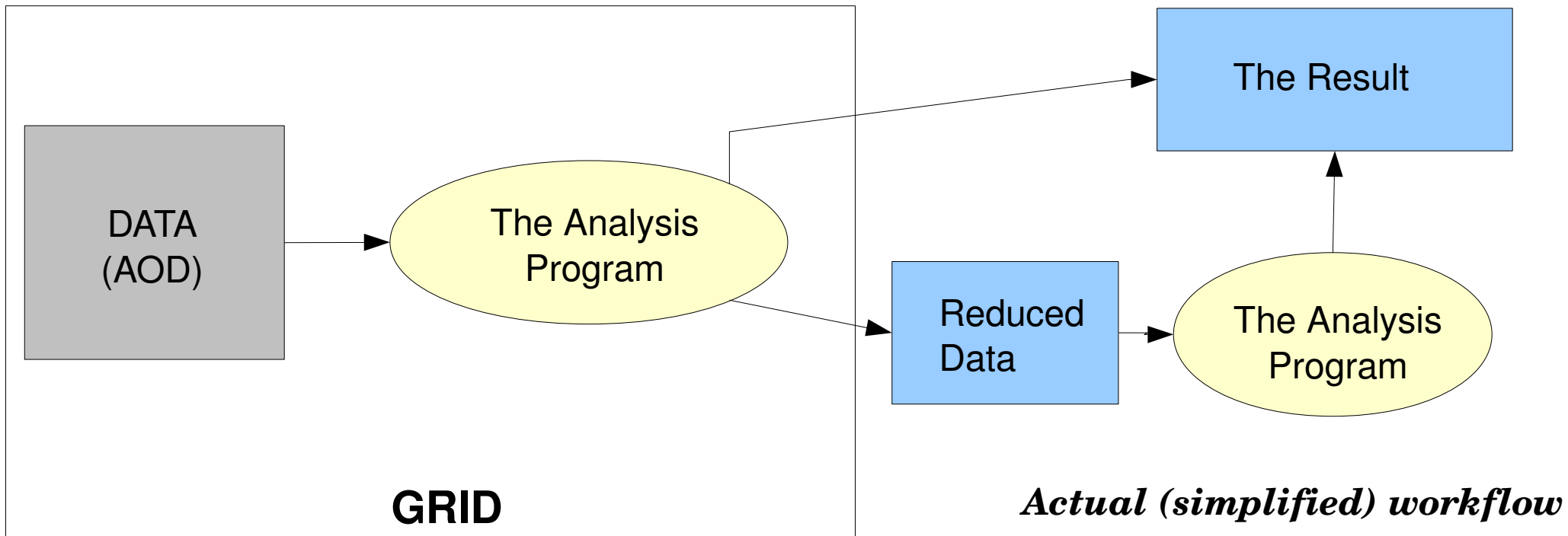
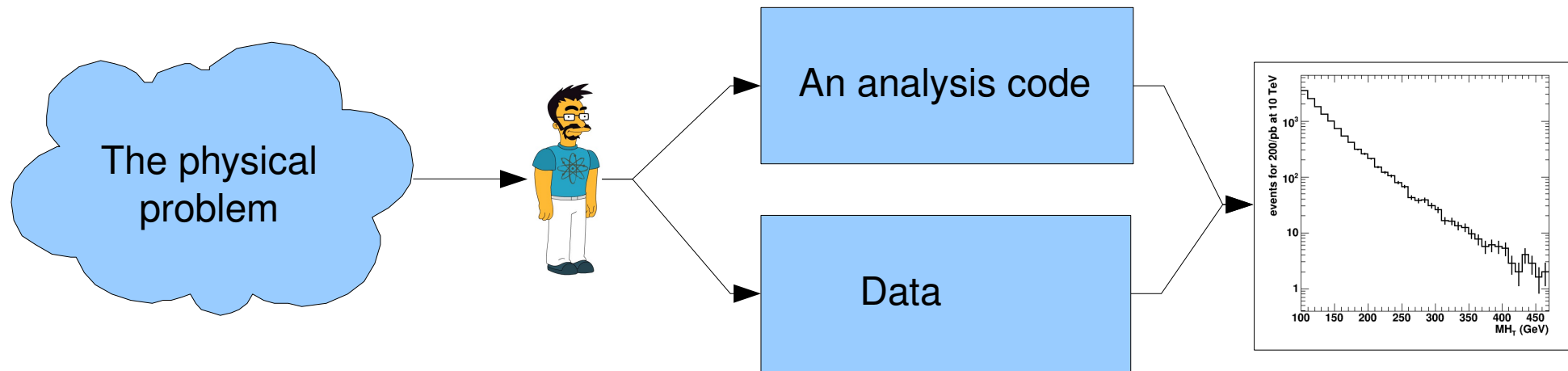


