so far) 7 universities
- **very active user communities**
- **frequent training and schools**
- **analysis facilities are emerging**
(funded by universities, BMBF & HGF)

LHC grid is largest Grid in Germany

LCG Sites in Germany

- Desy Hamburg u. Zeuthen
- Uni Dortmund
- Uni Wuppertal
- Uni Siegen
- RWTH Aachen
- GSI Darmstadt
- GridKa Karlsruhe
- Uni Karlsruhe
- Uni Freiburg
- MPI München
- LMU München

X=non-HEP

October '07
list is growing !



Particle physics groups are important
partners in the German D-Grid initiative

GridKa, the German T1

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Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft



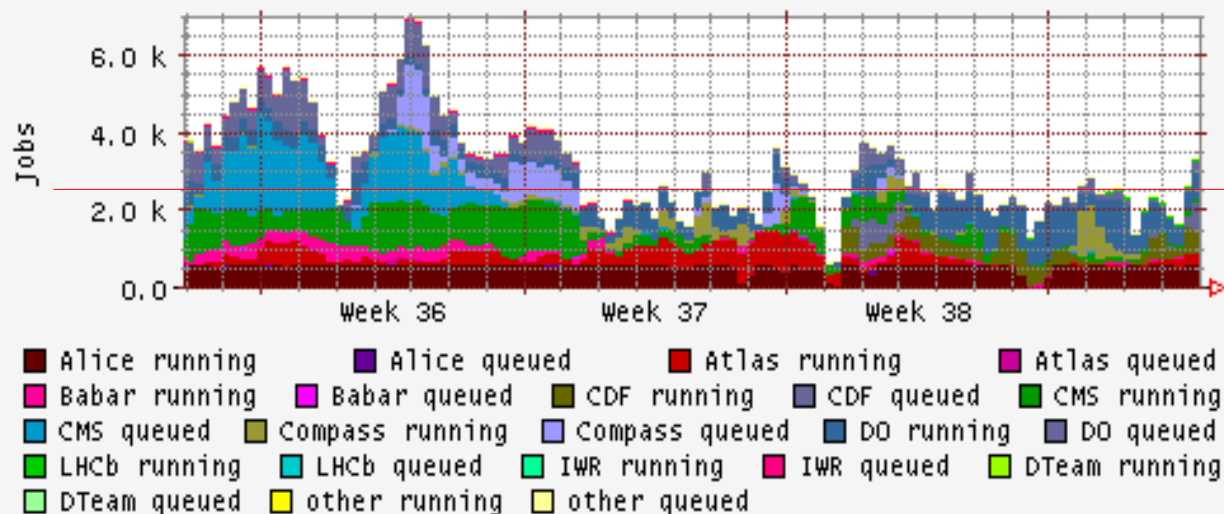
Forschungszentrum
Karlsruhe, member of
the Helmholtz Association

- inaugurated in 2002
- well established Tier1
- Supports
 - ALICE
 - ATLAS
 - CMS
 - LHCb
- & 4 non-LHC experiments
- Global Grid User support ("GGUS")
- Certification Authority ("CA") for Germany

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GridKa Jobs Last month (per Experiment)



Presently, GridKa has
 ~2500 job slots
all are permanently in use!
Will rise by a factor of ~4 in 2008

Successful participation in WLCG and experimental Service Challenges

GridKa Resources

as pledged in WLCG MOU; funding already approved until 2009

~1 average T1 for ALICE, ATLAS, LHCb

~10% of CMS T1 computing (< 1 average T1)

FZK-GridKa	2007	2008	2009	2010	2011
CPU (kS12K)	1860	7140	11545	17388	
Disk (Tbytes)	880	3261	5152	8075	
Tape (Tbytes)	1010	3443	7514	11763	
Nominal WAN (Mbits/sec)	10000	20000	20000	20000	20000

Collection of **resource requests** 2010-2012 started; reviewed by GridKa Technical advisory board and later by Overview Board, will lead to funding request to FZK/HGF

