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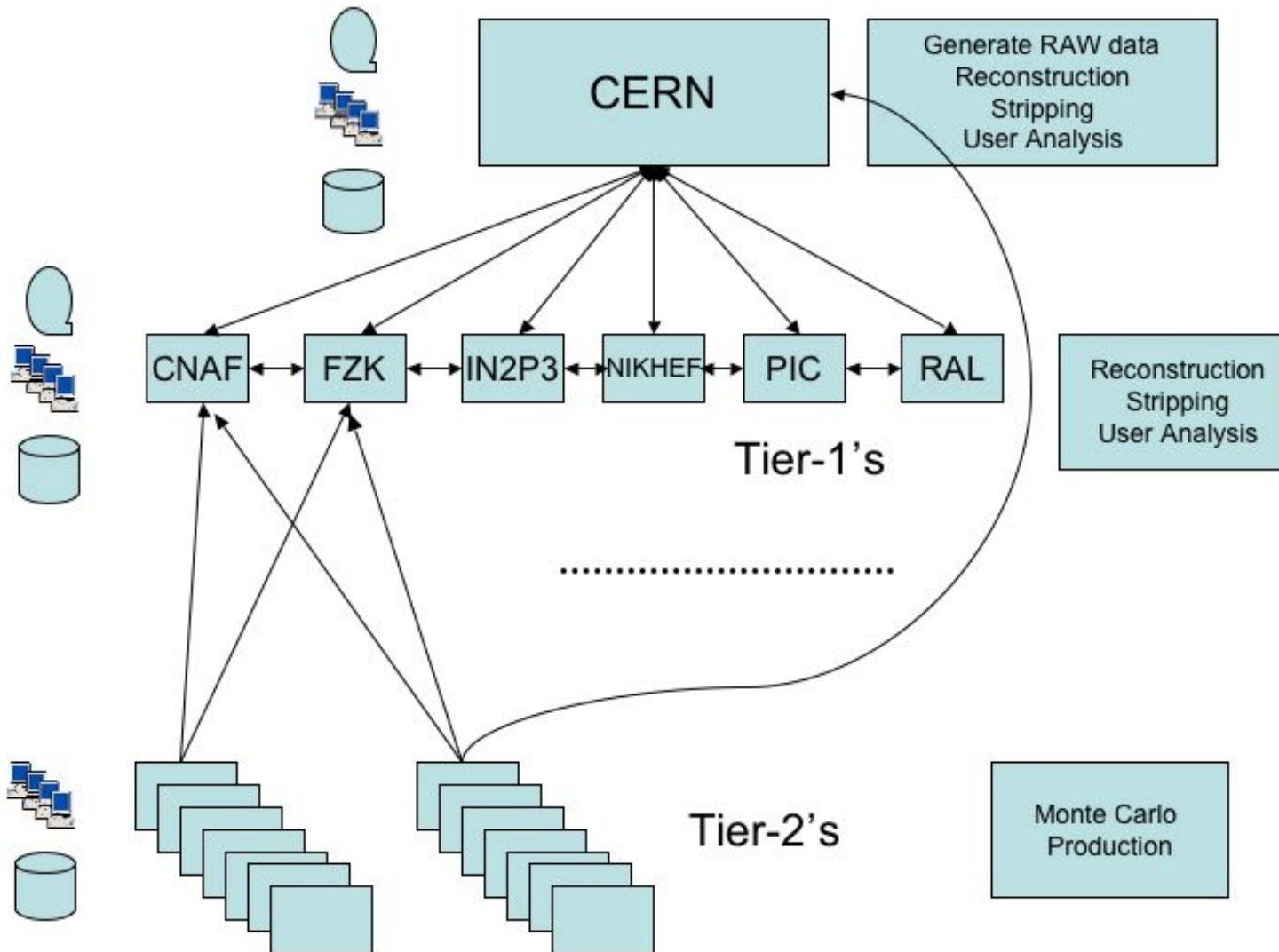
# **LHCb**

## **Monte Carlo Production**

**R. Graciani**

**T2 Workshop, June 2006**

- 
- **LHCb Computing Model**
  - **DIRAC**
  - **Monte Carlo Workflow**
  - **Requirements**
  - **Summary & Outlook**

