FSP-CMS Tier-2 Computing: Status and Plans

HGF Terascale Alliance
Annual Meeting
Dresden
Dec. 1st-3rd, 2010

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and
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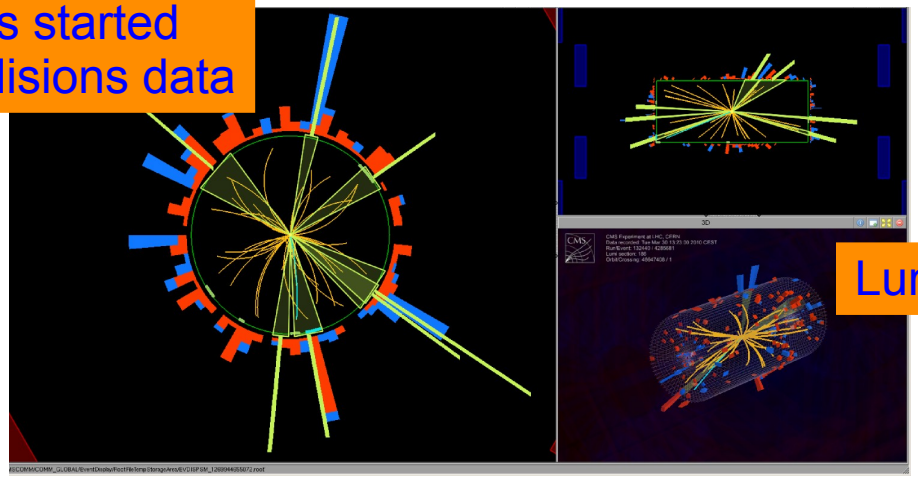
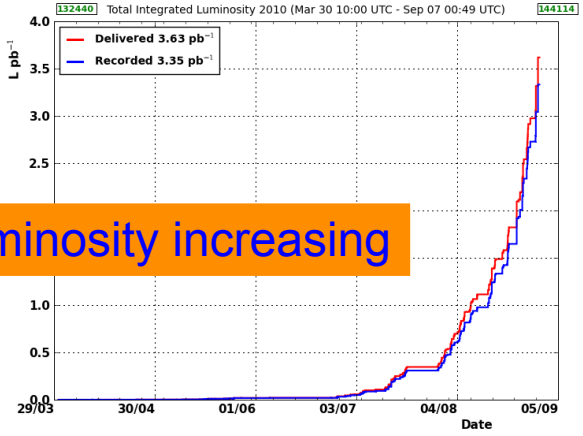
for the
FSP-CMS Computing Team

Does not cover T1_DE_KIT, NAF,.. and IT projects funded by Terascale Alliance, see other talks of the meeting!

Global CMS Computing

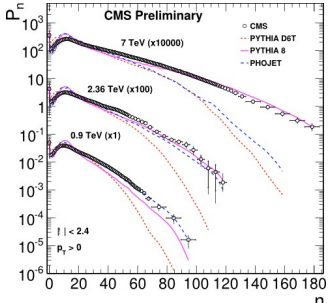
CMS has started taking collisions data

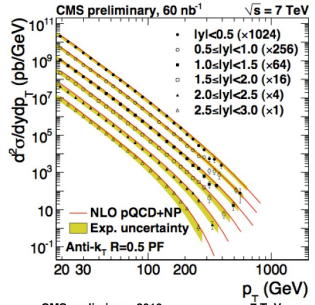


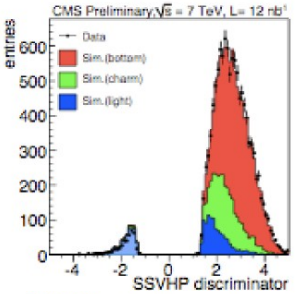


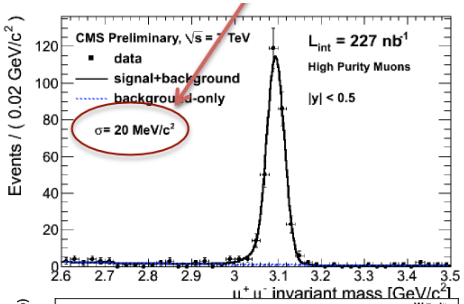
Luminosity increasing

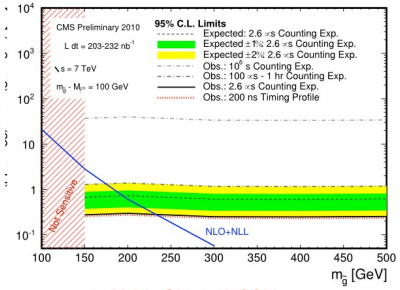
Computing works – There were some glitches – But ICHEP was quite a success

