

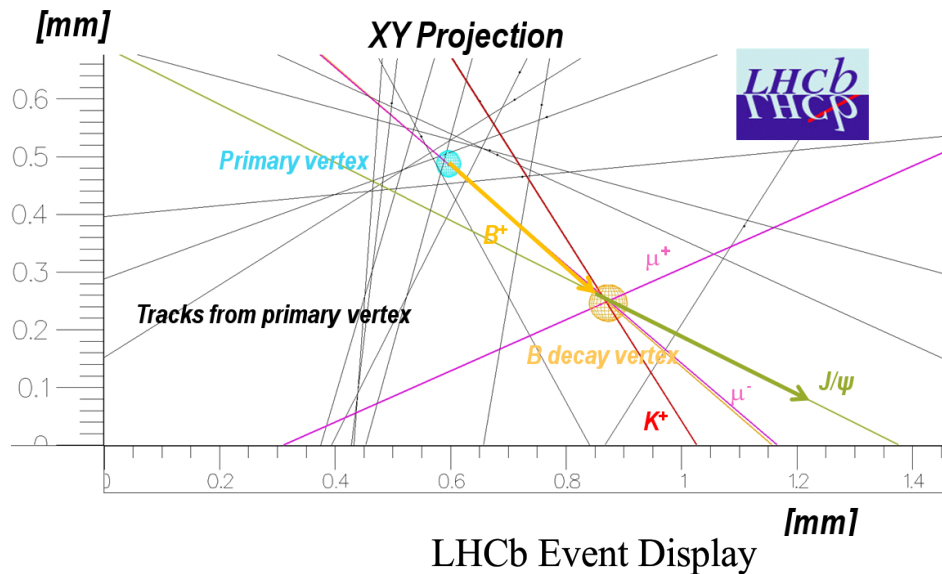
# LHCb Analysis



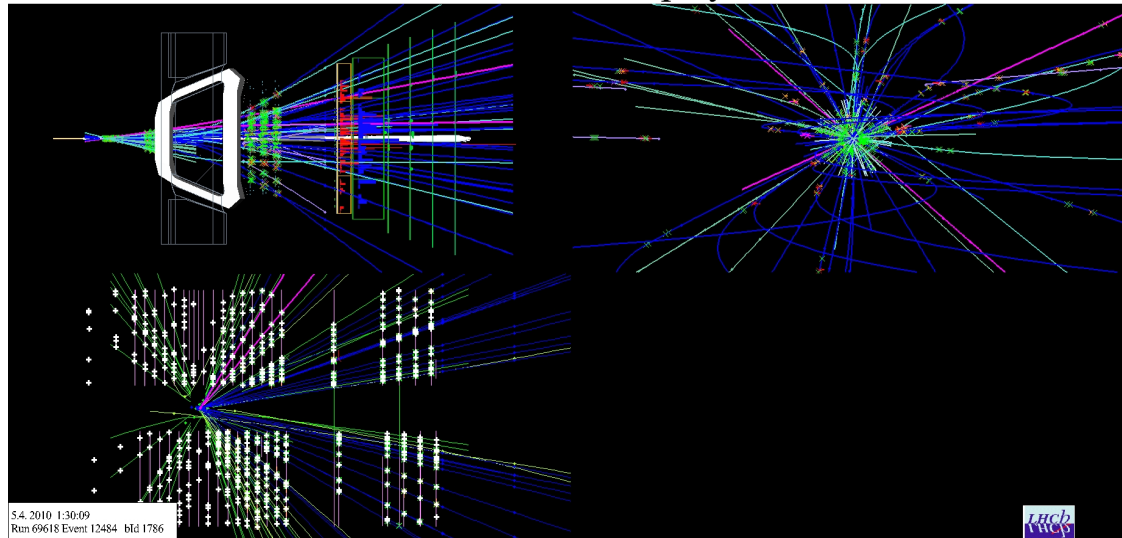
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Workshop CCR-INFN GRID  
20 May 2010

