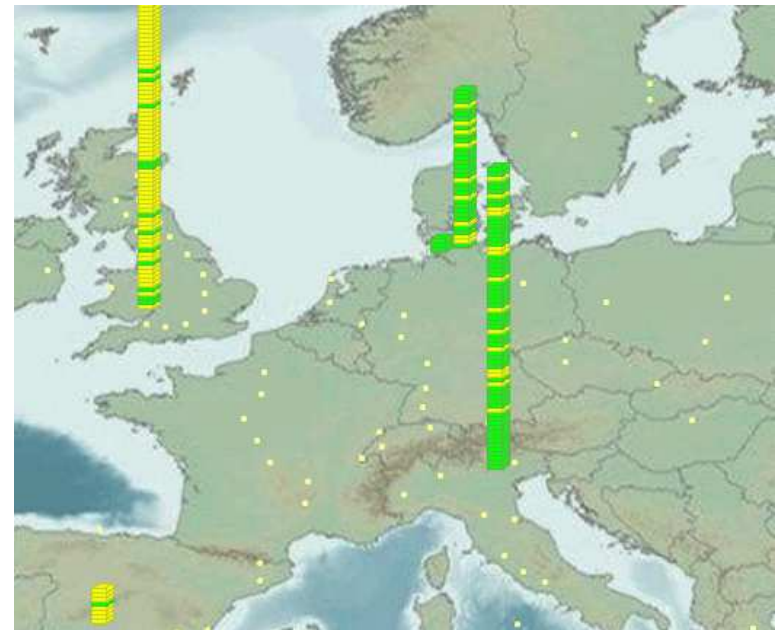


# Monte Carlo Mass Production for the ZEUS Experiment on the Grid

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## Outline:

- Introduction
- Integrated Production System
- ZEUS Grid-Toolkit
- Monitoring
- Conclusions



# The ZEUS Experiment

- HERA-II luminosity upgrade beams:

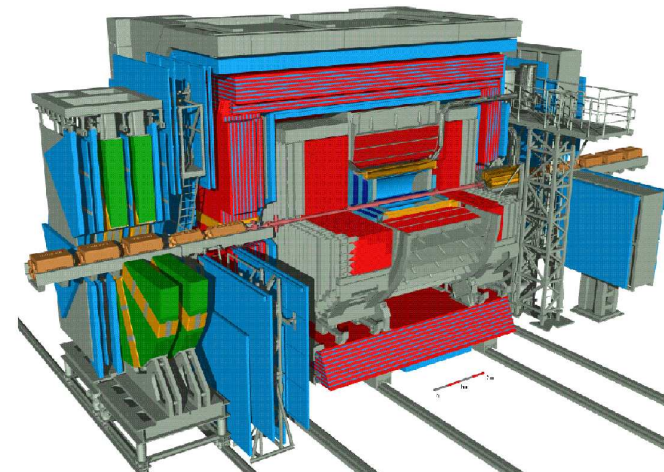
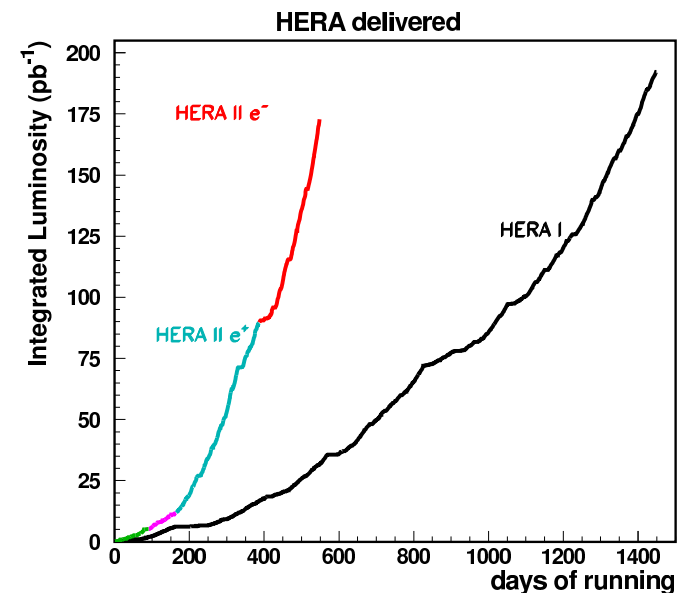
$p$  920 GeV

$e^{\pm}$  27.6 GeV

$\sqrt{s} \approx 320$  GeV

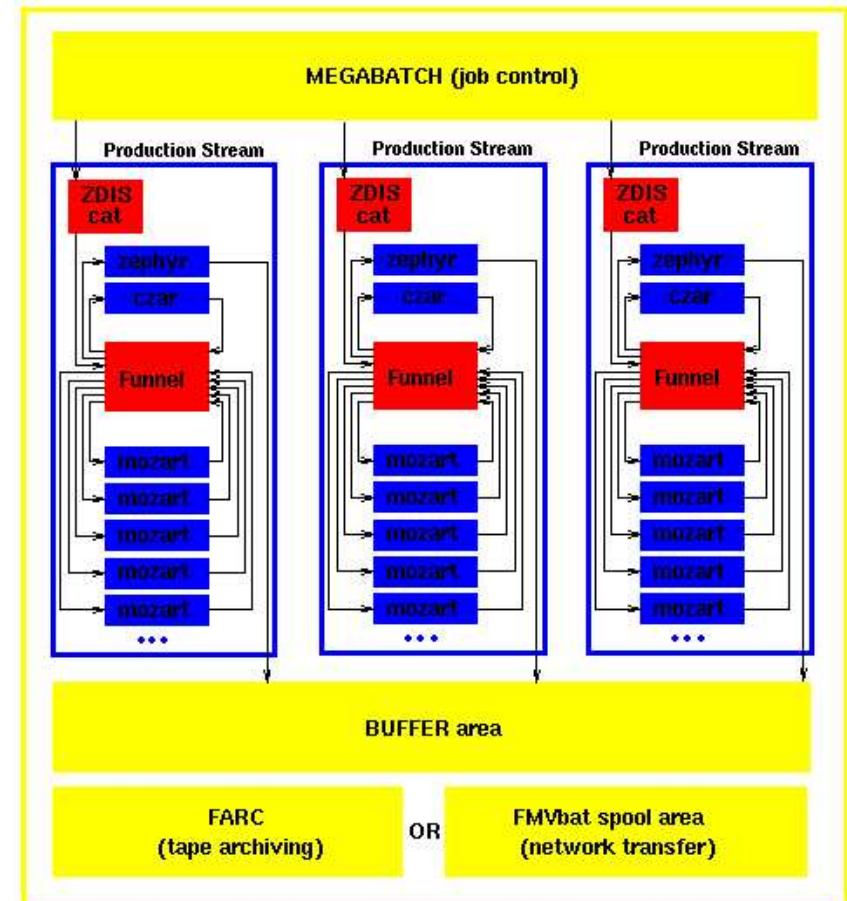
- detector upgrades

- trigger
- microvertex detector
- forward tracking



# Traditional MC Production System

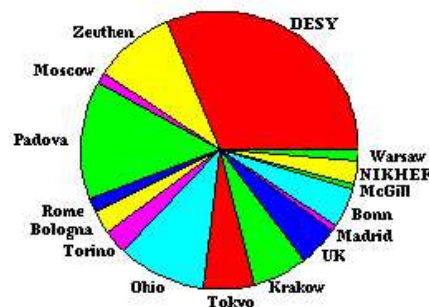
- handles MC requests
- stores all MC files at a central place
- pioneering distributed computing



Production by Institute



1996 41.7 million events



1997 54.6 million events

# Monte Carlo Demand

- physics data volume
- triggers, analyses
- HERA-II event simulation and reconstruction

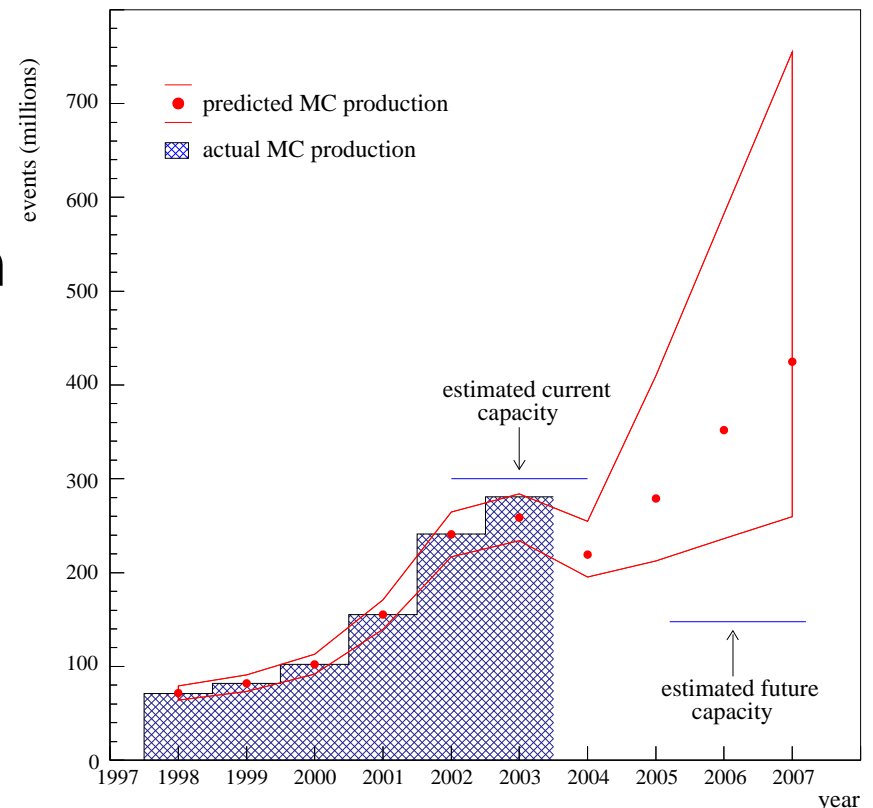
CPU time:

Executable	runtime ratio (post/pre)
simulation	2.08
trigger	1.7
reconstruction	3.46