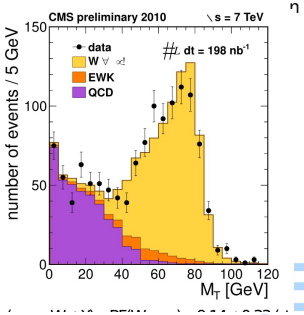


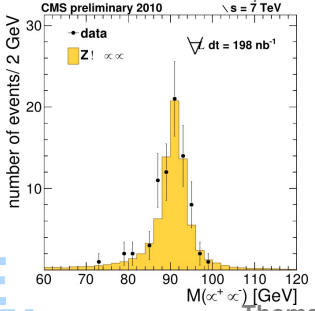


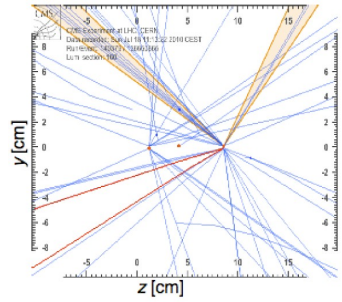


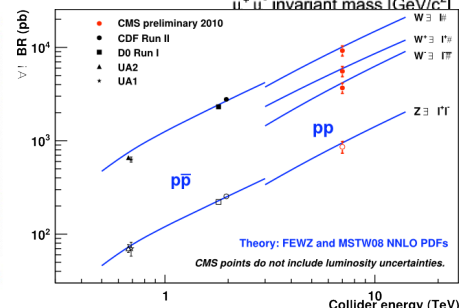


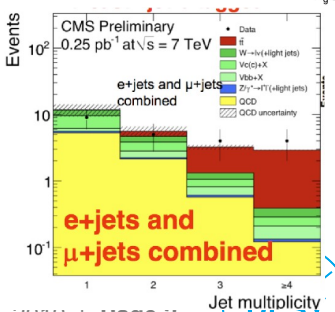












German Contributions to CMS Computing

- Analysis Operations
  - Management of the “central file space”
  - StoreResults service (elevating user files to CMS official data)
  - CMS CRAB server (one of 7 in the world) at DESY (just started production)
- Facilities Operations
  - L2 convener
  - CMS services, data management, monitoring, support at German sites
    - T1_DE_KIT
    - T2_DE_DESY
    - T2_DE_RWTH

    Credited with MoA
  - CMS software deployment on EGEE sites (Europe and Asia)
  - CMS computing shifts
- Lots of other computing related activities
  - DQM, alignment, analysis tools
  - Accounted in Offline CMS