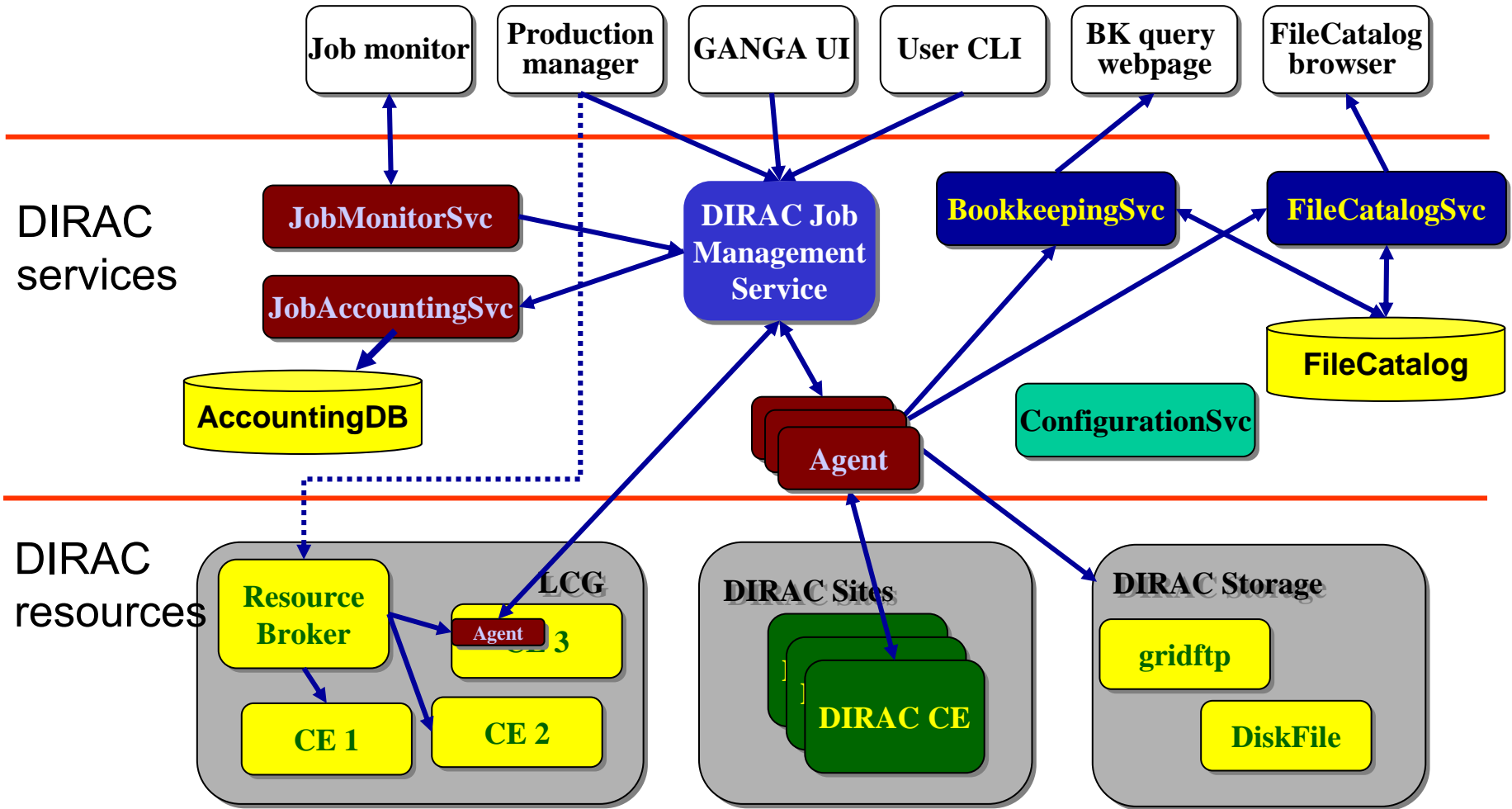


- **CERN-Tier-0:**
  - produce RAW data + Master copy
- **Tier-1's (+ CERN):**
  - Reconstruction
  - Stripping + Reprocessing
  - Data storage
  - User Analysis
- **Tier-2's:**
  - **Monte Carlo Production**

