CMS Data Quality Monitoring: Offline Workflow and Physics

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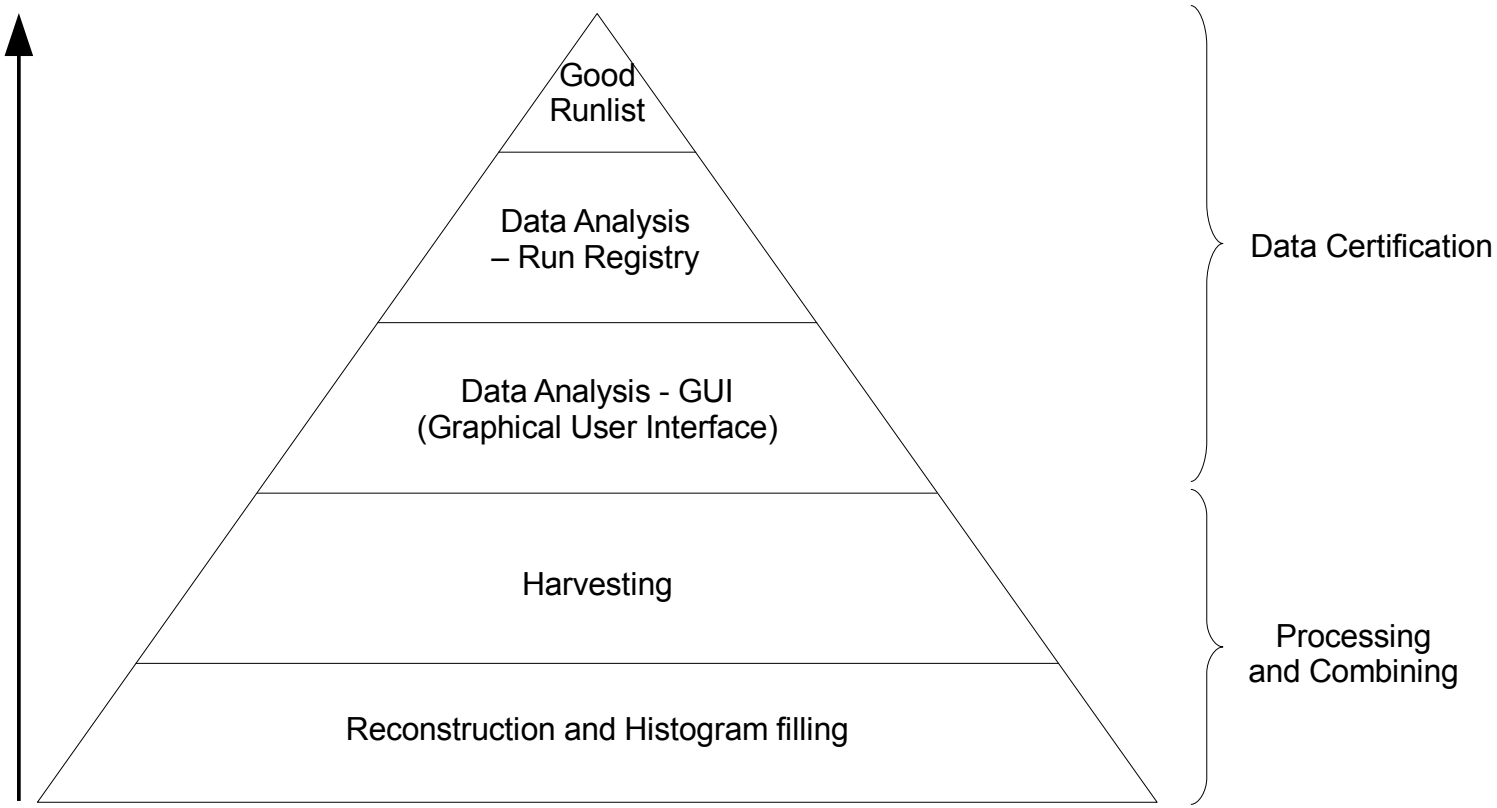
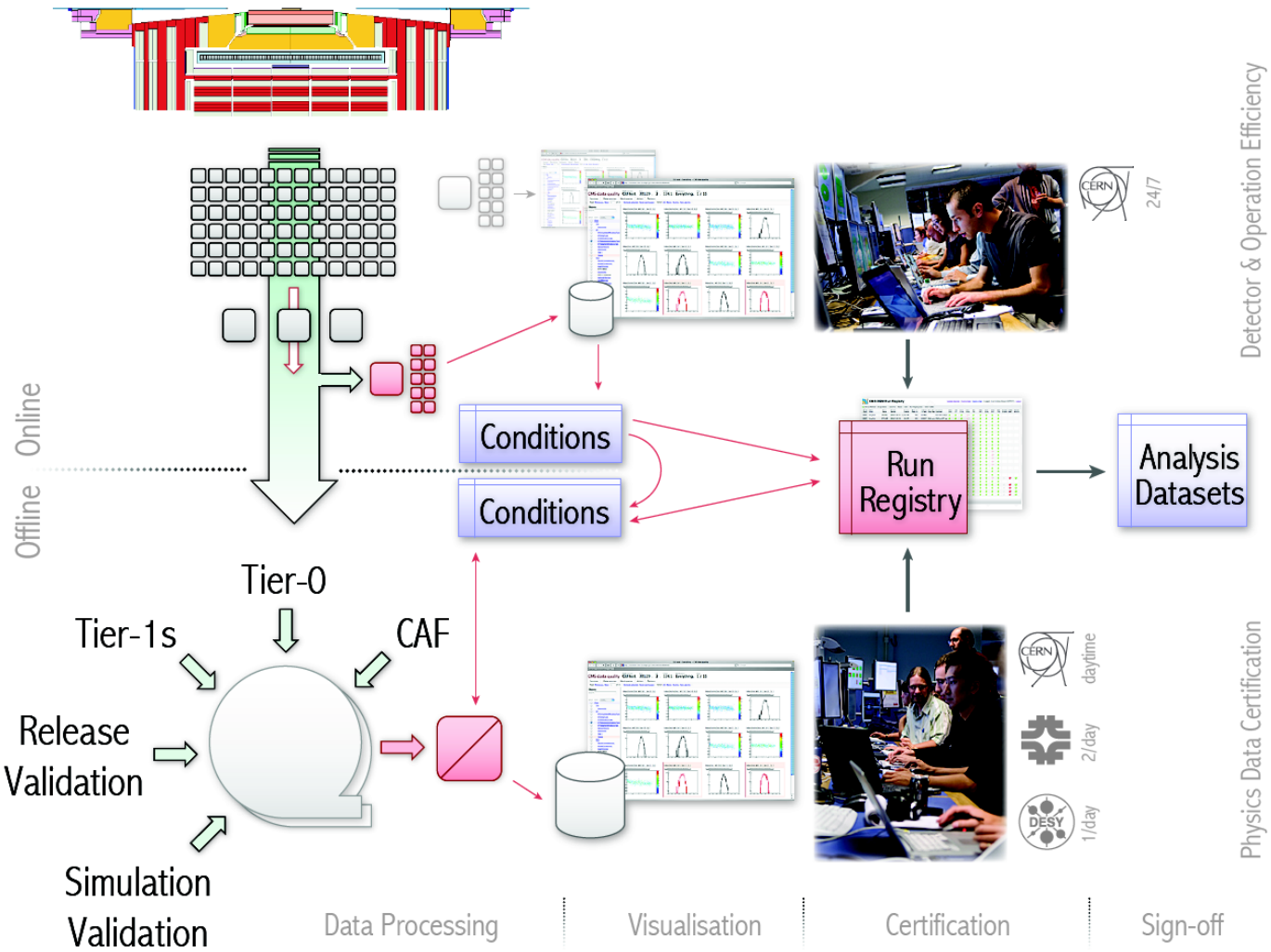
What is Data Quality Monitoring?