GridKa

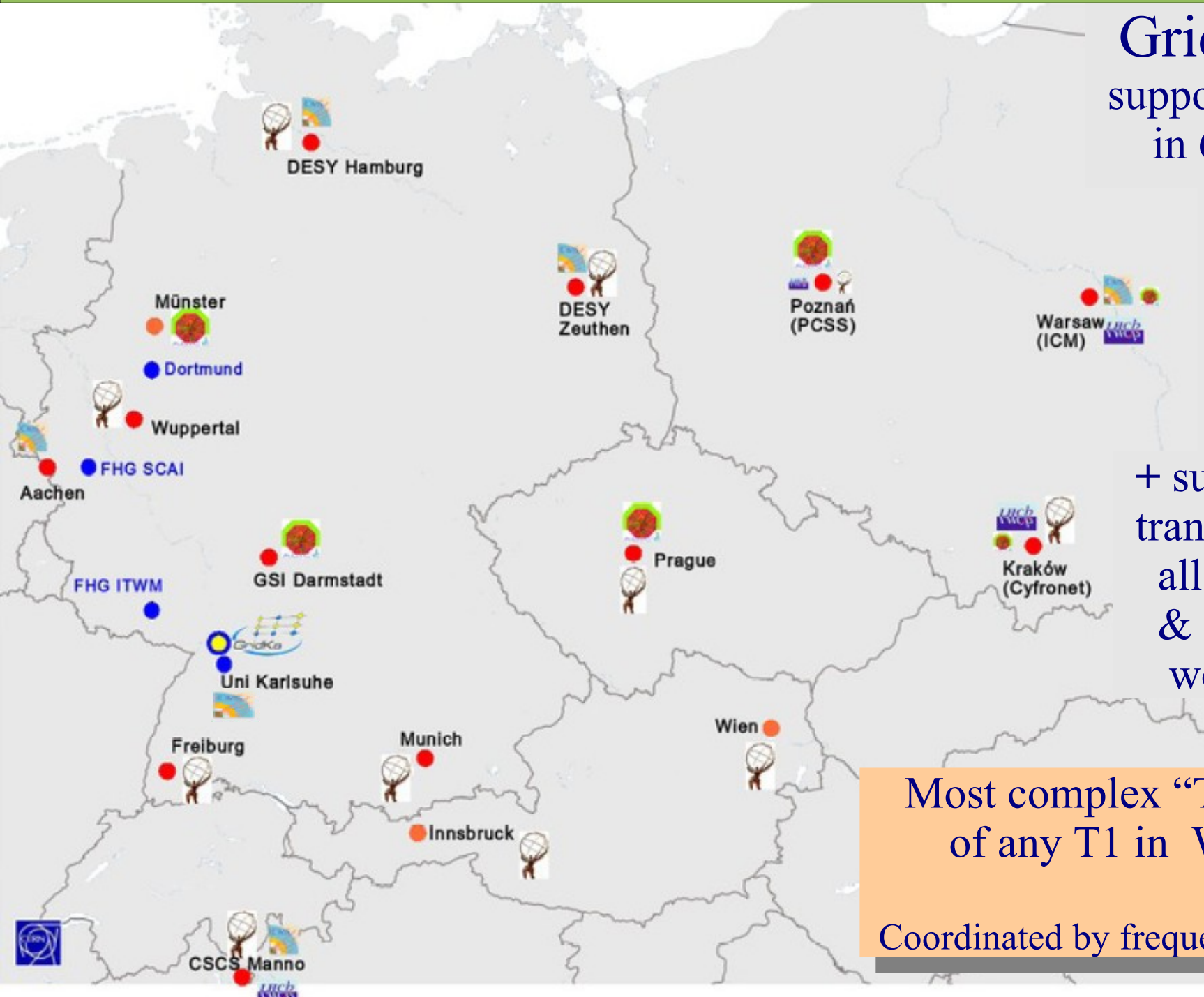
supports >20 T2s
in 6 countries

Alice T2 sites
in Russia

+ successful data
transfers from/to
all CMS T1
& >20 CMS T2
world-wide

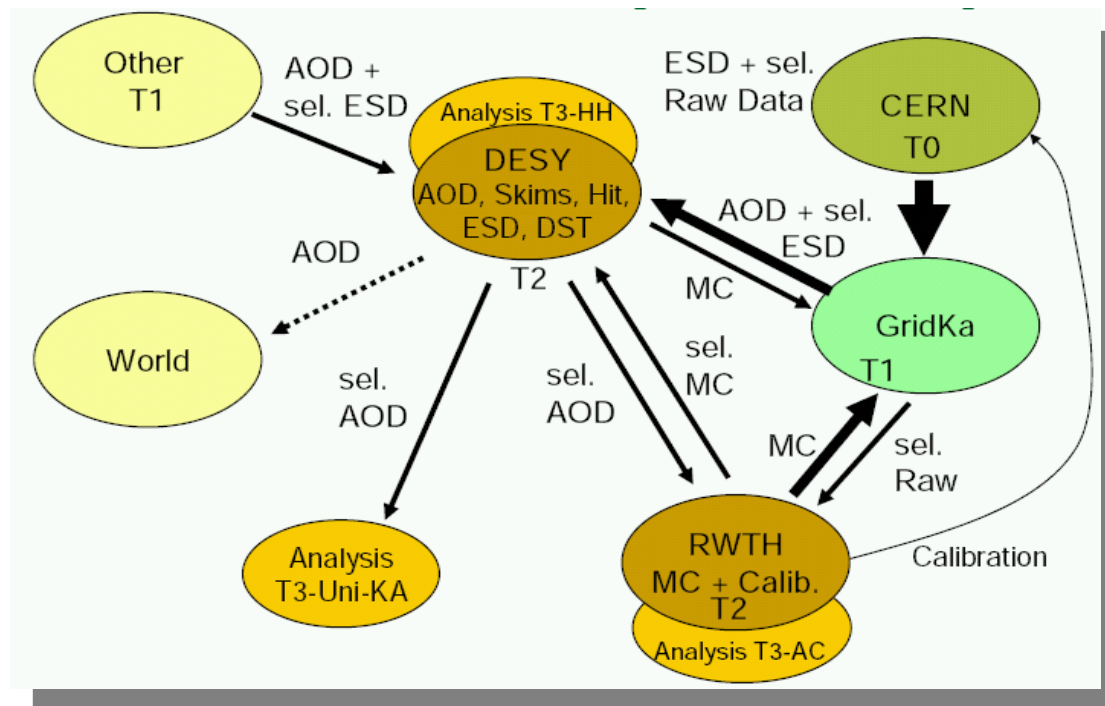
Most complex “T2 cloud”
of any T1 in WLCG

Coordinated by frequent T2 meetings



T2 Structure in Germany

7



Federated CMS T2 Aachen-DESY
1.5 average CMS T2

GSI Darmstadt is **ALICE** T2

Planned:

DESY/Dortmund/MPI Heidelberg
as future **LHCb** T2 for MC production

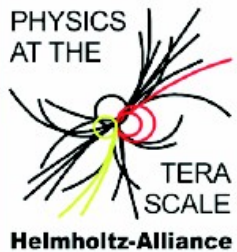
3 average ATLAS T2 distributed over 5 sites; 6th partner (Göttingen) being discussed

(see Appendix for numbers on T2 sizes)

Before July 2007:

Funding only for **1 ATLAS & 1 CMS T2 @ DESY** (Hamburg & Zeuthen)
½ ATLAS T2 @ MPI Munich
~¼ CMS T2 @ RWTH Aachen in 2008
1 ALICE T2 @ GSI Darmstadt

Since July 2007: Alliance of HGF Institutes and German Universities
„Physics at the Terascale“ approved and active.



