VO AUGER Large Scale Monte Carlo Simulations using the EGEE Grid Environment

J. Schovancová[1,2], J. Chudoba[1,2], P. Trávníček[2]

Job provenance team:
F. Dvořák[1], J. Filipovič[1], J. Kmuníček[1], A. Křenek[1],
L. Matyska[1], M. Mulač[1], M. Ruda[1], Z. Salvet[1],
J. Sitera[1], Z. Šustr[1]

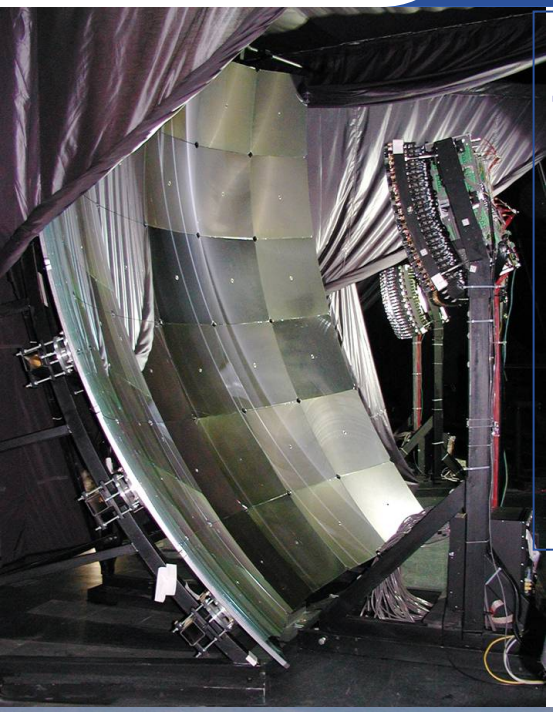
[1] CESNET, Prague
[2] FZU, Prague

www.eu-egee.org

Information Society and Media

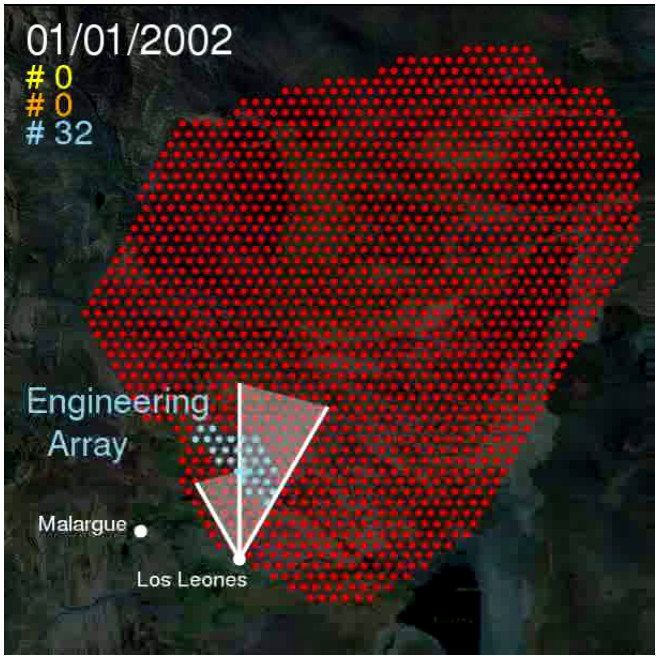
EGEE and gLite are registered trademarks

Pierre Auger Observatory (Detectors)



Fluorescence telescopes:
Number of telescopes: 24
Mirrors: 3.6 m x 3.6 m with field of view 30ºx30º, each telescope is equipped with 440 photomultipliers.

http://www.auger.org



Ground detectors:
Covered surface: 3000 km^2
Number of detectors: 1600
Type of detector: Detector of Cherenkov radiation, each consisting of 12 000 litres of ultrapure water and equipped with 3 photomultipliers.
Spacing between detectors: 1.5 km.

VO AUGER

- **Created in 2006 by the Czech group in cooperation with CESNET**
- **CESNET provides and maintains central resources**
  - LCG RB, gLite WMS, LB, UI, LFC, registration portal, VOMS server
- **VOMS server replica at FNAL**
- **10 sites from 8 countries support VO AUGER**

Resources, Usage

- **Production of libraries of cosmic ray showers**
- **Access to the simulated data files**
- **Resources for individual users**

