LCG Generator Services project

Witek Pokorski

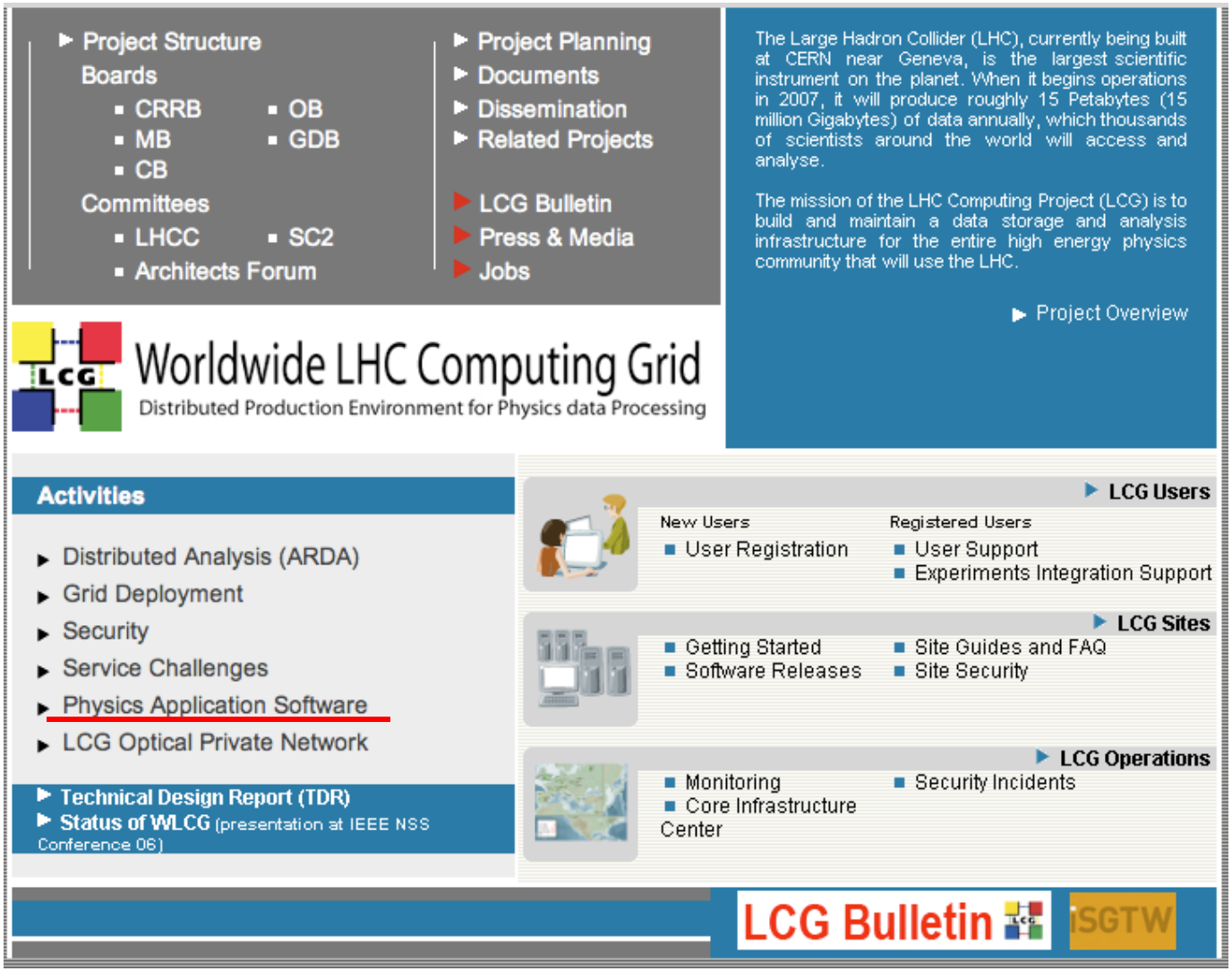
31.03.2010

MC4LHC readiness

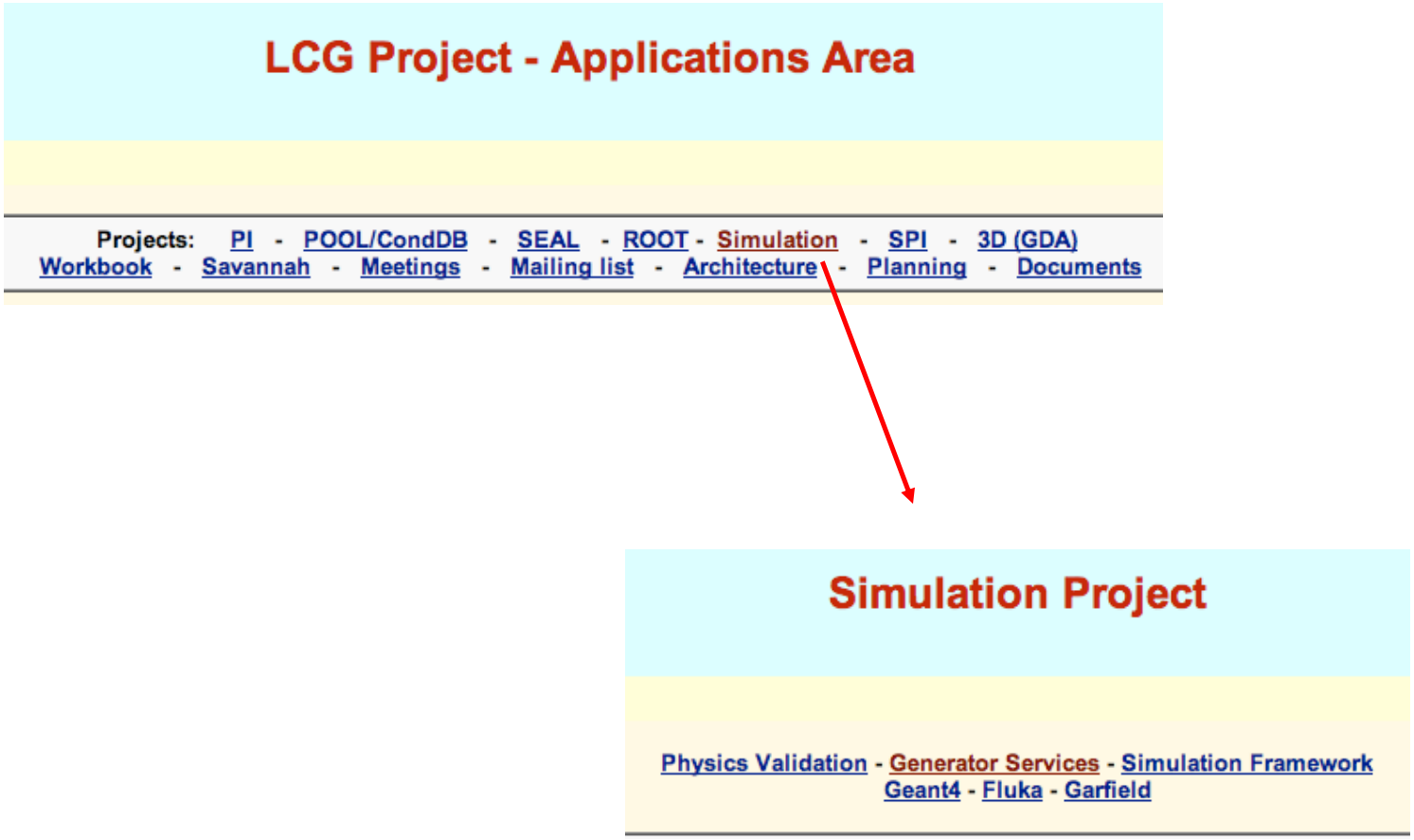
Outline

- Overview of LCG Generator Services project
- Workpackages discussion
- Conclusion

LCG project


Project Structure
Boards
CRRB
OB
MB
GDB
CB
Committees
LHCC
SC2
Architects Forum
Project Planning
Documents
Dissemination
Related Projects
LCG Bulletin
Press & Media
Jobs
The Large Hadron Collider (LHC), currently being built at CERN near Geneva, is the largest scientific instrument on the planet. When it begins operations in 2007, it will produce roughly 15 Petabytes (15 million Gigabytes) of data annually, which thousands of scientists around the world will access and analyse.
The mission of the LHC Computing Project (LCG) is to build and maintain a data storage and analysis infrastructure for the entire high energy physics community that will use the LHC.
Project Overview
LCG
Worldwide LHC Computing Grid
Distributed Production Environment for Physics data Processing
Activities
Distributed Analysis (ARDA)
Grid Deployment
Security
Service Challenges
Physics Application Software
LCG Optical Private Network
Technical Design Report (TDR)
Status of WLCG (presentation at IEEE NSS Conference 06)
LCG Users
New Users
User Registration
Registered Users
User Support
Experiments Integration Support
LCG Sites
Getting Started
Software Releases
Site Guides and FAQ
Site Security
LCG Operations
Monitoring