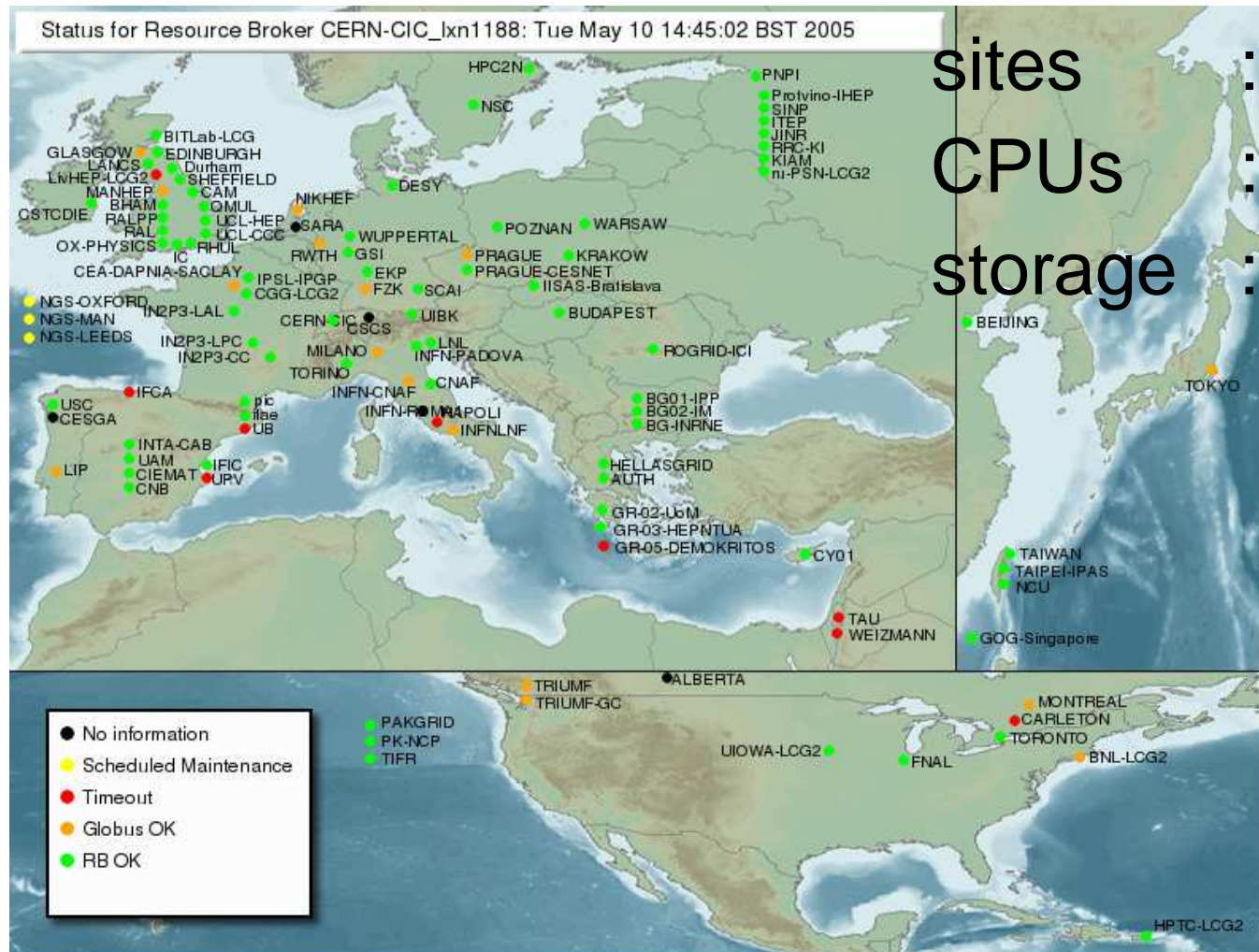
output files: 2.8 (1.13 - 3.3) times larger

- need for additional resources

Monte Carlo Production 1998 to 2007

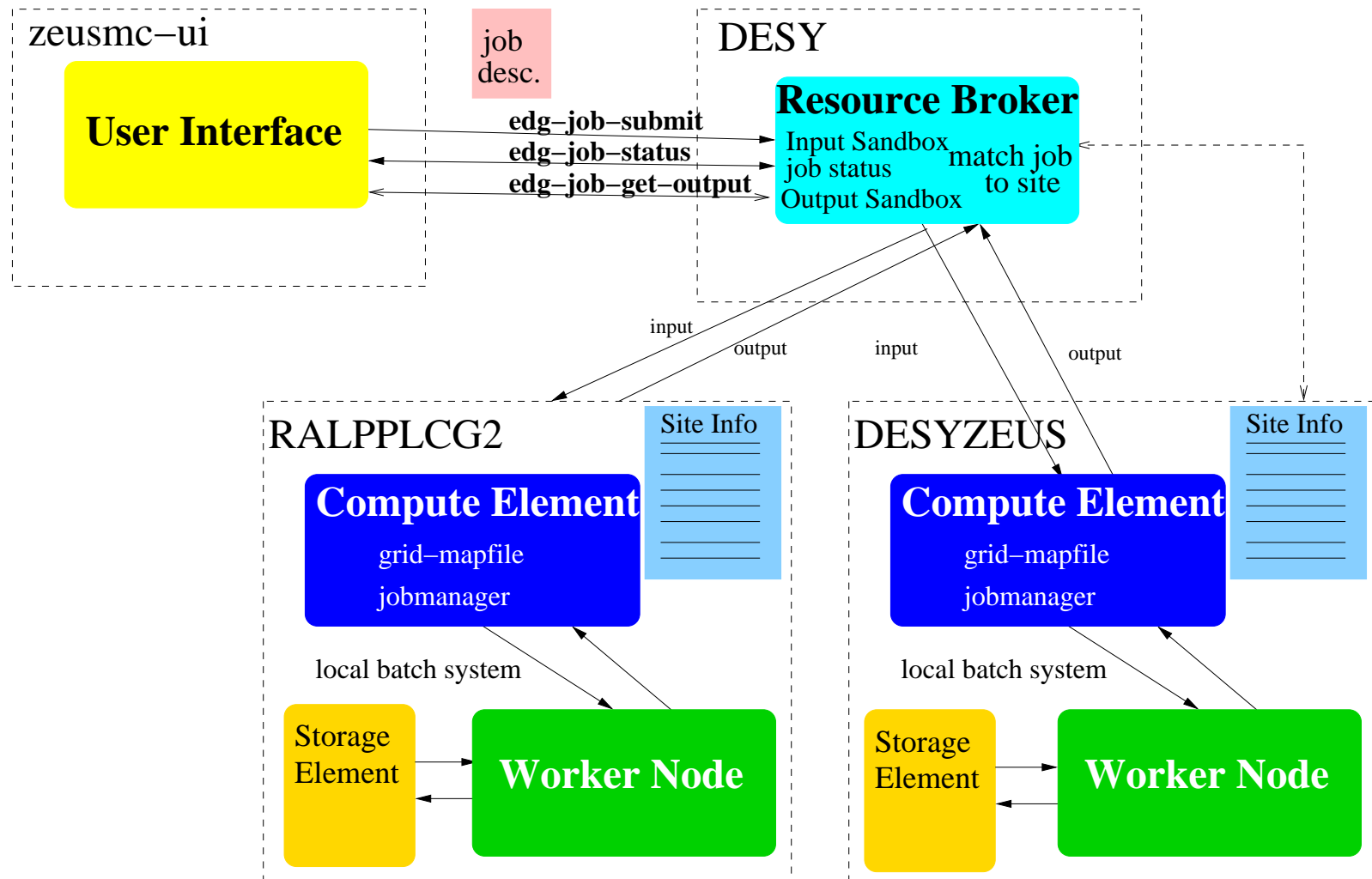


# LHC Computing Grid

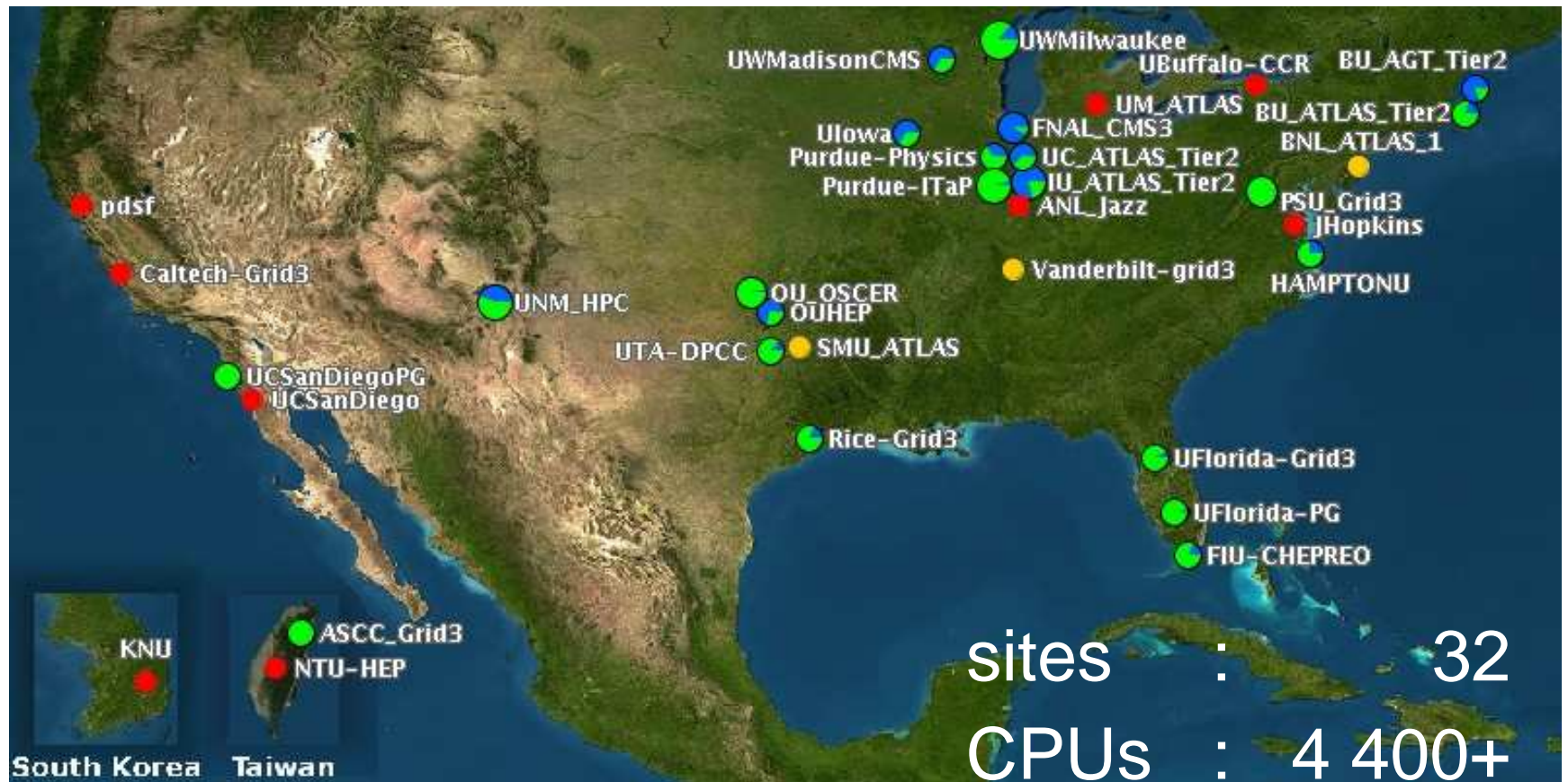


sites : 120+  
 CPUs : 10 000+  
 storage : 4 PB

# LCG Job Submission



# Grid3





# Using the Grid: ZEUS Advantages

- established distributed MC system since 1996
  - MC requests
  - bookkeeping
  - storage
- portable software
- lightweight jobs
  - three executables, each less than 25 MB
  - input data: 50 MB
  - calibrations, run scripts, etc.: 200 MB
- close collaboration with DESY/IT grid group