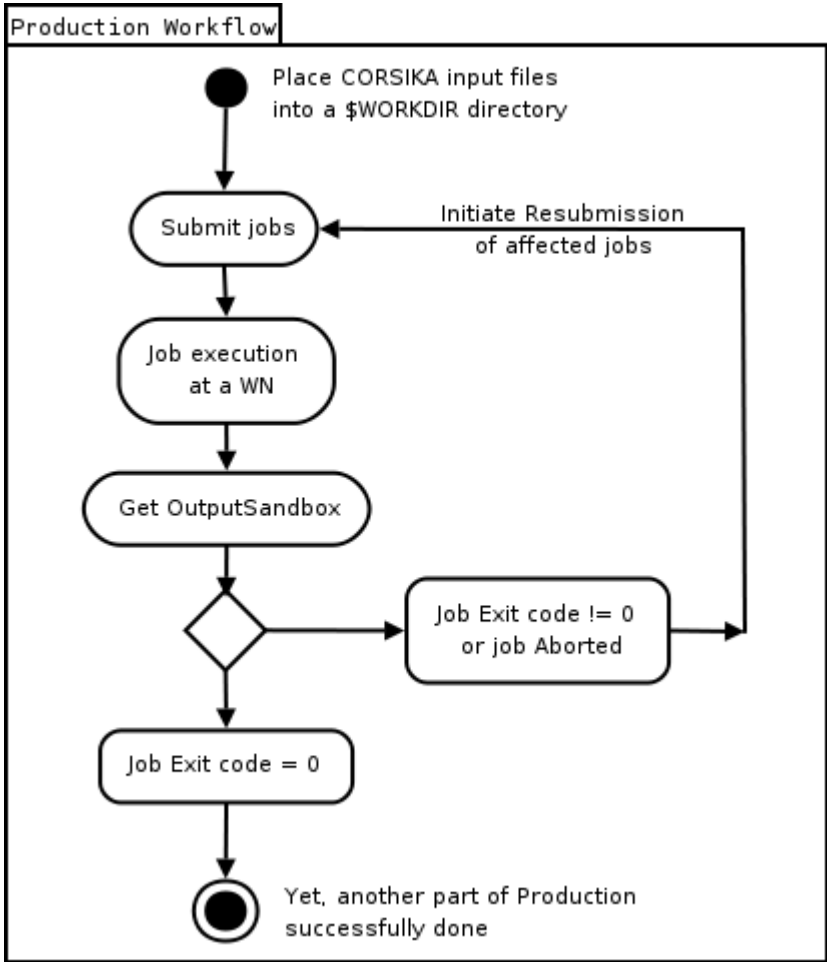
golias25.farm.particle.cz	Prague, ASCR	15	6 TB
skurut17.cesnet.cz	Prague, CESNET	20	1 TB
apcpc79.in2p3.fr	GRIF (APC), Paris	5	0 TB
grid10.lal.in2p3.fr	GRIF (LAL), Paris	15	0 TB
ce02.lip.pt	LIP, Lisboa	2	0 TB
tbn20.nikhef.nl	NIKHEF, Amsterodam	20	0 TB
lcgce.ijs.si	IJS, Ljubljana	10	2 TB
	UNAM	4	0 TB
	CCIN2P3, Lyon		
	FZK, Karlsruhe	100	50 TB
	Aachen	85	15 TB
	Wuppertal	50	25 TB

Number of CPUs and available storage for the VO AUGER are rough estimates fluctuating by a large factor.