Core Infrastructure Center
Security Incidents
LCG Bulletin
iSGTW

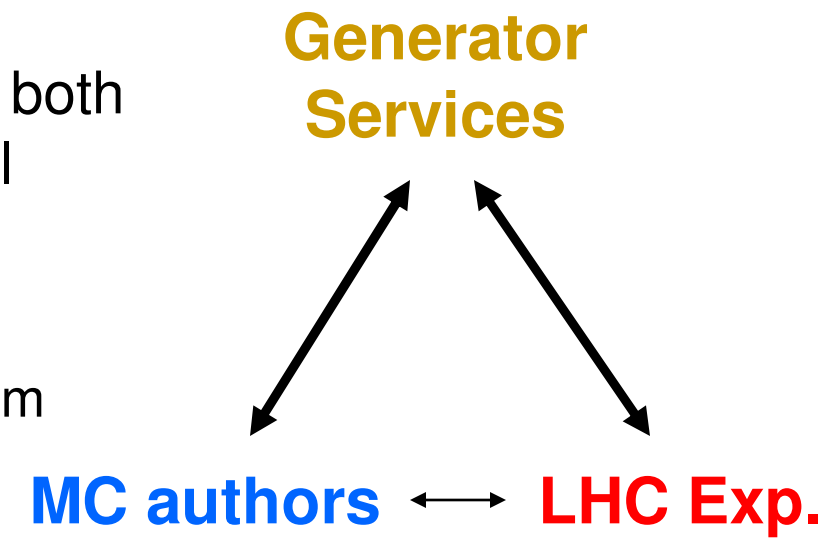
LCG Application Area Simulation Project



LCG Generator Services

http://lcgapp.cern.ch/project/simu/generator/

- mandate of the project:
  - "...to prepare validated LCG compliant (generators) code for both the theoretical and experimental communities at the LHC..."
- to avoid duplication of work
  - to build libraries for required platform
- to share experience between experiments
- to use common generators (tunings?)
- to offload authors from the 'basic support' duties



Project work packages

- generator libraries repository [GENSER]
- testing and validation of generators [VALIDATION]
- event record [HEPMC]
  - maintained by Lynn Garren (FERMILAB)
- event database [MCDB]

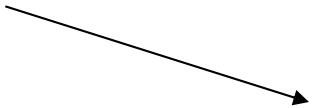
GENSER

- centralized installation of all the MC generators used by LHC experiments on all the LCG supported platforms
- common structure for all the generators
- ready to use libraries
- tarfiles with binaries
- tarfiles with sources

Repository structure (1/3)

```
/afs/cern.ch/sw/lcg/external/MCGenerators
                                        /pythia6
                                        /pythia8
                                        /herwig
                                        /herwig++
                                        /jimmy
                                        .....
                                        /distribution/..
```