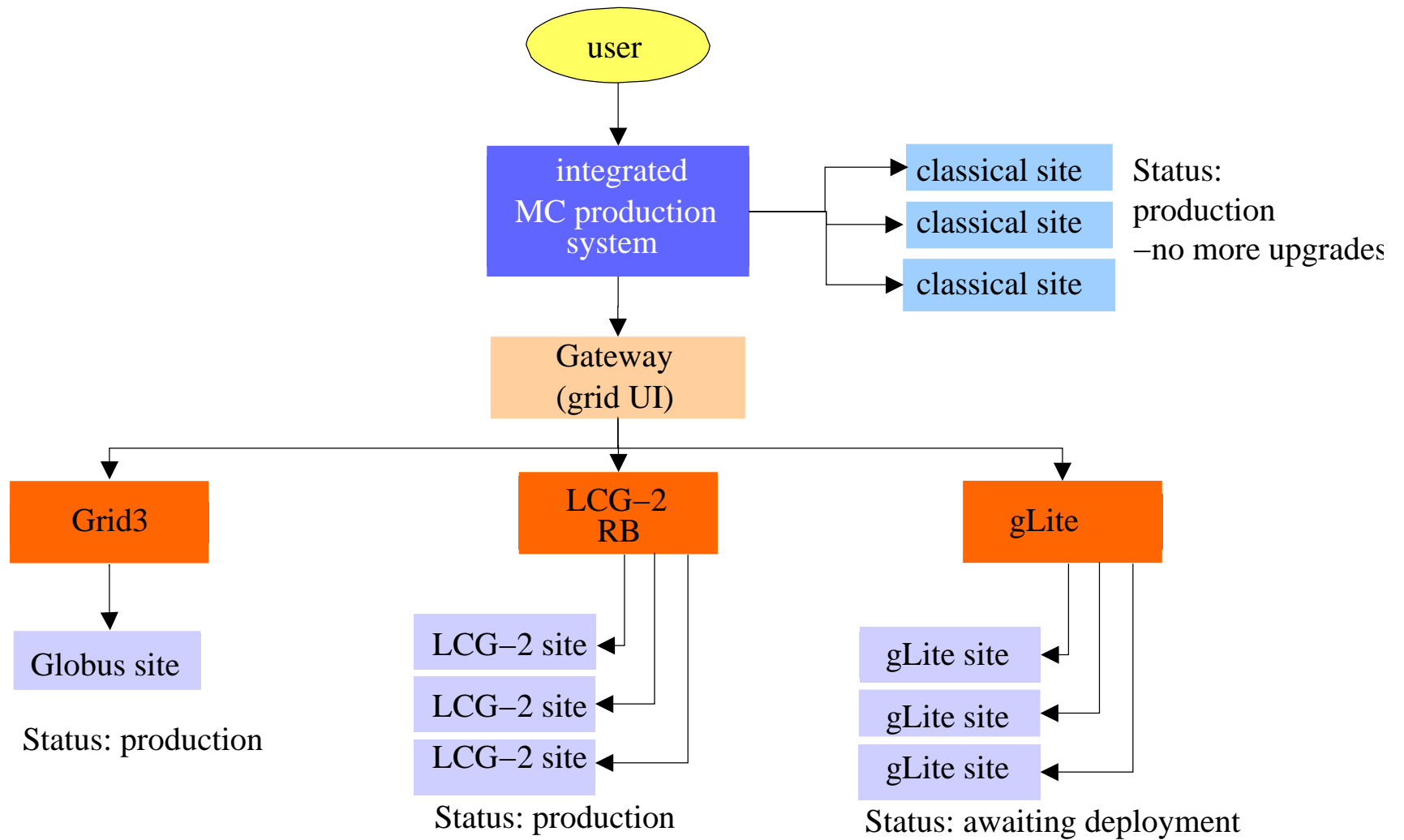
# Using the Grid: Design Aspects

- submitted jobs must run on their own
  - data handling
  - calibrations
  - error logging and handling
  - (re-)submission, bookkeeping
- different middleware with different interfaces
- different sites
- preserve existing MC system

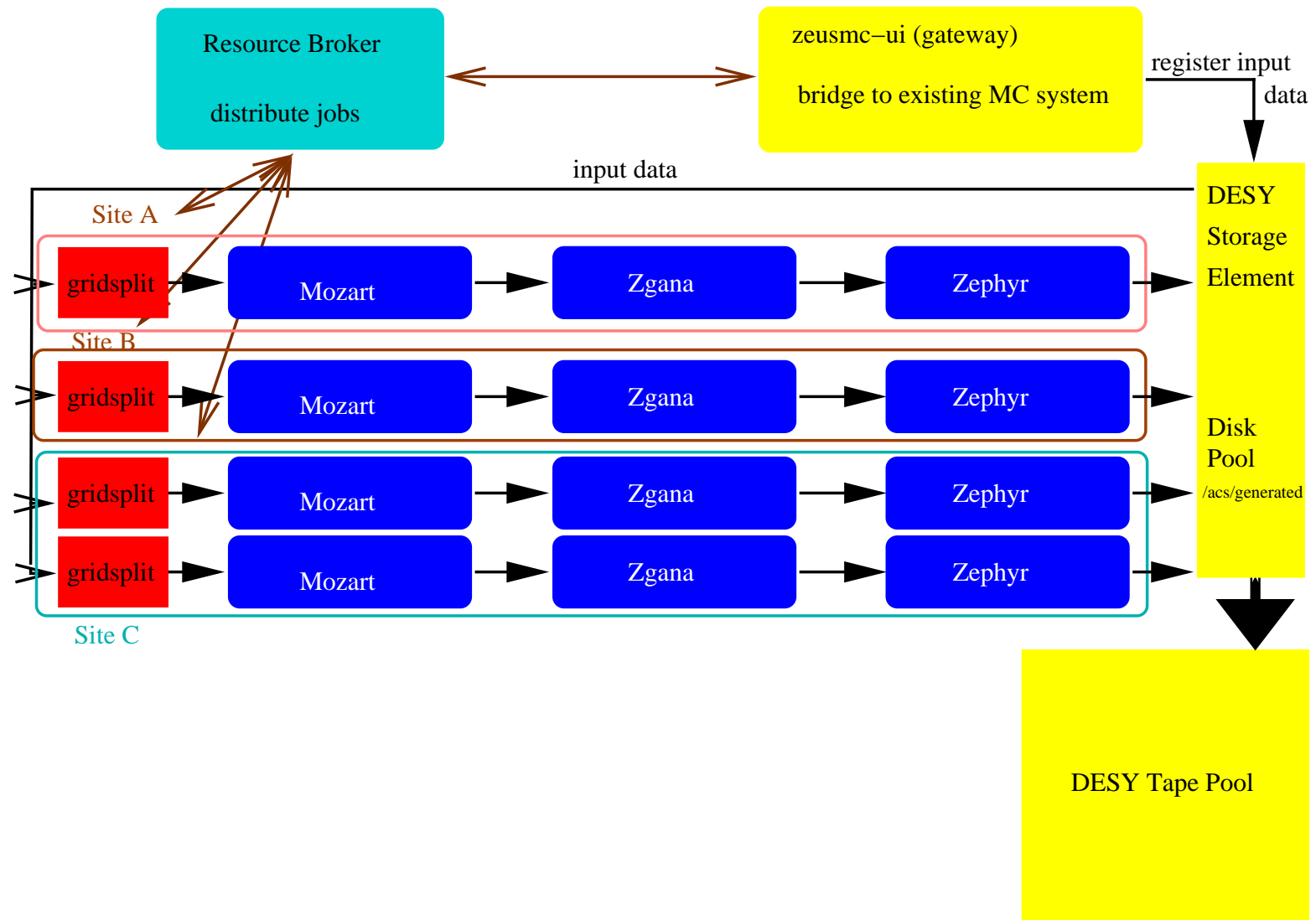
# Using the Grid: Design Aspects

- submitted jobs must run on their own
  - data handling                      use existing scripts
  - calibrations                      split input, check for errors
  - error logging and handling
  - (re-)submission, bookkeeping
- different middleware with different interfaces                      ZEUS grid-toolkit
- different sites                      good monitoring
- preserve existing MC system                      build bridge from the existing MC system to the grid

