RIVET in LHCb

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LHCb Generators Tuning mini-Workshop (LHCb-MC)
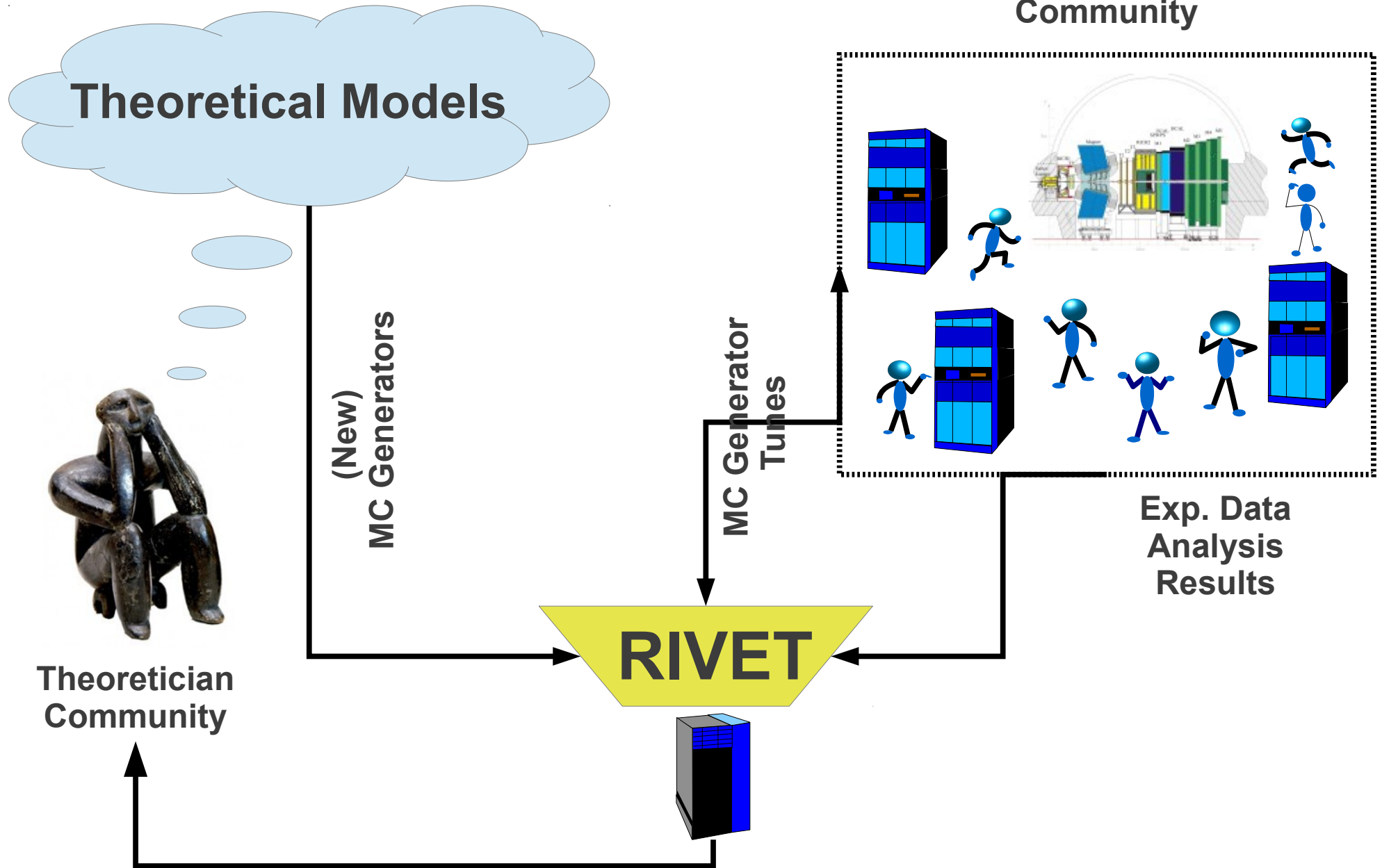*Bucharest, November 22-23, 2012*

Outline

- What is RIVET?

- Rivet Implementation in LHCb

- LHCb plugins

- Ideas for the future & Conclusions

What is RIVET?

- **R**obust **I**ndependent **V**alidation of **E**xperiment and **T**heory (rivet.hepforge.net) – toolkit for Monte Carlo (MC) generator validation.

- Generator abstractization layer based on *projections* – filter particles of interest and compute observable once per event for a suite of plugins

- Expects events in HepMC format (2.05 or later – propagate xsection information); use **A G**enerator **I**nterface **L**ibrary & **e**xecutable for Fortran MC generators

- Histogram reference data in bundled files – may be extracted from external databases – HepData (http://hepdata.cedar.ac.uk/)

- Used by both theoreticians and experimentalists for MC generator tuning & validation, analysis prototyping, MC-data comparisons

- May be run locally and in distributed system (CERNVM; Test4Theory - LHC@home 2.0); on lxplus available through GENSER project (http://sftweb.cern.ch/generators/)

- RIVET plugin == piece of C++ code (Rivet::Analysis derived class) + meta and reference data + histogram style information – stored in separate files

- Main component of the Professor tuning tool for MC event generators

What is RIVET?

