LISBON ACCORD [AND RIVET]

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LISBON ACCORD

a minimal set of standards to be adopted by both the experiments and the theoretical community involved in the development of event-generators to:

- ✓ automate 'fair comparison' of event generator outputs with experimental data
- ✓ guarantee appropriate legacy of experimental results

LISBON ACCORD [WHY WE NEED IT]

- ✓ scope, complexity and precision of experimental measurements performed in collisions involving nuclei has greatly increased over the last few years
  - ✓ meaningful theory/data comparison requires account of details of experimental analyses
- ✓ theoretical understanding of the physics involved in these collisions has evolved significantly and several simulation tools encoding such advances have been [and are being] developed
  - ✓ validation of such tools, and consequently of their physical content, requires fair and meaningful comparison with experimental data
- ✓ past and present data will be essential to test/validate future theoretical developments
  - ✓ details of experimental analyses must be preserved in usable form

LISBON ACCORD [GUIDING PRINCIPLES]

- ✓ requirements should be
  - ✓ minimal
  - ✓ generator and detector agnostic
- ✓ maximal reliance on existing tools
  - ✓ profit and contribute to extensive developments in the pp context
  - ✓ avoid wheel re-invention

LISBON ACCORD [WHAT IS ADDRESSED]

I. [input to event generator] nPDFs

II. [output of event generator] event record format

III. [theory/data comparison] scripting of analyses

nPDFs

[LisAcc] nPDFs should be provided through LHAPDF6

http://lhapdf.hepforge.org

- ✓ either as
  - ✓ a nuclear modification factor R to be convoluted with nucleon PDF
    - ✓ ‘standalone’ nucleus-specific nPDF [preferred]
- ✓ EPPS16 [NLO] with error sets already available in LHAPDF6
- ✓ older sets available in LHAPDF5 can be ported if needed [LO essential] :: requires simple and tedious work

event record format

[LisAcc] event generators should provide event record in HEPMC3 format

https://hepmc.web.cern.ch/hepmc/

✓ new HEPMC heavy-ion class

https://gitlab.cern.ch/hepmc/HepMC3/blob/LH17/include/HepMC/GenHeavyIon.h

- ✓ stores all HI event specific information
- ✓ will be frozen soon for release

✓ all other classes [eg, HEPMC::GenParticle] are not HI-specific

event record format [HEPMC:GenHeavyIon class]

```
// number of hard nucleon-nucleon collisions
int    Ncoll_hard;

// number of participating nucleons in the projectile
int    Npart_proj;

// number of participating nucleons in the target
int    Npart_targ;

// number of inelastic nucleon-nucleon collisions
int    Ncoll;

// collisions with a diffractively excited target nucleon
int    N_Nwounded_collisions;

// collisions with a diffractively excited projectile nucleon
int    Nwounded_N_collisions;

// non-diffractive or doubly diffractive collisions
int    Nwounded_Nwounded_collisions;

// the impact parameter
double impact_parameter;

// event plane angle
double event_plane_angle;
```

```
// the assumed inelastic nucleon-nucleon cross section
double sigma_inel_NN;

// centrality
double centrality;

// number of spectator neutrons in the projectile
int Nspec_proj_n;

// number of spectator neutrons in the target
int Nspec_targ_n;

// number of spectator protons in the projectile
int Nspec_proj_p;

// number of spectator protons in the target
int Nspec_targ_p;

// participant plane angles [calculated to different orders]
map<int,double> participant_plane_angles;

// eccentricities [calculated to different orders]
map<int,double> eccentricities;
```

any further needs should be discussed asap

scripting of analyses

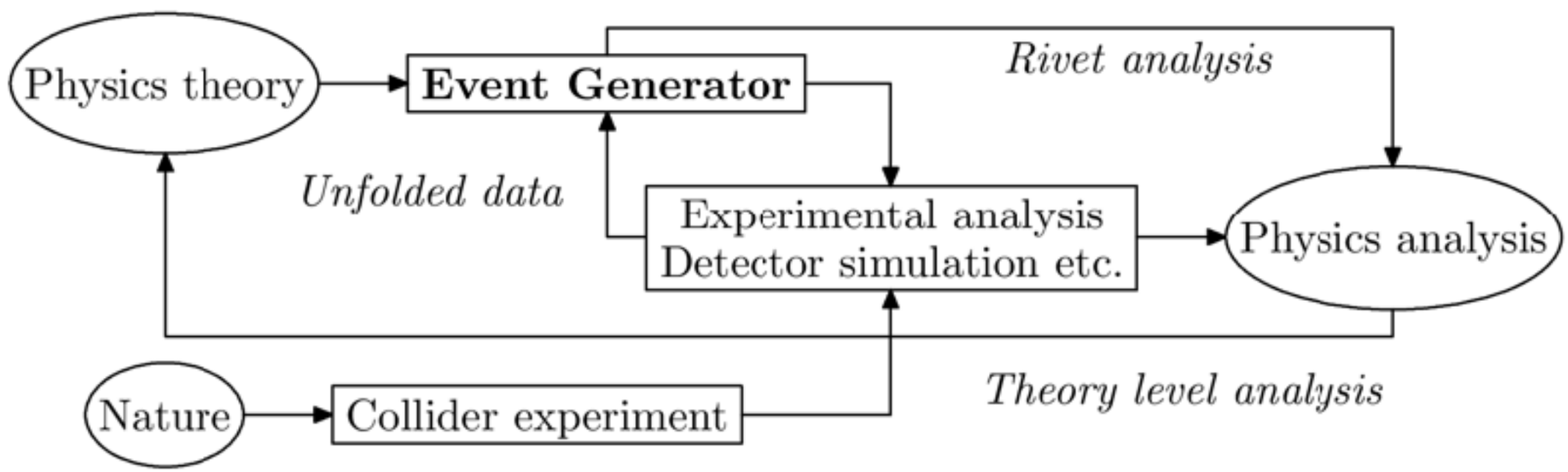
[LisAcc] each published experimental analysis should be accompanied by the corresponding RIVET code

https://rivet.hepforge.org

✓ full implementation requires extensions of current RIVET

✓ a few compromises required, at present, for HI

✓ scripted analysis should allow ‘plots’ in experimental papers to be produced effortlessly from event generator output



RIVET and compromises

RIVET's philosophy

✓ relies on availability of fully ***unfolded*** data

  ✓ not always the case in HI

✓ relies on simulation of ***full events***

  ✓ not always the case for HI event generators

PATHS FOR MEANINGFUL COMPARISON

			event generator			
			full event		*hard event*	
			with exp background subtraction	w/o background subtraction	with medium response and subtraction	w/o medium response
experimental data	*background subtracted*	unfolded				
		folded	***exp provides smearing***		***exp provides smearing***	***exp provides smearing***
	background not subtracted	unfolded				
		folded		***exp provides smearing***		

how to write a RIVET analysis

✓ read the manual *https://arxiv.org/abs/1003.0694*

✓ look at existing analyses

- ✓ no RIVET-validated HI analysis [our collective fault]
- ✓ JEWEL ‘background’ suppression available as RIVET analysis

Elayavalli, Zapp ::arXiv:1707.01539 [hep-ph]

not unlike any other analysis framework you may be used to

what next ?

- ✓ endorsement/adoption by experiments
  - ✓ each published paper accompanied by scripted analysis including [if applicable] background subtraction and smearing
- ✓ endorsement/adoption by MC developers
  - ✓ JETSCAPE is the key player here
  - ✓ if model-specific procedure needed, provide it [eg, JEWEL background subtraction]