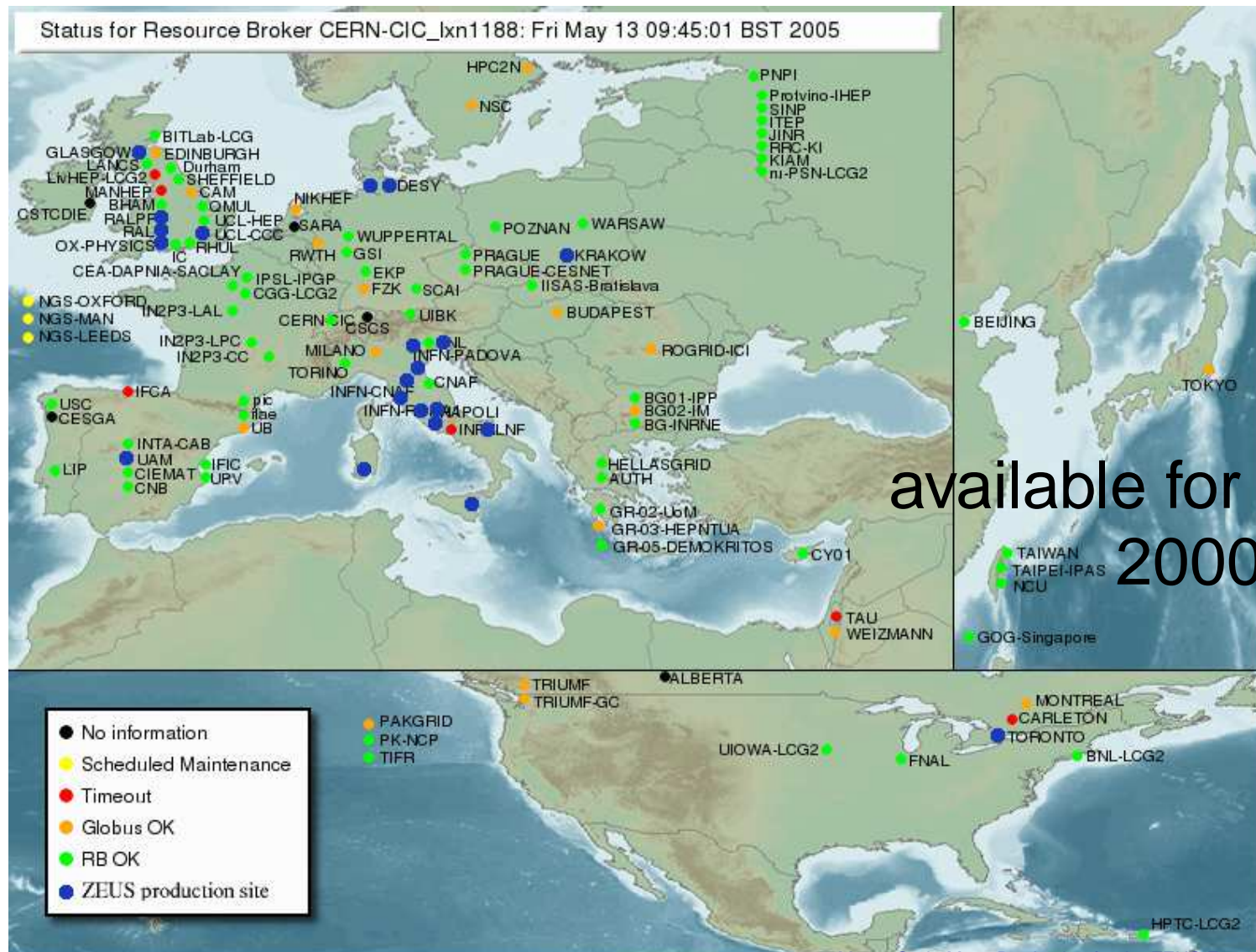
# Bridge to the Grid



# Dataflow



# LCG Sites





# Beyond LCG: Grid3 Site in Wisconsin

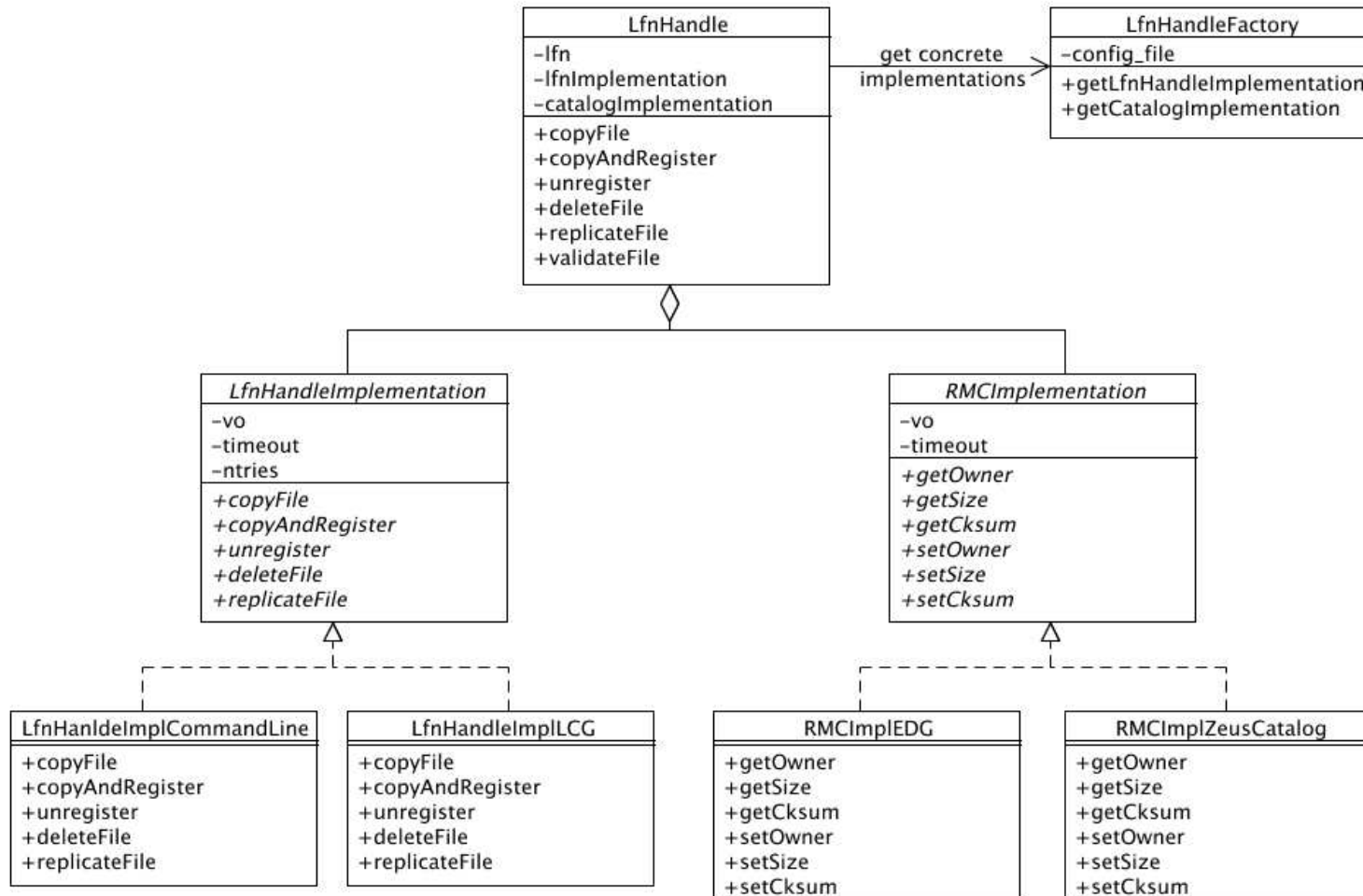
- at the University of Wisconsin
- uses Condor to submit jobs to 1440 CPUs
- approach:
  - use Globus toolkit and emulate LCG behavior
  - install a job wrapper script at CE
  - install LCG storage tools
  - use own JobCommand implementation in ZEUS grid-toolkit
- first Grid3 site participating in ZEUS MC production



# ZEUS Grid-Toolkit

- set of Perl classes for
  - basic data structures
  - job submission
  - data transfer
  - output validation
- implementation using grid tools encapsulated
- fixes known deficiencies of grid tools
- independent of the ZEUS software
- used by at least one other experiment
- <http://www-zeus.desy.de/grid>