LCG tar files with sources and binaries



- **For each generator:**

```
pythia8/130
       /135
       ....
```

Repository structure (2/3)

- **For each version:**

```
135/share
   /x86_64-slc5-gcc43-opt
   /slc4_amd64_gcc34
   ...
```

- **For each platform:**

```
slc4_amd64_gcc34/compile.log
                /config.mk
                /include/
                /lib/libpythia8.so
                /lib/archive/libpythia8.a
```

Repository structure (3/3)

- tarfiles:

```
/afs/cern.ch/sw/lcg/external/MCGenerators/distribution/

                                    pythia8-135-src.tgz
                                    pythia8-135-x86_64-slc5-gcc43-
  opt.tgz
                                    pythia8-135-slc4_amd64_gcc34.tgz
                                    pythia8-135-slc4_ia32_gcc34.tgz
```

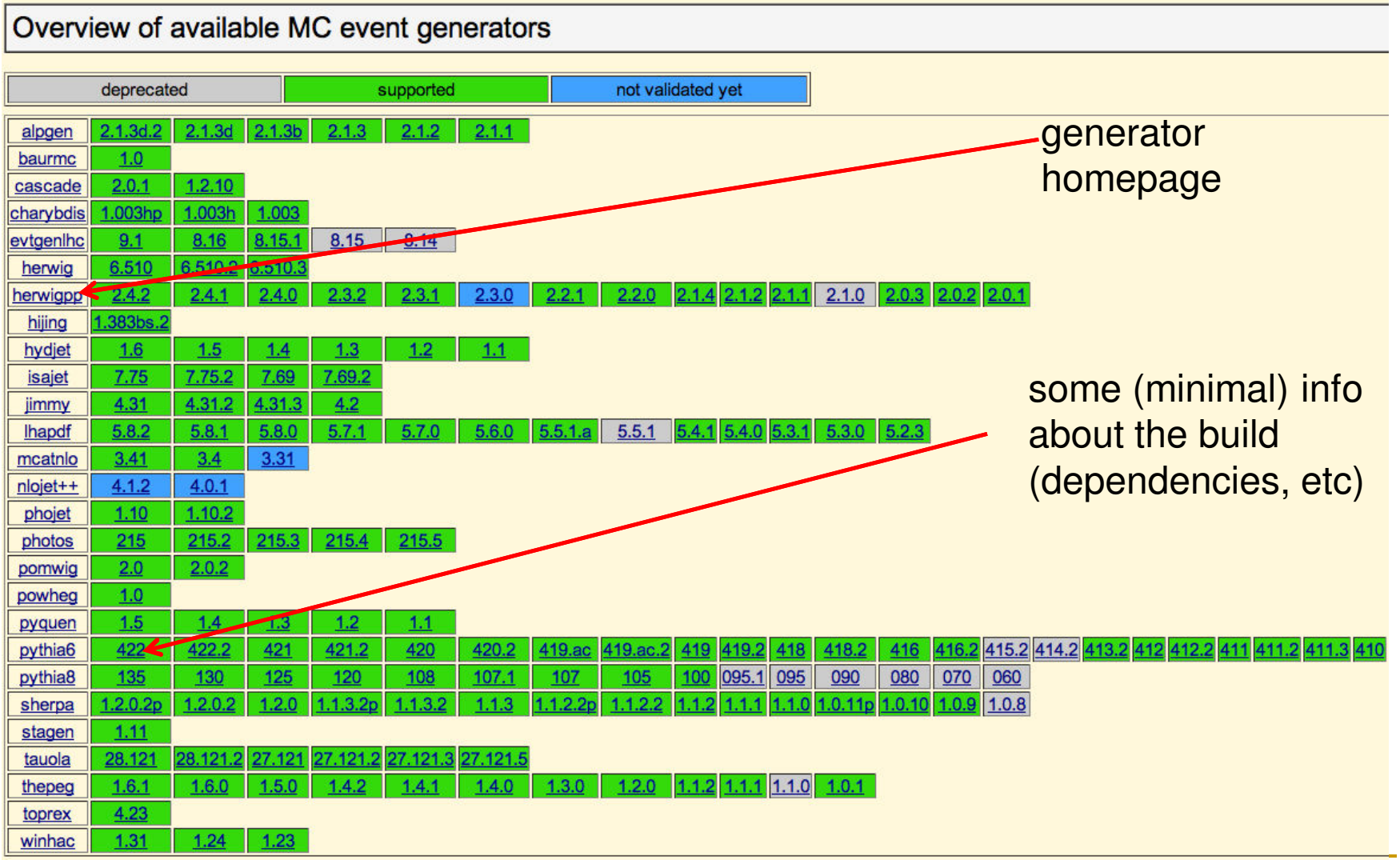
Using GENSER

- to use libraries from AFS
  - link to /afs/cern.ch/sw/lcg/external/MCGenerators/...
- to use binary tarfiles
  - download, unpack and link
- to use source tarfiles
  - tar zxvf pythia6-413-src.tgz
  - cd pythia6/413
  - ./configure --help
  - ./configure --your-options
  - make
  - libraries go to pythia6/413/lib/

Using GENSER - Bootstrap

- a set of tools to install GENSER generators following the same directory structure as on /afs/cern.ch
  - can be used to create 'mirrors' of GENSER
  - can be used to install individual generators in 'GENSER-like' way
  - allows to have a common structure that other tools (HepMC Analysis, Rivet, MCTester) can rely on

Available generators (1/2)



Available generators (2/2)

- over 25 different generators available
  - FORTRAN and the new C++ generators
- new versions installed with minimal delay
- binaries provided for several platforms
  - Linux (all)
  - MacOSX (most)
  - Windows (some)
- new generators added on experiments' request