- To **discover problems** with data and detector and provide feedback **during data taking**
- Check for problems with physics objects once they have been **reconstructed** from detector measurements
- To **certify** that data coming from the detector is reliable and free of known systematic errors

DQM Pyramid


Good
Runlist
Data Analysis
– Run Registry
Data Analysis - GUI
(Graphical User Interface)
Harvesting
Reconstruction and Histogram filling
Data Certification
Processing
and Combining

DQM Workflow

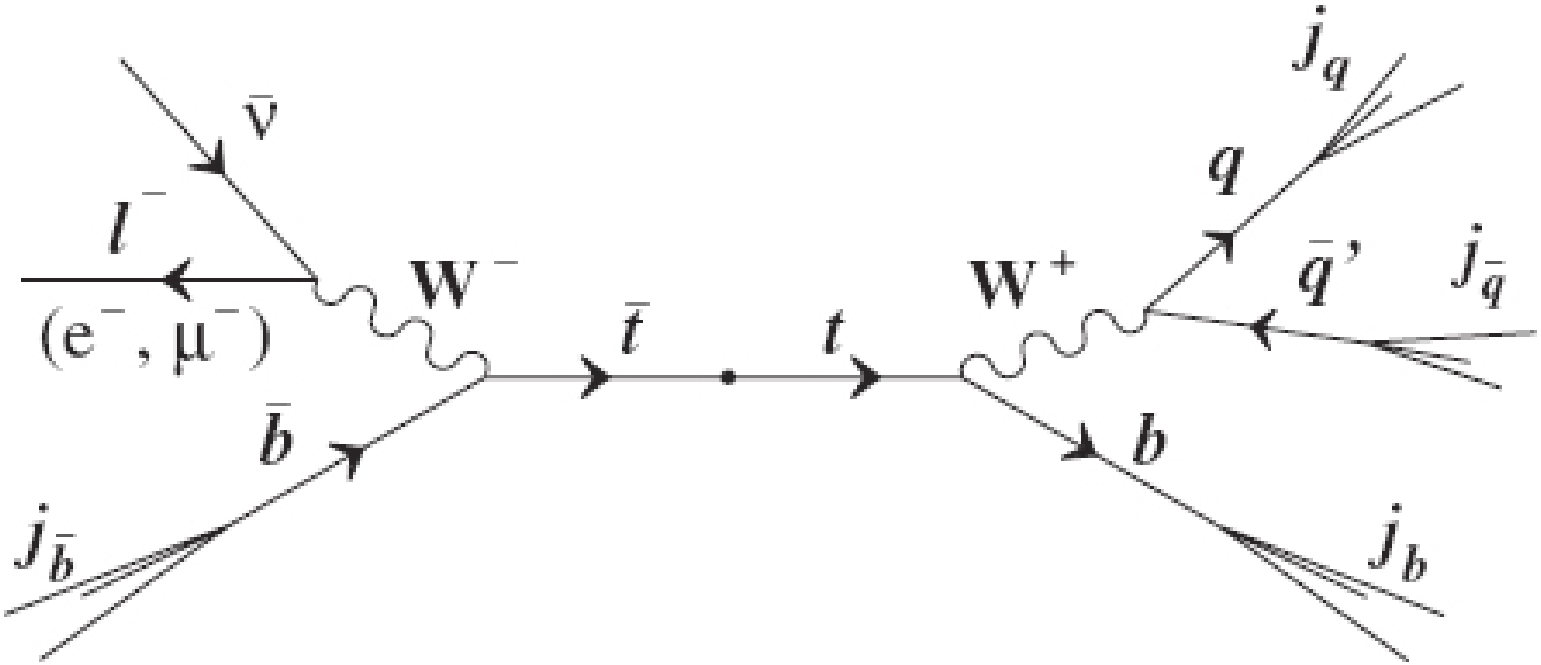


L. Tuura, A. Meyer, I. Segoni, G. Della Ricca: "CMS Data Quality Monitoring: systems and experiences"