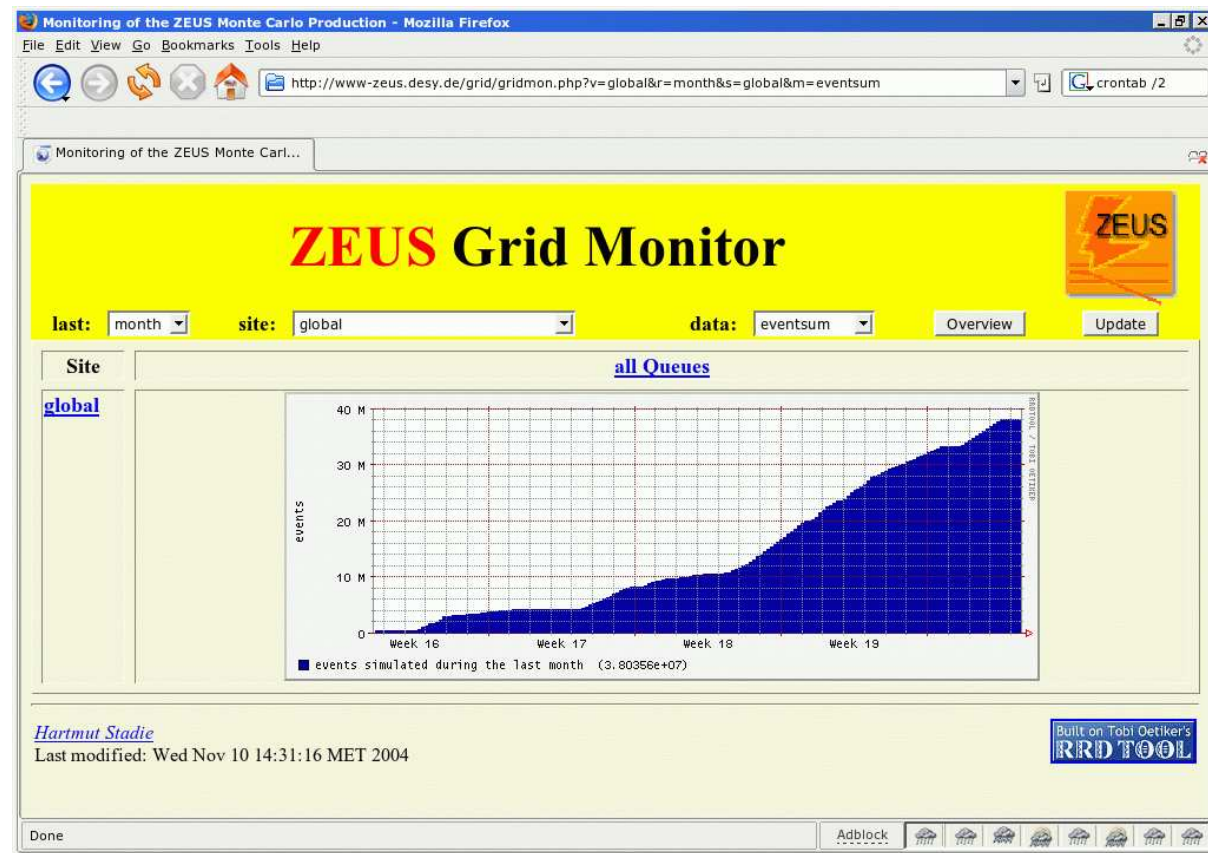
# ZEUS Grid-Toolkit: Design Example



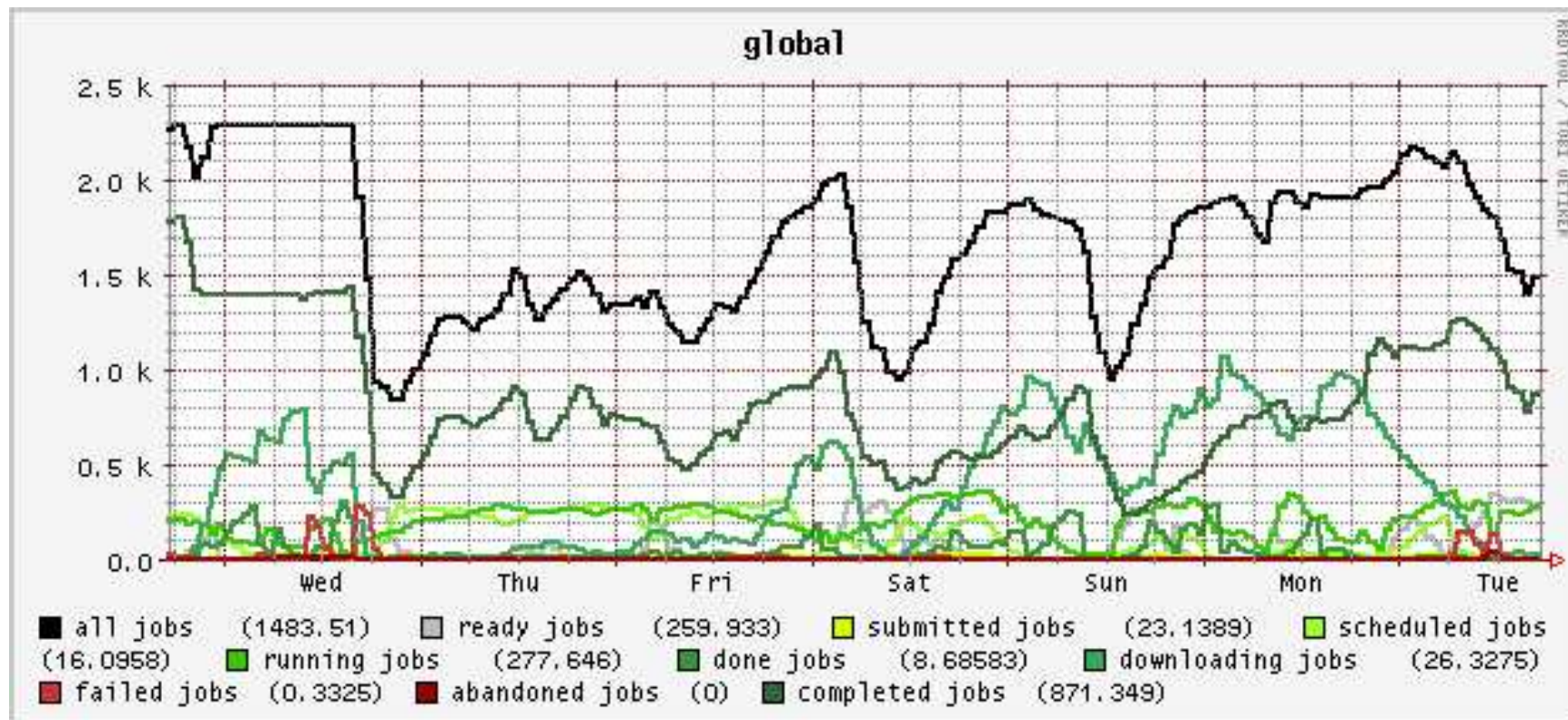


# How to improve the Grid Production?

- more sites
- monitoring
- move critical services to reliable sites
- exclude broken sites
- try to fix or circumvent problems
- identify and remove bottlenecks



# ZEUS Grid Job Status Monitoring



each grid job stored in a database  
continuous submission of jobs

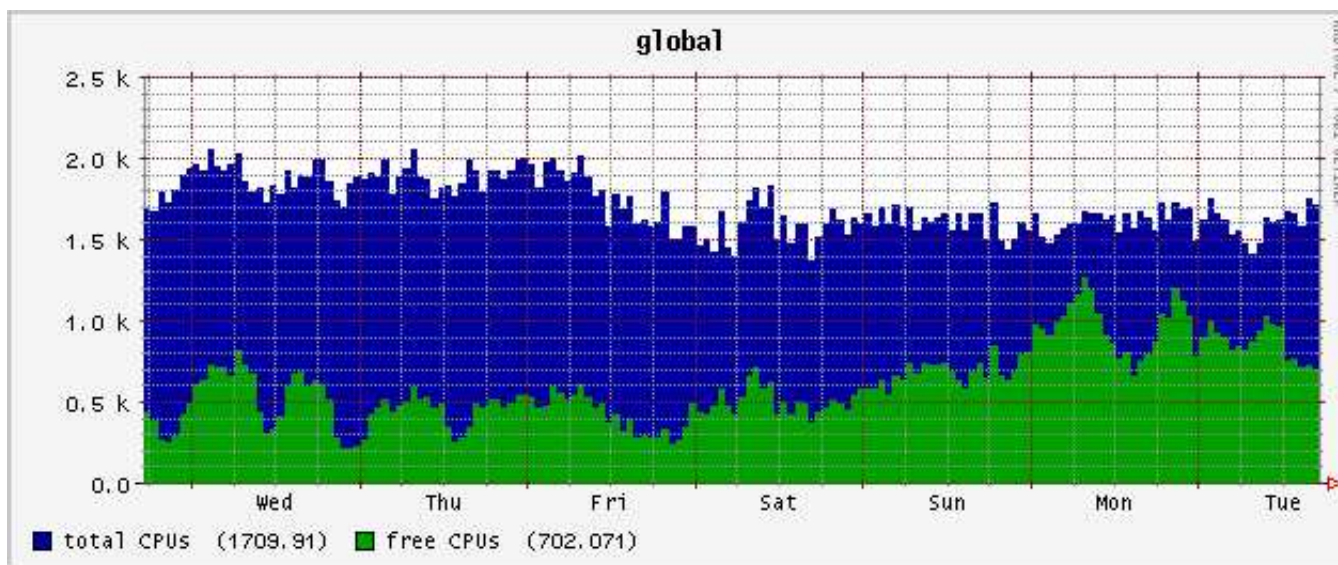
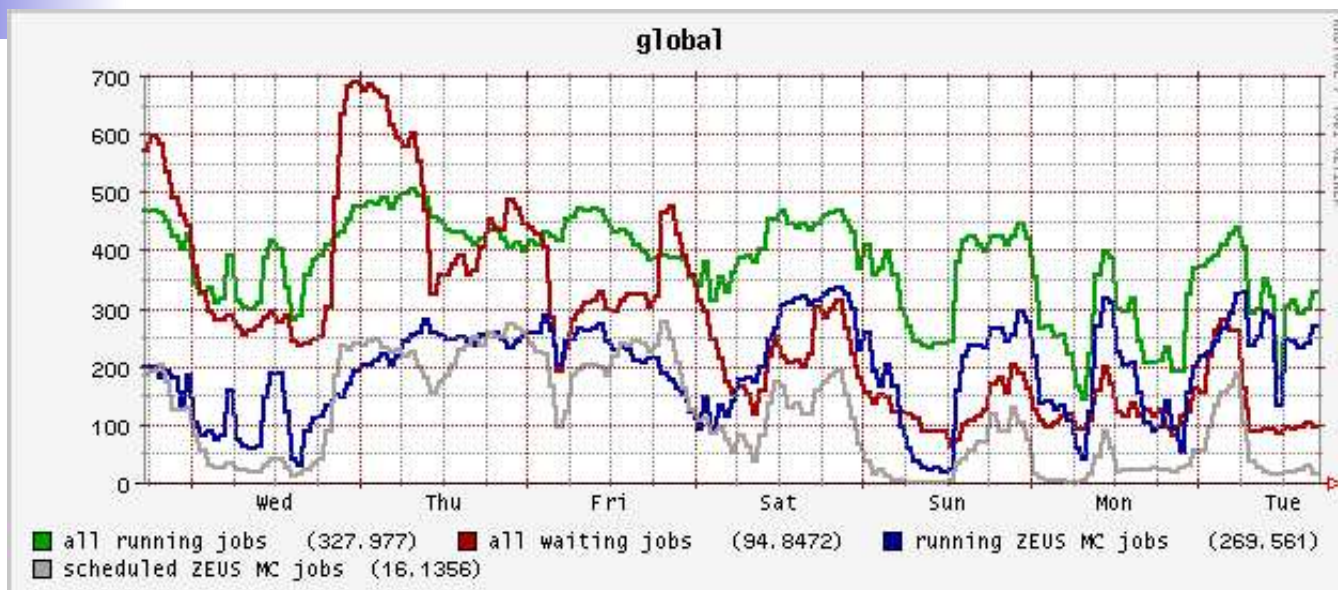
# ZEUS Grid Job Status Monitoring II

6001	1000	SUBMITTED	Thu Feb 24 14:37:33 2005	SUBMITTED and scheduled at gridit001.pd.infn.it:2119/jobmanager-lcglstf-long <a href="https://grid-rb.desy.de:9000/x7ogmSK0m-Jlx7Y1p6B36Q">https://grid-rb.desy.de:9000/x7ogmSK0m-Jlx7Y1p6B36Q</a>
12001	1000	SUBMITTED	Thu Feb 24 11:49:45 2005	SUBMITTED and running at zeus-cc.desy.de:2119/jobmanager-lcgpbs-long <a href="https://grid-rb.desy.de:9000/XLskr65mgDXW78G6Hg71A">https://grid-rb.desy.de:9000/XLskr65mgDXW78G6Hg71A</a>
15001	1000	SUBMITTED	Thu Feb 24 11:44:53 2005	SUBMITTED and running at grid-cc.desy.de:2119/jobmanager-lcgpbs-zeus <a href="https://grid-rb.desy.de:9000/QSWfr-L1ECOrF7HLFpWdDw">https://grid-rb.desy.de:9000/QSWfr-L1ECOrF7HLFpWdDw</a>
16001	1000	SUBMITTED	Thu Feb 24 11:54:37 2005	SUBMITTED and running at zeus-cc.desy.de:2119/jobmanager-lcgpbs-long <a href="https://grid-rb.desy.de:9000/cWPGrtZcDo0M1dveFTda1A">https://grid-rb.desy.de:9000/cWPGrtZcDo0M1dveFTda1A</a>
2001	1000	DONE	Thu Feb 24 14:42:23 2005	DONE at griditee01.na.infn.it:2119/jobmanager-lcgpbs-infinite <a href="https://grid-rb.desy.de:9000/rwXK23V3_fhaU7Z1DHLvUA">https://grid-rb.desy.de:9000/rwXK23V3_fhaU7Z1DHLvUA</a>