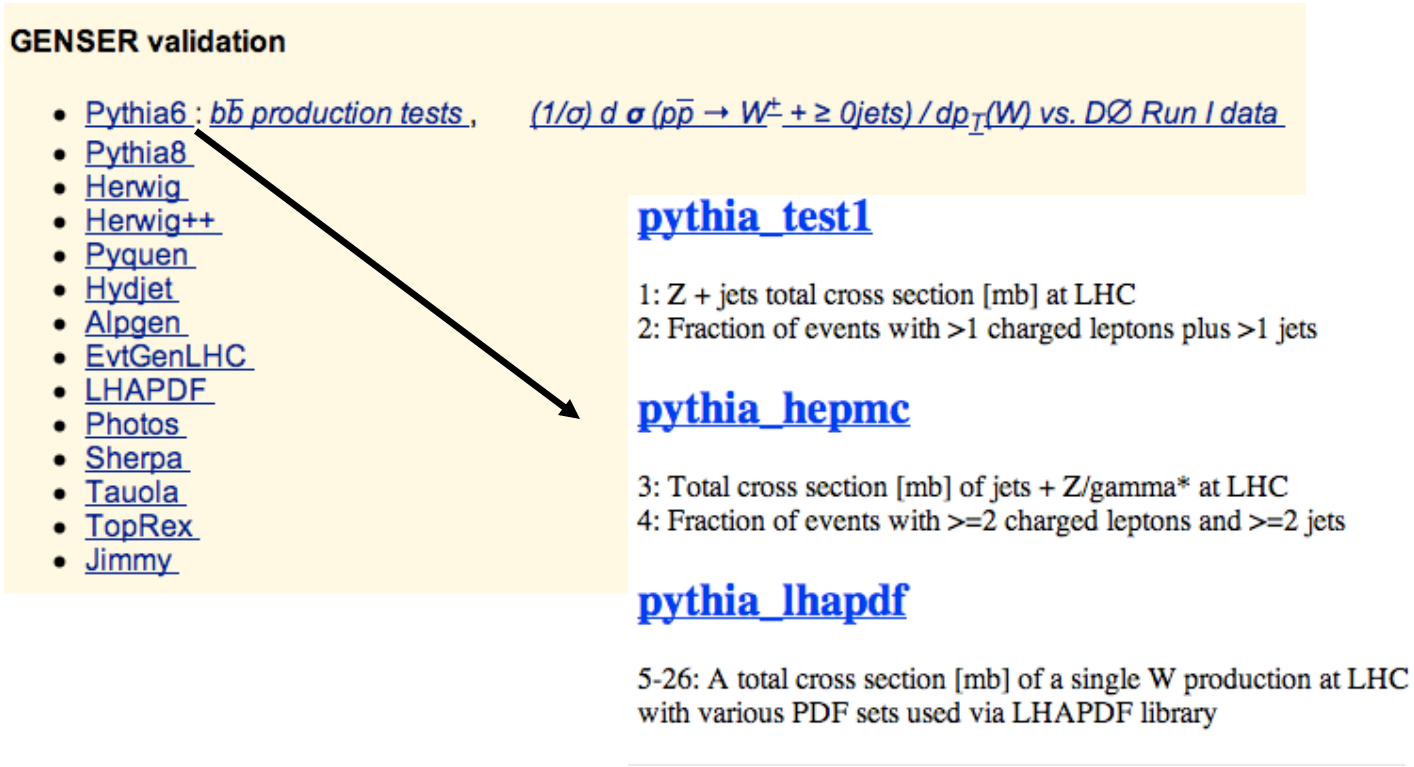
Testing and validation

- experiments used to independently test and validate each new version of the generator
  - clear duplication of work
- GENSER testing and validation
  - testing of generators on different platforms
  - comparing different (new) versions of each generator
  - physics validation (comparing to data)

GENSER testing

- simple tests
  - 'single number' output, observable (charged multiplicity, etc)
- histogramming tests (to be replaced by HepMC Analysis Tool)
  - distribution output (pT, etc)
  - needs to be linked with ROOT
- physics validation
  - Rivet validation

GENSER simple tests (1/2)



- at least one simple test per generator
- automatic checking between different versions of generators and platforms

GENSER simple tests (2/2)

Notation:

Y , dY	-- value of an observable and its stat. error
Y_{ref} , dY_{ref}	-- reference value of an observable and its stat. error
Pull	-- $(Y - Y_{ref}) / (dY^2 + dY^2_{ref})^{1/2}$
ok	-- tests are succesfully compiled and executed with *pull* < 3 for all versions
badstat	-- as above, but statistics is insufficient: $Y_{ref} < 5dY_{ref}$ or $Y < 4dY$
deviation	-- at least one *pull* > 3
failed	-- test crashed at least for one version
errors	-- test failed to compile at least for one version

---

slc4_ia32_gcc34

Version:		135					
Test		Y	dY	pull	Y_{ref}	dY_{ref}	Status
pythia8_test1	1	2.101970E-06	6.647000E-08	-0.019077	2.1033e-06	2.1033e-08	ok
pythia8_test1	2	5.800000E-02	7.615770E-03	0.767372	0.0519	0.00227816	ok
pythia8_test1	3	1.000010E+00	1.000000E-04	0.099504	1.	0.00001	ok
pythia8_test1	4	1.000030E-02	5.000000E-06	0.059988	0.01	0.0000001	ok
pythia8_test1	5	3.614130E+02	1.108270E+01	-0.437758	366.514	3.59942	ok
pythia8_test1	6	1.726120E+02	5.333450E+00	-0.444315	175.102	1.72066	ok
pythia8_test2	1	2.101970E-06	6.647000E-08	-0.018933	2.10329e-06	2.10329e-08	ok
pythia8_test2	2	6.600000E-02	8.124040E-03	-0.712926	0.0721	0.00268514	ok
pythia8_test3	1	1.916220E+02	5.570380E+00	0.210494	190.394	1.73354	ok