# Beauty is just around the corner...

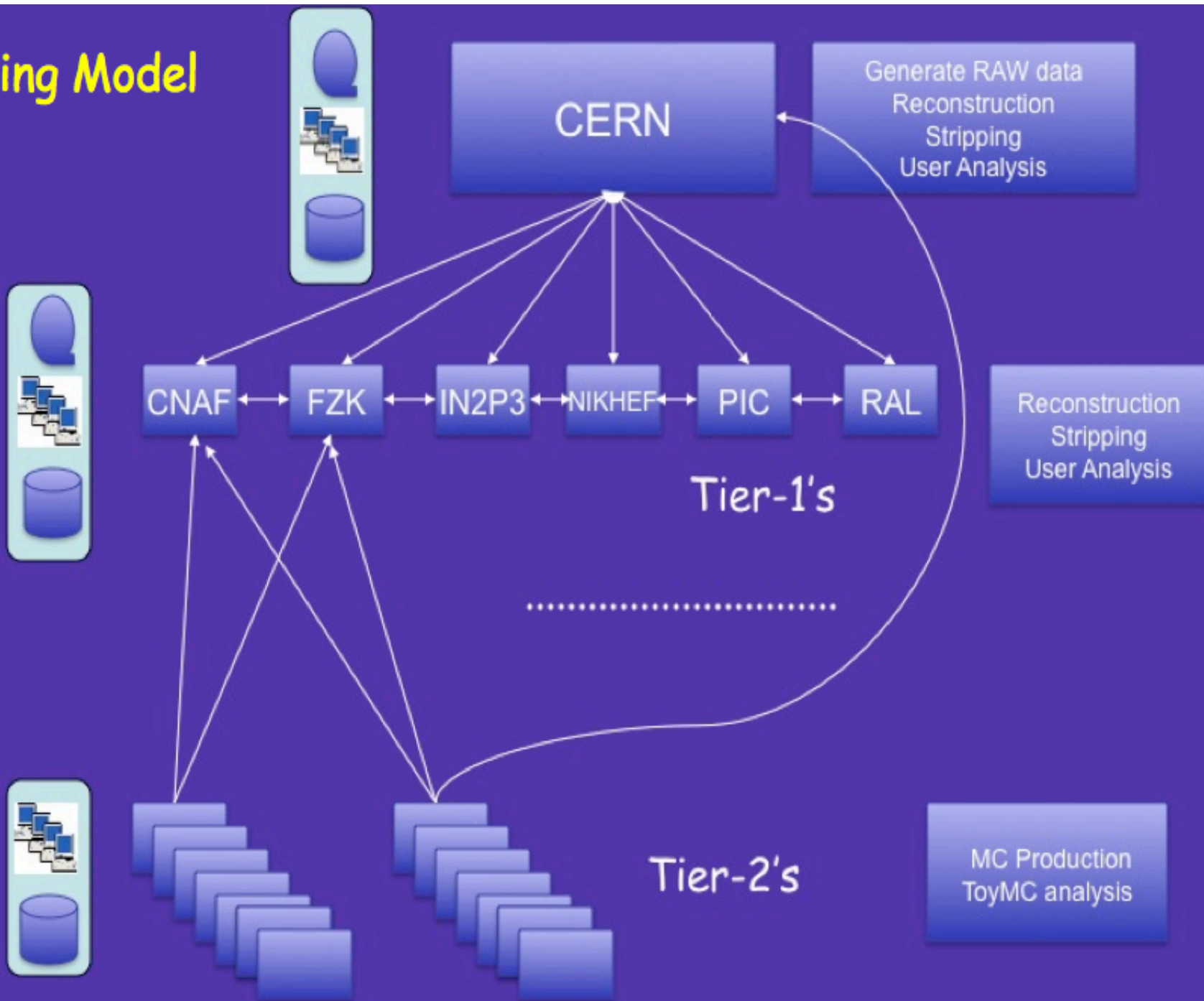


First B meson reconstructed at LHCb



The real data analysis is started!

## Computing Model



# Computing activities

- Production activities
  - Simulation, reconstruction, stripping, WG analysis ( $\mu$ DST)
  - Use DIRAC and the LHCb Production System
- User analysis
  - Data and MC analysis
  - For testing, use local resources (including local batch system)
  - For large datasets, use Grid Computing
- Toy MC and fits
  - Use Grid Computing for large samples
- Non-Grid user analysis
  - Mostly interactive analysis on local clusters (Tier-3), desk/lap-top (Tier-4)

# Data flow

- As soon as the raw data are recorded by the detector they are sent to Tier-1's+CERN-CAF to be reconstructed
- After the reconstruction, the Stripping process is performed
  - pre-selections provided by analysis working groups are applied in order to
    - write on disk different streams where each contains similar selected events, such as B-hadron,  $V^0$  decays, charm decays, etc...
    - reduce the data sample to a handy size in order to perform a finely tuned analysis
- The stripping can be performed several times on the same datasets (according to the availability of resources) if pre-selection algorithms change.