L'analisi per l'esperimento CMS

Leonardo Sala, INFN Milano-Bicocca

A typical workflow

From the User point of view



The Analysis workflow

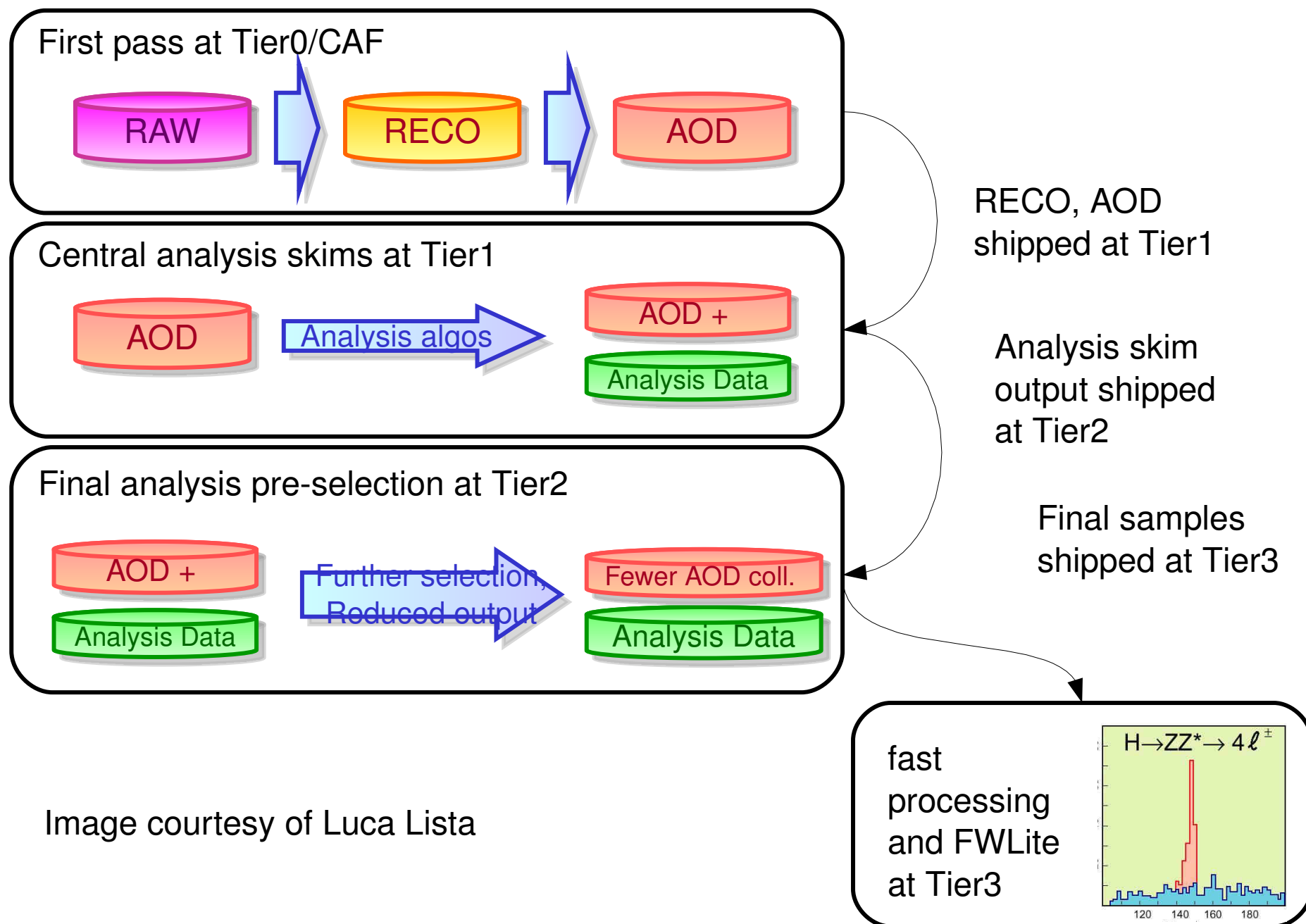
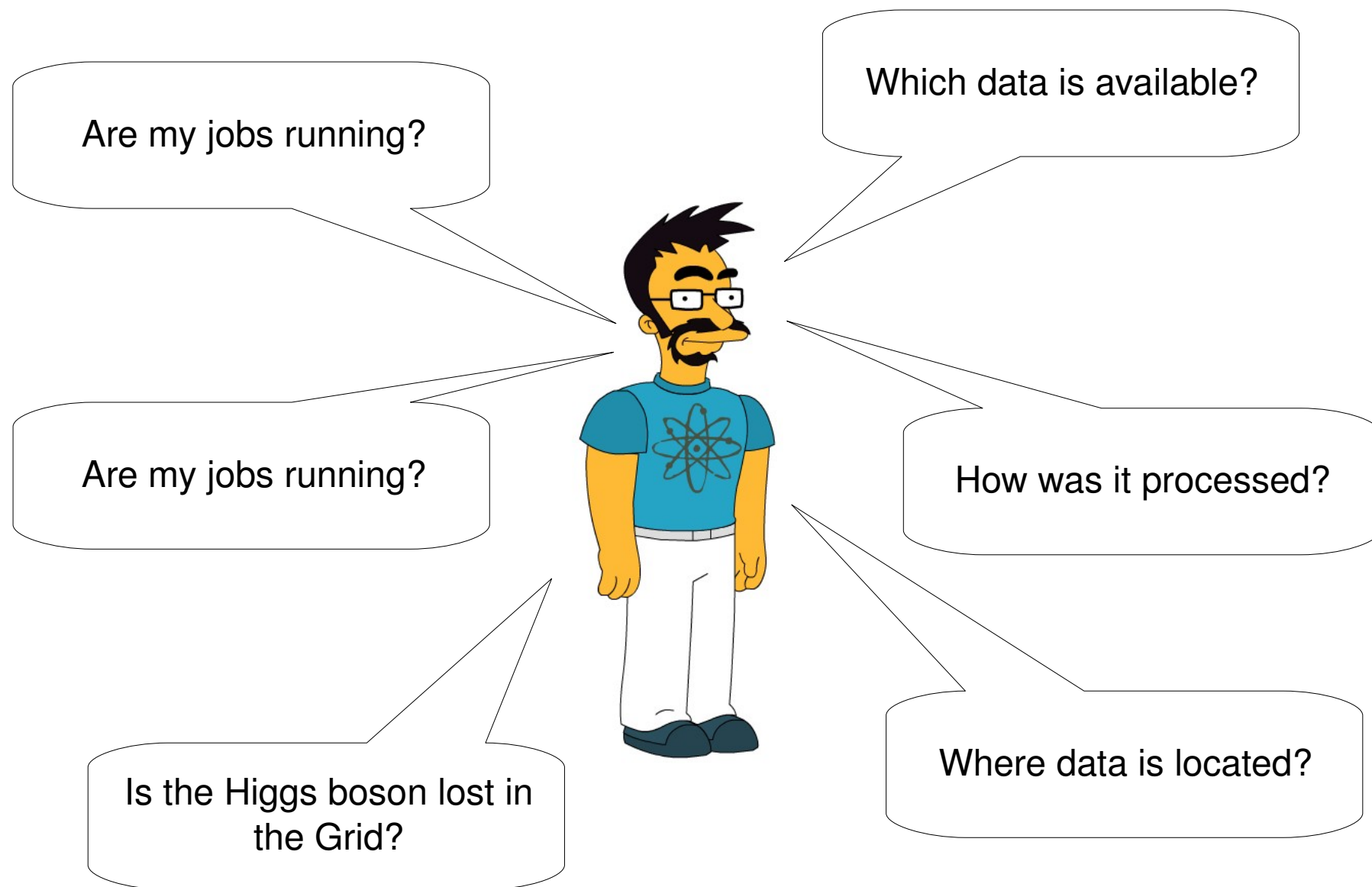