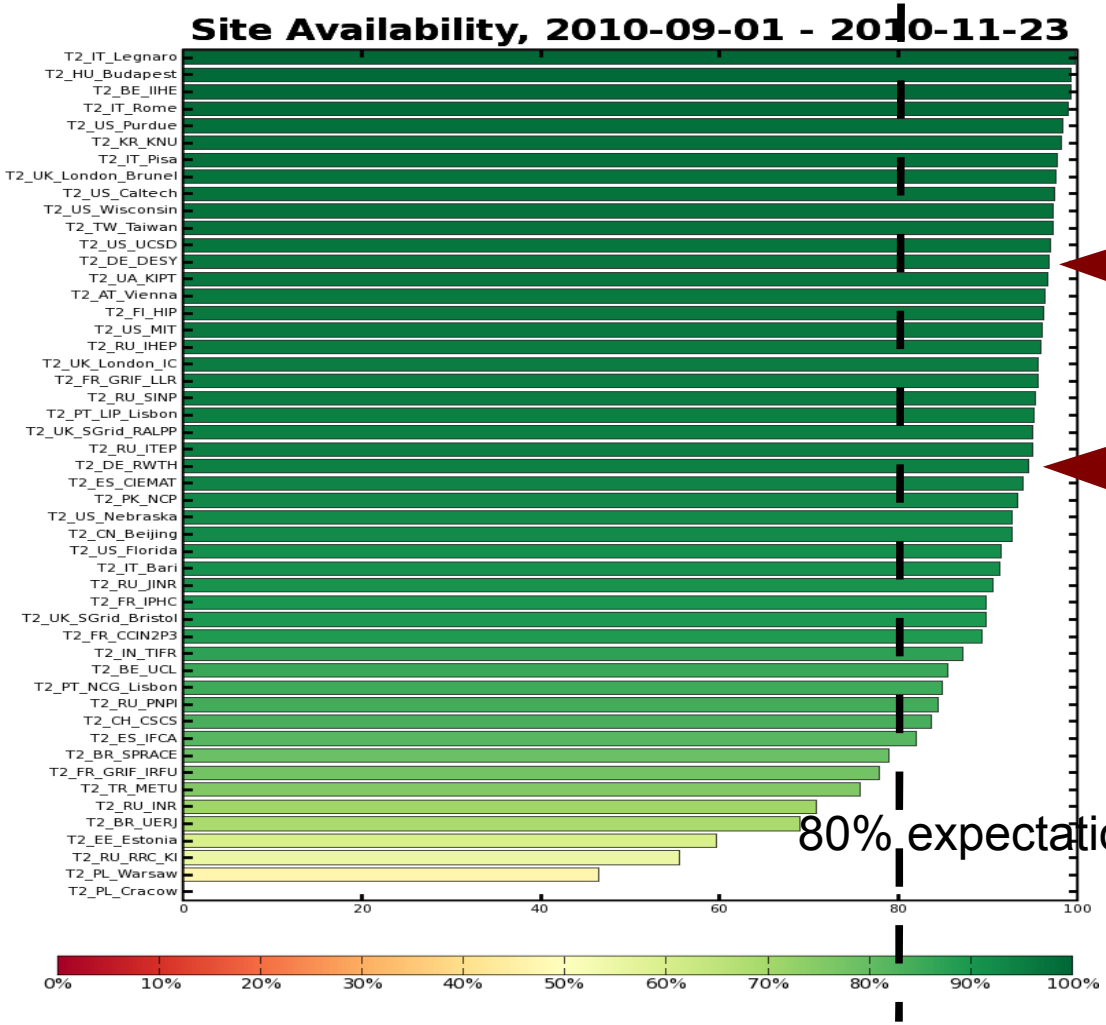
German CMS Compute Resources 2010/2011

Site	CPU [kHS06]	Disk	Tape	Comment
KIT (now)	10,5	1500TB	2500TB	+ 500 TB extra tape
KIT Pledge 2010	10,5	1500TB	2000TB	
KIT Pledge 2011	15,2	2000TB	5200TB	
DESY (now)	16	660TB		240TB from UniHH
DESY Pledge 2010	8	400TB		
DESY Pledge 2011	11,8	640TB		
RWTH (now)	15	500TB		
RWTH Pledge 2010	5	250TB		
RWTH Pledge 2011	6,6	330TB		
NAF/UniHH	1.8+3.8*	35TB Lustre*		Access to DESY SE
NGR @GridKa	3,5	120TB	available	D-Grid

* Contribution by UniHH available to all D-CMS

- Tier-1 and Tier-2 resources are pledged (WLCG) to CMS
  - Additional (local/national) resources are dedicated (mostly) to German groups
- 2011 Tier-2 pledges are already fulfilled (since substantial addit. resour.)
  - Further upgrade plans during 2011 for national resources

SAM Tests – Tier-2 Site Availability (Sep-Nov)



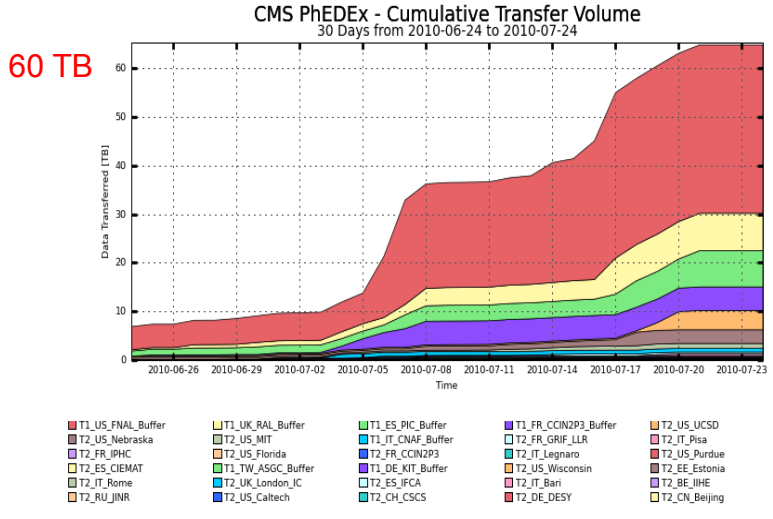
T2_DE_DESY and
T2_DE_RWTH (Aachen)
are very reliable sites !