- **Reduce CPU requirements.**
- **Use real DATA for:**
  - Tracking efficiency
  - Trigger efficiency
  - Systematic studies
  - Combinatorial backgrounds
- **Use Monte Carlo:**
  - Detector acceptance
  - Specific Backgrounds
  - Other channel dependent studies

- **LHCb uniform overlay network for all computing activities on the GRID:**
  - Data Processing & Stripping
  - Data Management
  - Physics Analysis
  - **MC Production**
- **Collaborative set of light-weighted Clients and Servers.**

- **Computing Tasks are submitted to Central TasksQueues:**
  - RAW Data Reconstruction
  - Data Distribution
  - **MC Simulation**
  - User Analysis
- **Tasks are matched and executed by Agents running at appropriated Computing resources.**
- **Tasks are associated with GRID proxies.**

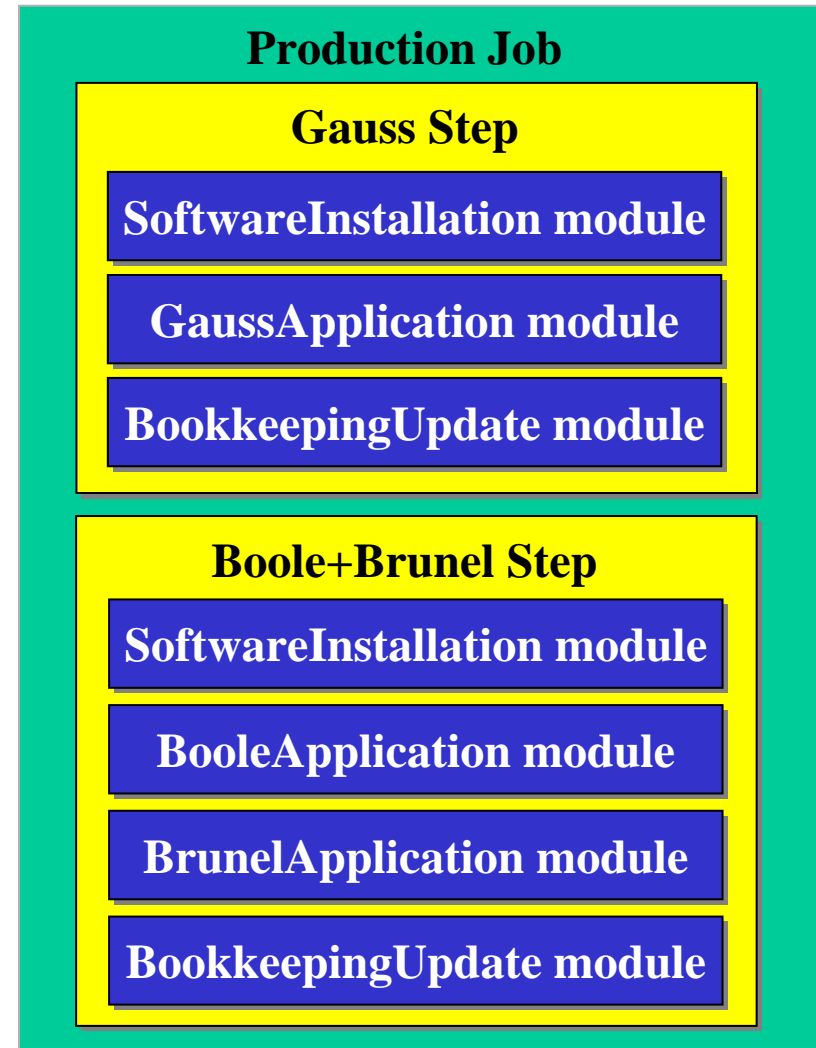


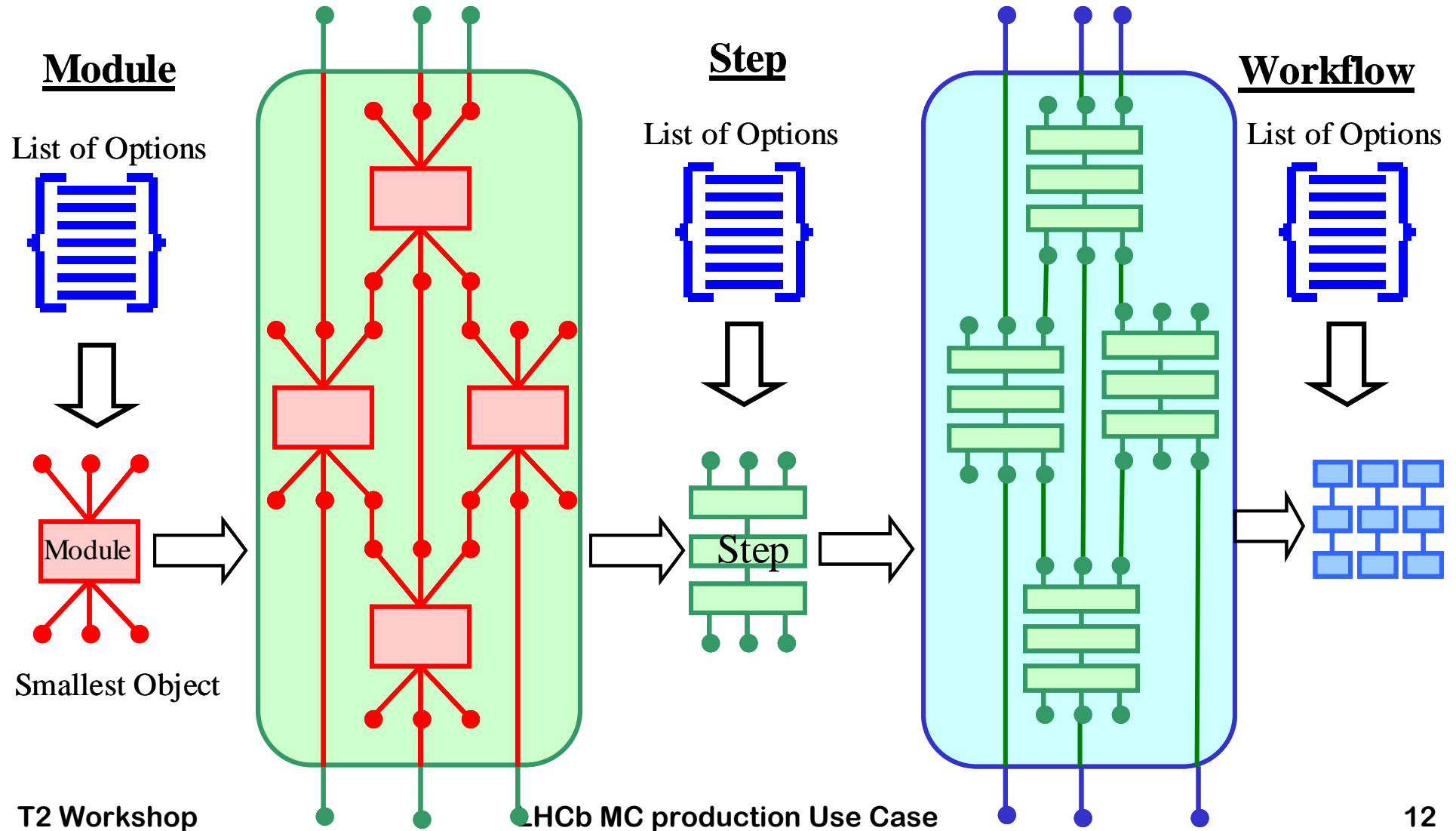


- Task taken by non-Tier-1 resources.
  - $4 \times 10^9$  Event / year (signal + specific backgrounds).
  - Factor 10 reduction after trigger.
  - Resources estimates:
    - CPU power: 7.7 M Spec 2000
    - Produced Data: 160 TB / year
    - Bandwidth T-2→T-1: 5 MB / s
- (Aggregated over all contributing Sites)

- **Complex task involving many pieces:**
  - pp interaction simulation (PYTHIA)
  - Detector response (GEANT)
  - Event build-up:
    - Pile up (>1 interaction per bunch crossing)
    - Spill Over (signal from previous bunch crossings)
  - Digitalization of Detector response:
    - Plus noise,...
  - Trigger and DAQ
  - Reconstruction of detector objects (Tracks, Clusters).
- Gauss / Boole / Brunel.
- RAW / DIGI / DST

- Job consists of one or more steps; can be split in subjobs corresponding to steps.
- Step consists of one or more modules; is indivisible w.r.t to the job scheduling;
- Module is the least unit of the execution:
  - Use standard modules in production;
  - User defined modules in analysis can be used.