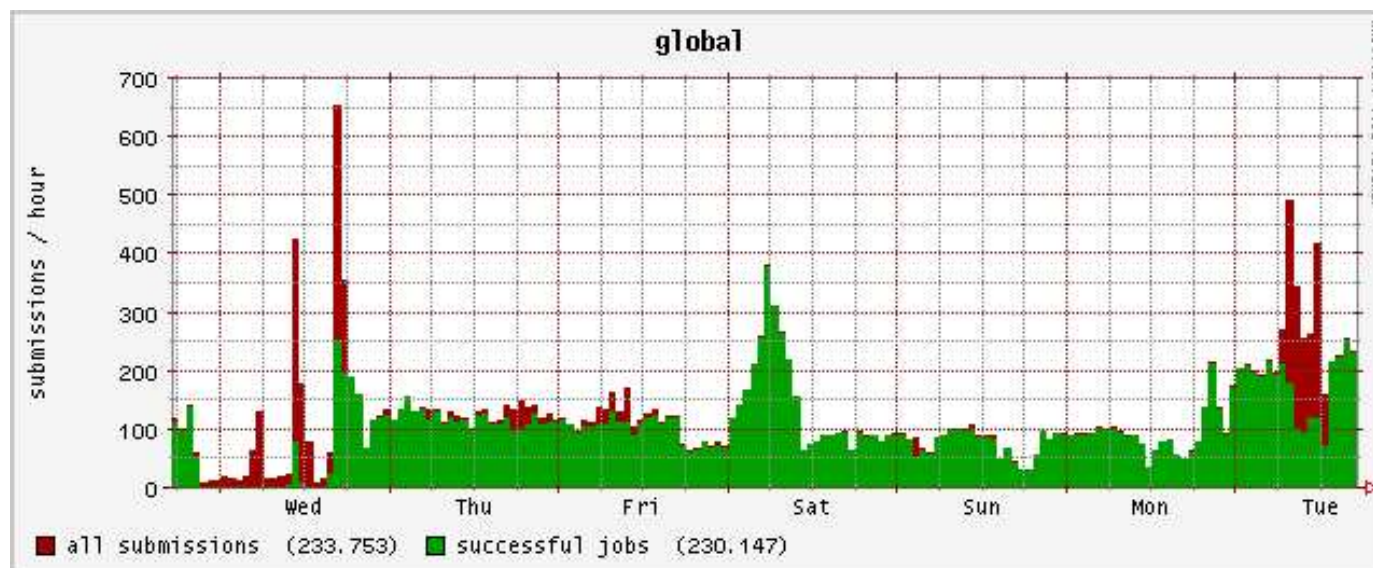
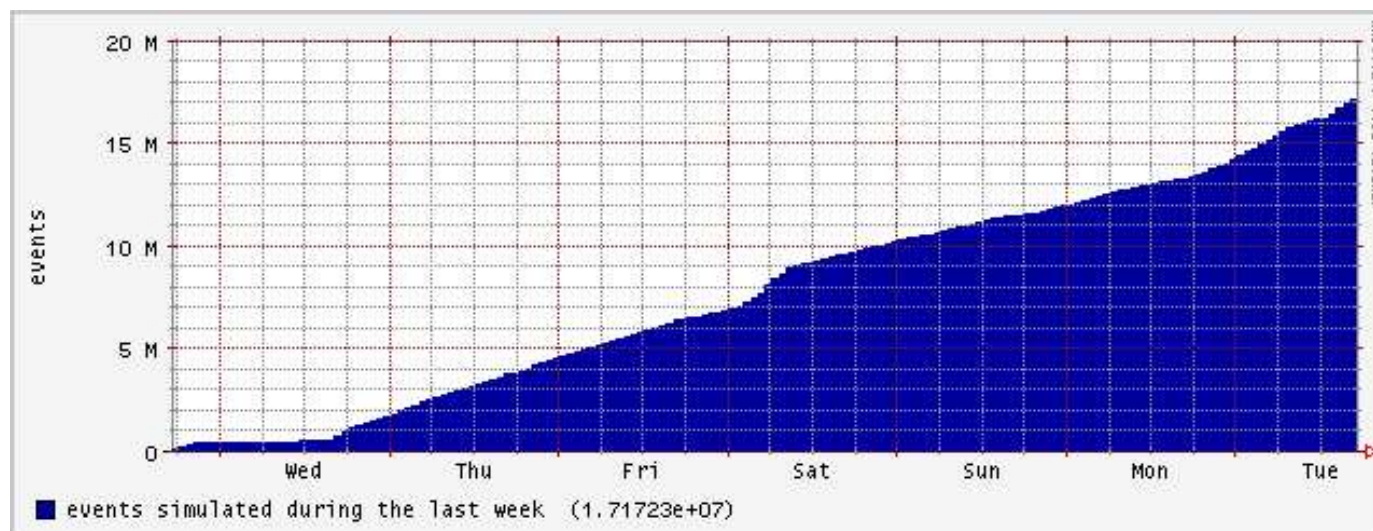
state  
date of last state change