Reconstruction and Histogram Filling

Example: top-antitop decay

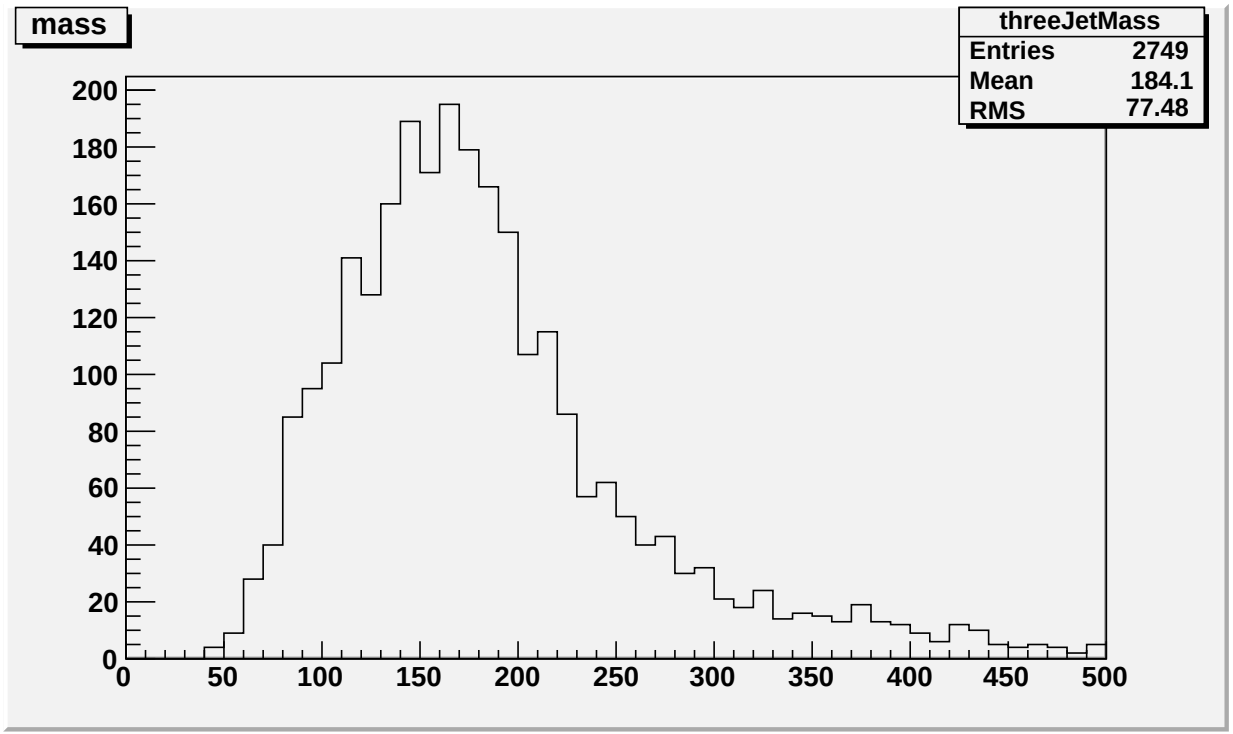
- Reconstruct top quantities
- Single muon, four jets



J. A. R. Cembranos, A. Rajaraman and F. Takayama: "Searching for CPT violation in $t\bar{t}$ production"

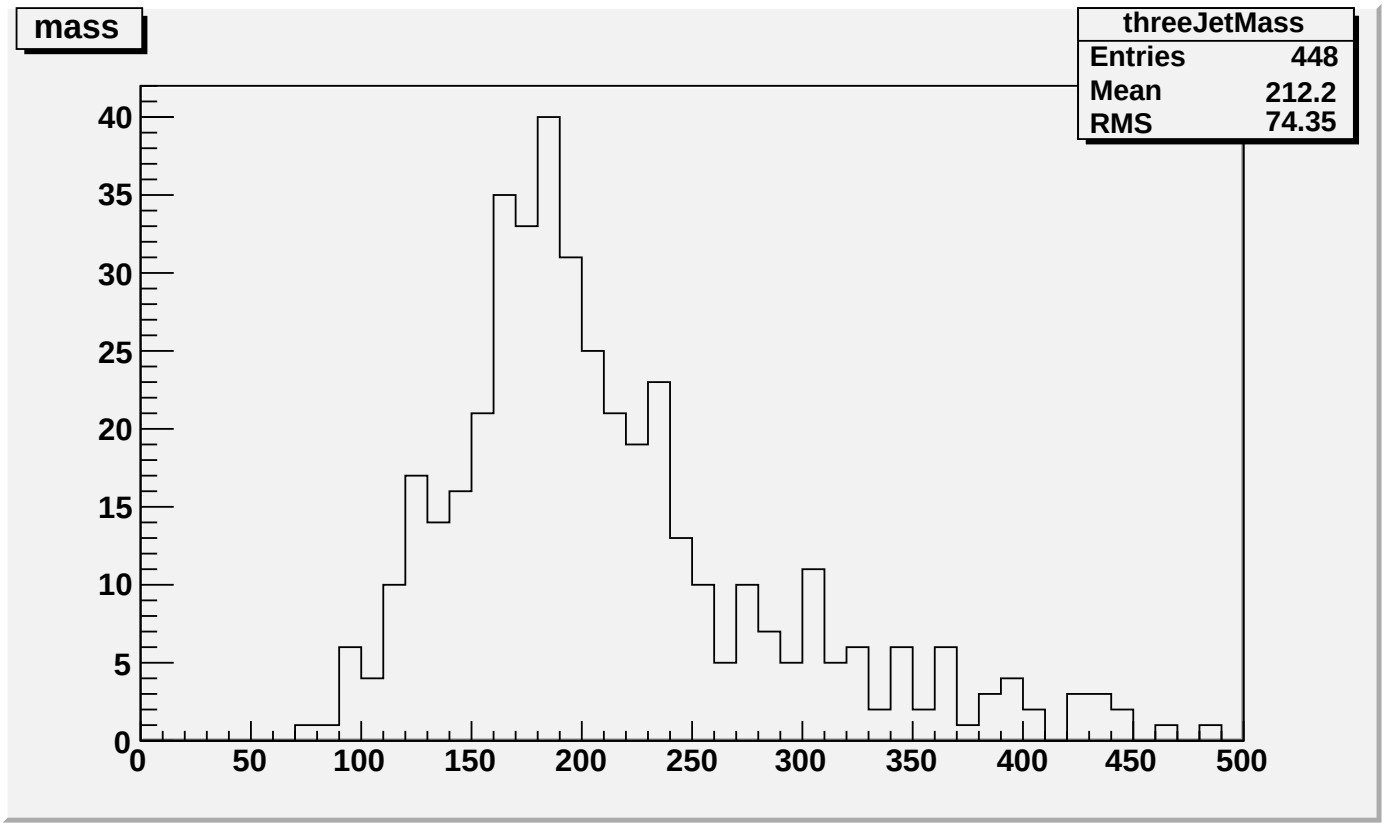
Reconstruction and Histogram Filling

- ROOT program processing Monte Carlo Data, $\approx$ 8000 events
- Back-to-back signature of top pair (leading order in transverse plane)
- Maximum vectorial sum of the transverse momentum of three jets
- Loose selection

