LCG Generator Services project

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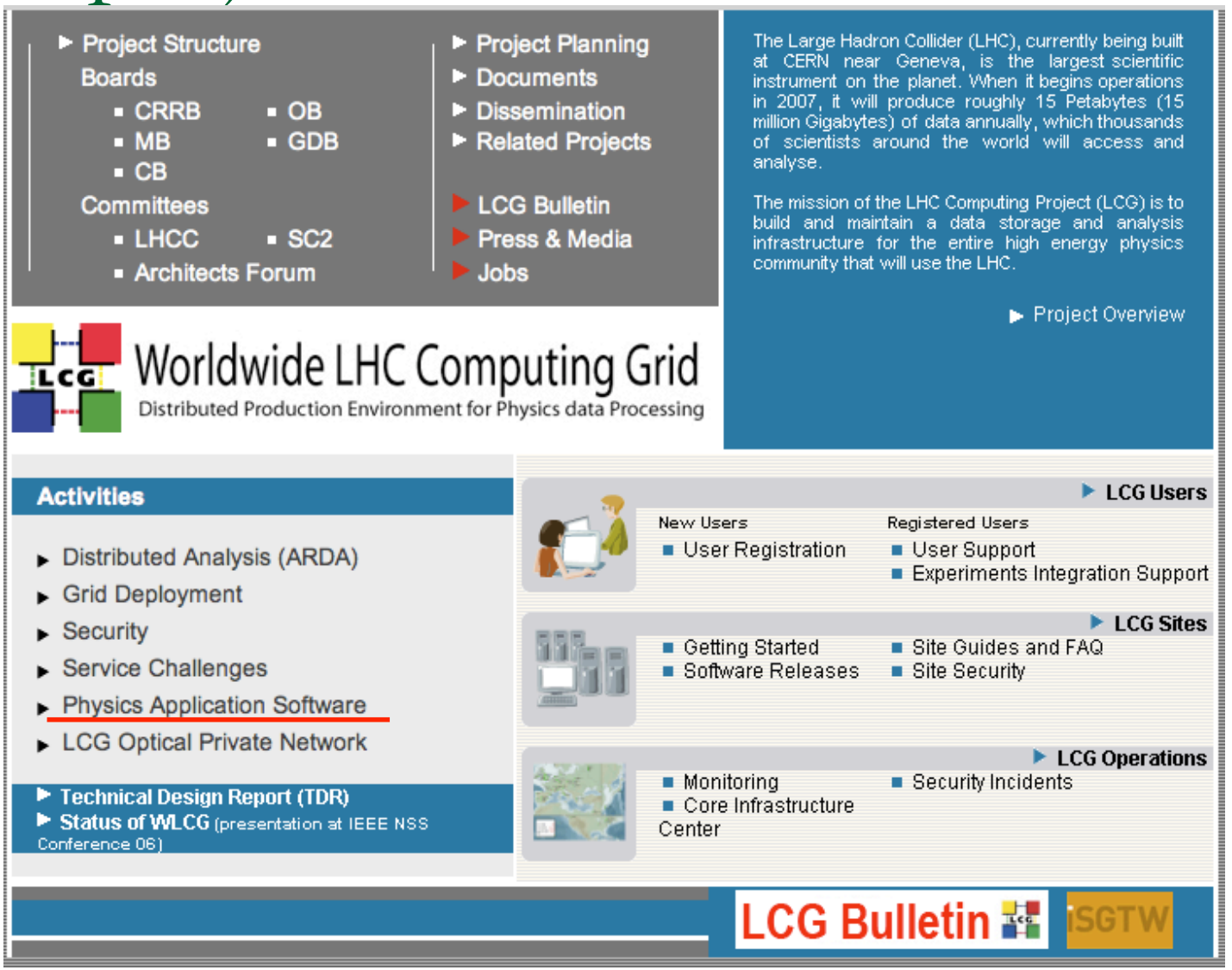
08.02.2010

DESY MC meeting

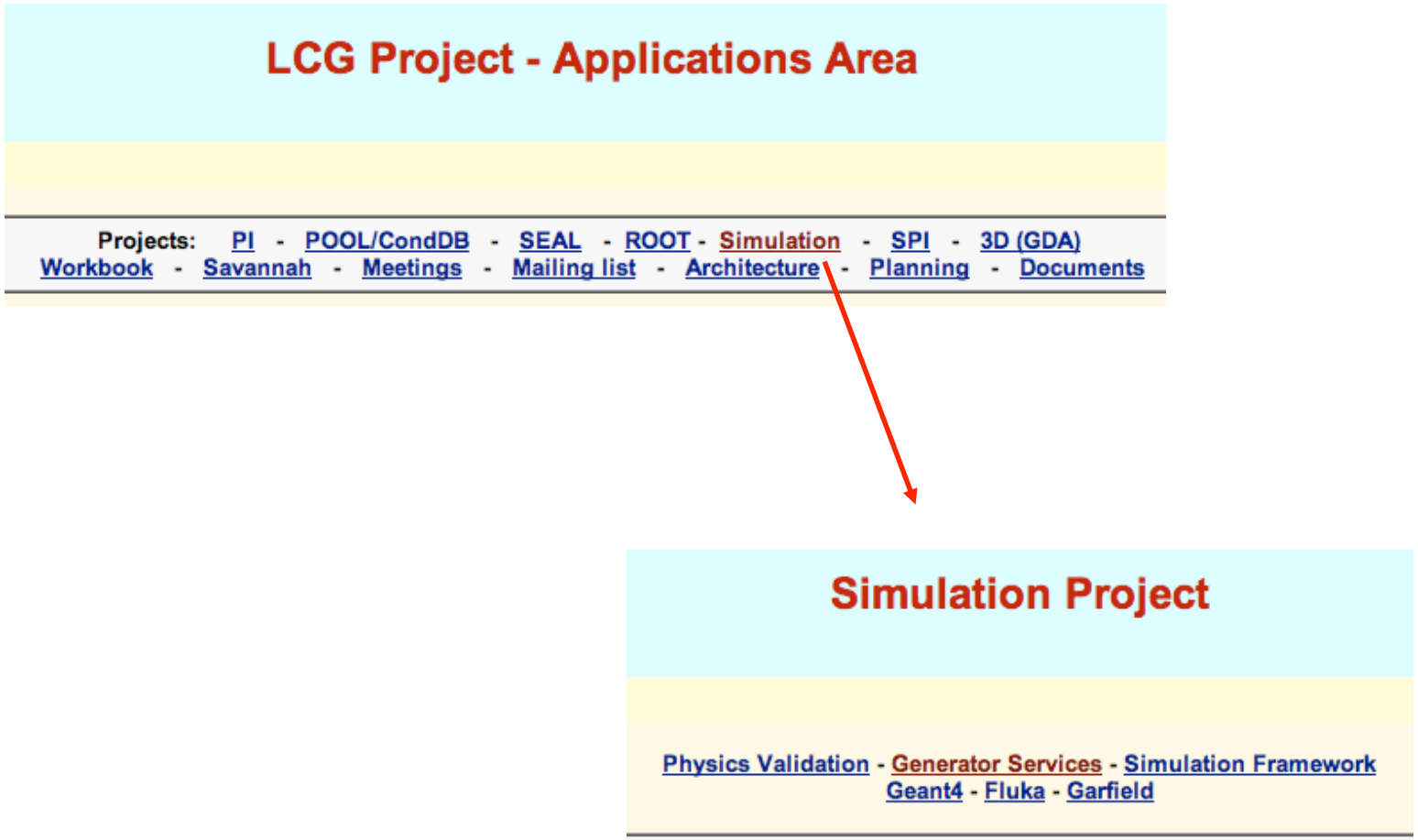
Outline

- 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

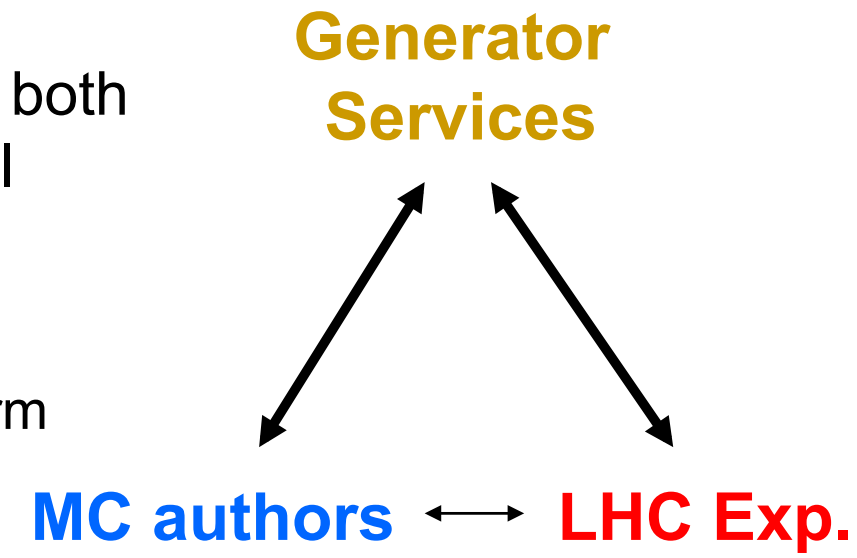
LCG Application Area Simulation Project



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]
- first level support [SUPPORT]
- event record [HEPMC]
  - maintained by Lynn Garren (FERMILAB)
- event database [MCDB]

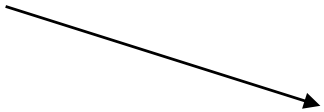
GENSER