last history entry

# Scheduled and Running Jobs, CPUs



# Produced Events and Submissions



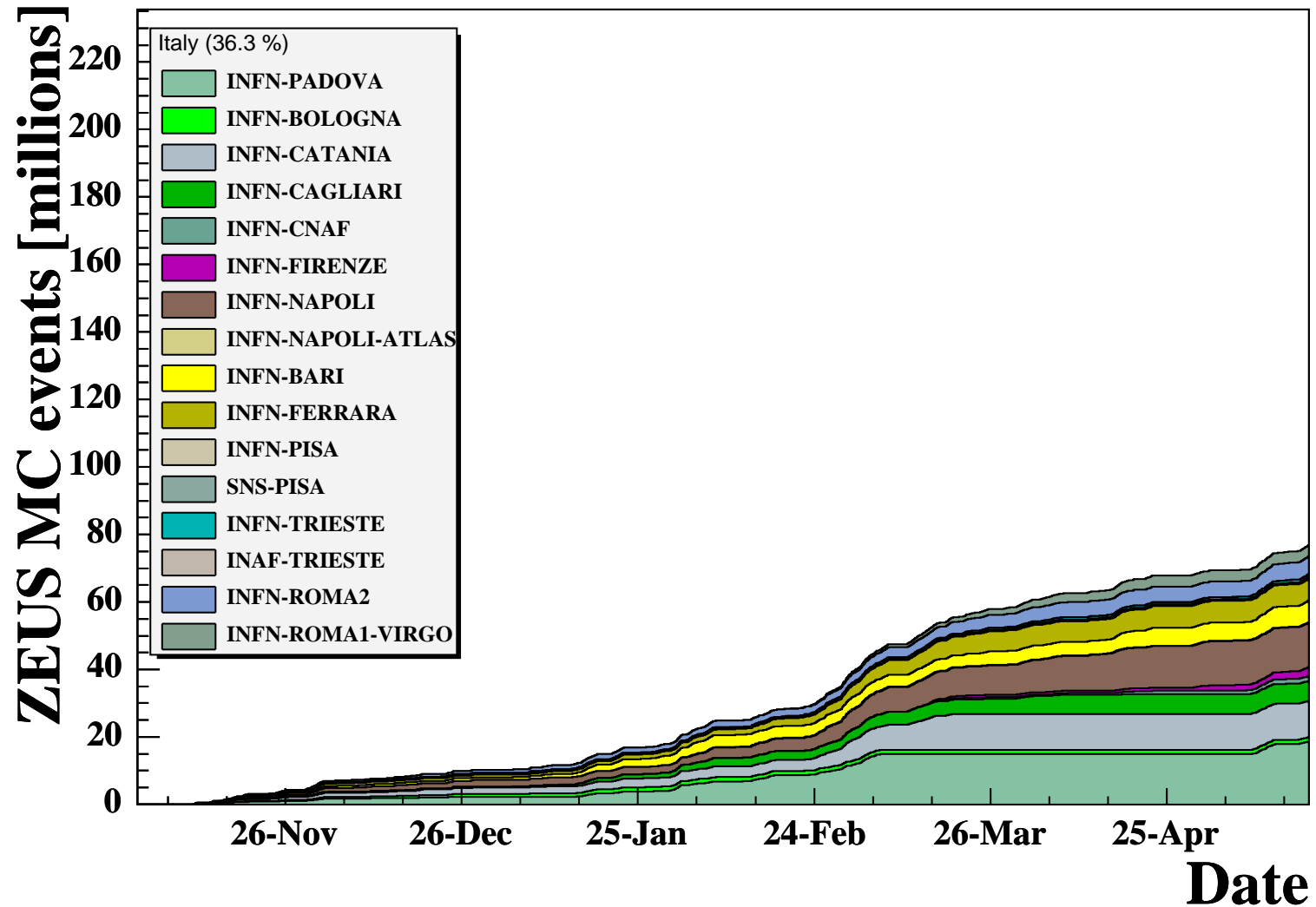
# Error List

## ZEUS Grid Latest Errors

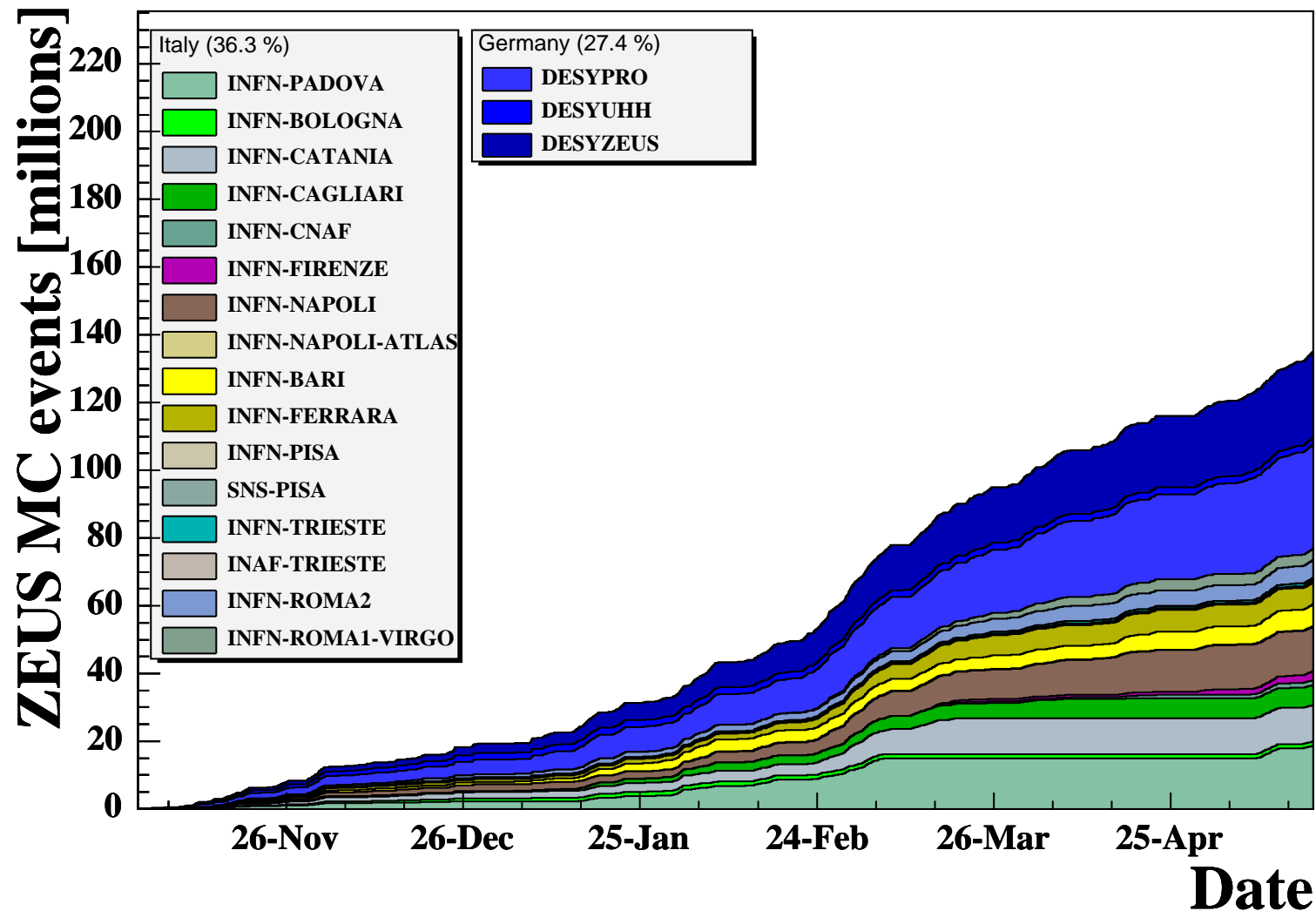


date	CE name	queue	funnel id	first event	error	
Thu Feb 24 13:48:05 2005	grid012.ct.infn.it	long	82P020.H10384.HRW6505.RMS.2J.61	13001	failed to tar zxvf gaf.tgz --dir rootdir/funnel;	<a href="https://">https://</a>
Thu Feb 24 13:24:04 2005	heplnx201.pp.rl.ac.uk	zeus	82P020.H10384.HRW6505.RMS.2J.32	17001	could not copy and register the output file to default SE; timeout reached 1200;	<a href="https://">https://</a>
Thu Feb 24 12:49:55 2005	heplnx201.pp.rl.ac.uk	zeus	82P020.H10384.HRW6505.RMS.2J.31	13001	could not copy and register the output file to default SE; timeout reached 1200;	<a href="https://">https://</a>
Thu Feb 24 12:38:53 2005	heplnx201.pp.rl.ac.uk	zeus	82P020.H10384.HRW6505.RMS.2J.117	9001	timeout reached 21600; failed to ./run mozart 82P020.H10384.HRW6505.RMS.2J.117 9001 1000;	<a href="https://">https://</a>
Thu Feb 24 11:25:11 2005	heplnx201.pp.rl.ac.uk	zeus	82P020.H10384.HRW6505.RMS.2J.19	19001	could not copy and register the output file to default SE; timeout reached 1200;	<a href="https://">https://</a>
Thu Feb 24 11:21:28 2005	heplnx201.pp.rl.ac.uk	zeus	82P020.H10384.HRW6505.RMS.2J.14	9001	failed to ./run mozart 82P020.H10384.HRW6505.RMS.2J.14 9001 1000;	<a href="https://">https://</a>
Thu Feb 24 10:57:45 2005	heplnx201.pp.rl.ac.uk	zeus	82P020.H10384.HRW6505.RMS.2J.113	1001	could not copy and register the output file to default SE; timeout reached 1200;	<a href="https://">https://</a>
Thu Feb 24 10:54:45 2005	heplnx201.pp.rl.ac.uk	zeus	82p020.s8954.sat.cdm.q80.009	9001	at heplnx201.pp.rl.ac.uk:2119/jobmanager-torque-zeus	<a href="https://">https://</a>