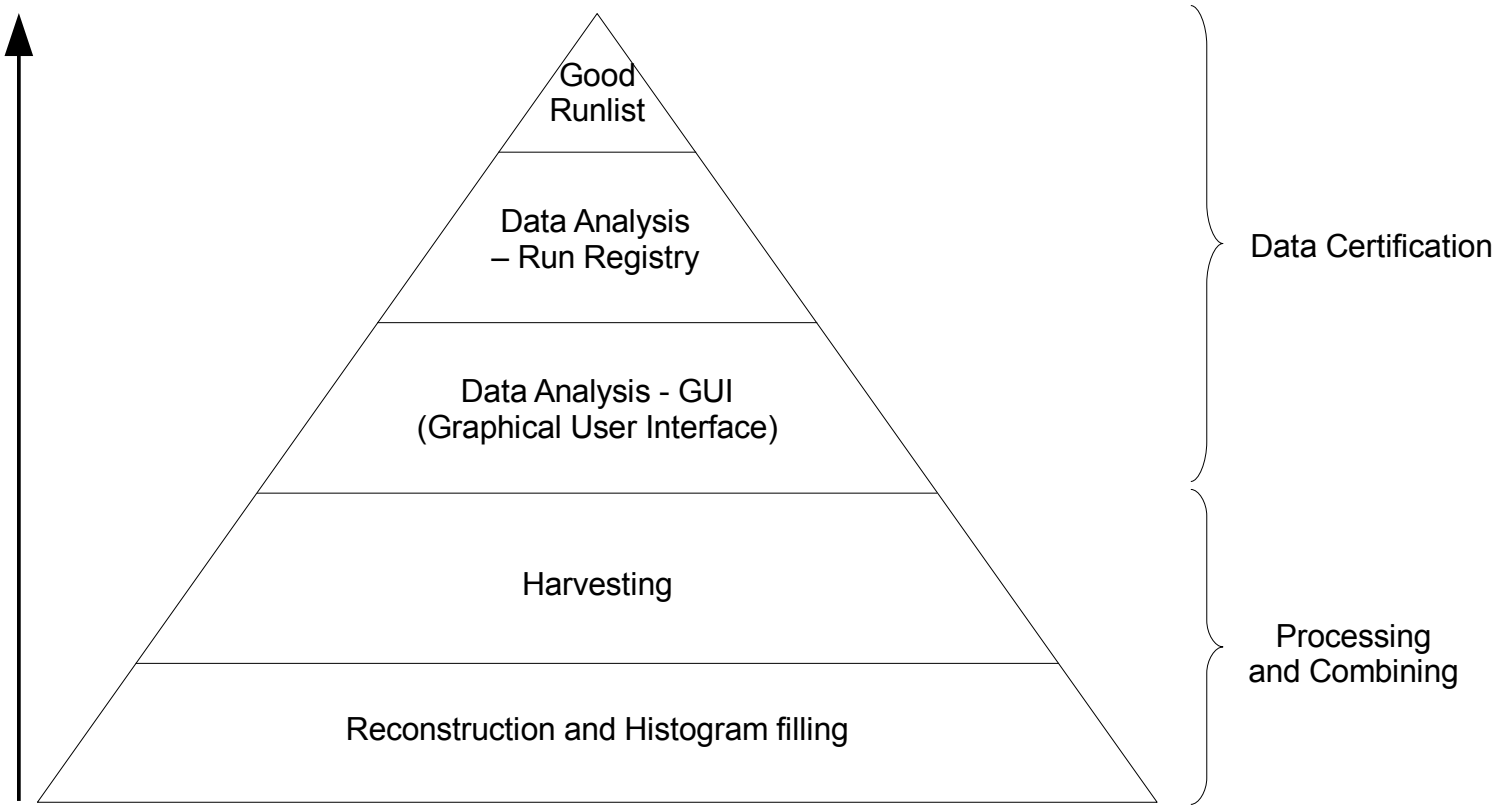


Reconstruction and Histogram Filling

- Additional selection criteria: muon and jet cuts, remove jet candidates which really are electrons, ...