- 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
```

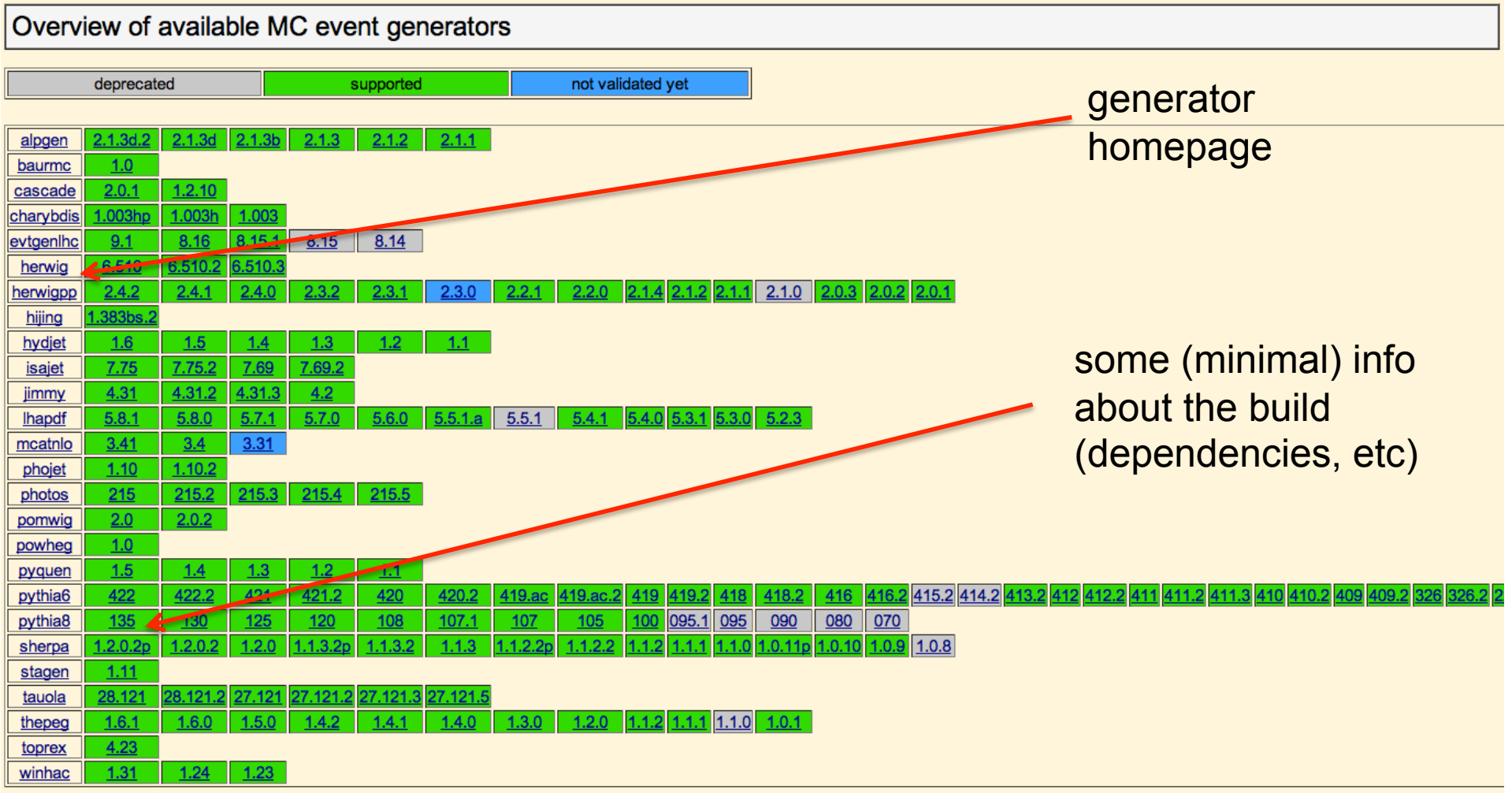
Using GENSER

- 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
  - for ex. nine versions of Pythia8 already installed
- binaries provided for several platforms (Linux, MacOSX, Windows)
  - request to install some generators on Windows
- new generators added on experiments' request

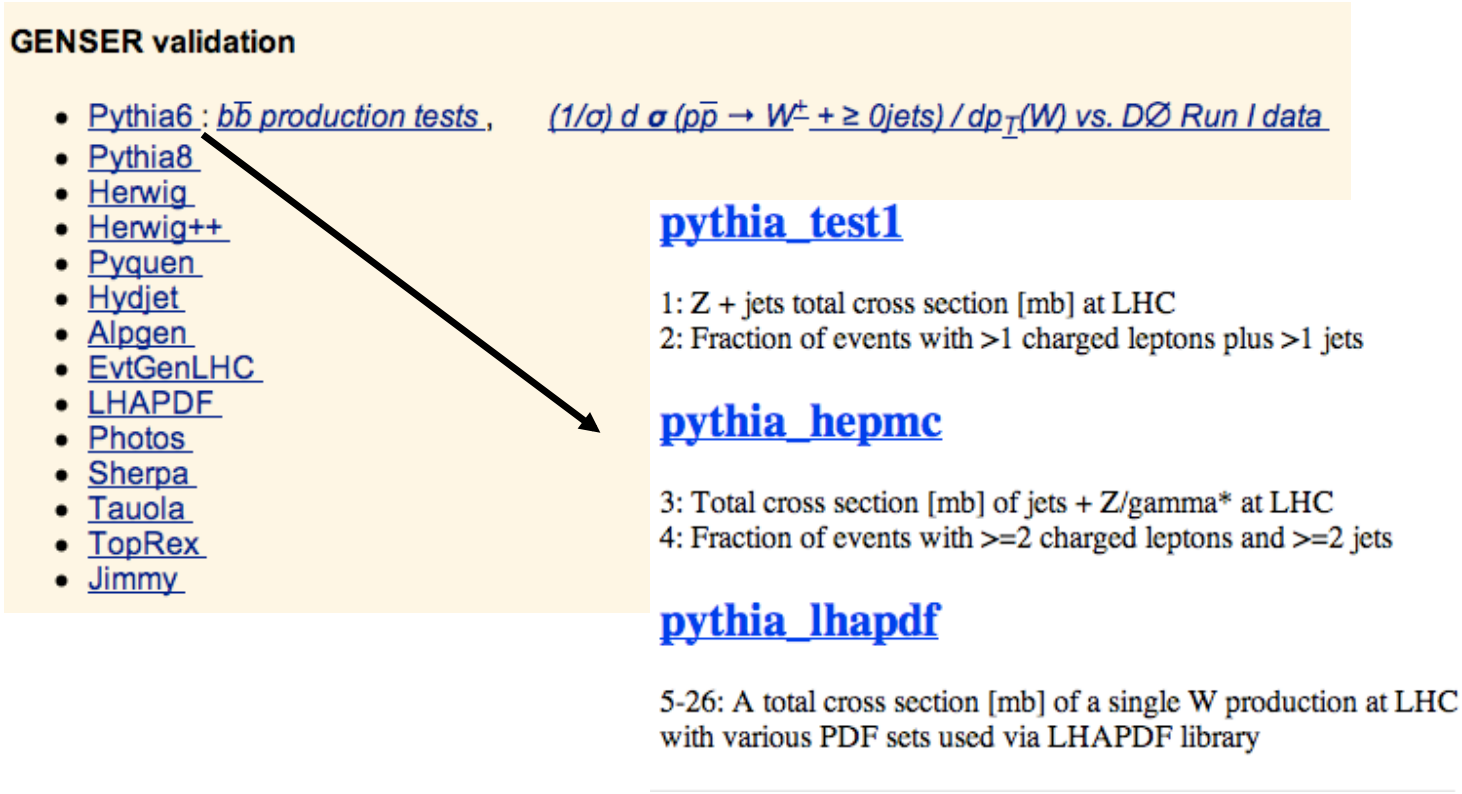
Testing and validation

- 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
  - distribution output (pT, etc)
  - needs to be linked with ROOT