# Overall Production

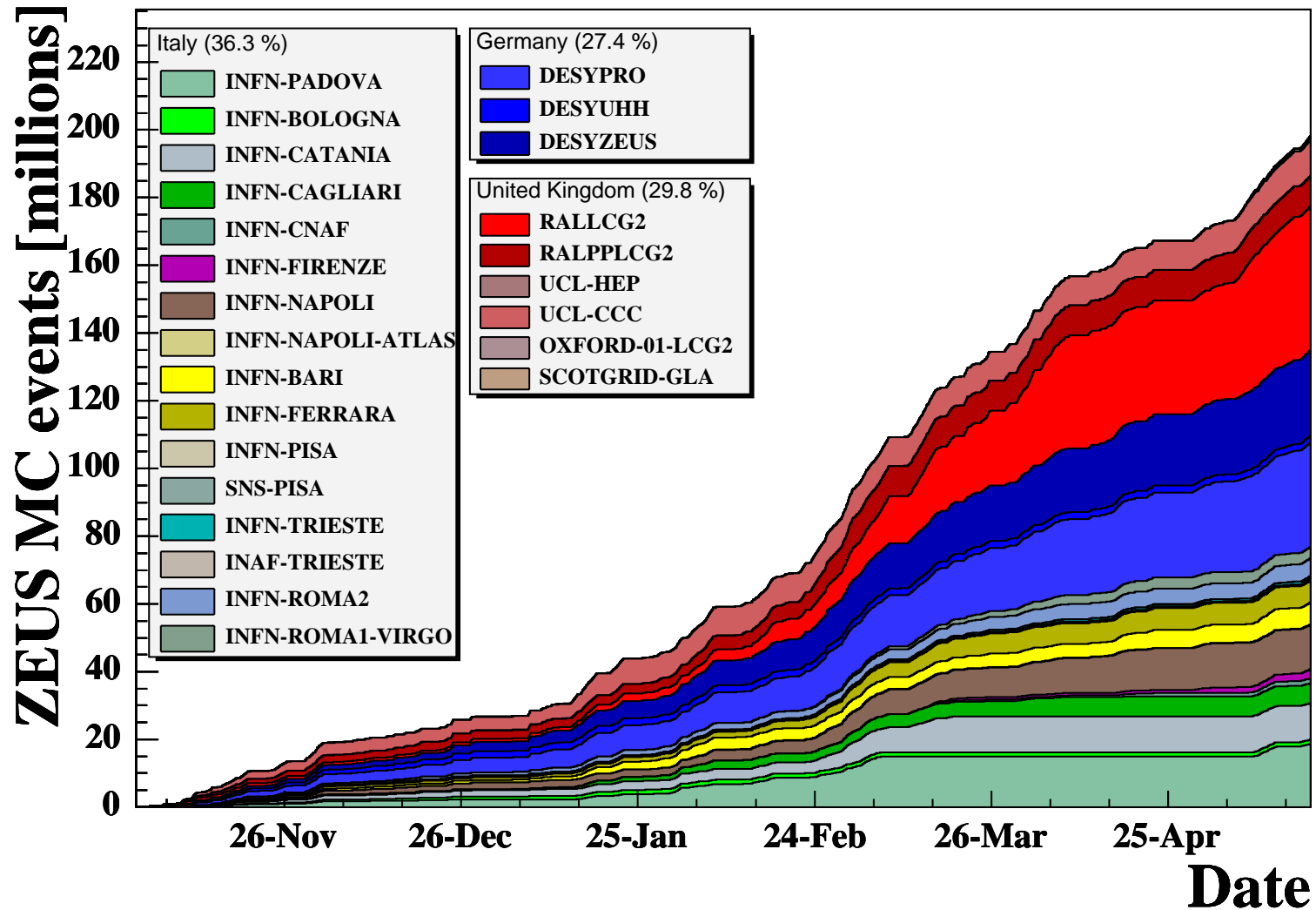


# Overall Production

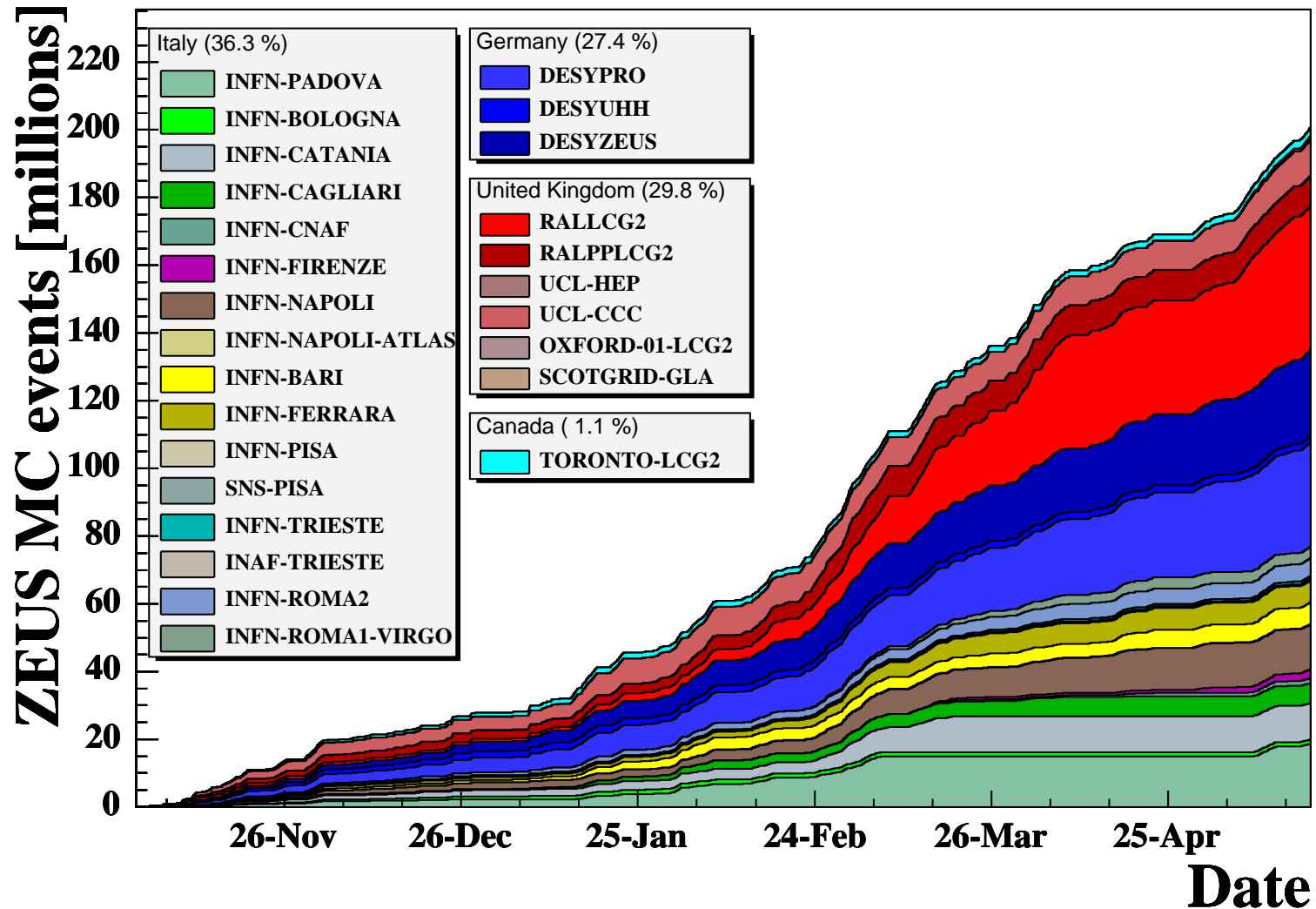




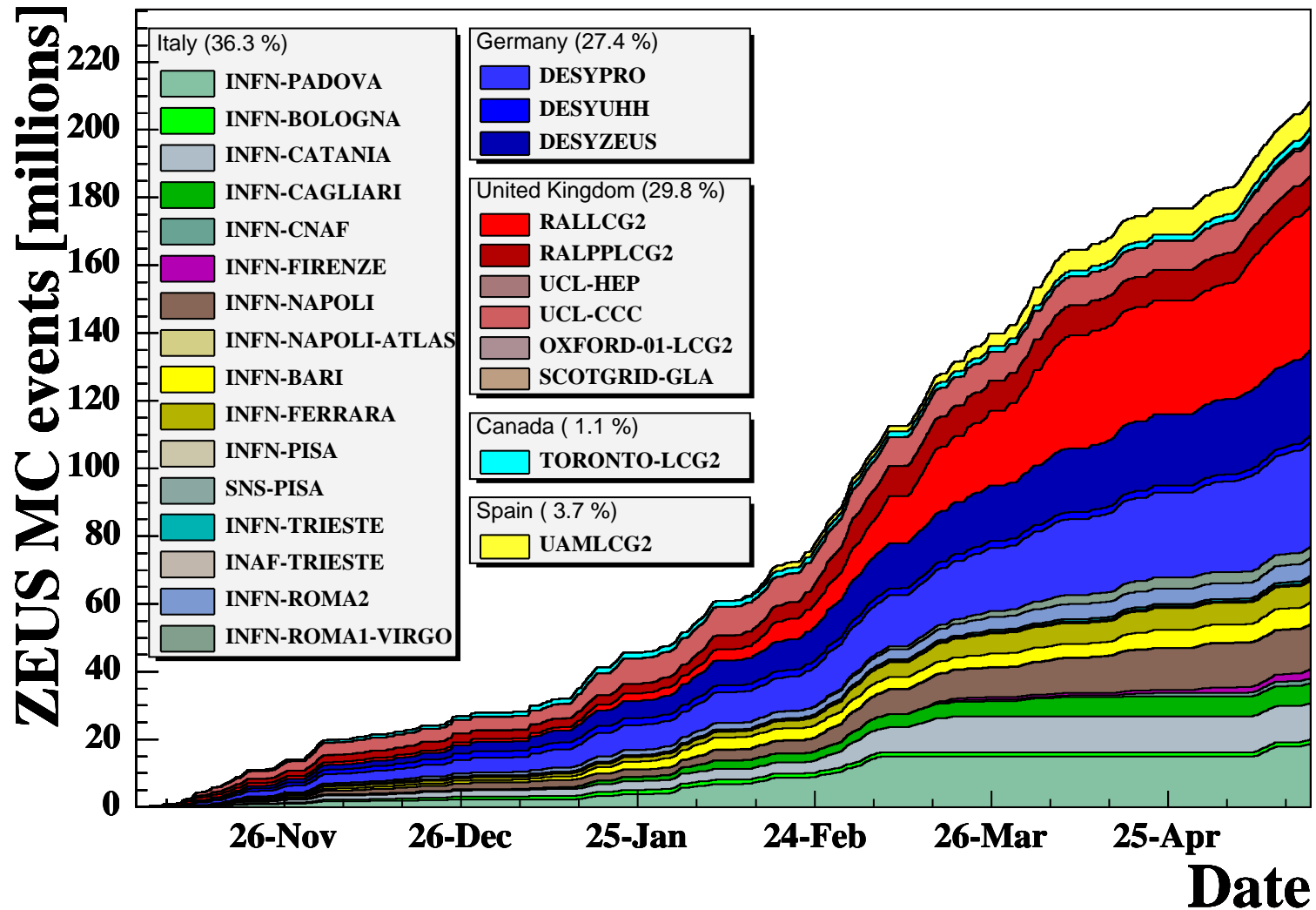
# Overall Production



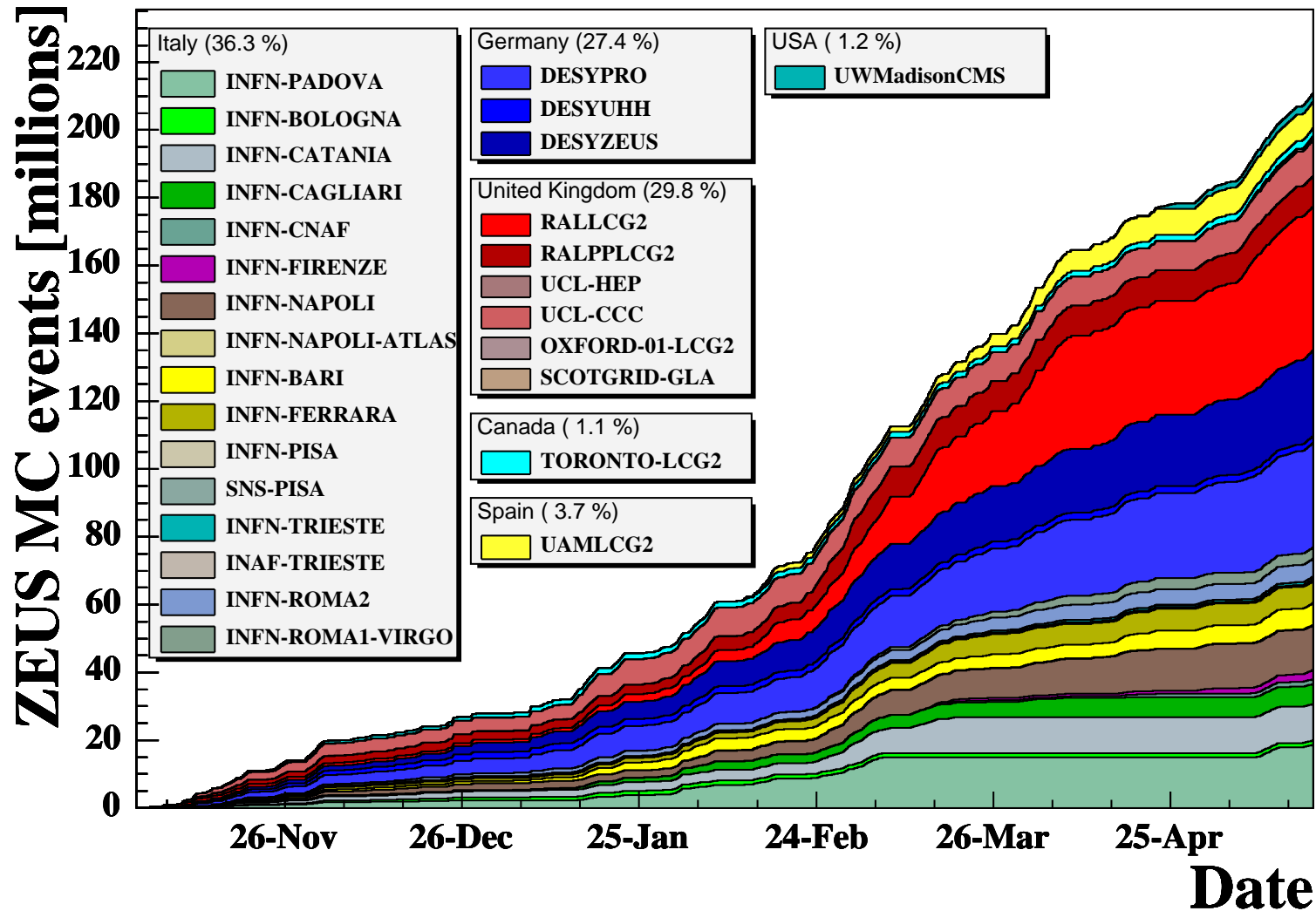
# Overall Production



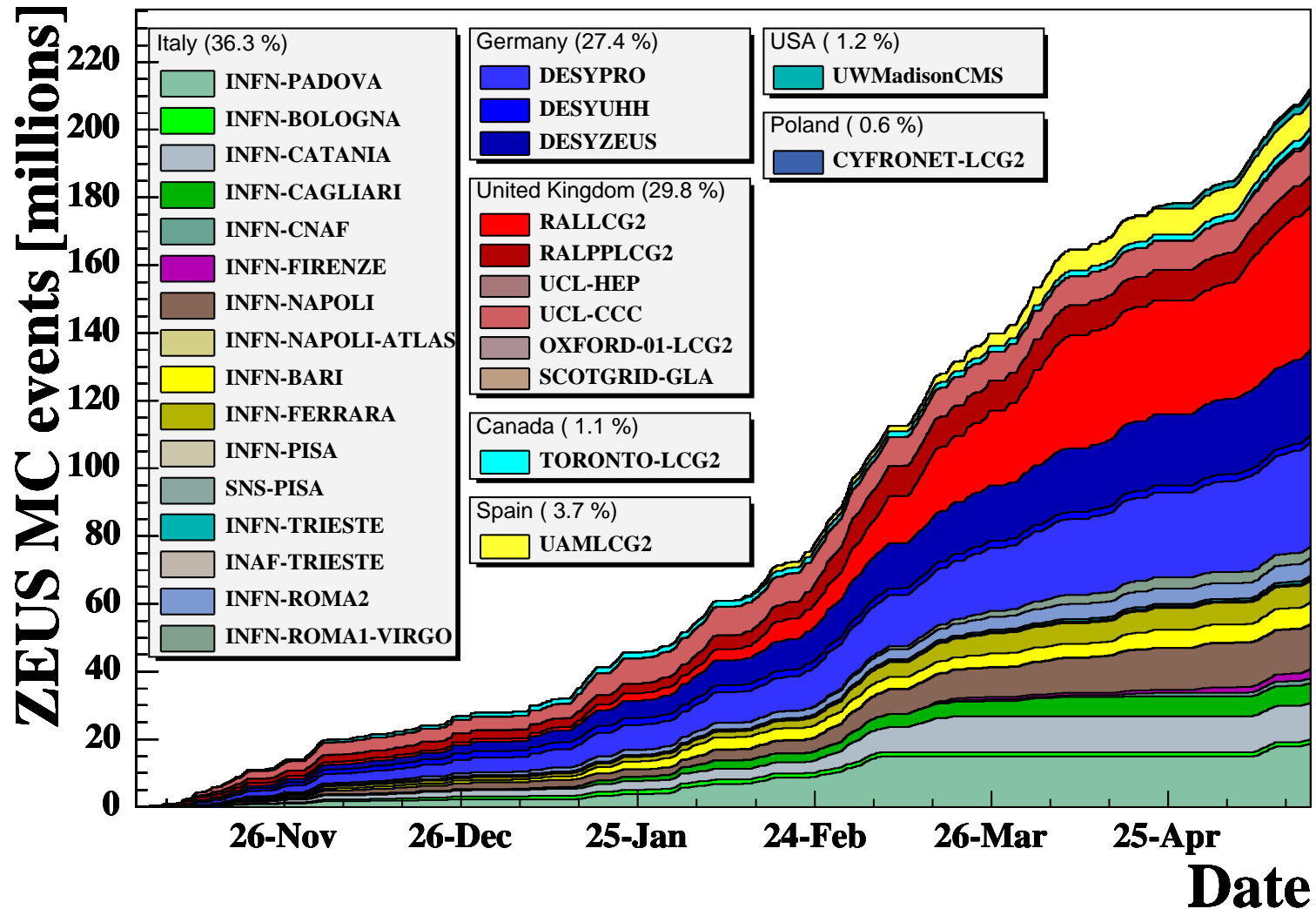
# Overall Production



# Overall Production



# Overall Production



# Conclusions

- integrated system using static and grid resources
- ZEUS grid-toolkit
- uses different grids
- 29 different sites produced events
- doubled production capacity
- <http://www-zeus.desy.de/grid/>