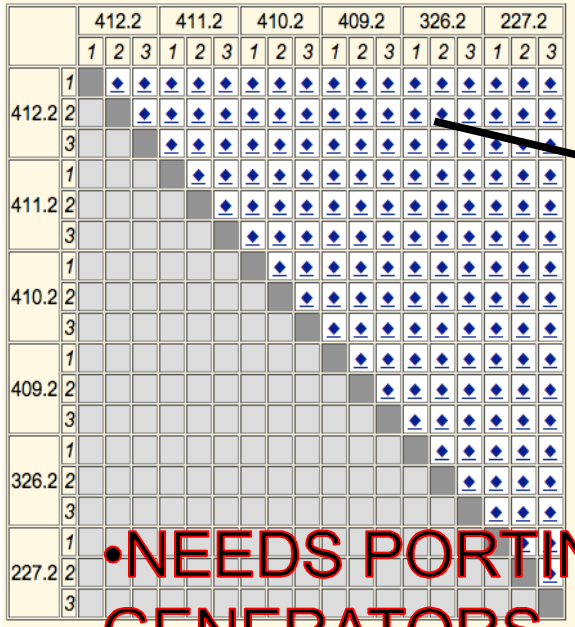
slc4_amd64_gcc34

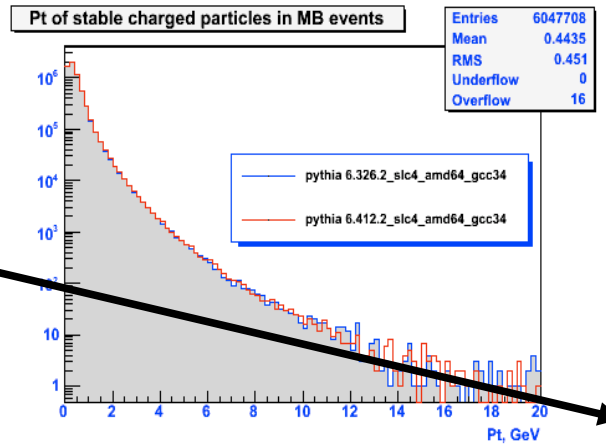
Version:		135					

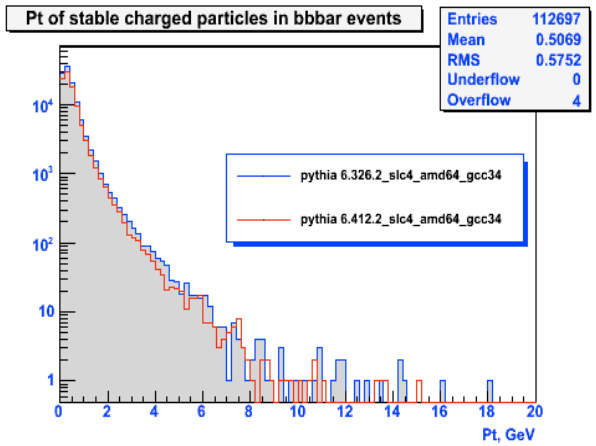
GENSER distribution tests

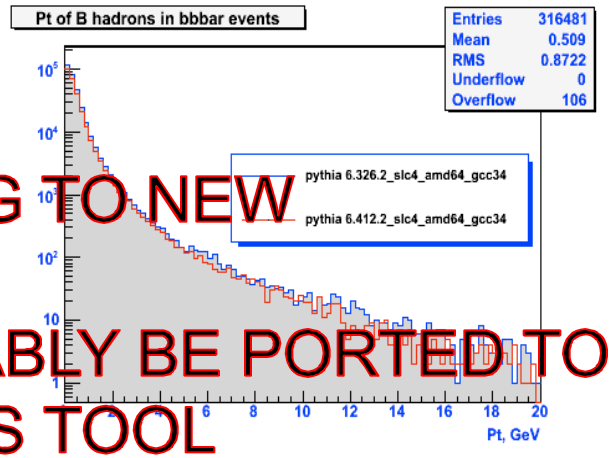
Pythia6, $b\bar{b}$ production

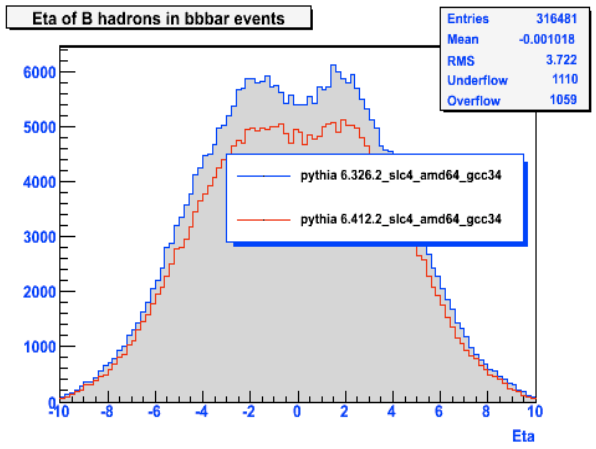
1. slc3_ia32_gcc323
2. slc4_amd64_gcc34
3. slc4_ia32_gcc34