# Baseline analysis model

- Batch analysis
  - Batch processing runs on the Grid at the Tier-1's
    - Submission to DIRAC from Ganga
  - Output data uploaded to the Tier-1 storage
    - MicroDST or Ntuples
  - Dedicated USER area at all sites
    - about 450 TB in total are kept permanently on disk
- Interactive analysis
  - Interactive clusters (Tier-3), desk/lap-tops (Tier-4)
  - These are NOT meant as part of the Grid
  - Data transfers up to users, as well as bookkeeping

# Ganga

- The batch analysis in LHCb is handled by Ganga
- Ganga is:
  - an Atlas/LHCb joint project
  - an application allowing a user to perform the complete life cycle of a job
  - Build – Configure – Prepare – Monitor – Submit – Merge – Plot
  - Run on the local machine (interactive or in background), submit to batch systems (LSF, PBS, SGE, Condor) or Grid systems (LCG, gLite, NorduGrid)
  - Jobs look the same whether they run locally or on the Grid

# LHCb Analysis Centres (LAC)

- All Tier-1's and CERN-CAF are LHCb Analysis Centres
- A Tier-2 may request to become a LAC if:
  - It provides sufficient storage in a Grid-SE, supported by LHCb Core Software (Castor, StoRM, dCache, DPM...)
  - It provides resources that are in addition to resources provided for simulation
  - It provides enough local LHCb manpower for managing the datasets, in coordination with the LHCb Data Manager.
  - It is open to the whole collaboration as specified before
- An agreement should be signed between LHCb and the Tier-2 LAC site
  - Full commitment by the site (MoU-like)



# Non-Grid Analysis support

- Tier-3's may or may not have direct access to a Grid-SE
  - None of these resources are pledged nor accounted for the LHCb Collaboration in WLCG
  - The Computing project provides support for:
    - Data Management: with DIRAC tools
    - Software distribution and installation for applications, Gaudi, Ganga and DIRAC clients
  - All the rest is responsibility of the groups owning the Tier-3

# Resource accounting and analysis priorities

- Priorities
  - Assigned for groups of users
    - Groups are defined by the PPG (Physics Planning Group)
    - Currently a single generic group exists: lhcb\_user
  - Group priorities will be defined by the PPG
- Accounting
  - Grid CPU usage is accounted for by DIRAC
    - Group accounting, user accounting
  - No CPU quota, but regular checks for excessive usage
    - Individual priority may be affected by heavy usage
  - Storage accounting for user spaces
    - User quotas managed by DIRAC
    - No hard limit for the moment
    - Mail sent to the user when approaching the quota
      - Asking for clean up of old datasets

# Working hypothesis 2010-2011

- We assume  $6.1 \times 10^6$  s of DAQ in 2010 and  $5.2 \times 10^6$  s in 2011