Provides additional funding over a period of five years for

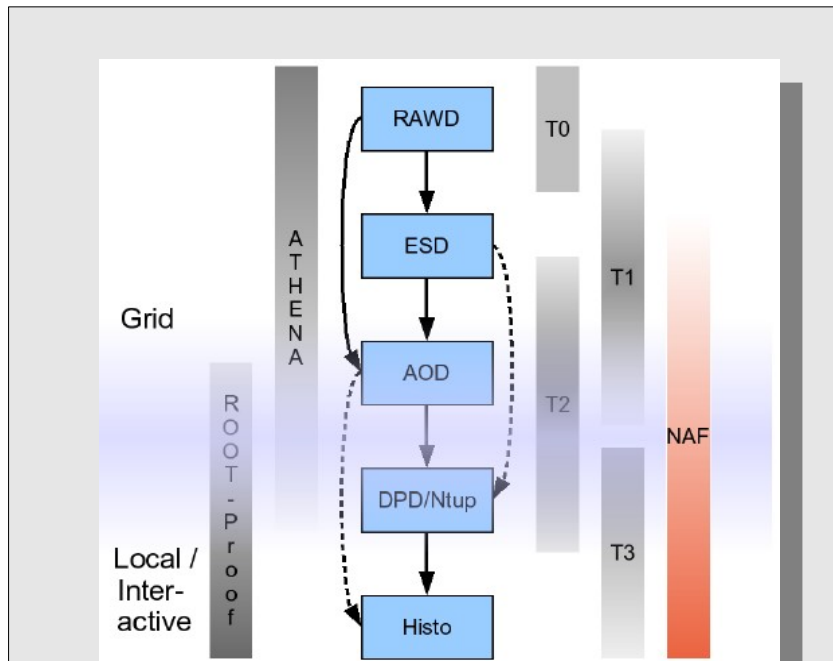
- **T2 hardware at universities** (~3M€ over 5 years)
 - 3 · ½ T2s for ATLAS @ Freiburg, Munich & Wuppertal
 - ½ T2 for CMS @ RWTH Aachen
- hardware operation and grid services secured by universities
(cost exceeds HGF funding!)
- funding of **personnel for experiment-specific tasks**
by BMBF (~8 FTE for ATLAS & CMS T2s)

- **WLCG MOU resources pledged by all sites;**
- **participation in WLCG and experimental challenges with prototypes**

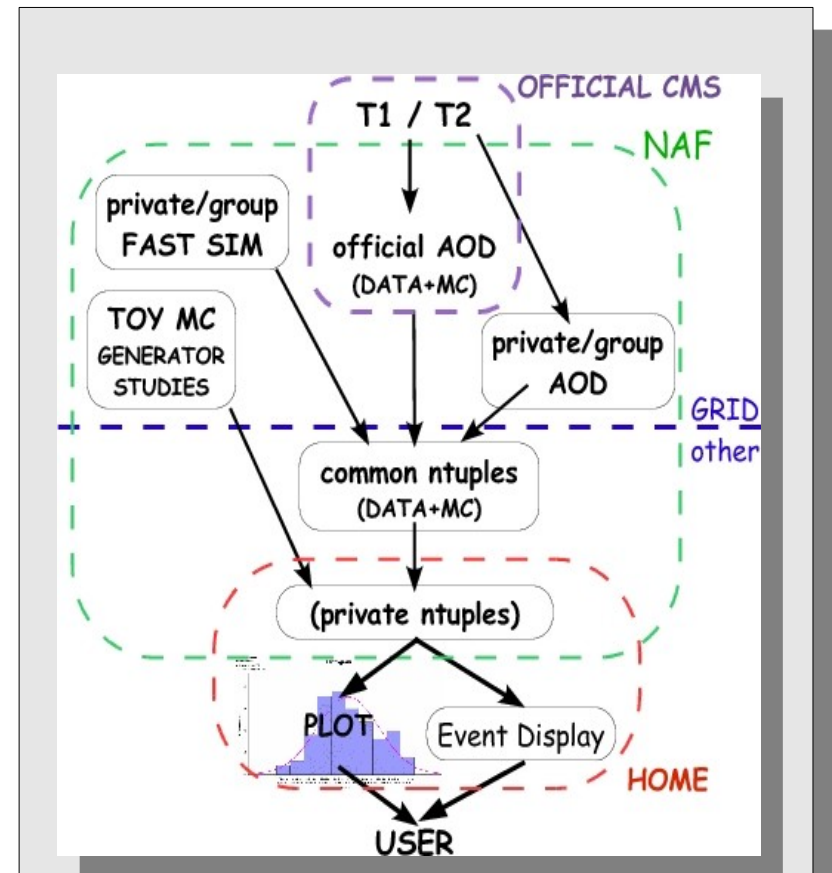
Also need dedicated user analysis facilities

- institute clusters @ universities
- National Analysis Facility („NAF“) @ DESY)
- D-Grid resources dedicated to HEP @ D-Grid sites

Required size approximately equals T2 capacity, services are complementary !