- **Consists of:**
  - 5 - 10 Steps
- **Produces:**
  - Events: 250 - 800
  - Data Files: 100 - 800 MB (1 or more)
  - Log Files: 0.1 - 1 MB (several)
- **Requires:**
  - 1.5 GB of pre-compiled software
  - < 24 hours of CPU (2.5 day @ 500 SpecInt 2000)

- **CPU:**
  - Queue with  $> 2.5$  day @ 500 S100
- **At WN:**
  - Python  $> 2.2$  (DIRAC)
  - 2.5 GB of disk space per CPU
  - Outbound connectivity
- **Convenient:**
  - VO shared area for pre-installed software
  - Local working directory

- **The Pilot Approach:**
  - Minimal LHCb DIRAC job submitted for each LCG Task.
  - **This is the Job that arrives to the Sites.**
  - Install current DIRAC version.
  - Check running environment.
  - Request a Task to Central Server
  - **Execute Task.**
  - Upload & Register results
- **Pilot jobs scheduled at all queues.**

- **Special distributed DIRAC Services:**
  - Release WN CPU as soon as possible.
  - Provide extra redundancy.
  - Sitting at LHCb Tier-1's
- **Data only uploaded to 1 destination SE + transfer request sent to VO Box.**
- **Fail-over if LFC registration fails.**
- **Reduce need for retry at WN.**
- **Request DB for all asynchronous operations: bookkeeping,...**



- **Relevant for:**
  - first Data Transfer
  - search for VO box redundant server
- **CNAF: it**
- **RAL: uk**
- **PIC: es**
- **Karlsruhe: de, ch (excluding CERN)**
- **CERN: ru**
- **Lyon: fr, br + west of meridian line**
- **NIKHEF: nl, pl + east of meridian line**

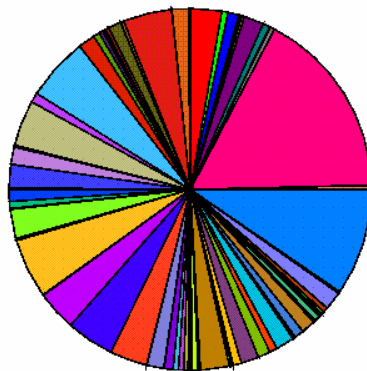
- Overview of LHCb production activities:
- Monitoring:
  - <http://lhcb01.pic.es/DIRAC/Monitoring>
  - Reports current situation of pending, executing and recently finished Tasks.
- Accounting:
  - <http://lhcb01.pic.es/DIRAC/Accounting>
  - Reports accumulated use of Resources



• 2006  
(Jan-May)