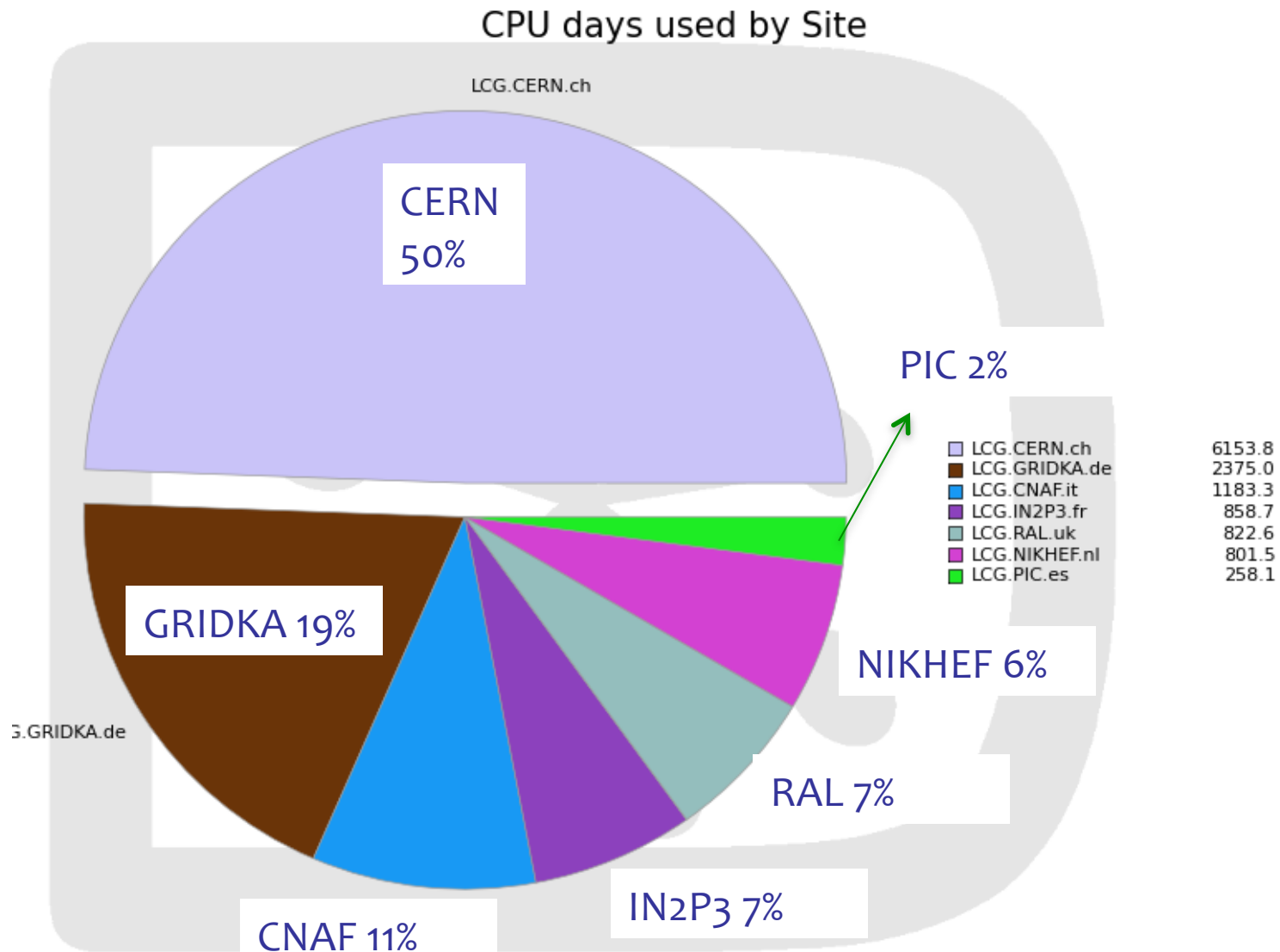
- $1.2 \times 10^{10}$  events (2010) and  $1 \times 10^{10}$  events (2011) at 2 kHz