DQM Pyramid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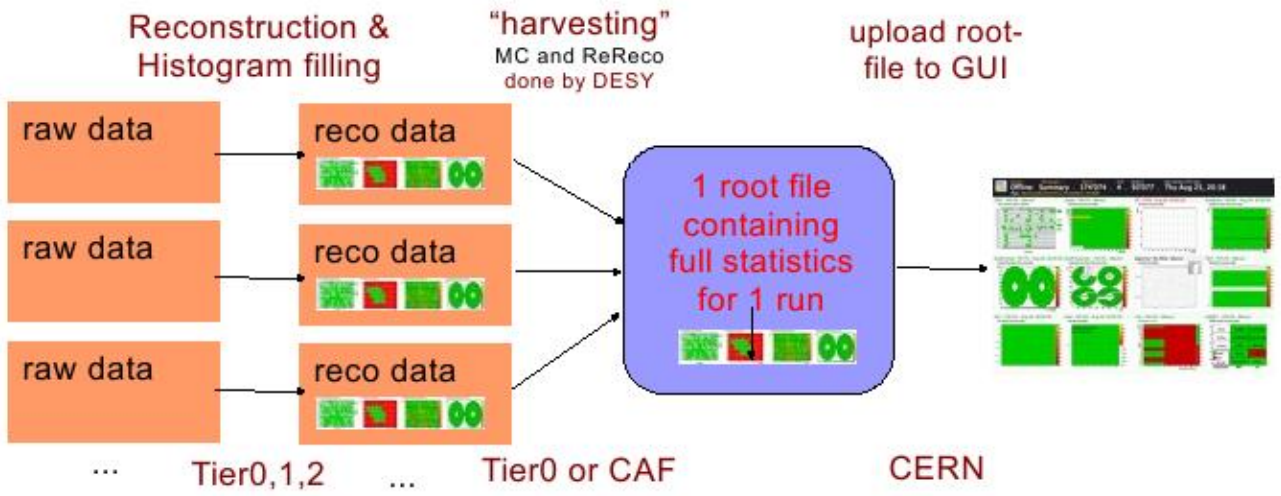
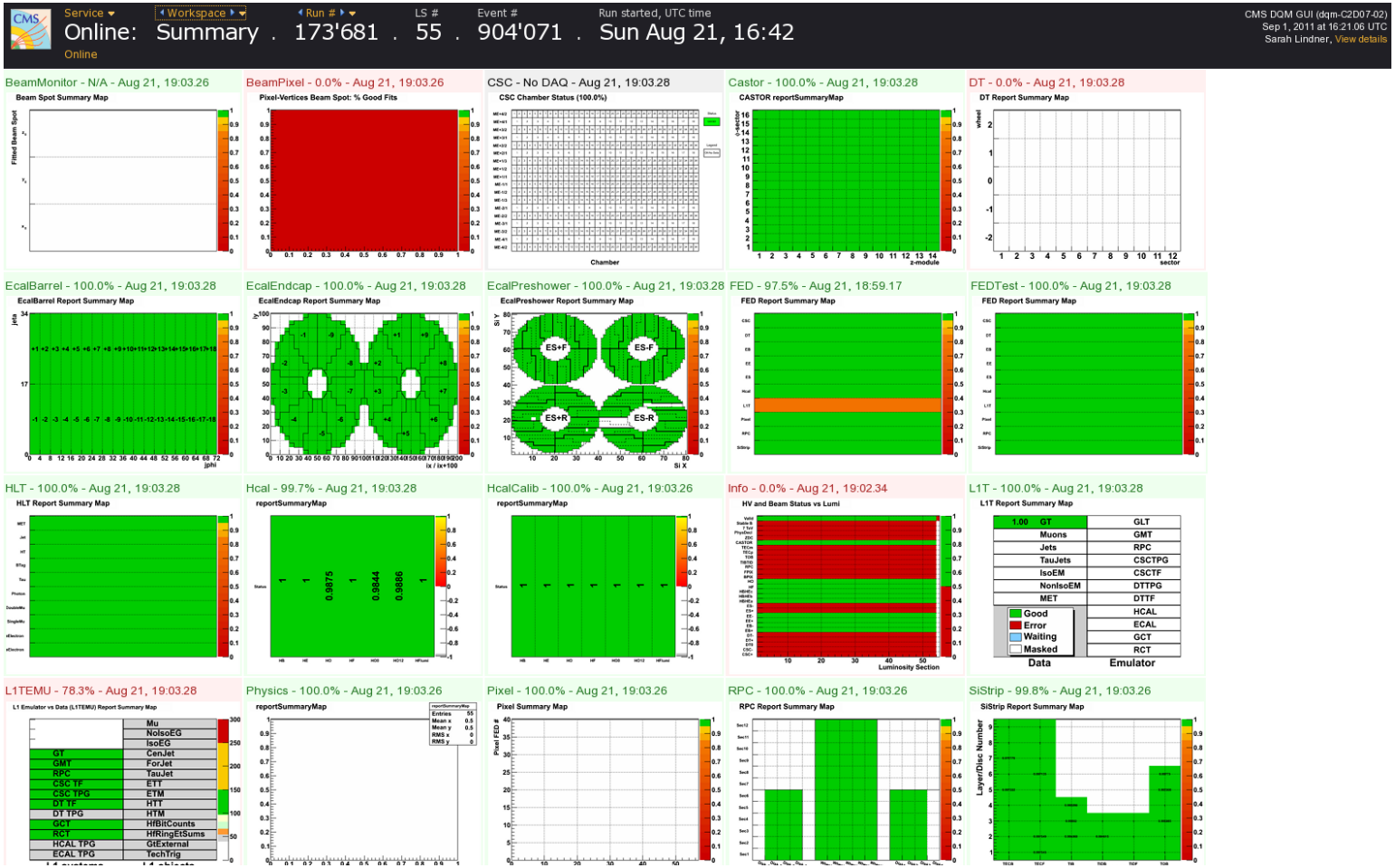
DQM Harvesting



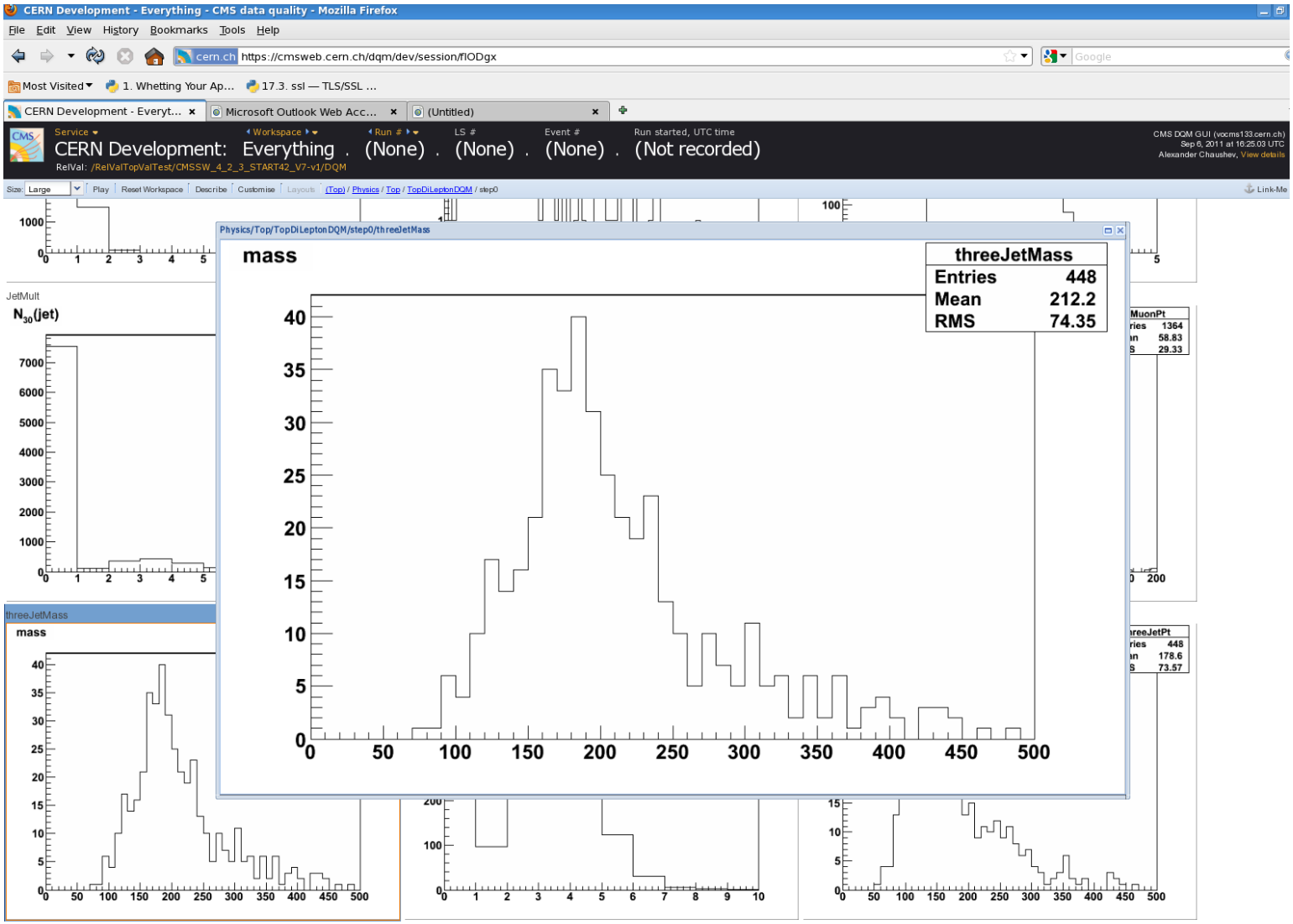
- Improved/revised existing harvester automation script
- The function of the revised script is to run the CMS Harvester, find new data and upload the resulting histograms to the DQM GUI
- At DESY data harvesting is done for Monte Carlo and Re-Reco data sets for CMS experiment