- physics validation
  - implemented first analysis using Rivet
  - plan to implement further analysis

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

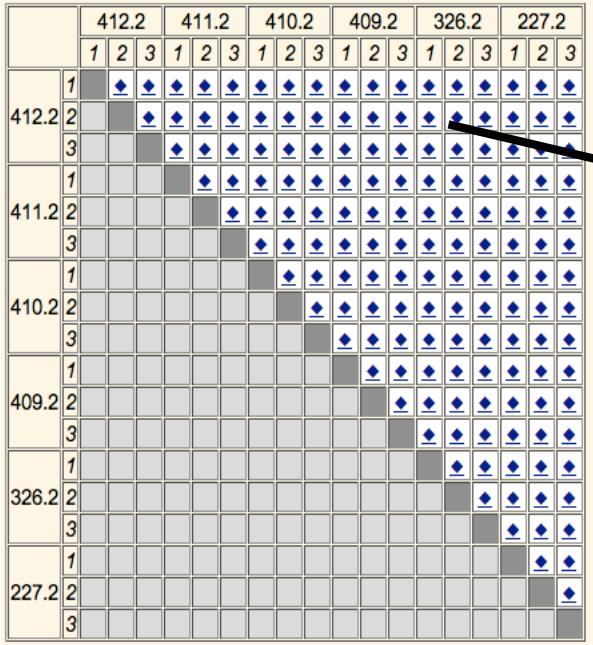
slc4_amd64_gcc34

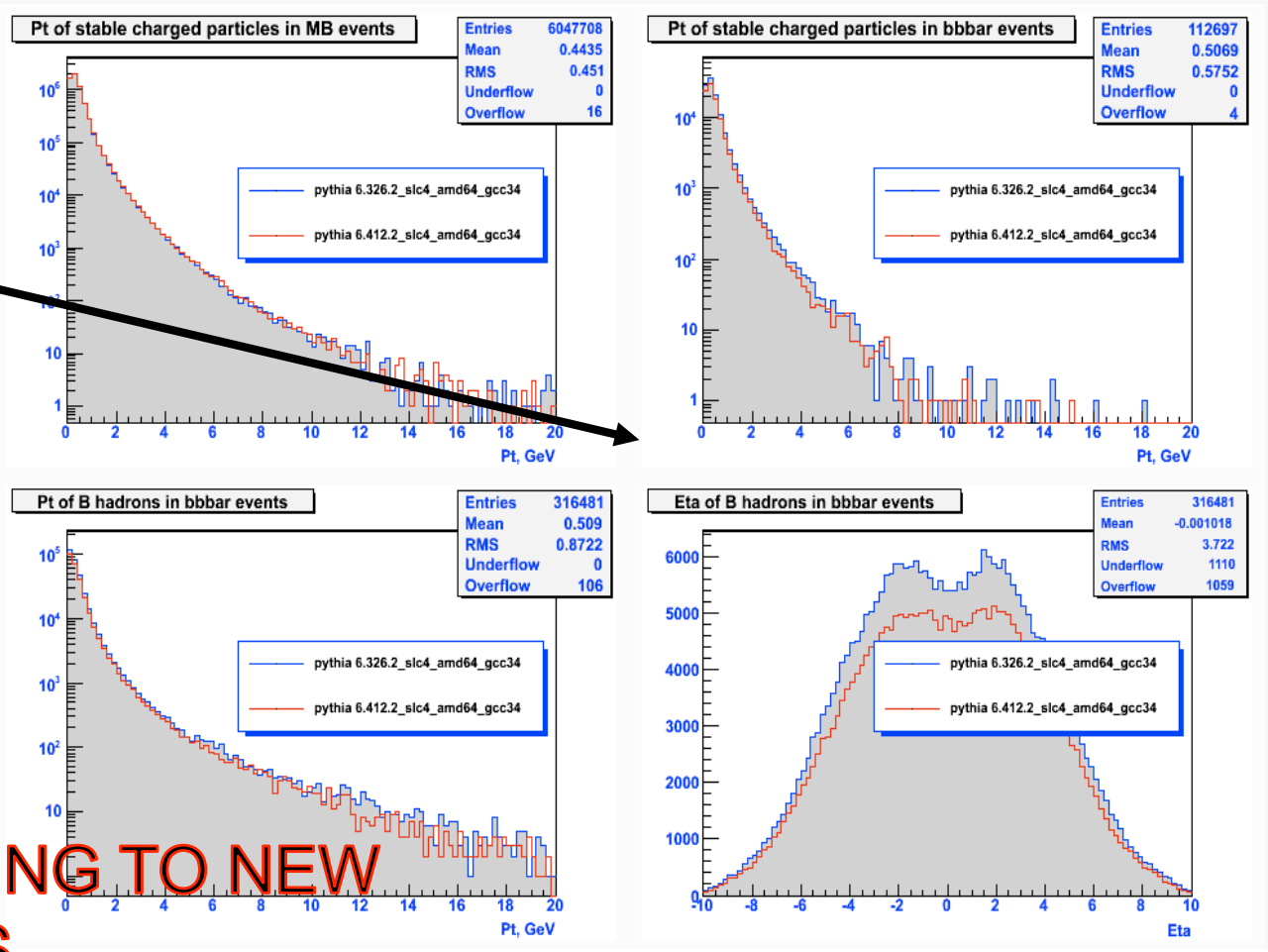
Version:		135					

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

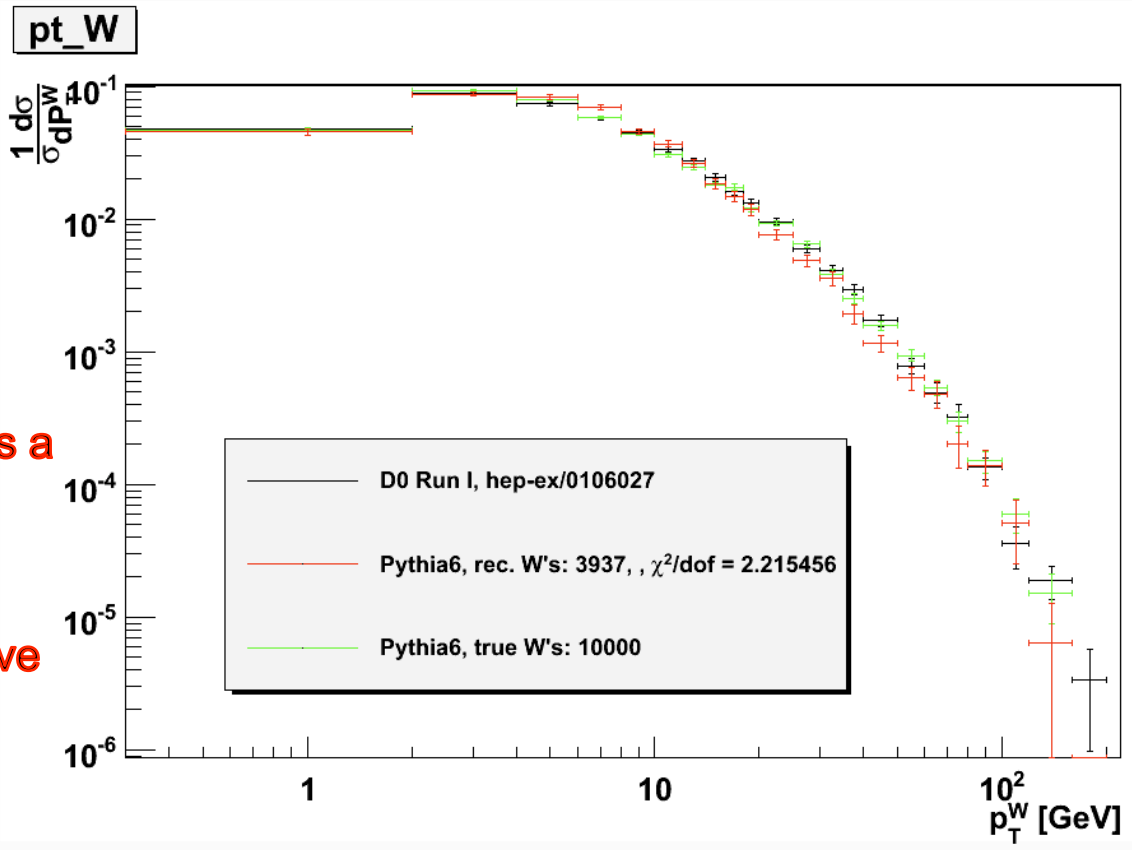
GENSER validation using Rivet

MC vs. DØ Run I, $(1/\sigma)\, d\sigma\,(p\bar{p} \rightarrow W^{\pm} + \geq 0 jets) / dp_T(W)$

A comparison of $p_T(W^{\pm})$ distributions obtained with Pythia 6.411 vs. DØ Run I data:
Abazov, V.M., et al. [DØ Collaboration], hep-ex/0106027

A skeleton of comparison procedure is as follows:

1. The main routine linked to **Rivet** library instantiates HepMC::GenEvent. The analysis procedure utilizes selects events according to the criteria from the DØ
   - an isolated (as defined in the publication, see
   - missing $p_T > 25$ GeV.
2. The main routine launches an event cycle with each
3. Each event is passed to UserAnalysis::analyze() me W candidate to be put to a ROOT histogram.
4. Upon completion of the event cycle the routine calls
5. The histogram is read from the ROOT file and upon experimental data points from the publication. χ^2/d.c



- implemented some time ago as a proof of principle
- needs to be redone with new version of Rivet
- would certainly be useful to have a collection of physics validation tests to be run on different generators

HepMC Analysis Tool validation (1/2)

- you guys know more than me...
- we certainly want to profit from your work and integrate it into GENSER tests
  - infrastracture for automatic running/comparison
  - integration into the nightly builds
    - we have an infrastracture to automatically check out from CVS and compile software every night
- 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 (6.422.2 ok)*
PYTHIA8: Di-Jets Top (6.130 ok, 6.135 to be done)
HERWIG6: Di-Jets Top (6.510 ok)
HERWIG++: Di-Jets Top (2.4.2 ok)
CASCADE: Di-Jets Top (2.0.1 ok)
Sherpa:
Tauola:
etc.:

Latest generator version (above in parantheses) is validated against previous generator version(s).

*Something needs to be clearified/cross-checked

Updates in progess...

Todo-list (suggestions welcome)

Contact: albert.knutsson[nospam]desy.de

HepMC (1/2)

HepMC
a C++ Event Record for Monte Carlo Generators

[HepMC Savannah] [HepMC Homepage] [Downloads]

Index

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
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0006844 times visited since October 2005; Statistics of visits to MCDB
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MCDB (2/2)

- Monte Carlo Data Base
  - used to store generated event
- CMS is using it in large Grid production
  - for saving intermediate parton-level events

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