80% expectation from CMS

Data Transfers to German T-2 Sites (within 30 d)

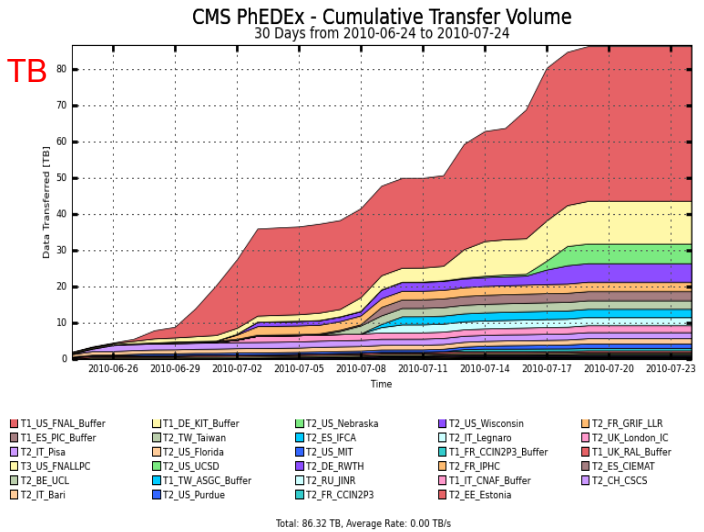
to T2_RWTH

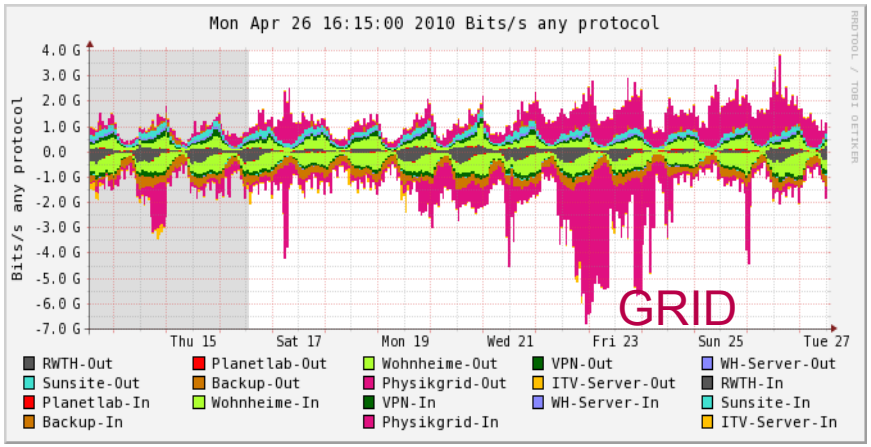
60 TB



to T2_DE_DESY

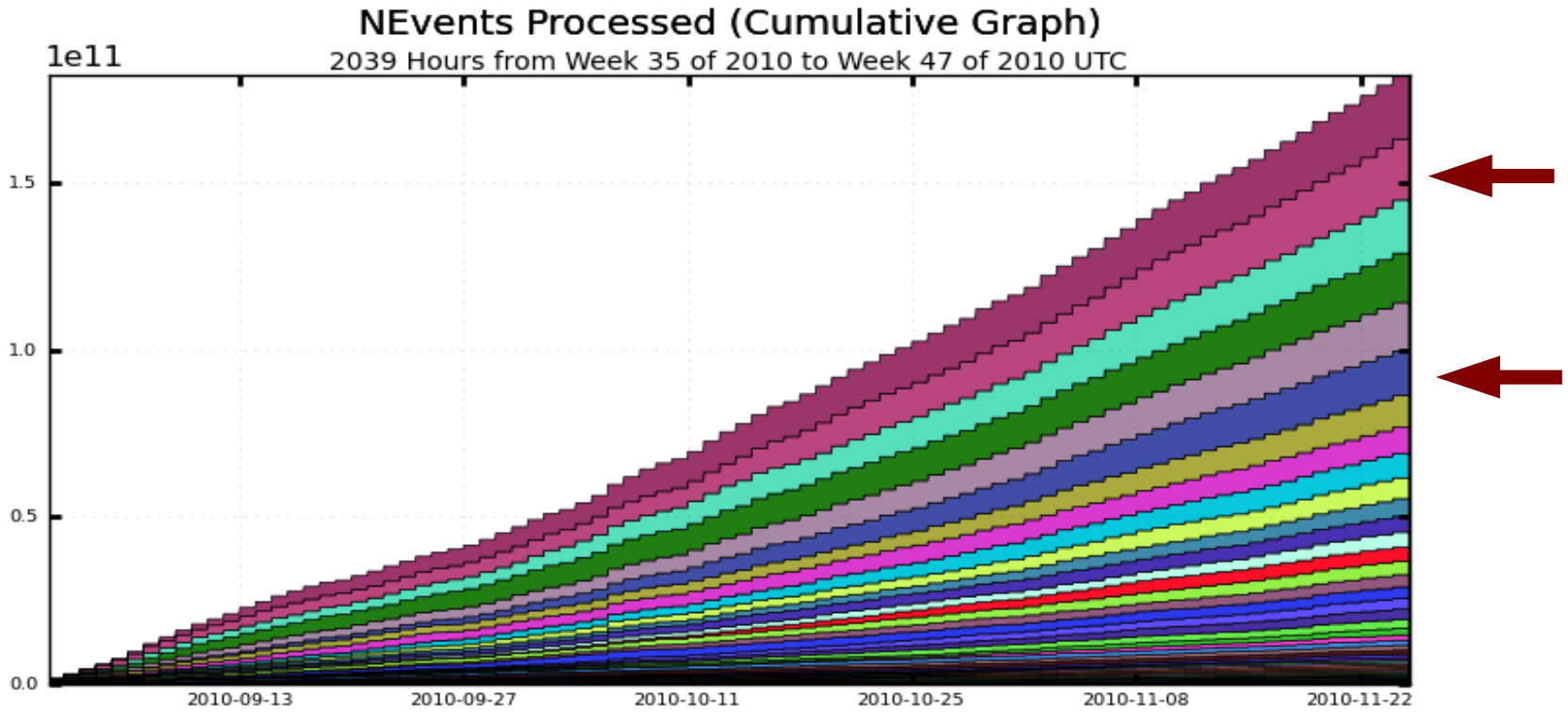
80 TB





Excellent WAN at DESY and AC
Key condition for data transfers and fast analyses
Several Gbit/s used sustained
Serving also data for other T-2s