Image courtesy of Luca Lista

What's in user's mind



Starting point: the Analysis Code

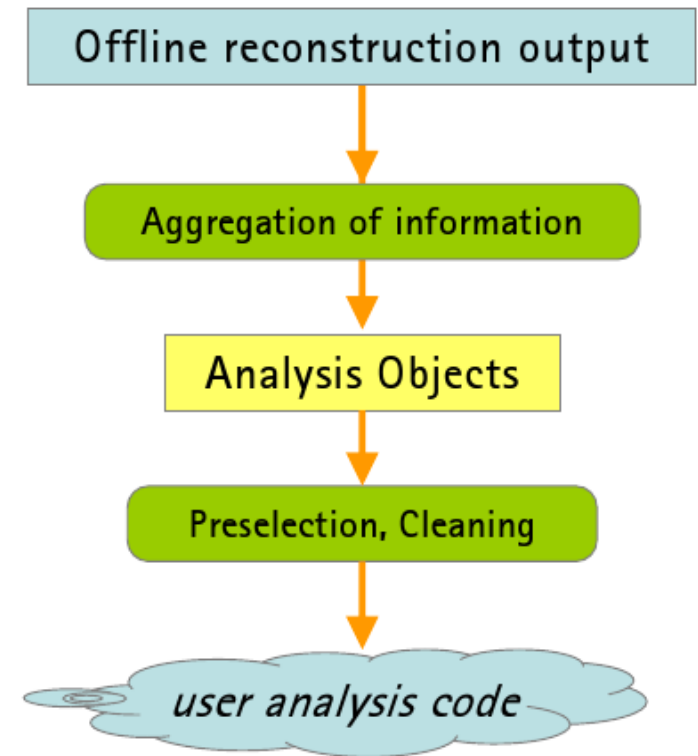
A clear idea in mind, need to be coded:

- Reconstruction format intended for sw performances (not user-friendly!)
- Information not always easy to retrieve

PAT (**P**hysics **A**nalysis **T**oolkit) provides common Physics objects with aggregate information (algo output) and also preselection and cleaning steps.

Useful because:

- Gives common analysis object, which uses the official algorithm from the Physics Object Groups
- Allows an easy-to-implement analysis
- Less error prone (configurable from configuration files)
- Flexible, as also user-defined quantities (C++ objects) can be stored



First Step: the Data

Usually, users have in mind what kind of data they want to use, at least the physical channel... what they want to discover is:

- Is that kind of data existing?
- Does it fit my needs?
- How many events?
- How were them produced?

Good questions claim good answers... and a good starting point:

<http://cmsweb.cern.ch/>

First Step: the Data



First Step: the Data

DBS data discovery page - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://cmsweb.cern.ch/dbs_discovery/

Dashboard DBS Discovery DataTransfer SiteDB CondDB Support

Home - aSearch - Navigator - RSS - Status - Runs - Admin - Tools - Help - Contact

leo » logout View

ADVANCED KEYWORD SEARCH

DBS instances cms_dbs_prod_global **HELP**

Search Reset

MENU-DRIVEN INTERFACE

Physics groups Any

Data tier Any

☐ composed tier, e.g. GEN-SIM:

Software releases CMSSW_2_2_7

→ Data types Any

Primary dataset/
MC generators Any

Any
Calo
Cosmics
DYJets-sherpa
H130_ZZ_4l_2lfilter
H150_ZZ_4l_2lfilter
H200_ZZ_4l_2lfilter
Hydjet_MinBias_4TeV
MinimumBias
Monojet_MD1d2-sherpa
Monojet_MD1d4-sherpa
Monojet_MD1d6-sherpa
Monojet_MD2d2-sherpa
Monojet_MD2d4-sherpa
Monojet_MD2d6-sherpa
Monojet_MD3d2-sherpa
Monojet_MD3d4-sherpa
Monojet_MD3d6-sherpa
Monophoton_MD1d2-sherpa
Monophoton_MD1d3-sherpa

Which kind of data
(FullEvent, AOD,
PAT-tuple...)

With which SW data
has been produced

The Dataset selection

Second Step: Submitting jobs

CMS Remote Analysis Builder (CRAB): a tool to create, submit and handle Grid jobs in an user friendly way

Example of crab.cfg

```
### The data you want to access (to be found on DBS)
#datasetpath=/Zjets-
#madgraph/Winter09_IDEAL_V11_FastSim_v1/GEN-SIM-DIGI-
#RECO

### The ParameterSet you want to use
pset=pythia.cfg

### Splitting parameters
total_number_of_events=-1
events_per_job = 1000

### The output files (comma separated list)
output_file = mcpool.root
ui_working_dir =
/afs/cern.ch/user/l/leo/scratch0/CMSSW_2_2_7/src/Analysis/
MonoJet_PAT/test/crab_Wjets-madgraph-Winter09/

[USER]
### OUTPUT files Management
## output back into UI
return_data = 1
```

Other important parameters:

- Server mode: it is based on a client-server arch, it allows more features in a transparent way
- Output on SE
- Input files
- Black/White list (CE,SE)