Data samples and Analysis in ATLAS
German Atlas groups, Aug. 2007



Data samples and proposed services of
CMS Analysis Facility

D-CMS Workshop, DESY June 2007

Requirements specified by ATLAS and CMS , presently under review by DESY IT
Long-term goal: „Virtual IT centre“ for LHC analysis

Funding for development work within Helmholtz Alliance

Grid Computing

Improved Grid

- Virtualization
- Application-driven monitoring
- Development of NAF tools

Data Storage + Retrieval

- Mass storage
- Data Access

Virtual Computing Centre

- Computing resources Tier 2
- National Analysis Facility
- High performance network
- User friendliness
- Grid-based mass storage

R&D on Grid Tools:

- Virtualisation of resources
- Application driven monitoring
- Data access management

Grid Training

Funding by Helmholtz Alliance for Grid projects:

6.7 M€ over five years (hardware & personnel !!)

Contributions by partners

(personnel, operation and maintenance of hardware):

15,3 M€ over five years

Projects

Hardware: - Tier2 at DESY and three Universities
- National Analysis Facility

Network: Virtual private network among HEP sites

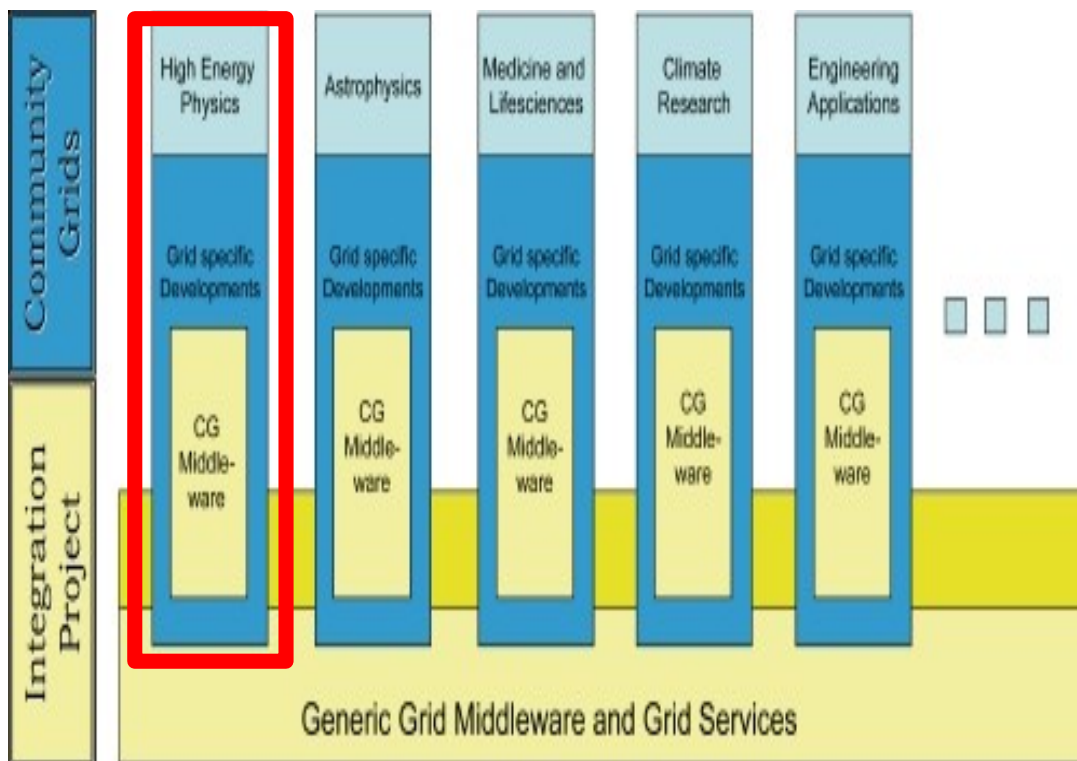
Workpackages:

WP1: Establishing a virtual computing centre

WP2: Development of GRID tools and optimization of GRID components

WP3: Training, workshops and schools

D-Grid projects



Goals of HEP project:

- distributed and dynamic data management, job scheduling, accounting and monitoring of data resource utilization
- automated user support tasks, monitoring of jobs, error identification and enabling direct access to executing jobs for early control and steering
- Grid technologies for individual scientific data analysis.

9 partners from HEP and computer science

Additionally, D-Grid initiative provided extra funding for Hardware share of HEP and Hadrons&Nuclei in 2007: ~4.0 M€ (will be integrated in national grid and analysis infrastructure @ T1 and T2 sites and some universities)

Tier3 & Analysis centres funded by :

- Universities: clusters with 50-100 CPU cores, several 10 TB storage
- HGF Alliance: CPU & Storage resources & Personnel
volume: ~1M€ over five years for NAF@DESY
~40 FTE years of personnel
- D-Grid: additional resources, mainly at T1 / T2 sites, for German HEP
~4.0 M€ for HEP and Hadrons&Nuclei (approved two weeks ago, details being negotiated)
- BMBF extra initial funding for NAF @ DESY
aim: have sufficient analysis capacity available for LHC data
(details still being negotiated)

Projects of HGF Alliance in the area of T2/T3/NAF:

- virtualisation of resources
- application-driven monitoring
- improved data access management
- training, schools and workshops
- Grid-based storage systems
- High-performance network between HEP sites: **Virtual Computer Centre**

Since 2002: **GridKa School**
with large participation from HEP

Lectures and hands-on sessions:

- in Grid middleware
(usage and installation & administration)
- Grid and HEP applications
- developments in science and industry

Complemented by training sessions
of experimental communities during
national workshops

**HGF Alliance also committed to
training and education**



The 5th international
GridKa School 2007
Grid Computing and e-Science
www.fzk.de/gks07

Application Development
Virtualization
Industry
D-Grid
EGEE

Globus Toolkit
ROOT/PROOF
g-Eclipse
Unicore
dCache
gLite

GridKa School

September 10 - 14

Applied Grid Computing

Forschungszentrum
Karlsruhe

140 participants from 14 Countries

Grid computing and efficient usage of WLCG resources
well established in German HEP !

Organisational Structure



German T1/T2 well represented in WLCG committees

C-RRB

CB

OB

MB

GDB

HGF, BMBF, Experiments
GridKa overview board

HGF Alliance
Management Board

GridKa T1

WLCG

T2s

T3s/Analysis

GridKa Technical advisory Board

HGF Alliance
Grid Project Board

Large personal overlap

Experimental communities



- **GridKa is well established T1 within WLCG**
 - supports ALICE, ATLAS, CMS and LHCb
- **T2 structure being built up for all 4 LHC experiments**
 - funding secured recently by HGF Alliance “Physics at the Terascale”
 - all sites involved showed working prototypes already
- **T3 and analysis infrastructure evolving**
 - complicated funding
 - development of tools and grid integration of end-user analysis facilities depends strongly on personnel funded by HGF Alliance
 - HEP community projects within German Grid initiative important
- **Very tight situation concerning personnel**
 - difficult to find qualified people for development and operation
 - lack of positions with long-term prospects

- Pledged WLCG Tier2 resources in Germany
- Program of HFG Alliance “Physics at the Tera Scale”

Tier2 in Germany

Germany, DESY, Hamburg		X		
Germany, GSI, Darmstadt	X			
Germany, ATLAS Federation FR/W - Albert-Ludwigs-Universität, Freiburg - Bergische Universität, Wuppertal		X		
Germany, ATLAS Federation, Munich - MPI für Physik - Ludwig Maximilian Universität - Leibniz Rechenzentrum - Rechenzentrum Garching der MPG		X		
Germany, CMS Federation - DESY, Hamburg - RWTH, Aachen			X	