Analysis Events Processed – T2_DE_* among leading sites !



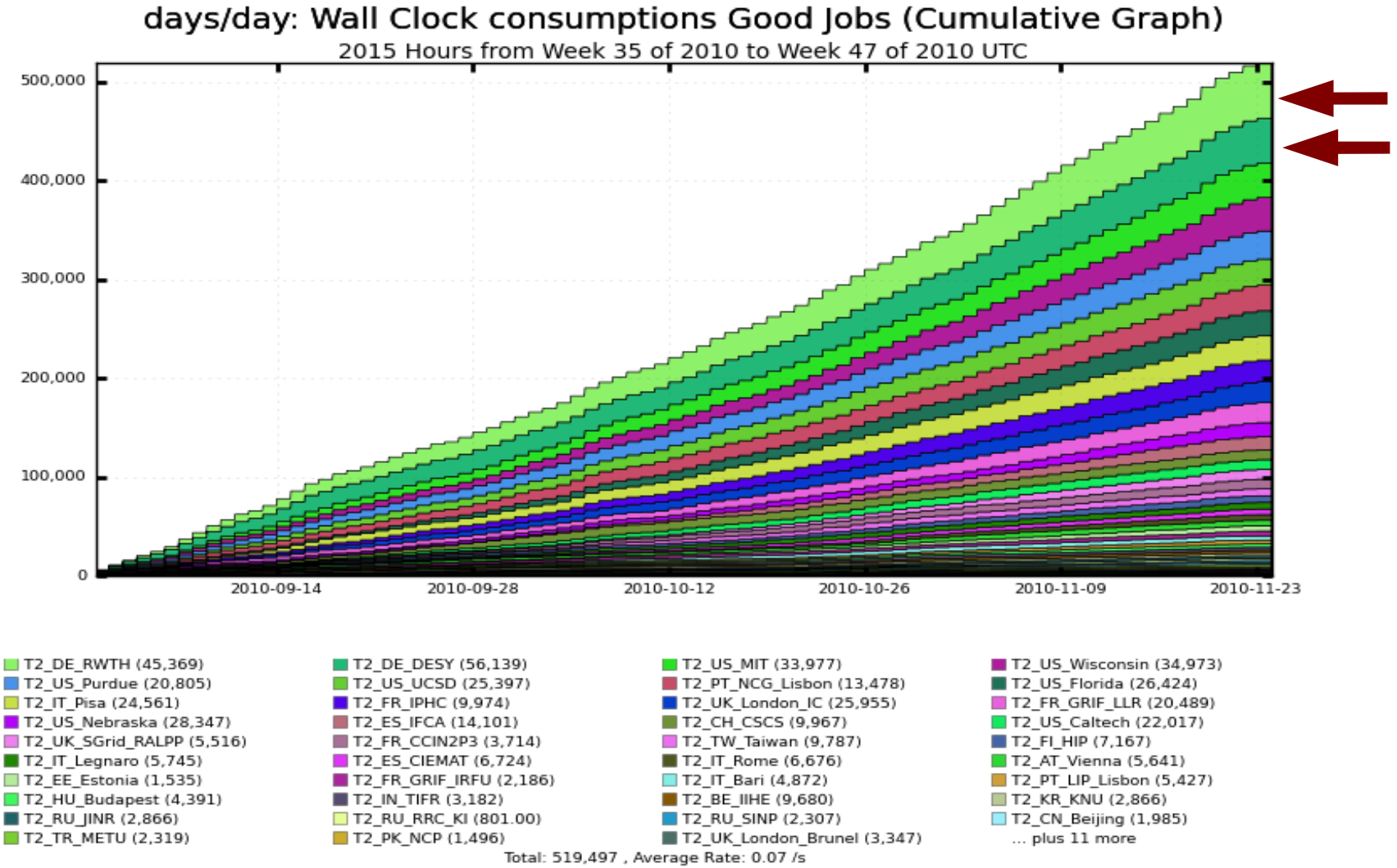
T2_US_Wisconsin (19,200,421,923)
T2_US_UCSD (13,309,186,421)
T2_US_MIT (9,511,563,506)
T2_US_Purdue (6,225,880,231)
T2_US_Caltech (7,344,758,120)
T2_ES_IFCA (4,543,371,510)
T2_BE_IIHE (3,228,199,767)
T2_FR_GRIF_IRFU (813,835,622)
T2_AT_Vienna (1,562,389,863)
T2_BR_SPRACE (372,334,503)