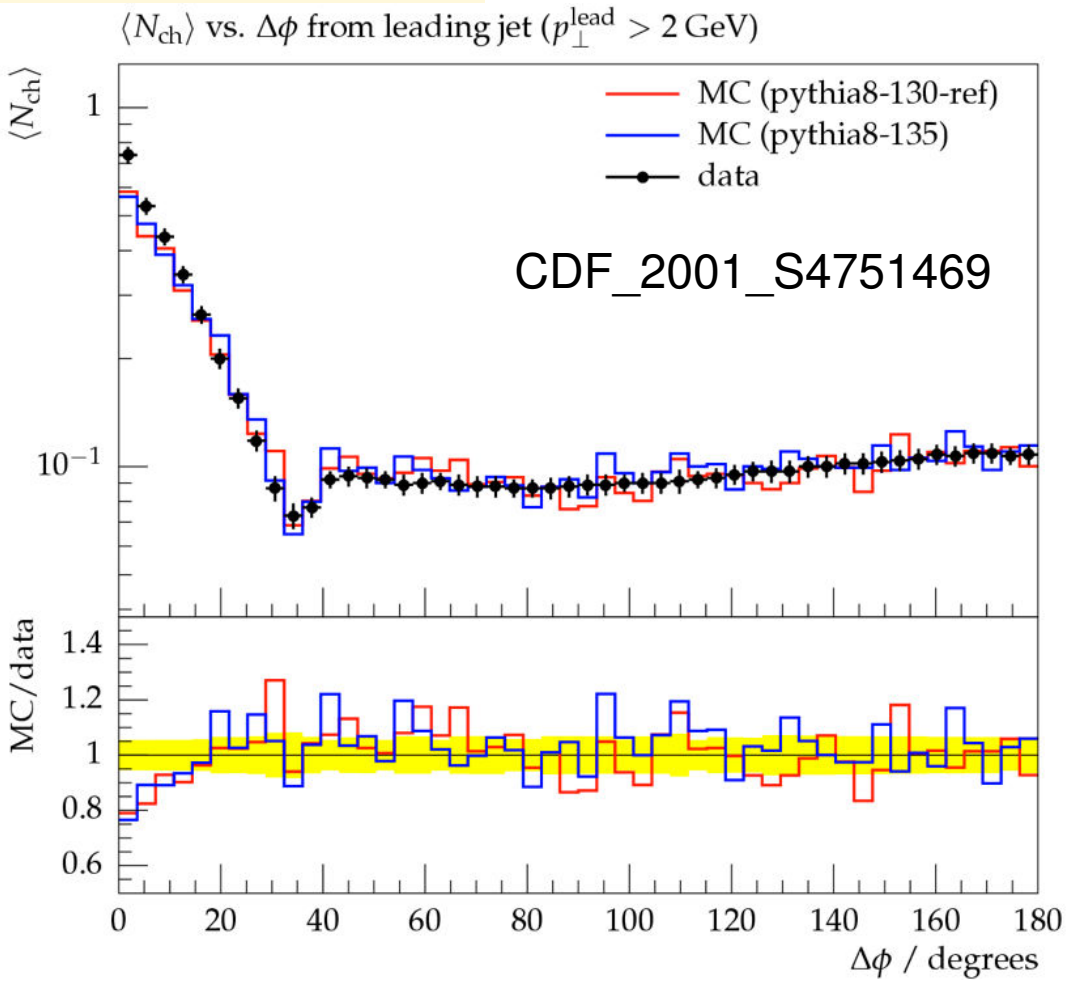


- NEEDS PORTING TO NEW GENERATORS
- SHOULD PROBABLY BE PORTED TO HEPMC ANALYSIS TOOL

GENSER validation using Rivet

Validation with Rivet

- herwig: 6.510
- pythia6: 422 420 418 415 413 412 411
- pythia8: 135 130 125 120 108
- herwig++: 2.4.2 2.4.1 2.4.0 2.3.2



- just starting to use Rivet in GENSER
- plan to have a collection of physics validation tests to be run on different generators
- especially LHC data

HepMC Analysis Tool validation (1/2)

- we certainly want to profit from the DESY group work and integrate it into GENSER tests
  - infrastracture for automatic running/comparison
- so far: web page on the GENSER site created and Albert is filling it out

HepMC Analysis Tool validation (2/2)

HepMC Analysis Tool Validation

Generator Services

PYTHIA6: Di-Jets Top Tau Z W+Jet (6.422.2 ok)*
PYTHIA8: Di-Jets Top Tau Z W+Jet (8.135 ok)
HERWIG6: Di-Jets Top Tau Z W+Jet (6.510 ok)
HERWIG++: Di-Jets Top Tau Z W+Jet (2.4.2 ok)
CASCADE: Di-Jets (2.0.2 ok)

Latest generator version (above in parantheses) is validated ag

*Something needs to be clearified/cross-checked

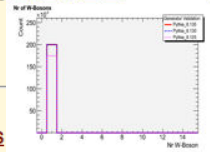
Shape comparison between the above generators: Di-Jets

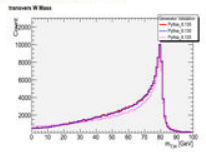
Todo-list (suggestions welcome)

Contact: albert.knutsson[nospam]desy.de

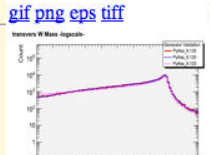
Home of the HepMCAnalysisTool: http://hepmcanalysistoo

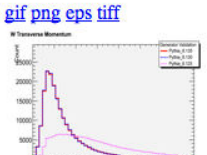
gif png eps tiff | gif png eps tiff



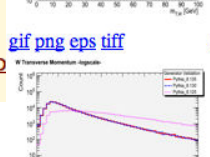


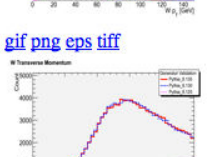
gif png eps tiff | gif png eps tiff



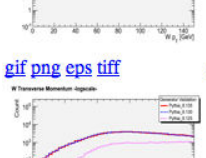


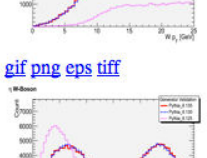
gif png eps tiff | gif png eps tiff





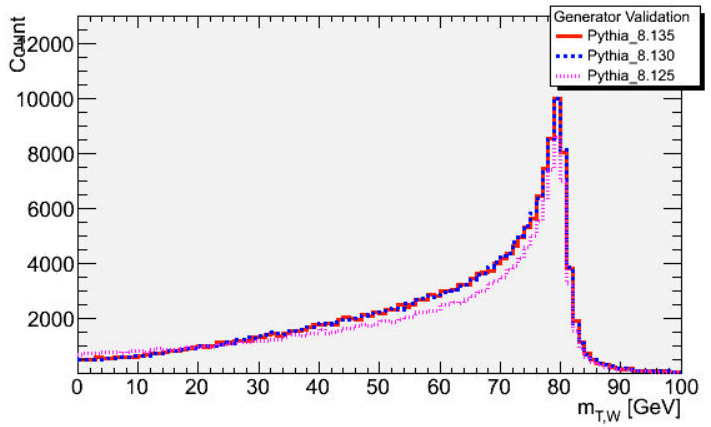
gif png eps tiff | gif png eps tiff





For these plots the following setup was used:
configuration of the process (analysis kind, steering file, etc.)
steering of the generating process
source code of the analysis

transvers W Mass



HepMC (1/2)