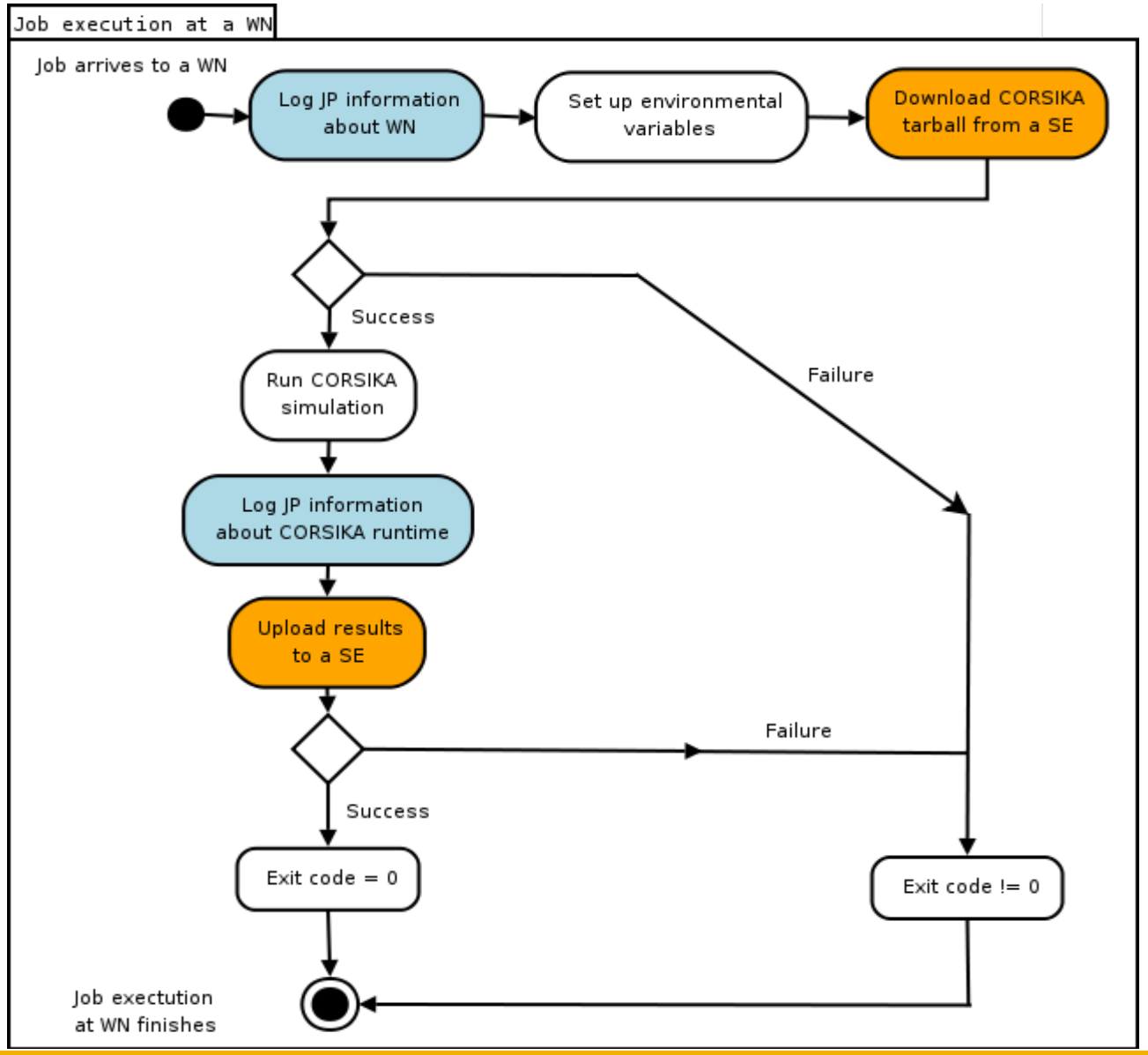
Production Framework

- **Aim: enable VO AUGER users to run their small private offline productions using EGEE Grid**
- **Production using a set of bash scripts:**
  - Put CORSIKA inputs into a $WORKDIR directory
    e.g. **INIT.**epos_gr01_en21.000_th60.000_00001
  - Place the submission scripts into $WORKDIR
    Submit_corsika.6617.sh,
    TEMPLATE_corsika.jdl, TEMPLATE_corsika.sh
  - Run the submission script in $WORKDIR
    ./Submit_corsika.6617.sh gliteWMS auger
  - Resubmit affected jobs, if necessary
    Resubmit_corsika.6617.sh gliteWMS auger
  - Get OutputSandboxes of Done jobs
    GET_OUTPUT.sh

Production Framework



Production Framework



Offline Production

- **Offline software: CORSIKA** **http://www-ik.fzk.de/corsika/**
  (v. 6.611 for tests, v. 6.617 for proton and iron production)
- **Model:**
  epos, fluka
- **Projectile particle**
  proton (epos_gr03, epos_gr07) or iron (epos_gr04, epos_gr06)
- **Energy of primary particle**
  log(E/eV)=17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0
- **Zenith angle**
  θ=0, 18, 26, 38, 45, 53, 60 deg
- **50 jobs per each [E, θ] pair**
  - different random number seed
  - seed generated using **srand(time(NULL))** and **rand()** functions implemented in standard math.h library

Current Production Inputs

CORSIKA inputs (current production)

```
RUNNR      2800
NSHOW      1
PRMPAR     14 (5626)
ESLOPE      -2.7
ERANGE      1.000000E+12  1.000000E+12
THIN        1.000000E-06 1.000000E+06 1.000000E+04
THINH       1.000E+00 1.000E+02
THETAP      6.000000E+01  6.000000E+01
PHIP         -180.  180.
SEED         150685160   0   0
SEED         153361358   0   0
OBSLEV      1.452E+05
FIXCHI      0.
MAGNET      2.010E+01  -1.420E+01
HADFLG      0  0  0  0  0  2
ECUTS       1.000E-01 1.000E-01 2.500E-04 2.500E-04
MUADDI      T
MUMULT      T
ELMFLG      T   T
STEPFC     1.1.2000
RADNKG      5.0E+05
ARRANG      0.
EPOPAR     input ../epos/epos.param
EPOPAR     fname inics ../epos/epos.inics
EPOPAR     fname iniev ../epos/epos.iniev
EPOPAR     fname initl ../epos/epos.initl
EPOPAR     fname inirj ../epos/epos.inirj
EPOPAR     fname inihy ../epos/epos.ini1b
EPOPAR     fname check none
EPOPAR     fname histo none
EPOPAR     fname data  none
EPOPAR     fname copy  none
LONGI       T  5.  T  T
ECTMAP      2.5E+5
MAXPRT     1
DIRECT      ./
DATBAS      T
USER        yourname
PAROUT     T T
DEBUG       F  6  F  1000000
EXIT
```

Shower libraries

epos_gr01	proton, EPOS	1 – 2800, test (deleted)
epos_gr02	proton, EPOS	test (deleted)
epos_gr03	proton, EPOS	1 - 2800
epos_gr04	iron, EPOS	1 - 2800
epos_gr05	proton, EPOS	JPtest
epos_gr06	iron, EPOS	2801 - 5600
epos_gr07	proton, EPOS	2801 - 5600

Library productions

- **2800 jobs per production**
- **Test production (epos_gr01)**
  - August 28 – September 10, 2007 (14 days)
- **1st usable proton production (epos_gr03)**
  - start: October 3, 2007 (major part in 19 days)
  - 2595 showers finished, < 2.5 % crashes
- **1st iron production (epos_gr04)**
  - start: October 22, 2007 (major part in 46 days)
  - 2728 showers finished, < 2.5 % crashes
- **Job outputs stored on SE**
  - Primarily at golias100.farm.particle.cz, later also at dcache.ijs.si