Second Step: Submitting jobs

Jobs can be submitted/monitored/handled with command line utilities:

creating

```
[lxplus219] ~/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test > crab -create
crab. crab (version 2.5.1) running on Tue May  5 12:18:41 2009
crab. Working options:
  scheduler      glite
  job type       CMSSW
  working directory /afs/cern.ch/user/l/leo/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test/crab_Wjets-madgraph-Winter09/

crab. Contacting Data Discovery Services ...
crab. Requested dataset: /Wjets-madgraph/Winter09_IDEAL_V11_FastSim_v1/GEN-SIM-DIGI-RECO has 101467739 events in 38 blocks.

crab. 1031 job(s) can run on 101467739 events.

crab. List of jobs and available destination sites:

Block   1: jobs                1: sites: cmsdcache.pi.infn.it,srm.ciemat.es,grid-srm.physik.rwth-aachen.de
Block   2: jobs                2-33: sites: cmsdcache.pi.infn.it,srm.ciemat.es,grid-che.pi.infn.it,srm.ciemat.es,grid-srm.physik.rwth-aachen.de

[omissis]
crab. Adding reduced-Wjets-madgraph-Winter09_IDEAL_V11_FastSim_v1-GEN-SIM-DIGI-RECO-iterativeCone5CaloJets.root (from TFileService) to list of output files

crab. Creating 1031 jobs, please wait...
crab. Total of 1031 jobs created.
```

submitting

```
[lxplus219] ~/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test > crab -submit 1-10 -c crab_Wjets-madgraph-Winter09
crab. crab (version 2.5.1) running on Tue May  5 14:28:07 2009

crab. Working options:
  scheduler      glite
  job type       CMSSW
  working directory /afs/cern.ch/user/l/leo/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test/crab_Wjets-madgraph-Winter09/

crab. Checking available resources...
crab. Found compatible site(s) for job 1
crab. 1 blocks of jobs will be submitted

                               Submitting 10 jobs
100% [=====]
                               please wait

crab. Total of 10 jobs submitted.
crab. Log-file is /afs/cern.ch/user/l/leo/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test/crab_Wjets-madgraph-Winter09/log/crab.log
```

Second Step(bis): Monitoring jobs

Jobs can be submitted/monitored/handled with command line utilities:

checking

```
[lxplus219] ~/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test > crab -status -c crab_Wjets-madgraph-Winter09
crab. crab (version 2.5.1) running on Tue May  5 14:46:44 2009

crab. Working options:
  scheduler      glite
  job type       CMSSW
  working directory /afs/cern.ch/user/l/leo/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test/crab_Wjets-madgraph-Winter09/

crab. Checking the status of all jobs: please wait
ID      STATUS      E_HOST      EXE_EXIT_CODE JOB_EXIT_STATUS
-----
1       Running      grid-ce.physik.rwth-aachen.de
2       Running      grid-ce.physik.rwth-aachen.de
3       Running      grid-ce.physik.rwth-aachen.de
4       Running      grid-ce.physik.rwth-aachen.de
5       Running      grid-ce.physik.rwth-aachen.de
6       Running      lcg02.ciemat.es
7       Running      lcg02.ciemat.es
8       Running      lcg02.ciemat.es
9       Running      lcg02.ciemat.es
10      Running      grid-ce.physik.rwth-aachen.de
-----
11      Created
[omissis]
>>>>>>>> 1031 Total Jobs

>>>>>>>> 1021 Jobs Created

          List of jobs Created: 11-1031

>>>>>>>> 10 Jobs Running

          List of jobs Running: 1-10

crab. You can also follow the status of this task on :
  CMS Dashboard: http://dashb-cms-job-task.cern.ch/taskmon.html#task=leo\_crab\_Wjets-madgraph-Winter09\_3sy2j8
  Your task name is: leo_crab_Wjets-madgraph-Winter09_3sy2j8
```



Select a User:

"BourgeoisLe"

Select a Time Range:

Last 3 Days

[Help](#)
[User Support](#)

Task:

leo_crab_Wjets-madgraph-Winter09_3sy2j8

All Jobs

[Back to all Tasks](#)

[This Task](#)

TaskMonitorId	Num of Jobs	Pending	Running	Successful	Failed	Unknown	Consumed Time	Plots
leo_crab_Wjets-madgraph-Winter09_3sy2j8	10	0	9	1	0	0	Time Info	Plot Selection

Dashboard Plots

[Successful Jobs Distributed by Site](#)

[Processed Events by Site](#)

[Terminated Jobs in terms of Success/Failures](#)