Data Certification - Graphical User Interface

Offline shifter and general user view of the system

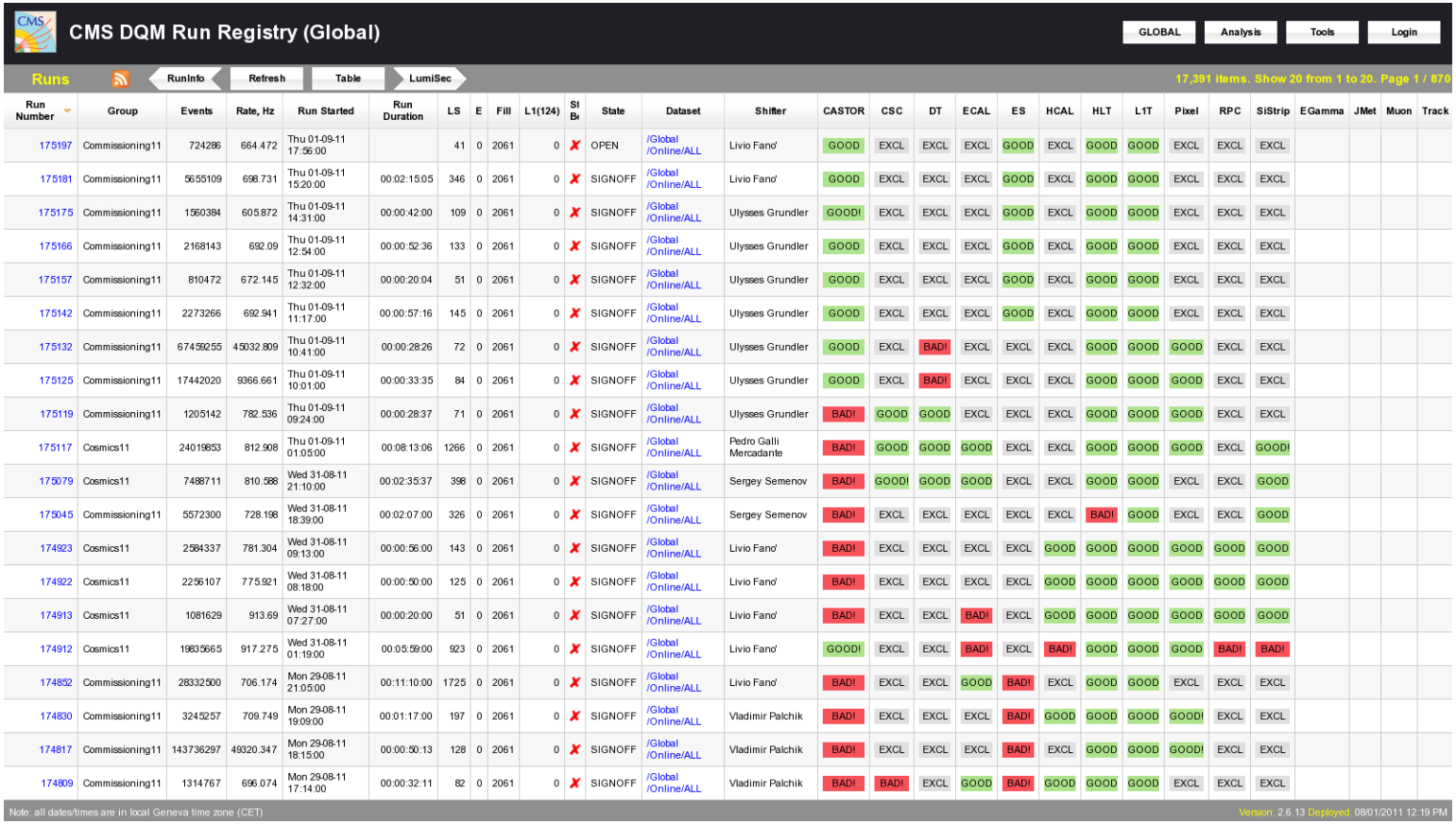


New Histogram on DQM GUI



Data Certification - Run Registry

- Data certification for physics analysis
- For each run good and bad flags are set based on DQM histogram inspection



CMS DQM Run Registry (Global)