T2_DE_RWTH (18,284,556,930)
T2_UK_London_IC (14,781,508,989)
T2_CH_CSCS (4,778,736,172)
T2_US_Florida (7,818,543,043)
T2_FR_GRIF_LLR (5,244,479,350)
T2_IT_Bari (2,041,331,197)
T2_IT_Pisa (3,029,497,396)
T2_IT_Rome (1,420,011,517)
T2_PT_NCG_Lisbon (741,506,124)
T2_BR_UERJ (254,206,161)

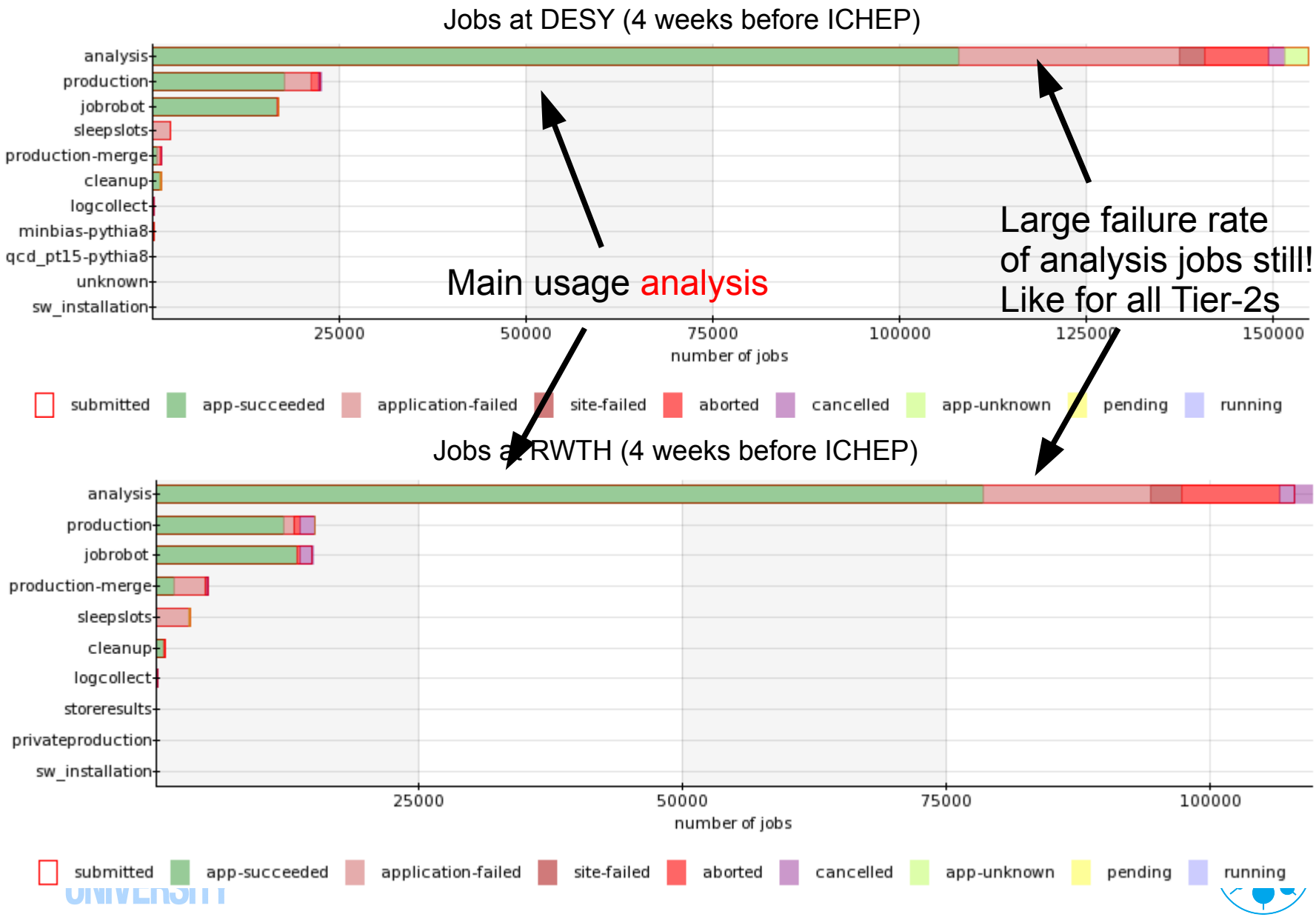
T2_US_Nebraska (15,933,681,857)
T2_DE_DESY (14,515,302,939)
T2_FR_IPHC (3,447,205,665)
T2_FI_HIP (3,709,660,422)
T2_TW_Taiwan (4,146,294,574)
T2_IT_Legnaro (2,640,659,417)
T2_RU_JINR (1,519,420,780)
T2_ES_CIEMAT (4,039,569,733)
T2_CN_Beijing (998,014,602)
... plus 21 more