WLCG MoU, August 2007

Germany, GSI, Darmstadt	Pledged	Planned to be pledged			
	2007	2008	2009	2010	2011
CPU (kSI2K)	260	660	860	1100	1320
Disk (Tbytes)	80	200	260	340	450
Nominal WAN (Mbits/sec)	100	1000	1000	1000	1000

ALICE

Germany, CMS Federation	Pledged	Planned to be pledged			
	2007	2008	2009	2010	2011
CPU (kSI2K)	300	600	1000	1800	2300
Disk (Tbytes)	50	170	340	530	850
Nominal WAN (Mbits/sec)	1000	10000	10000	10000	10000

Germany, CMS Federation	Pledged	Planned to be pledged			
	2007	2008	2009	2010	2011
CPU (kSI2K)	200	450	700	700	
Disk (Tbytes)	50	100	150	150	
Nominal WAN (Mbits/sec)	2000	2000	2000	2000	

CMS

Tier2 Ressources (2)

Germany, DESY, ATLAS	Pledged	Planned to be pledged			
	2007	2008	2009	2010	2011
CPU (kSI2K)	80	580	900	1720	2300
Disk (Tbytes)	40	260	440	740	1040
Nominal WAN (Mbits/sec)	1000	10000	10000	10000	10000

Germany, ATLAS Federation, Munich	Pledged	Planned to be pledged			
	2007	2008	2009	2010	2011
CPU (kSI2K)	60	330	530	880	
Disk (Tbytes)	30	150	270	430	
Nominal WAN (Mbits/sec)	660	1000	1000	1000	

Germany, ATLAS Fed. FRW	Pledged	Planned to be pledged			
	2007	2008	2009	2010	2011
CPU (kSI2K)	40	290	450	860	1150
Disk (Tbytes)	20	130	220	370	520
Nominal WAN (Mbits/sec)	620	1000	1000	1000	1000

Germany, ATLAS Fed. FRW	Pledged	Planned to be pledged			
	2007	2008	2009	2010	2011
CPU (kSI2K)	40	290	450	860	1150
Disk (Tbytes)	20	130	220	370	520
Nominal WAN (Mbits/sec)	620	1000	1000	1000	1000

ATLAS

Scientific Goals

Work Packages

	Physics Analysis	Grid Computing	Detector Science	Accelerator Science
Scientific Goals	Data Analysis <ul style="list-style-type: none"> • Understanding LHC Detectors • Physics at the LHC • The path to the ILC 	Improved Grid <ul style="list-style-type: none"> • Virtualization • Application-driven monitoring • Development of NAF tools 	ILC Detectors <ul style="list-style-type: none"> • Vertex Detector • Tracking • Calorimetry • Forward Detectors 	Optimizing the ILC <ul style="list-style-type: none"> • Acceleration Technology • Sources • Beam Dynamics
	Analysis Tools <ul style="list-style-type: none"> • Algorithms and Techniques • Simulation Tools 			
	Theory/Phenomenology <ul style="list-style-type: none"> • Monte Carlo Generators • Precise Predictions • New Models 	Virtual Computing Centre <ul style="list-style-type: none"> • Computing resources Tier 2 • National Analysis Facility • High performance network • User friendliness • Grid-based mass storage 	Virtual Detector Lab <ul style="list-style-type: none"> • VLSI & Electronics • Support Sensor Design & Characterization • Detectors Systems Support 	
Analysis Network <ul style="list-style-type: none"> • Alliance Working Groups • Monte Carlo Group • Virtual Theory Institute 	R&D on Grid Tools: <ul style="list-style-type: none"> • Virtualisation of resources • Application driven monitoring • Data access management 			R&D Projects
Analysis Centre at DESY				
Work Packages	Training and Exchange			

Backbone Activities

Management – Young Investigator Groups - Fellowships – Equal Opportunities – Outreach – Interim Professorships