Running jobs

@ end of Jan 2008

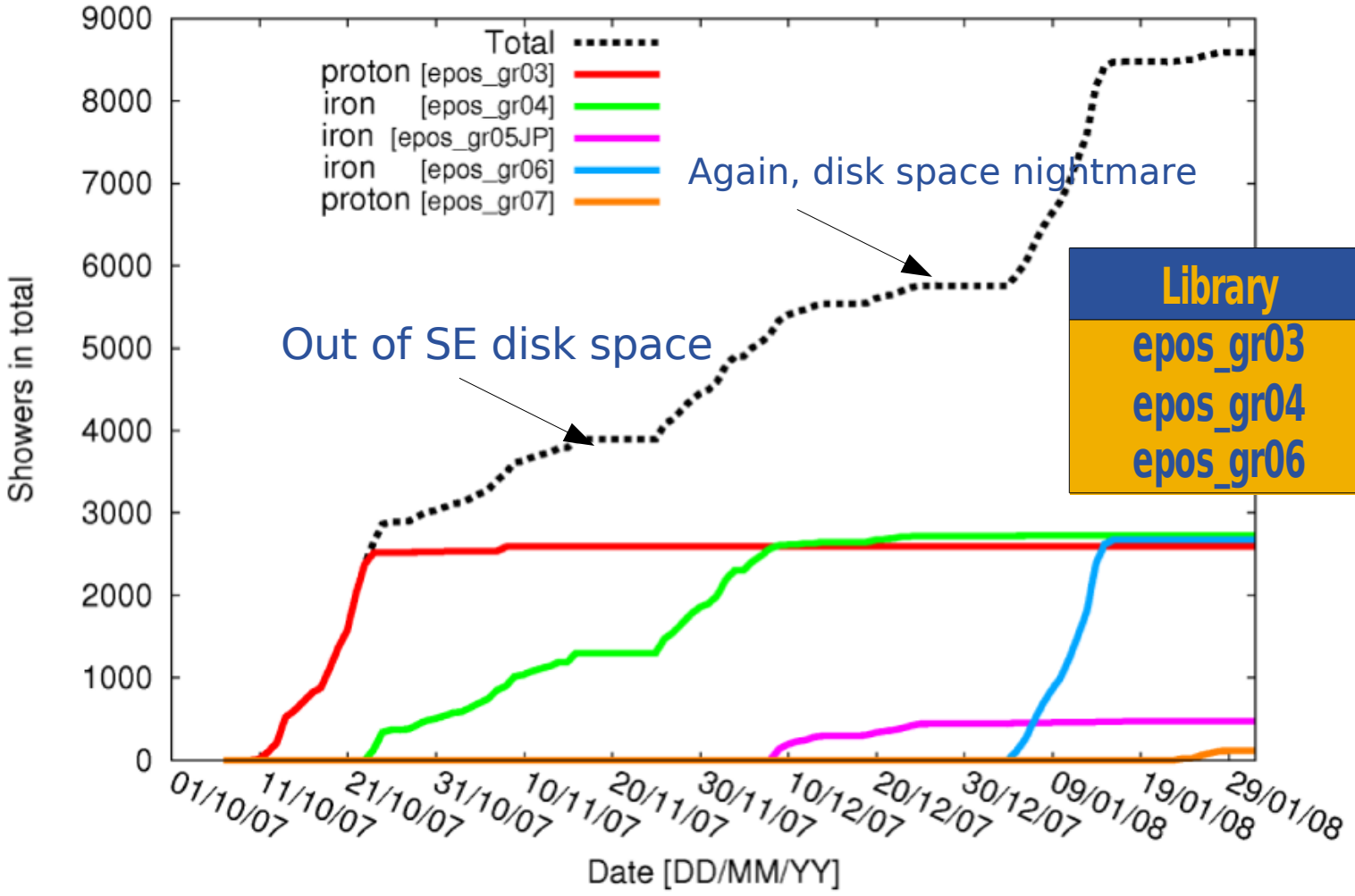
CE	CE	epos_gr03 (proton) Jobs [#]	CPU time [hr]	Avg. CPU time [hr]
ce02.lip.pt	LIP, Lisbon	45	697	15
golias25.farm.particle.cz	FZU, Prague	397	9875	25
grid10.lal.in2p3.fr+apcpc79	GRIF, Paris	91	876	10
lcgce.ijs.si	IJS, Ljublan	618	12390	20
skurut17.cesnet.cz	CESNET, Prague	140	6064	43
tbn20.nikhef.nl	NIKHEF, Amsterdam	1470	15448	11
JOBS COMPUTED (DONE)		2761	45351	16
SHOWERS DONE		2595	42613	16
TOTAL (SHOWERS)		2800		

CE	CE	epos_gr04 (iron) Jobs [#]	CPU time [hr]	Avg. CPU time [hr]	epos_gr06 (iron) Jobs [#]	CPU time [hr]	Avg. CPU time [hr]
ce02.lip.pt	LIP, Lisbon	65	1156	18	26	487	19
golias25.farm.particle.cz	FZU, Prague	937	29382	31	84	3946	47
grid10.lal.in2p3.fr+apcpc79	GRIF, Paris	143	1767	12	751	10861	14
lcgce.ijs.si	IJS, Ljublan	447	9981	22	44	1044	24
skurut17.cesnet.cz	CESNET, Prague	91	7900	87	1122	14622	13
tbn20.nikhef.nl	NIKHEF, Amsterdam	1807	24995	14	758	9306	12
JOBS COMPUTED (DONE)		3490	75181	22	2785	40265	14
SHOWERS DONE		2728	53011	19	2678	38791	14
TOTAL (SHOWERS)		2800			2800		

example of a logical file name:

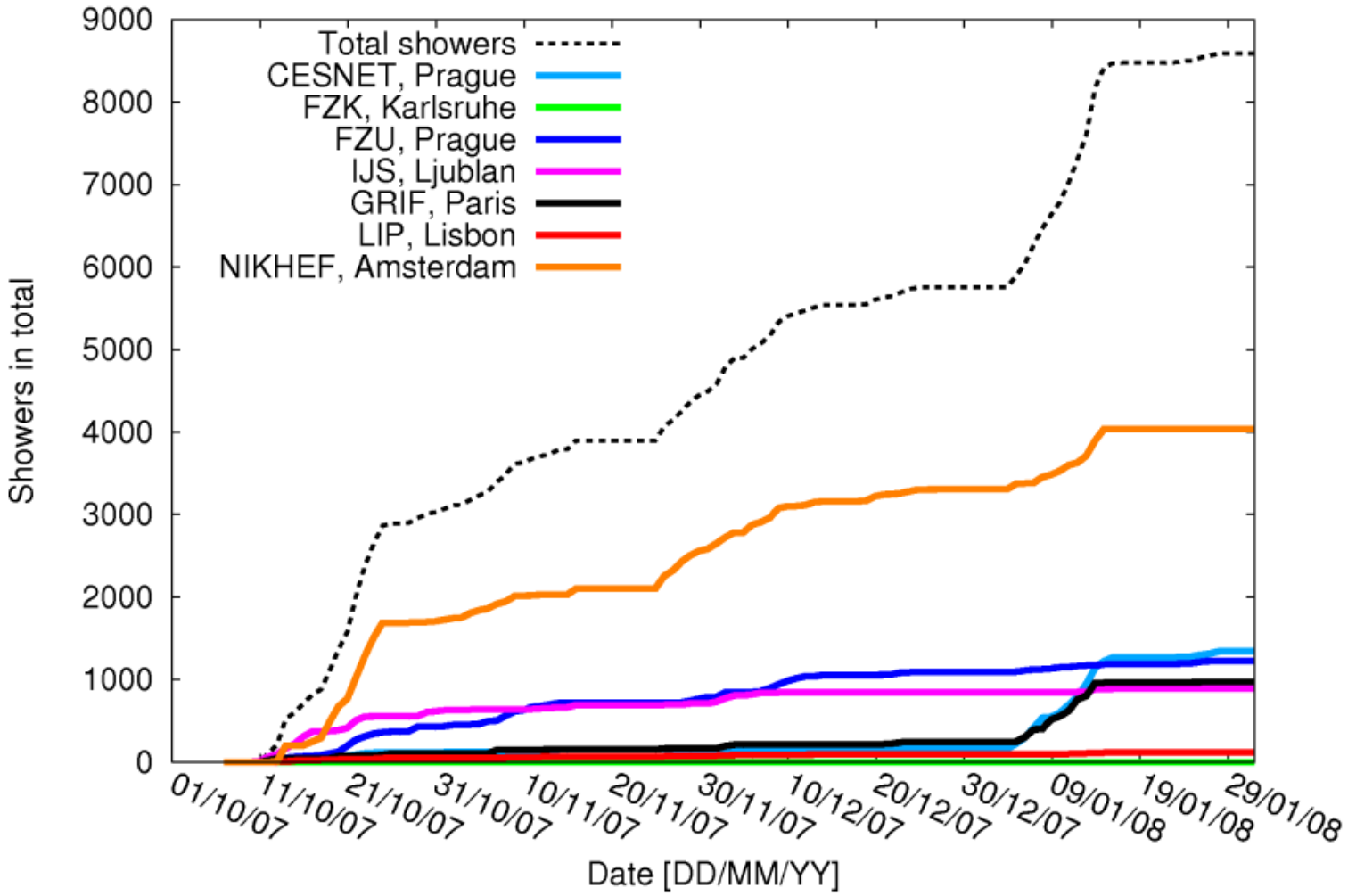
lfn:/grid/auger/prod/epos_gr04/en20.000/th18.000/DAT001845.part