Total: 182,471,006,188 , Average Rate: 24,846 /s

Job Wall Clock Consumptions – T2_DE_* top leading sites !



Job Usage at DESY and RWTH (German CMS Tier-2s)

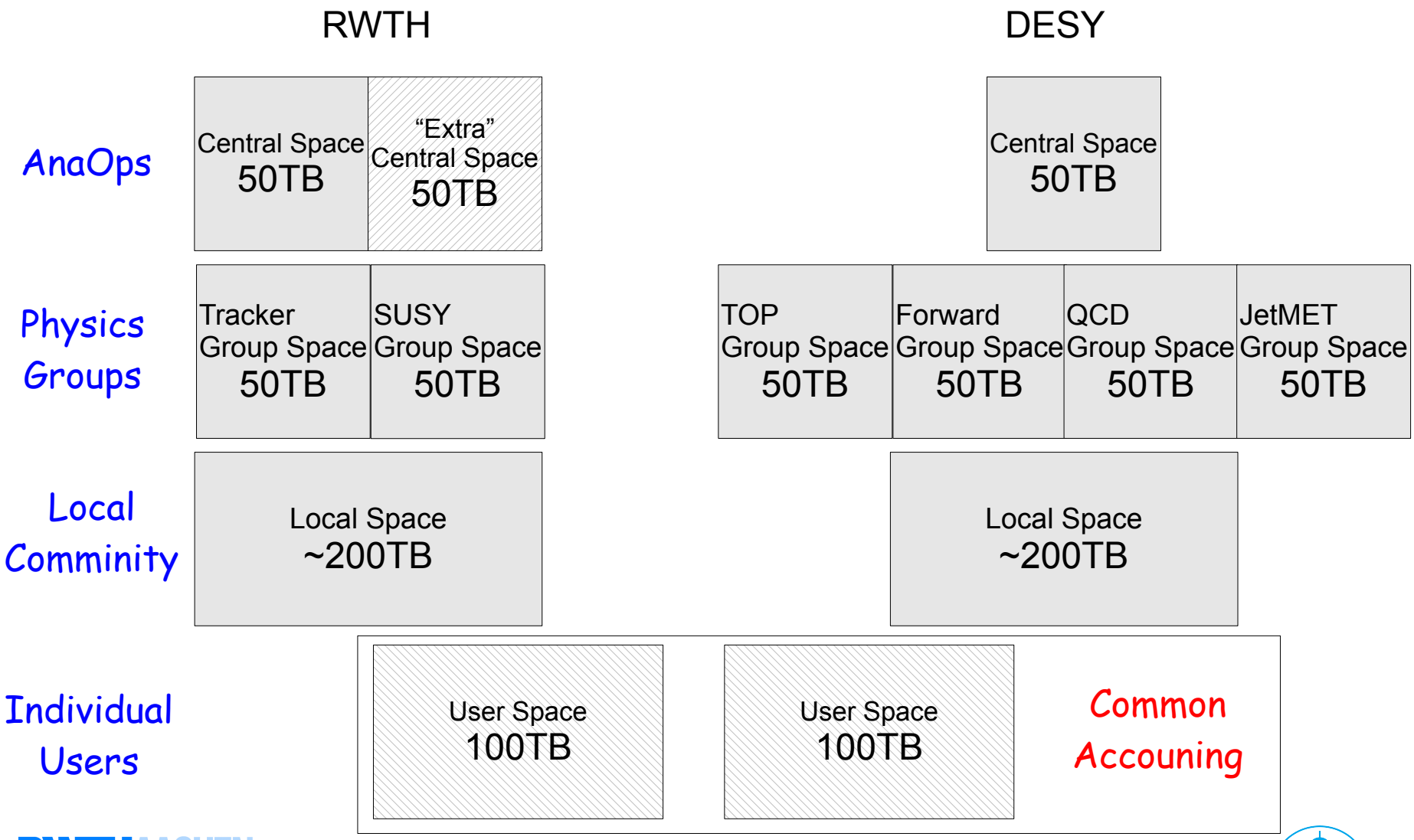


Job Efficiency (of 10 most used analysis sites)

Not yet optimal! Improvements ?