- 2 kHz is the design DAQ rate at LHCb

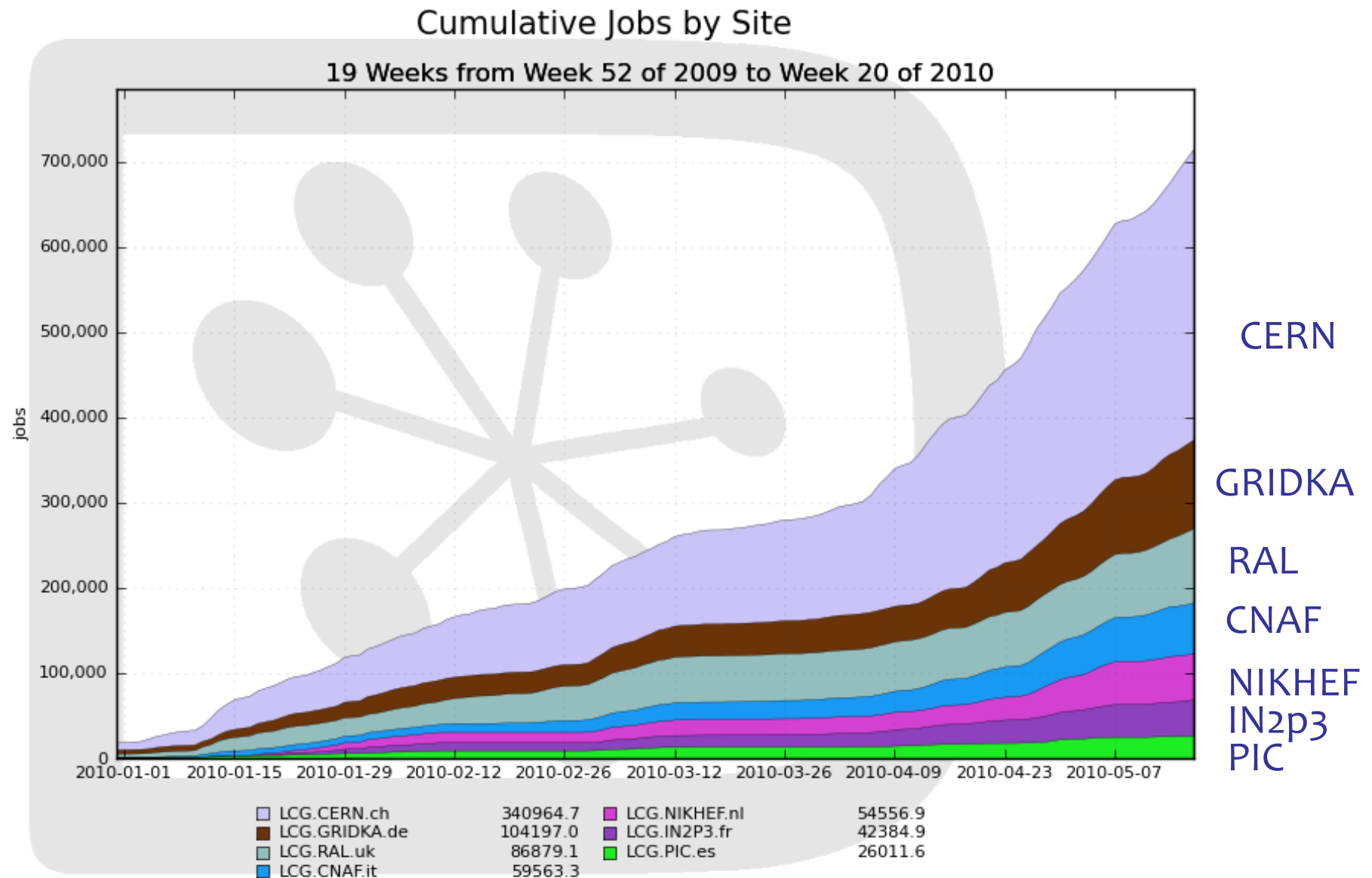
Period		Running Mode	Availability	Efficiency	All	
					running	Total
1-mars-10	1-avr-10	p-p	0.3	0.3	2.41E+05	6.1E+06
1-avr-10	16-oct-10	p-p	0.7	0.4	4.79E+06	
16-oct-10	1-nov-10	HI	0.7	0.4	3.87E+05	
1-nov-10	1-déc-10	HI	0.7	0.4	7.26E+05	
1-déc-10	1-janv-11	Shutdown	0	0	0.00E+00	
1-janv-11	1-févr-11		0	0	0.00E+00	
1-févr-11	1-mars-11	p-p	0.4	0.3	2.90E+05	
1-mars-11	1-avr-11	p-p	0.7	0.4	7.50E+05	
1-avr-11	16-oct-11	p-p	0.7	0.4	5.18E+06	
16-oct-11	1-nov-11	HI	0.7	0.4	3.87E+05	
1-nov-11	1-déc-11	HI	0.7	0.4	7.26E+05	1.1E+06
1-déc-11	1-janv-12	Shutdown	0	0	0.00E+00	

- 7 copies of stripping output (for each Tier-1) permanently kept on disk
  - Latest and next-to-latest version
  - About 3.5 PB in total
- The plan is that 60% of the analysis will be made outside CERN
  - Although several instabilities in many Tier-1 storage systems
- Typical analysis run from a single user:  $2.5 \times 10^6$  events
  - 1k runs per week
  - About 100-150 users will be making analyses this year
- The aim is to reach in 2011 75% of analysis made outside CERN

# Analysis jobs at Tier-1's last month



# Cumulative analysis jobs at Tier-1's in 2010



Generated on 2010-05-18 21:02:30 UTC

# Conclusions

- Analysis model being exercised for the first time on real data and so far matching expectations
- 60% of the analysis to be made outside CERN in 2010
- About 100-150 analysis users this year
  - ~15% in Italy
- Batch analysis mainly performed at CERN CAF and Tier-1's
  - Plus some Tier-2 centers if approved
- Tier-3 sites not gridified and not officially supported by LHCb
  - Each group can organize its own cluster for interactive analysis