HepMC
a C++ Event Record for Monte Carlo Generators

[HepMC Savannah] [HepMC Homepage] [Downloads]

Index

- Introduction
- Releases
- Online Documentation
- Downloads
- Find bug reports, feature requests, news, etc. at HepMC Savannah
  - Code Browser
  - Changes since the previous version
- Production Release: 2.03.10
  - HepMC 2.06 proposal
  - HepMC 2.05 release notes and reference manual
  - HepMC 2.04.00 release notes
  - HepMC 2.04 User Manual: pdf
  - HepMC 2.04 Reference Manual: pdf or doxygen
  - HepMC 2.03 User Manual: postscript or pdf
  - HepMC 2.03 Reference Manual: postscript, pdf, or doxygen

Introduction

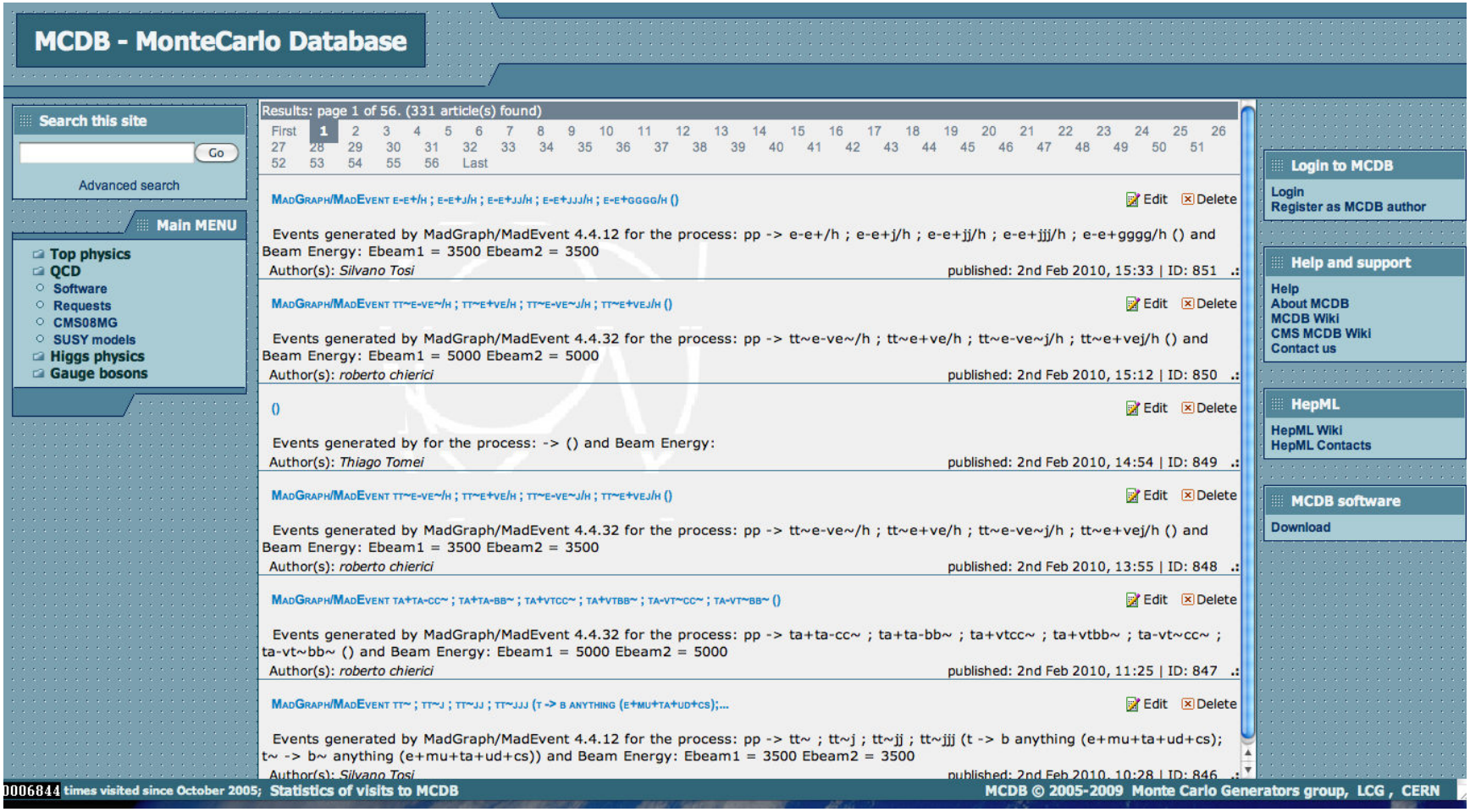
The best way to get a fast overview of the HepMC event record is to browse the first 3 pages of the user manual (linked above). The abstract is reproduced here:

The HepMC package is an object oriented event record written in C++ for High Energy Physics Monte Carlo Generators. Many extensions from HEPEVT, the Fortran HEP standard, are supported: the number of entries is unlimited, spin density matrices can be stored with each vertex, flow patterns (such as color) can be stored and traced, integers representing random number generator states can be stored, and an arbitrary number of event weights can be included. Particles and vertices are kept separate in a graph structure, physically similar to a physics event. The added information supports the modularisation of event generators. The package has been kept as simple as possible with minimal internal/external dependencies. Event information is accessed by means of iterators supplied with the package.
Reference: M. Dobbs and J.B. Hansen, Comput. Phys. Commun. 134 (2001) 41.