RIVET implementation in LHCb

- interface in package **Gen/GenTune** part of GAUSS project

- using Rivet from GENSER repository through MC Generator Interfaces

- offers ability to run RIVET plugins through *RivetAnalysisHandler* Gaudi algorithm (credit to Andy Buckley for providing the skeleton interface)

- new package (v1r0) released with GAUSS v42r2

- only available in Gauss Generator phase (HepMC 2.06.05 input)

- instructions to run and design new plugins to appear on twiki (by the end of 2012)
https://twiki.cern.ch/twiki/bin/view/LHCb/GenTuneWithRivet

- *$GENTUNEROOT/options/example* for basic instructions and working example

- code tested daily thanks to QMTest(s)

RIVET implementation in LHCb

RivetAnalysisHandler initializes libRivet.so, controls the run and adjust HepMC events according to options:

* **MCEventLocation** – HepMC data location in Transient Event Store (TES)
* **BaseFileName** – the name of the file (w/o extension) where histograms are saved
* **RunName** – the AIDA directory where output histograms are stored

  What AIDA?

* **Analyses** – list of analysis names that one wants to run (invalid ones are automatically discarded)

  Still AIDA?!

* **StreamName** – should control the AIDA axis/path where data is stored
* **AnalysisPath** – supplemental paths to be searched for analysis plugins
* **CorrectStatusID** – flag to enable code that corrects the status ID of particle to match Pythia's status code scheme (bug to be solved in v1r1 !)
* **CorrectCrossingAngles** – flag to enable/disable code that detects at run-time the beam crossing angles from *BeamParameters* class and perform the boost back to center-of-mass system accordingly

RIVET implementation in LHCb

RivetAnalysisHandler initializes libRivet.so, controls the run and adjust HepMC events according to options:

* **XsectionNeeded**, **xSectionValue** – flags to force the algorithm to check that cross-section value is provided and the alternative value of the cross-section if not provided in HepMC (obsolete)

Logging level is set automatically according to Gaudi log level using a simple mapping.

LHCb Rivet plugins

Released plugins (Rivet 1.8.1, July 2012)

- **LHCB_2011_I917009** - *Measurement of V^0 production ratios in pp collisions at sqrt(s)=0.9 and 7 TeV*, JHEP08:034,2011

- **LHCB_2011_I919315** - *Measurement of the inclusive phi cross-section in pp collisions at sqrt(s) = 7 TeV*, Phys.Lett.B703:267-273,2011

- **LHCB_2010_S8758301** - *Prompt K_short production in pp collisions at sqrt(s)=0.9 TeV*, Phys.Lett.B693:69-80,2010

LHCb Rivet plugins

Plugins in final phase of development

- **LHCB_2012_I1119400** - *Measurement of prompt hadron production ratios in pp collisions at $\sqrt{s}$= 0.9 and 7 TeV*, Eur.Phys.J. C72 (2012) 2168
- **LHCB_2012_I1082369** - *Measurement of charged particle multiplicities in pp collisions at $\sqrt{s}$=7TeV in the forward region*, Eur.Phys.J. C72 (2012) 1947
- **LHCB_2011_I891233** - *Measurement of J/ψ production in pp collisions at $\sqrt{s}$=7 TeV*, Eur.Phys.J. C71 (2011) 1645
- **LHCB_2010_I867355** - Measurement *of $\sigma(pp \to b\bar{b}X)$ at $\sqrt{s}$=7 TeV in the forward region*, Phys.Lett. B694 (2010) 209-216

On wish list:
- **LHCB_2012_I1091071** - *Measurement of Upsilon production in pp collisions at sqrt(s)=7 TeV*, Eur.Phys.J. C72 (2012) 2025

Thanks to P. Skands, Sercan Sen and corresponding authors from LHCb...

Ideas for the future & Conclusions

- Use Professor and Rivet to create/test/validate new LHCb tunes

- Use Rivet as alternative MC validation tool for GAUSS

- Deploy Rivet on grid via LHCb software framework

- Write some Python scripts to help developers (e.g. hardcoding LHCb particle table - lifetime)

- Convince LHCb members to submit new and more complex analysis plugins for published results

- Where are your plugins currently used? (Quick example – if local connection doesn't break)

BACKUPS

Who is **this** guy?

"The Thinker of Hamangia and his consort"
Clay figurines iconic for the Late Neolithic Hamangia culture (~5200 BC) discovered in present day Baia (Tulcea county), Dobrogea, Romania (1952).