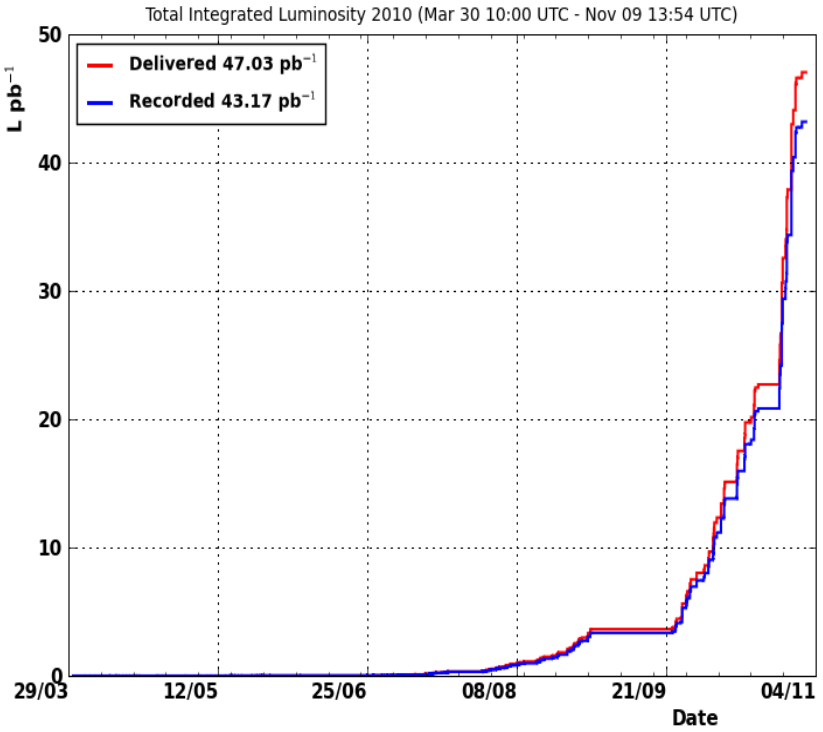
- Optimizations in CMS data placements ?
- dCache hot data set replications ?

Group Associations & Tier-2 Storage Setup



Looking into the Future

- Luminosity expectation:
  - ~43 pb^{-1} until November 2010
  - 2011: at least an order of magnitude
- Computing and storage resources
  - Must not scale with luminosity
- Changes in analysis required
  - Increased number of primary data sets
  - Secondary datasets/central skims
    - Analysis input more selective
  - Move from RECO to AOD format



Data management will become the challenge

CMS Resource Projections 2011

- CMS Tier-2 “storage units” (2011)
  - Central space 50TB → 100TB
  - Physics groups 50TB → 75TB
  - Growth of user/group space
- Tier-1 (2011):
  - CPU increase: 50%
  - Disk/Tape increase: 50% / 100%
- Tier-2 (2011):
  - CPU increase: 60%
  - Disk increase: 100%

CMS Request (WLCG):

CMS	2010	2011	2012*
CERN CPU (kHS06)	96.6	106.1	106.1
CERN disk (PB)	4.1	4.5	4.5
CERN tape (PB)	14.6	21.6	24.6
T1 CPU (kHS06)	100.5	150.7	150.7
T1 disk (PB)	13.4	19.5	25.1
T1 tape (PB)	23.3	52.4	64.7
T2 CPU (kHS06)	195	319.5	319.5
T2 disk (PB)	9.2	19.9	23

Must keep our share of resources to stay competitive

Summary

- Germany makes substantial contributions to CMS computing & analysis
  - Tasks in Analysis Operations and Facility Operations
  - Very good performance of the German Grid sites, only possible with substantial man-power
    - T1_DE_KIT, T2_DE_DESY and T2_DE_RWTH
- The two Tier-2s play a leading role for CMS operations and user analysis
- Significant (additional) resources available for FSP-CMS members
  - National Analysis Facility (NAF)
  - Tier-3 extensions of Grid sites at KIT, DESY and RWTH
  - All actively and successfully used by German CMS members
- Increase of LHC luminosity requires
  - Drastic changes in the analysis strategies
  - Steady ramp-up of computing and storage resources
    - Expect to remove existing hardware resources after ~5 years lifetime
- To stay competitive and to continue playing a leading role in LHC analysis, Grid'able hardware and operation & development project man-power require a continuous national financial support!