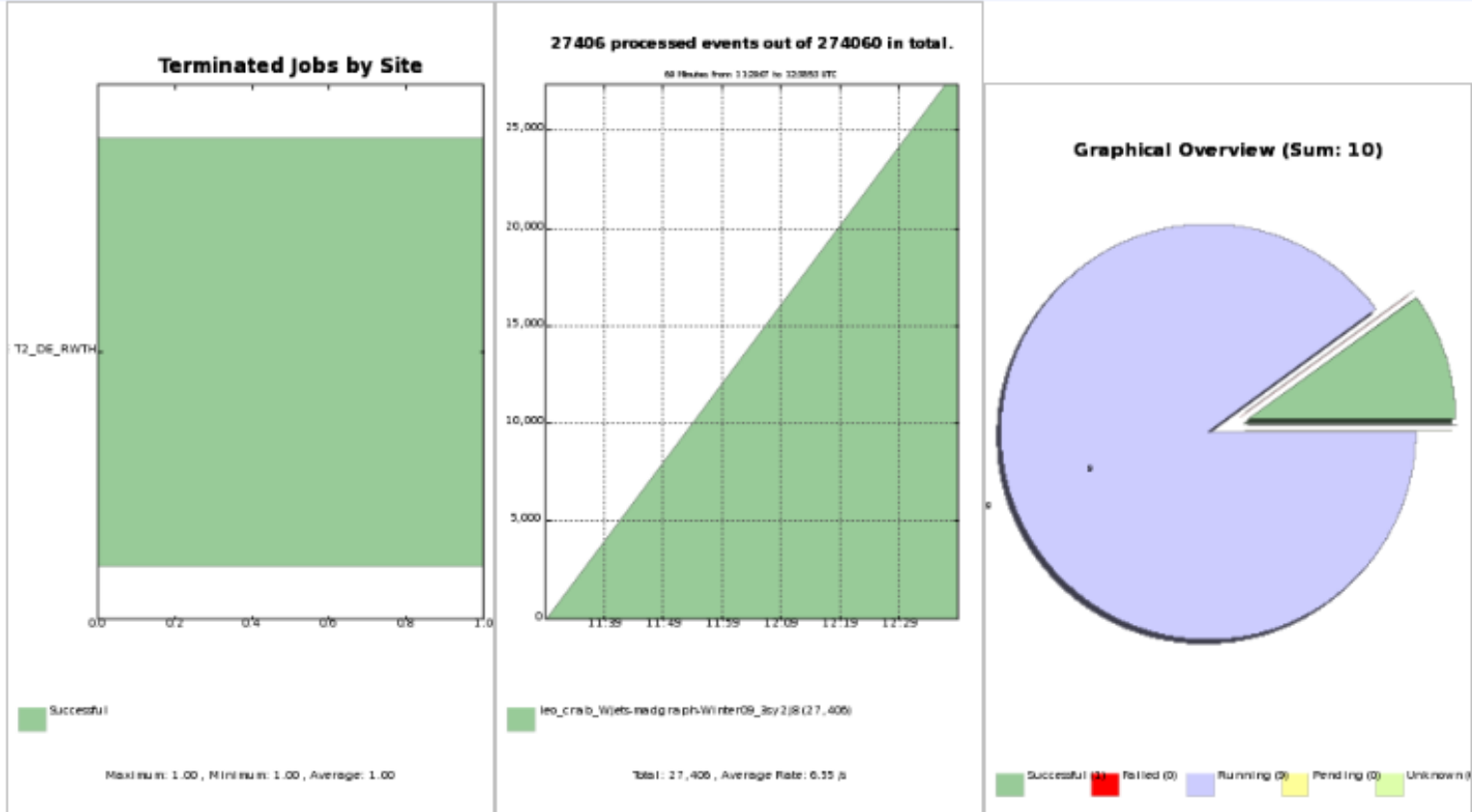
[Application Failed Jobs by Reason of Failure](#)

[Grid Aborted Jobs by Reason of Failure](#)

[Terminated Jobs by Site](#)

[Processed Events Cumulative Plot](#)

[Terminated Jobs Distributed over Time](#)



Click on a plot to increase its size.

SchedulerJobId	Id in Task	Status	Appl Exit Code	Grid End Status	Retries	Site	Submitted	Started	Finished
https://wms212.cern.ch:9000/lp4y6kXaHFrCR2fMSUweEg	1	Success	0	Unknown	1	T2_DE_RWTH	2009-05-05 12:28:33	2009-05-05 12:29:07	2009-05-05 13:36:53
https://wms212.cern.ch:9000/88_ZjxLnky4IwR1fpJHHg	2	Running	Not Yet	Unknown	1	T2_DE_RWTH	2009-05-05 12:28:33	2009-05-05 12:29:08	Unknown
https://wms212.cern.ch:9000/gCnRaAsyZE2JeI-TynFgTw	3	Running	Not Yet	Unknown	1	T2_DE_RWTH	2009-05-05 12:28:33	2009-05-05 12:29:08	Unknown

Third Step: Retrieving output

From command line, one can retrieve job outputs (if job in DONE status). The outfile is place where the user decided to (UI or SE)