DIRAC.Lyon.fr	2.79%
DIRAC.Zurich-MH.ch	0.55%
DIRAC.Zurich.ch	0.97%
ICG.ACAD.bg	0.02%
ICG.Alberta.ca	0.07%
ICG.BHAM-HEP.uk	0.18%
ICG.BIFI.es	0.23%
ICG.Barcelona.es	1.76%
ICG.Bari.it	0.63%
ICG.Bologna.it	0.05%
ICG.Bristol.uk	0.02%
ICG.Brunel.uk	0.42%
ICG.CERN.ch	16.92%
ICG.CESGA.es	0.04%
ICG.CG.fr	0.24%
ICG.CNAF-GRIDIT.it	0.10%
ICG.CNAF.it	9.58%
ICG.CNB.es	0.16%
ICG.CPDM.fr	1.64%
ICG.CSCS.ch	0.46%
ICG.CY01.cy	0.24%
ICG.Cagliari.it	0.02%
ICG.Cambridge.uk	0.21%
ICG.Catania-fails.it	0.02%
ICG.Catania.it	0.55%
ICG.Dortmund.de	0.14%
ICG.Durham.uk	0.01%
ICG.Edinburgh.uk	0.04%
ICG.FORTH.gr	1.26%
ICG.Ferrara.it	0.00%
ICG.Firenze.it	0.85%
ICG.GR-01.gr	0.09%
ICG.GR-02.gr	0.01%
ICG.GR-03.gr	0.02%
ICG.GR-04.gr	0.06%
ICG.GR-05.gr	0.06%
ICG.GRIDKA.de	1.67%
ICG.GRNET.gr	0.68%
ICG.Glasgow.uk	1.11%
ICG.HG-02.gr	1.59%
ICG.HG-04.gr	0.74%
ICG.ICI.ro	0.16%
ICG.IHEP.su	0.19%
ICG.IN2P3.fr	2.56%
ICG.INR.ru	0.09%
ICG.INTA.es	0.01%
ICG.IPF.bg	0.01%
ICG.IPSL-IPGP.fr	0.09%
ICG.ITEP.ru	0.53%
ICG.ITWM.de	0.00%
ICG.Imperial.uk	0.14%
ICG.Iowa.us	0.16%
ICG.JINR.ru	0.06%
ICG.KFKI.hu	0.38%
ICG.KIAE.ru	0.46%
ICG.KIAM.ru	0.48%
ICG.KNU.kr	0.01%
ICG.Krakow.pl	0.78%
ICG.LAL.fr	0.02%
ICG.LPC-fails.fr	0.02%
ICG.LPC.fr	1.50%
ICG.LFN.fr	0.06%
ICG.Lancashire.uk	3.31%
ICG.Legnaro.it	4.28%
ICG.Liverpool.uk	3.57%
ICG.Lyon.fr	0.06%
ICG.Manchester.uk	5.31%
ICG.Milano.it	0.06%
ICG.Montreal.ca	0.06%
ICG.NCP.pk	0.05%
ICG.NCU.tw	0.03%
ICG.NIKHEF.nl	2.60%
ICG.Napoli-Atlas.it	0.09%
ICG.Napoli.it	0.61%
ICG.OU.il	0.00%
ICG.Oxford.uk	1.04%
ICG.PAKGRID.pk	0.06%
ICG.PDC.se	0.10%
ICG.PIC.es	2.07%
ICG.PNPI.ru	0.02%
ICG.Padova.it	1.54%
ICG.Pisa.it	0.17%
ICG.QMUL.uk	4.10%
ICG.RAL-HEP.uk	0.96%
ICG.RAL.uk	3.64%
ICG.RHUL.uk	1.51%
ICG.SARA.nl	0.56%
ICG.SINP.ru	0.34%
ICG.Sheffield.uk	0.02%
ICG.Sofia.bg	0.01%
ICG.TAU.il	0.14%
ICG.TCD.ie	0.10%
ICG.Torino.it	0.33%
ICG.Toronto.ca	1.12%
ICG.Triumf.ca	0.03%
ICG.UCL-CCC.uk	0.00%
ICG.ULAKBIM.tr	0.29%
ICG.USC.es	4.34%
ICG.WARSAW-failed.pl	0.03%
ICG.WARSAW.pl	1.44%
ICG.WEIZMANN.il	0.18%
ICG.test.no	0.00%