Showers computed

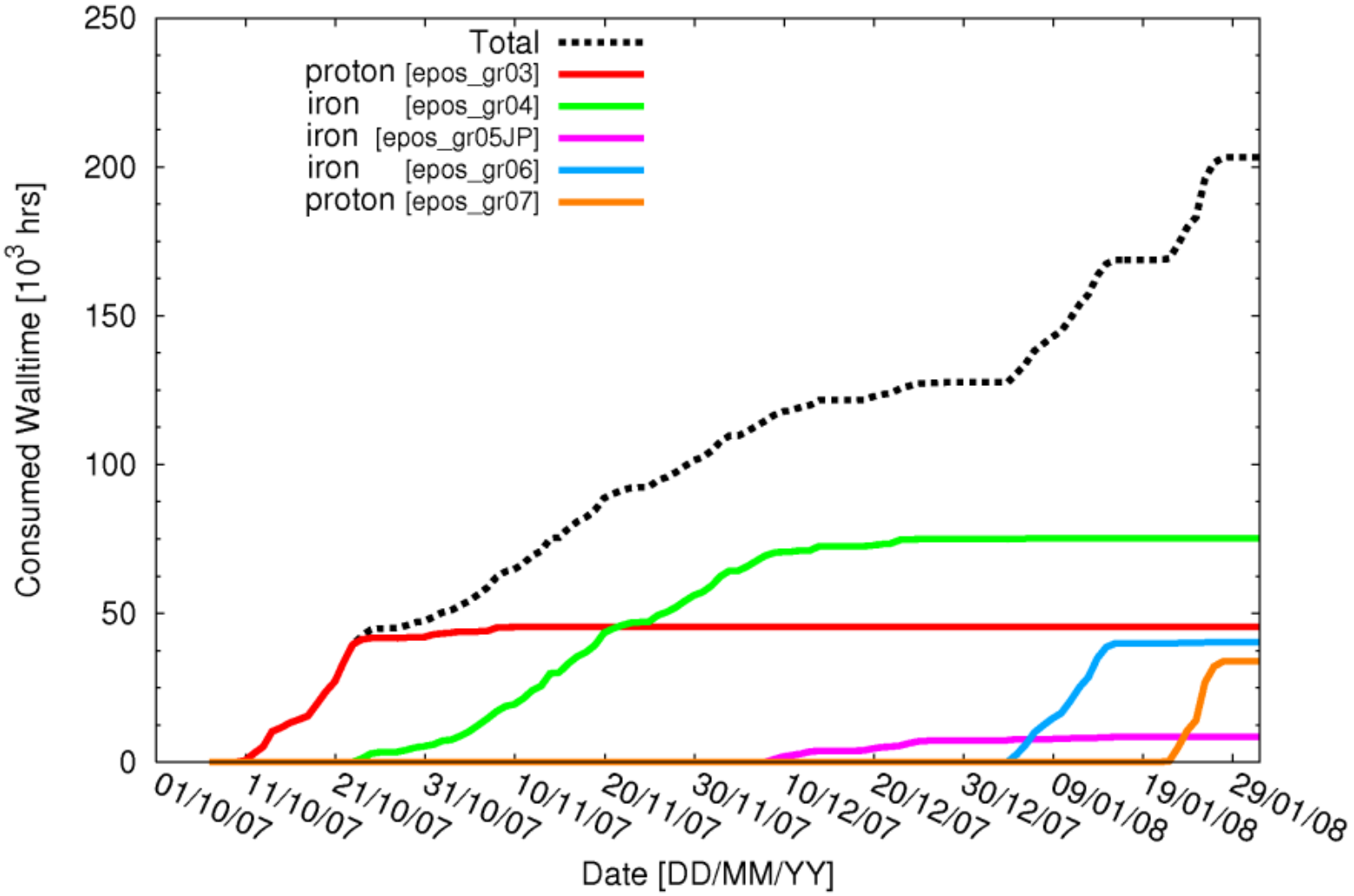


Library	ΔT(90 %) [d]
epos_gr03	19
epos_gr04	46
epos_gr06	11

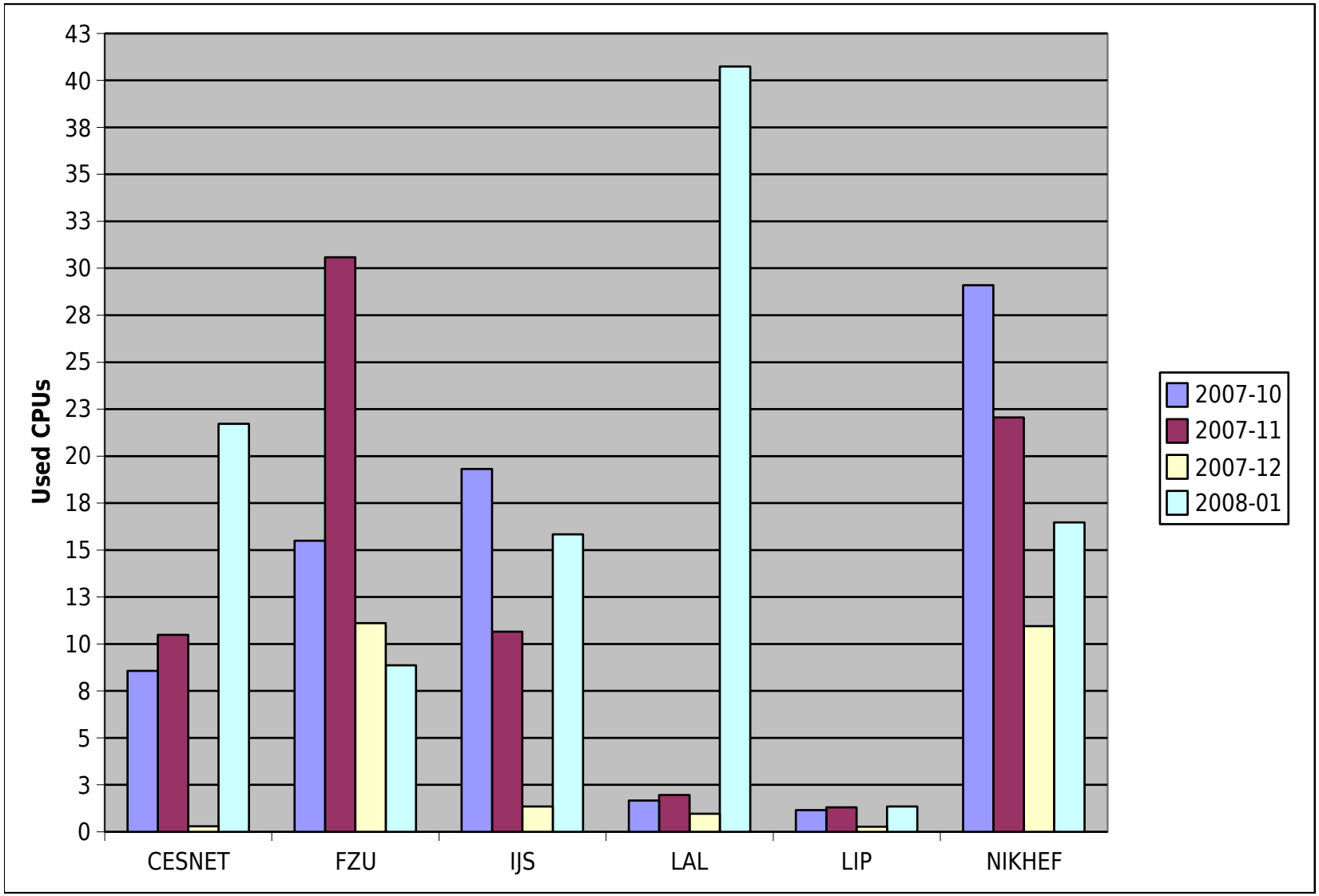
Site ratios


Total showers
CESNET, Prague
FZK, Karlsruhe
FZU, Prague
IJS, Ljublan
GRIF, Paris
LIP, Lisbon
NIKHEF, Amsterdam
Showers in total
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
01/10/07
11/10/07
21/10/07
31/10/07
10/11/07
20/11/07
30/11/07
10/12/07
20/12/07
30/12/07
09/01/08
19/01/08
29/01/08
Date [DD/MM/YY]