GLOBAL | Analysis | Tools | Login

Runs | RunInfo | Refresh | Table | LumiSec

17,391 items. Show 20 from 1 to 20. Page 1 / 870

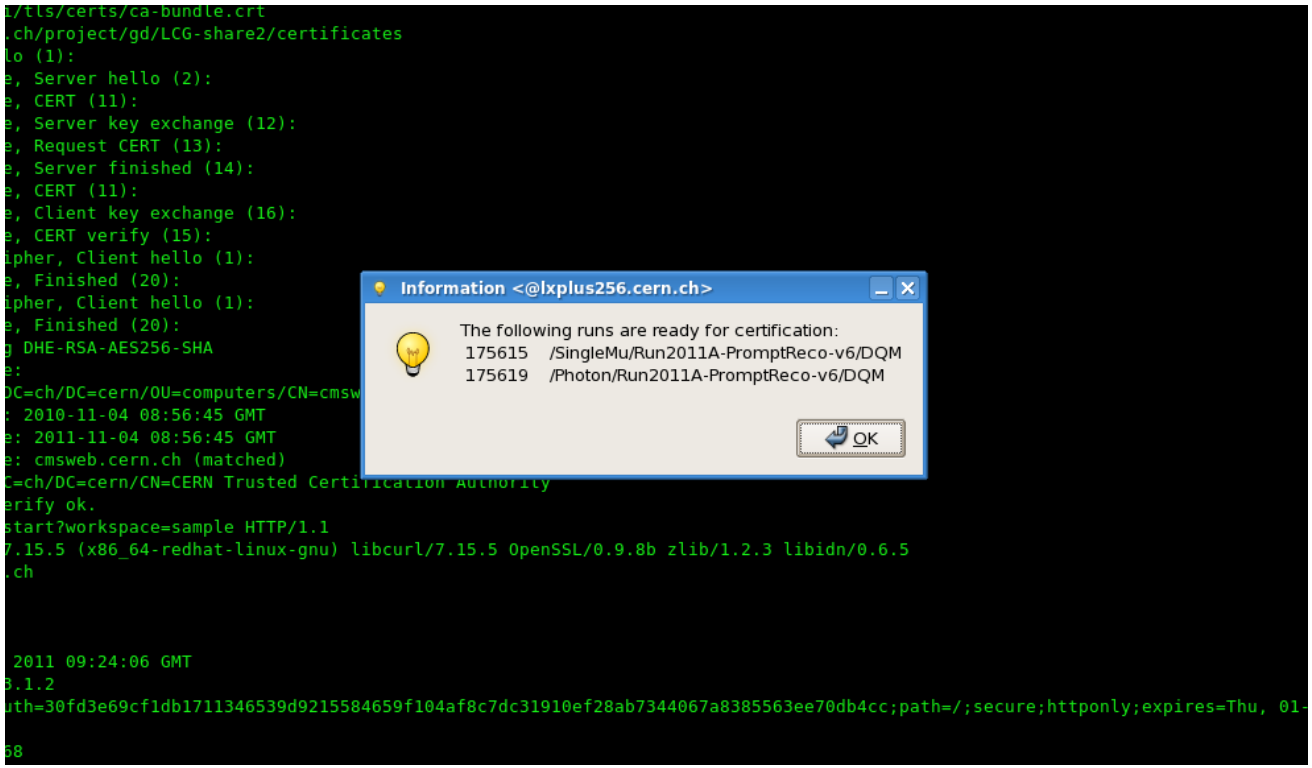
Run Number	Group	Events	Rate, Hz	Run Started	Run Duration	LS	E	Fill	L1(124)	Sl Be	State	Dataset	Shifter	CASTOR	CSC	DT	ECAL	ES	HCAL	HLT	L1T	Pixel	RPC	SiStrip	EGamma	JMet	Muon	Track
175197	Commissioning11	724286	664.472	Thu 01-09-11 17:56:00		41	0	2061	0	✗	OPEN	/Global /Online/ALL	Livio Fano'	GOOD	EXCL	EXCL	EXCL	GOOD	EXCL	GOOD	GOOD	EXCL	EXCL	EXCL				
175181	Commissioning11	5655109	698.731	Thu 01-09-11 15:20:00	00:02:15:05	346	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Livio Fano'	GOOD	EXCL	EXCL	EXCL	GOOD	EXCL	GOOD	GOOD	EXCL	EXCL	EXCL				
175175	Commissioning11	1560384	605.872	Thu 01-09-11 14:31:00	00:00:42:00	109	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Ulysses Grundler	GOOD!	EXCL	EXCL	EXCL	GOOD	EXCL	GOOD	GOOD	EXCL	EXCL	EXCL				
175166	Commissioning11	2168143	692.09	Thu 01-09-11 12:54:00	00:00:52:36	133	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Ulysses Grundler	GOOD	EXCL	EXCL	EXCL	GOOD	EXCL	GOOD	GOOD	EXCL	EXCL	EXCL				
175157	Commissioning11	810472	672.145	Thu 01-09-11 12:32:00	00:00:20:04	51	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Ulysses Grundler	GOOD	EXCL	EXCL	EXCL	GOOD	EXCL	GOOD	GOOD	EXCL	EXCL	EXCL				
175142	Commissioning11	2273266	692.941	Thu 01-09-11 11:17:00	00:00:57:16	145	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Ulysses Grundler	GOOD	EXCL	EXCL	EXCL	GOOD	EXCL	GOOD	GOOD	EXCL	EXCL	EXCL				
175132	Commissioning11	67459255	45032.809	Thu 01-09-11 10:41:00	00:00:28:26	72	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Ulysses Grundler	GOOD	EXCL	BAD!	EXCL	EXCL	EXCL	GOOD	GOOD	GOOD	EXCL	EXCL				
175125	Commissioning11	17442020	9366.661	Thu 01-09-11 10:01:00	00:00:33:35	84	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Ulysses Grundler	GOOD	EXCL	BAD!	EXCL	EXCL	EXCL	GOOD	GOOD	GOOD	EXCL	EXCL				
175119	Commissioning11	1205142	782.536	Thu 01-09-11 09:24:00	00:00:28:37	71	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Ulysses Grundler	BAD!	GOOD	GOOD	EXCL	EXCL	EXCL	GOOD	GOOD	GOOD	EXCL	EXCL				
175117	Cosmics11	24019853	812.908	Thu 01-09-11 01:05:00	00:08:13:06	1266	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Pedro Galli Mercadante	BAD!	GOOD	GOOD	GOOD	EXCL	EXCL	GOOD	GOOD	GOOD	EXCL	GOOD!				
175079	Cosmics11	7488711	810.588	Wed 31-08-11 21:10:00	00:02:35:37	398	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Sergey Semenov	BAD!	GOOD!	GOOD	GOOD	EXCL	EXCL	GOOD	GOOD	EXCL	EXCL	GOOD				
175045	Commissioning11	5572300	728.198	Wed 31-08-11 18:39:00	00:02:07:00	326	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Sergey Semenov	BAD!	EXCL	EXCL	EXCL	EXCL	EXCL	BAD!	GOOD	EXCL	EXCL	GOOD				
174923	Cosmics11	2584337	781.304	Wed 31-08-11 09:13:00	00:00:56:00	143	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Livio Fano'	BAD!	EXCL	EXCL	EXCL	EXCL	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD				
174922	Cosmics11	2256107	775.921	Wed 31-08-11 08:18:00	00:00:50:00	125	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Livio Fano'	BAD!	EXCL	EXCL	EXCL	EXCL	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD				
174913	Cosmics11	1081629	913.69	Wed 31-08-11 07:27:00	00:00:20:00	51	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Livio Fano'	BAD!	EXCL	EXCL	BAD!	EXCL	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD				
174912	Cosmics11	19835665	917.275	Wed 31-08-11 01:19:00	00:05:59:00	923	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Livio Fano'	GOOD!	EXCL	EXCL	BAD!	EXCL	BAD!	GOOD	GOOD	GOOD	BAD!	BAD!				
174852	Commissioning11	28332500	706.174	Mon 29-08-11 21:05:00	00:11:10:00	1725	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Livio Fano'	BAD!	EXCL	EXCL	GOOD	BAD!	EXCL	GOOD	GOOD	EXCL	EXCL	EXCL				
174830	Commissioning11	3245257	709.749	Mon 29-08-11 19:09:00	00:01:17:00	197	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Vladimir Palchik	BAD!	EXCL	EXCL	EXCL	BAD!	GOOD	GOOD	GOOD	GOOD!	EXCL	EXCL				
174817	Commissioning11	143736297	49320.347	Mon 29-08-11 18:15:00	00:00:50:13	128	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Vladimir Palchik	BAD!	EXCL	EXCL	EXCL	BAD!	EXCL	GOOD	GOOD	GOOD!	EXCL	EXCL				
174809	Commissioning11	1314767	696.074	Mon 29-08-11 17:14:00	00:00:32:11	82	0	2061	0	✗	SIGNOFF	/Global /Online/ALL	Vladimir Palchik	BAD!	BAD!	EXCL	GOOD	BAD!	GOOD	GOOD	GOOD	EXCL	EXCL	EXCL				