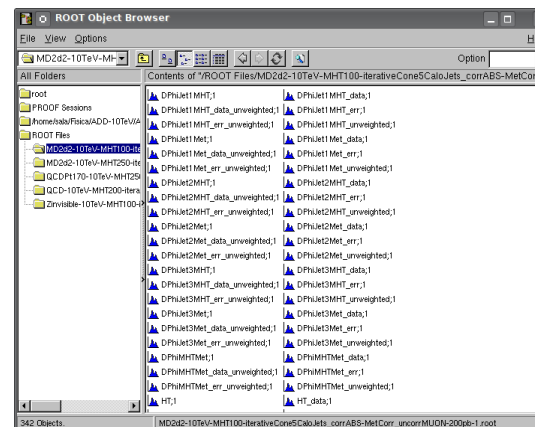
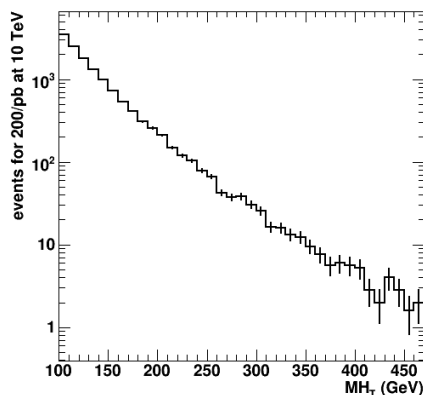
```
[lxplus219] ~/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test > crab -getoutput 1 -c crab_Wjets-madgraph-Winter09  
crab. crab (version 2.5.1) running on Tue May 5 16:02:29 2009
```

crab. Working options:

```
scheduler      glite  
job type       CMSSW  
working directory /afs/cern.ch/user/l/leo/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test/crab_Wjets-madgraph-Winter09/
```

```
crab. Results of Jobs # 1 are in /afs/cern.ch/user/l/leo/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test/crab_Wjets-madgraph-Winter09/res/  
crab. Log-file is /afs/cern.ch/user/l/leo/scratch0/CMSSW_2_2_7/src/Analysis/MonoJet_PAT/test/crab_Wjets-madgraph-Winter09/log/crab.log
```

The output can be an histo file (the final result) or a reduced ntupla/PAT-tupla than needs some more (light) analysis.

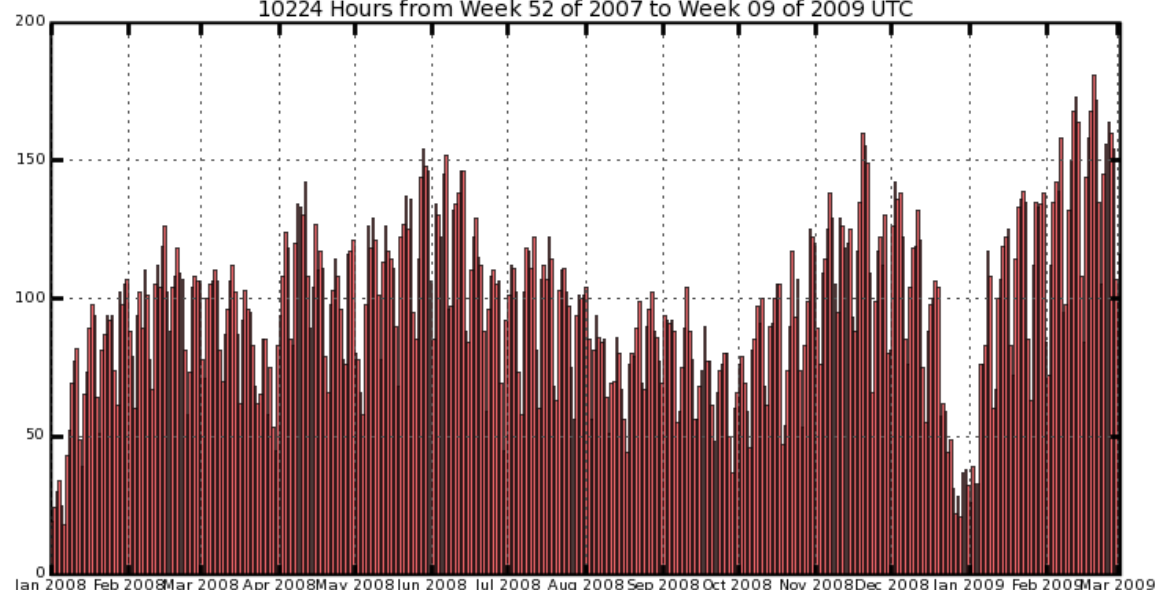


CRAB can also take care of retrieved data publication in local dbs, so they can be used later with CRAB itself.