Used walltime per library



Walltime per site



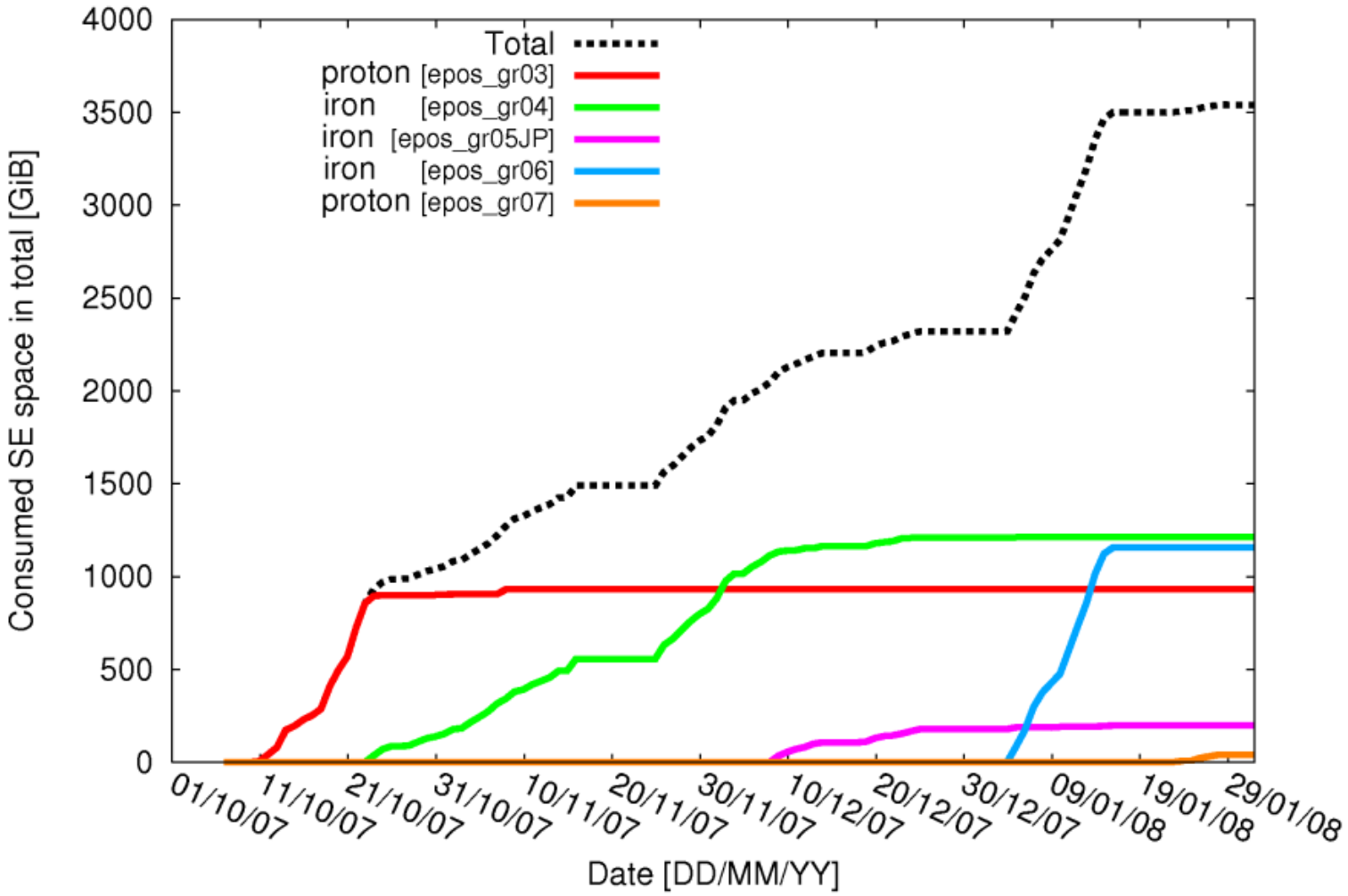
Job outputs

- **OutputSandbox**
  Corsika input file, corsika.out, job.stdout, job.stderr
- **Storage element**
  - used SE: golias100.farm.particle.cz, dcache.ijs.si
  - VO AUGER SE policy:

/grid/auger/prod/*PROD_ID*/*ENERGY*/*THETA*/*OUTFILE*

  - *PROD_ID*=epos_gr01, epos_gr03, epos_gr04, ...
  - *ENERGY*=**en**21.500, ..., *THETA*=**th**60.000, ...
  - *OUTFILE*=
    DATxxxxxx.part – particle file,
    DATxxxxxxx.long – longitude distribution,
    DATxxxxxx.tab, DATxxxxxx.info, DATxxxxxx.input,DATxxxxxx.lst,
    DATxxxxxx.md5.sum, DATxxxxxx.job.out, DATxxxxxx.job.err
  - **filesize per job: ca. 600 MiB particle file, 0.5 MiB small files**

Storage – consumed space



Production overview

Within 4 months (Oct 2007 – Jan 2008)