HepMC (2/2)

- de facto standard for HEP events
- Lynn Garren maintaining the code
- changes and new features discussed within the community
  - two HepMC planning meetings per year
  - one major release per year (unless the second one is strictly necessary)
  - bugfixes released as soon as possible
  - currently preparing HepMC 2.06

MCDB (1/2)


MCDB - MonteCarlo Database
Search this site
Go
Advanced search
Main MENU
Top physics
QCD
Software
Requests
CMS08MG
SUSY models
Higgs physics
Gauge bosons
Results: page 1 of 56. (331 article(s) found)
First 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
52 53 54 55 56 Last
MadGraph/MadEvent e-e+/h ; e-e+j/h ; e-e+jj/h ; e-e+jjj/h ; e-e+gggg/h ()
Edit Delete
Events generated by MadGraph/MadEvent 4.4.12 for the process: pp -> e-e+/h ; e-e+j/h ; e-e+jj/h ; e-e+jjj/h ; e-e+gggg/h () and Beam Energy: Ebeam1 = 3500 Ebeam2 = 3500
Author(s): Silvano Tosi
published: 2nd Feb 2010, 15:33 | ID: 851
MadGraph/MadEvent tt~e-ve~/h ; tt~e+ve/h ; tt~e-ve~j/h ; tt~e+vej/h ()
Edit Delete
Events generated by MadGraph/MadEvent 4.4.32 for the process: pp -> tt~e-ve~/h ; tt~e+ve/h ; tt~e-ve~j/h ; tt~e+vej/h () and Beam Energy: Ebeam1 = 5000 Ebeam2 = 5000
Author(s): roberto chierici
published: 2nd Feb 2010, 15:12 | ID: 850
()
Edit Delete
Events generated by for the process: -> () and Beam Energy:
Author(s): Thiago Tomei
published: 2nd Feb 2010, 14:54 | ID: 849
MadGraph/MadEvent tt~e-ve~/h ; tt~e+ve/h ; tt~e-ve~j/h ; tt~e+vej/h ()
Edit Delete
Events generated by MadGraph/MadEvent 4.4.32 for the process: pp -> tt~e-ve~/h ; tt~e+ve/h ; tt~e-ve~j/h ; tt~e+vej/h () and Beam Energy: Ebeam1 = 3500 Ebeam2 = 3500
Author(s): roberto chierici
published: 2nd Feb 2010, 13:55 | ID: 848
MadGraph/MadEvent ta+ta-cc~ ; ta+ta-bb~ ; ta+vtcc~ ; ta+vtbb~ ; ta-vt~cc~ ; ta-vt~bb~ ()
Edit Delete
Events generated by MadGraph/MadEvent 4.4.32 for the process: pp -> ta+ta-cc~ ; ta+ta-bb~ ; ta+vtcc~ ; ta+vtbb~ ; ta-vt~cc~ ; ta-vt~bb~ () and Beam Energy: Ebeam1 = 5000 Ebeam2 = 5000
Author(s): roberto chierici
published: 2nd Feb 2010, 11:25 | ID: 847
MadGraph/MadEvent tt~ ; tt~j ; tt~jj ; tt~jjj (t -> b anything (e+mu+ta+ud+cs);...
Edit Delete
Events generated by MadGraph/MadEvent 4.4.12 for the process: pp -> tt~ ; tt~j ; tt~jj ; tt~jjj (t -> b anything (e+mu+ta+ud+cs); t~ -> b~ anything (e+mu+ta+ud+cs)) and Beam Energy: Ebeam1 = 3500 Ebeam2 = 3500
Author(s): Silvano Tosi
published: 2nd Feb 2010, 10:28 | ID: 846
Login to MCDB
Login
Register as MCDB author
Help and support
Help
About MCDB
MCDB Wiki
CMS MCDB Wiki
Contact us
HepML
HepML Wiki
HepML Contacts
MCDB software
Download
0006844 times visited since October 2005; Statistics of visits to MCDB
MCDB © 2005-2009 Monte Carlo Generators group, LCG , CERN

MCDB in Production, lessons of last year (2/2)

- Current content and contributors:
  - 8966 event samples with parton level MC (1.65 TB)
  - 586 articles (384 publicly available)
  - 60 authors
- Stable interfaces:
  - WEB interface (authors and users)
  - Automatic uploading and documenting of new LHEF files (MadGraph and HepML headers are supported)
  - Automatic access to the content of MCDB (C++)
- Automatic interfaces are implemented in CMSSW and used for CMS production (MCDB is accessible from LHEInterface in CMSSW)

New stable release of HepML arXiv:1001.2576

- HepML is the unified XML based description of parton level MC model (is used in the header of LHEF file or as a standalone XML block)
  - XML schemes
  - C++ library to write/read/modify HepML blocks
- New stable version of libhepml is released
  - HepML documents creating, parsing and mixing; support for standard Xerces and Expat XML libraries; autotools support
  - Can be easily added to ME or SH MC generator to describe the events (TH model parameters, generator parameters, cuts, etc.)
  - Already used in CompHEP, MCDB, CMSSW

Available at http://mcdb.cern.ch/distribution and http://svnweb.cern.ch/guest/lcghepml/tags/0.2.6/

Generator Services plans

- involvement in the join tuning exercise
  - repository of tuning tools
  - repository/web resources with different tunes documented, validated, compared, etc
  - tuning/validation of generators using publicly available data
- repository of NLO tools
- contribution to LHC data 'publication'
  - common format (?)
  - feeding into HEPDATA (?)

Conclusions

- Generator Services proves to play a useful role for the LHC experiments
  - generators repository
  - testing
  - event record
  - MC event database
- Generator Services future plan is to contribute more to the physics validation and tuning of the generators