Events 53.312 M

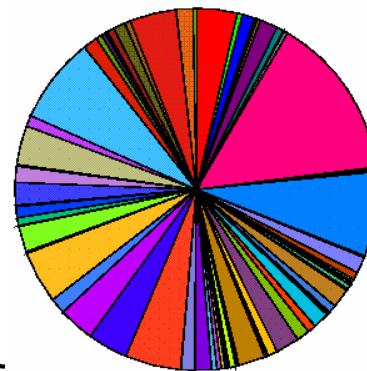


T2 Workst

@2006-05-29 Between 2006-01-01 - 2006-05-28

production L

Output data 24.103 TB



@2006-05-29 Between 2006-01-01 - 2006-05-28

DIRAC.Lyon.fr	3.63%
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ICG.BIFI.es	0.29%
ICG.Barcelona.es	1.60%
ICG.Bari.it	0.63%
ICG.Bologna.it	0.06%
ICG.Bristol.uk	0.01%
ICG.Brunel.uk	0.34%
ICG.CERN.ch	14.63%
ICG.CESGA.es	0.05%
ICG.CG.fr	0.16%
ICG.CNAF-GRIDIT.it	0.20%
ICG.CNAF.it	7.56%
ICG.CNB.es	0.16%
ICG.CPDM.fr	1.46%
ICG.CSCS.ch	0.67%
ICG.CY01.cy	0.23%
ICG.Cagliari.it	0.14%
ICG.Cambridge.uk	0.20%
ICG.Catania-fails.it	0.01%
ICG.Catania.it	0.42%
ICG.Dortmund.de	0.14%
ICG.Durham.uk	0.01%
ICG.Edinburgh.uk	0.03%
ICG.FORTH.gr	1.71%
ICG.Ferrara.it	0.00%
ICG.Firenze.it	0.72%
ICG.GR-01.gr	0.08%
ICG.GR-02.gr	0.01%
ICG.GR-03.gr	0.11%
ICG.GR-04.gr	0.06%
ICG.GR-05.gr	0.05%
ICG.GRIDKA.de	1.45%
ICG.GRNET.gr	0.76%
ICG.Glasgow.uk	1.15%
ICG.HG-02.gr	1.21%
ICG.HG-04.gr	0.85%
ICG.ICI.ro	0.15%
ICG.IHEP.su	0.18%
ICG.IN2P3.fr	2.38%
ICG.INR.ru	0.15%
ICG.INTA.es	0.01%
ICG.IPF.bg	0.01%
ICG.IPSL-IPGP.fr	0.12%
ICG.ITEP.ru	0.55%
ICG.ITWM.de	0.00%
ICG.Imperial.uk	0.17%
ICG.Iowa.us	0.14%
ICG.JINR.ru	0.07%
ICG.KFKI.hu	0.33%
ICG.KIAE.ru	0.41%
ICG.KIAM.ru	0.45%
ICG.KNU.kr	0.01%
ICG.Krakow.pl	1.49%
ICG.LAL.fr	0.00%
ICG.LPC-fails.fr	0.02%
ICG.LPC.fr	1.19%
ICG.LFN.fr	0.04%
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ICG.Legnaro.it	3.59%
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ICG.Manchester.uk	4.67%
ICG.Milano.it	0.01%
ICG.Montreal.ca	0.08%
ICG.NCP.pk	0.04%
ICG.NCU.tw	0.03%
ICG.NIKHEF.nl	2.31%
ICG.Napoli-Atlas.it	0.07%
ICG.Napoli.it	0.70%
ICG.OU.il	0.00%
ICG.Oxford.uk	0.98%
ICG.PAKGRID.pk	0.07%
ICG.PDC.se	0.05%
ICG.PIC.es	2.02%
ICG.PNPI.ru	0.00%
ICG.Padova.it	1.44%
ICG.Pisa.it	0.15%
ICG.QMUL.uk	3.49%
ICG.RAL-HEP.uk	0.98%
ICG.RAL.uk	7.72%
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ICG.SARA.nl	0.51%
ICG.SINP.ru	0.36%
ICG.Sheffield.uk	0.02%
ICG.Sofia.bg	0.00%
ICG.TAU.il	0.13%
ICG.TCD.ie	0.10%
ICG.Torino.it	0.63%
ICG.Toronto.ca	1.06%
ICG.Triumf.ca	0.03%
ICG.UCL-CCC.uk	0.00%
ICG.ULAKBIM.tr	0.50%
ICG.USC.es	4.14%
ICG.WARSAW-failed.pl	0.03%
ICG.WARSAW.pl	1.48%
ICG.WEIZMANN.il	0.29%
ICG.test.no	0.00%

BARCELONA

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- **GRID:**
  - **edg-job-submit / globus-url-copy**
- **Configuration:**
  - “Wrong” Queue settings (SI00 = 381)
- **Operation:**
  - Faulty WN (ssh keys)
  - Expired certificates, CRL’s, CA’s
  - Missing software
  - Overloaded file servers
  - Software bugs
- **Non-reliable Central Services**
  - SE, FC failure



# Problem solving



- **Direct site contact:**
  - e-mail
  - phone
- **GGUS Ticket:**
  - Simpler tracking
- **Dedicated pages:**
  - [http://santinel.home.cern.ch/santinel/cgi-bin/logging\\_info](http://santinel.home.cern.ch/santinel/cgi-bin/logging_info)

- **Large Scale MC Simulation is not a simple Task.**
- **Main contribution for LHCb non Tier-1 Sites.**
- **Mostly CPU bounded, but ...**
- **Close VO – Site work to iron remaining problems.**
- **Thanks to all the Sites for their efforts.**