- successfully ran more than **9500 jobs**
- created libraries with more than **8400 showers**
- spent **170,000 hrs** of walltime
  - over 7,000 CPUdays, 60 CPUs at the same time 24/7
- showers took ca **4 TiB** of disk space on SEs

Production pain:

- **SE disk space!!!**

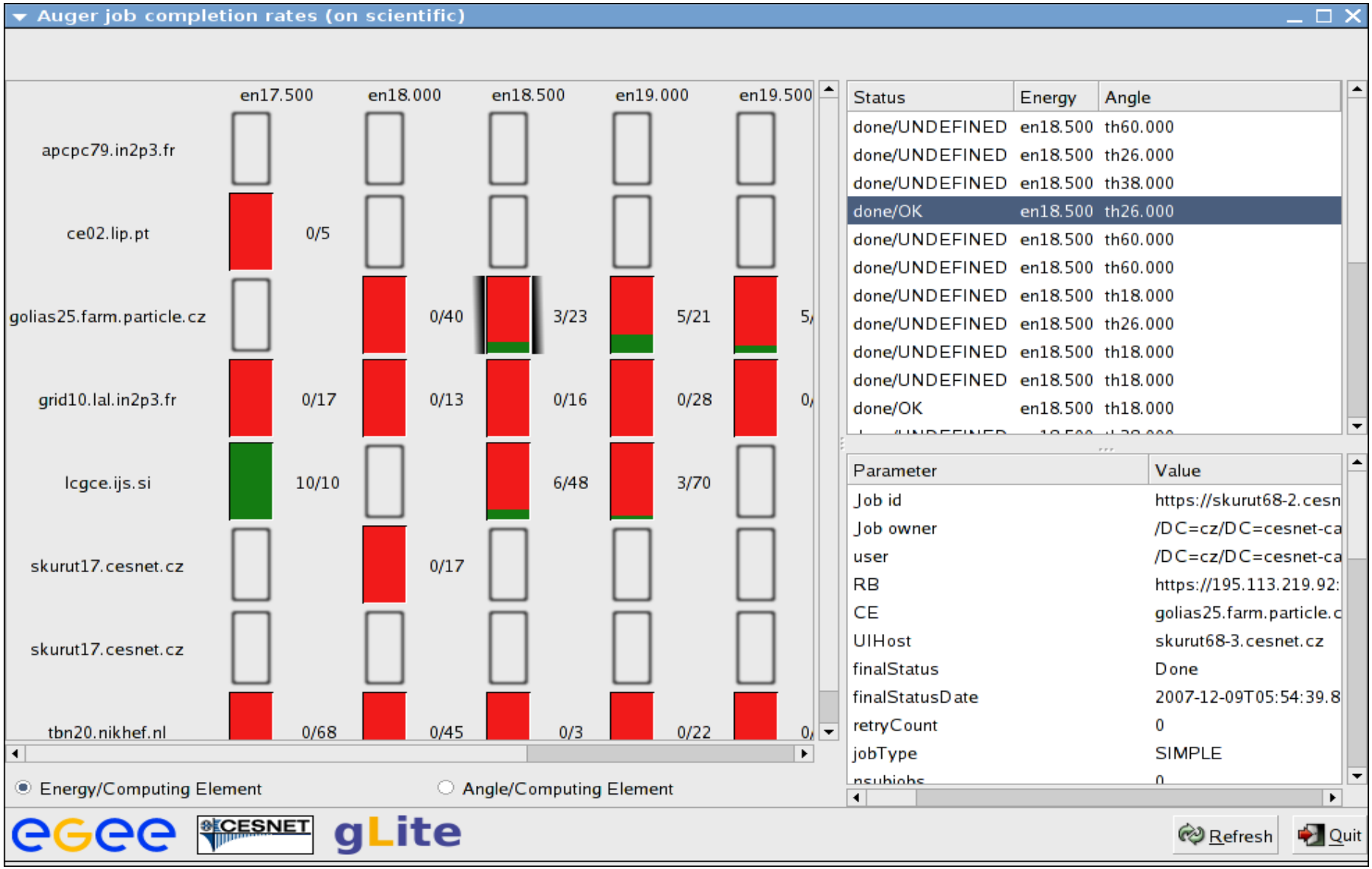
Job Provenance

- **Generic gLite service: long-term archiving of information on executed jobs**
  - scalability,
  - extensibility,
  - uniform data view, and
  - configurability
- **User tags:**
  predefined in JDL file or defined during the job execution

AUGER Production Tags

- **Production ID:**
  auger_type
- **Simulation description:**
  auger_CORSIKA_energy,
  auger_CORSIKA_theta, and
  auger_CORSIKA_primaryparticle
- **WN information:**
  auger_host,
  auger_CORSIKA_cpu_vendor_id,
  auger_CORSIKA_cpu_model_name,
  auger_CORSIKA_cpu_frequency_MHz,
  auger_CORSIKA_cpu_cache_size, and
  auger_CORSIKA_cpu_bogomips
- **Computation flow information:**
  auger_CORSIKA_output_long,
  auger_CORSIKA_output_dat,
  auger_CORSIKA_cpu_output_cputime,
  auger_CORSIKA_output_walltime, and
  auger_CORSIKA_coredump

Job Provenance for AUGER



Conclusions & Outlooks

- Production of CORSIKA libraries for AUGER
- Files are accessible by VO auger members
- Plans to copy (part of) libraries to CCIN2P3
- Current productions limited by available storage

- Working on the detector simulation on the grid
- Expect at least double CPU capacity soon
- Challenge to keep these resources busy

The End

Thank you for your attention!