CRAB statistics

Daily distribution of distinct analysis users using CRAB for job processing.

10224 Hours from Week 52 of 2007 to Week 09 of 2009 UTC

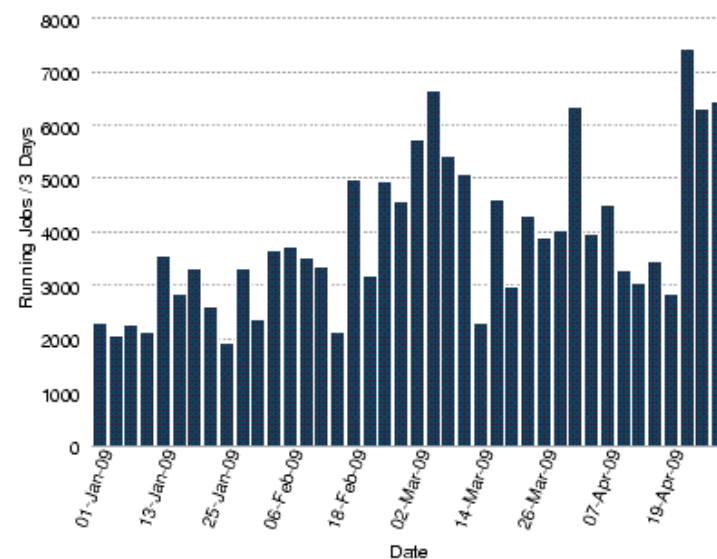
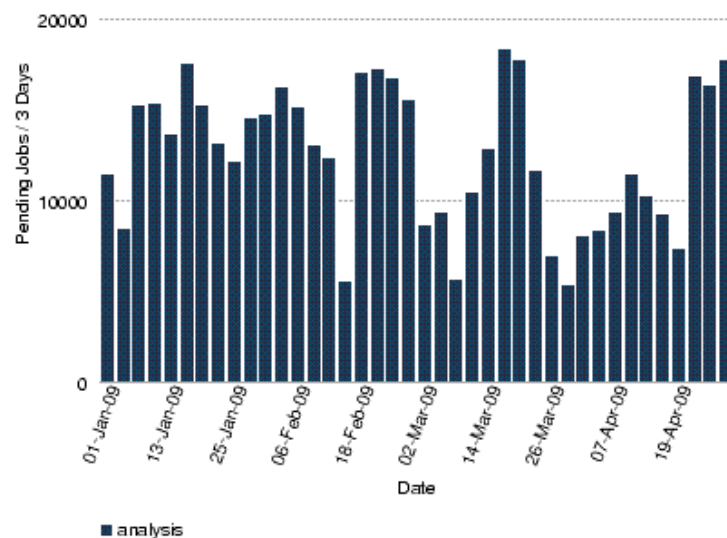


Distinct users running CRAB

Users

Maximum: 181.00 , Minimum: 0.00 , Average: 95.28 , Current: 116.00

Pending and
running jobs
@T2s



Many things have been improved during this last period:

- The introduction of PAT (Physical Analysis Tools) gave a common interface and common methods to reconstruct and access physical objects
- T2-only analysis (T1 now dedicated to central operations only) performant, after a short transition period
- Data @T2s is transferred upon user request, not custodial: network is fundamental! Replicas satisfactory (from users' side)
- CRAB is simple, need few configuration option, the use of TFileService automatically retrieves the right output file from the WN
- Data is fully searchable from DBS, and (more important) also the configuration files used

“Bad”

- CRAB in server mode not always reliable (lack of crab servers or of dedicated personnel)
- Sometimes issues at T2s are not promptly solved: issues are often related to access to Storage
- Storage @T2s is intended also for CRAB output: “how” is under discussion a.t.m., open issues.
- Physics related (but significant): framework SW sometimes changes too often, and some changes are not advertised. Tracking them e.g. in DBS is time consuming
- More general: too many information sources! HyperNews, Twiki, talks at various meetings... information is too spread.

Conclusions

- The CMS analysis workflow is well defined
- Many improvements during the last year, allowing a continuous and resource-demanding analysis
- Some issues still remains, not critical but can slow the analysis flow
- All the “Analysis Challenges” performed in the CMS community greatly improved the scheme: moreover, it made users more aware of Grid/Computing possibilities
- Thanks to all the people which give me the material and suggestions (L.Lista, F.Fanzago, D.Spiga, G.Petrucciani, R.Tenchini, S.Belforte, L.Silvestris, D.Bonacorsi...)