Note: all dates/times are in local Geneva time zone (CET)

Version: 2.6.13 Deployed: 08/01/2011 12:19 PM

Checking for Available Runs

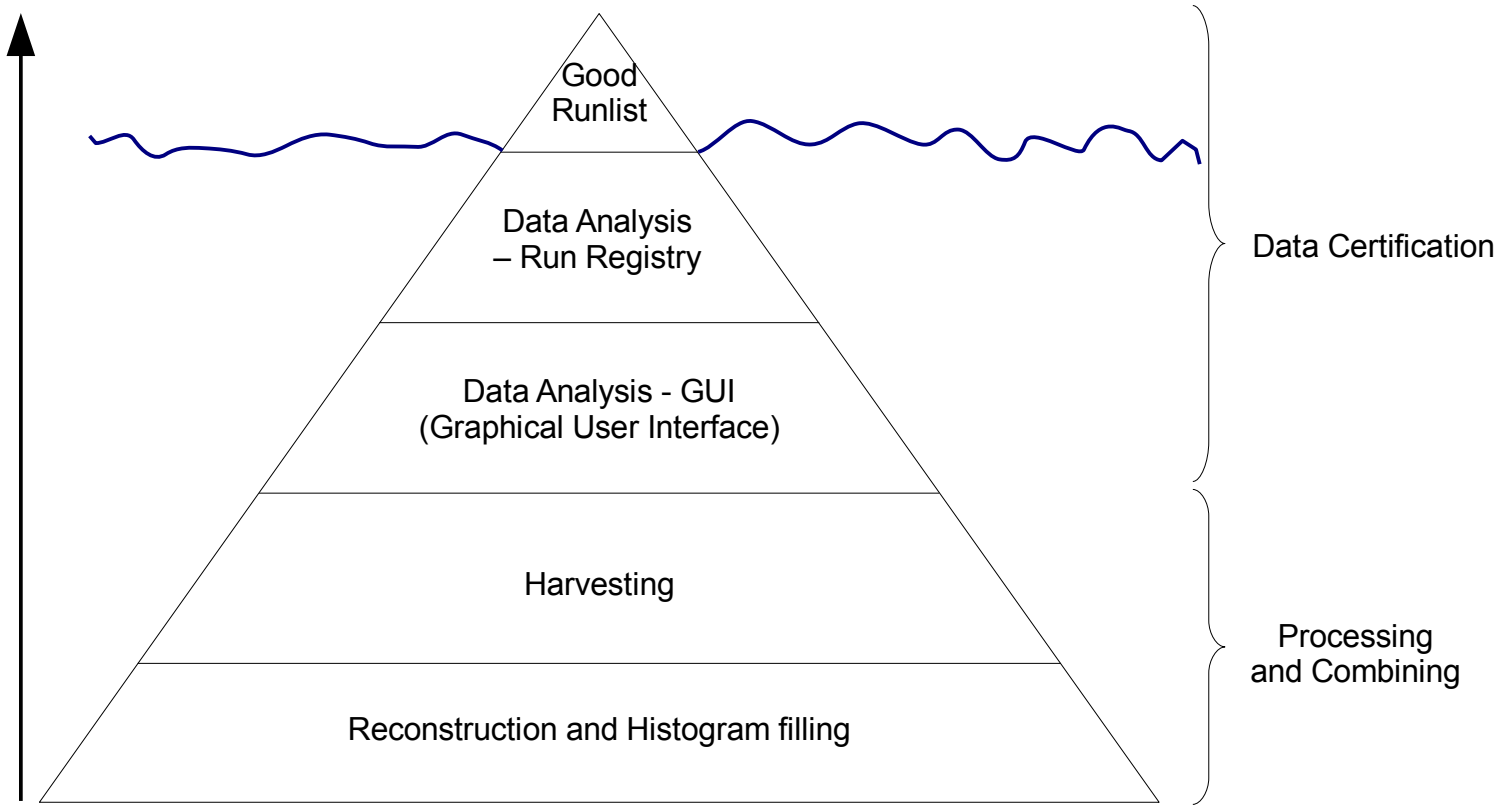
- Checking for new runs for certification is an iterative task which is done by hand during the shift
- Script automatically checks for runs which are available and ready for certification
- Runs are ready for certification once data has arrived in the GUI - script checks for this



Scripting Technicalities - Python to the Rescue!

- Python is good at connecting to and handling servers
- Python also makes string and file handling easier
- This is useful for:
  - Fetching data from many different locations
  - Authentication with GRID and for using https connections
  - Data validation - checking that everything is correct
  - Running the script periodically
  - Connecting to and using API (Application Programming Interface)

DQM Iceberg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Thank you for the opportunity to take part in the Summer Student Program in the CMS group!

Thank you for your attention!