MCPLOTS
update and plans

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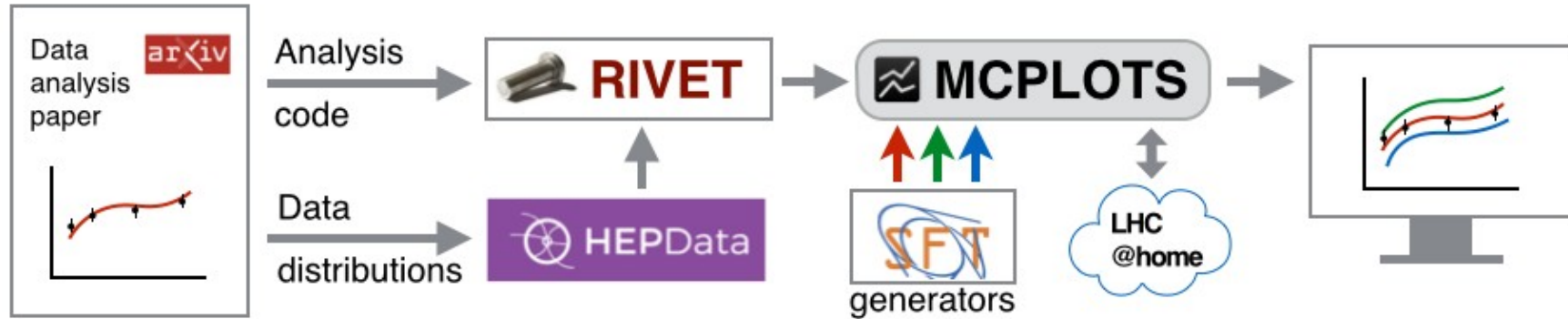
[1] University of Notre Dame
[2] Monash University
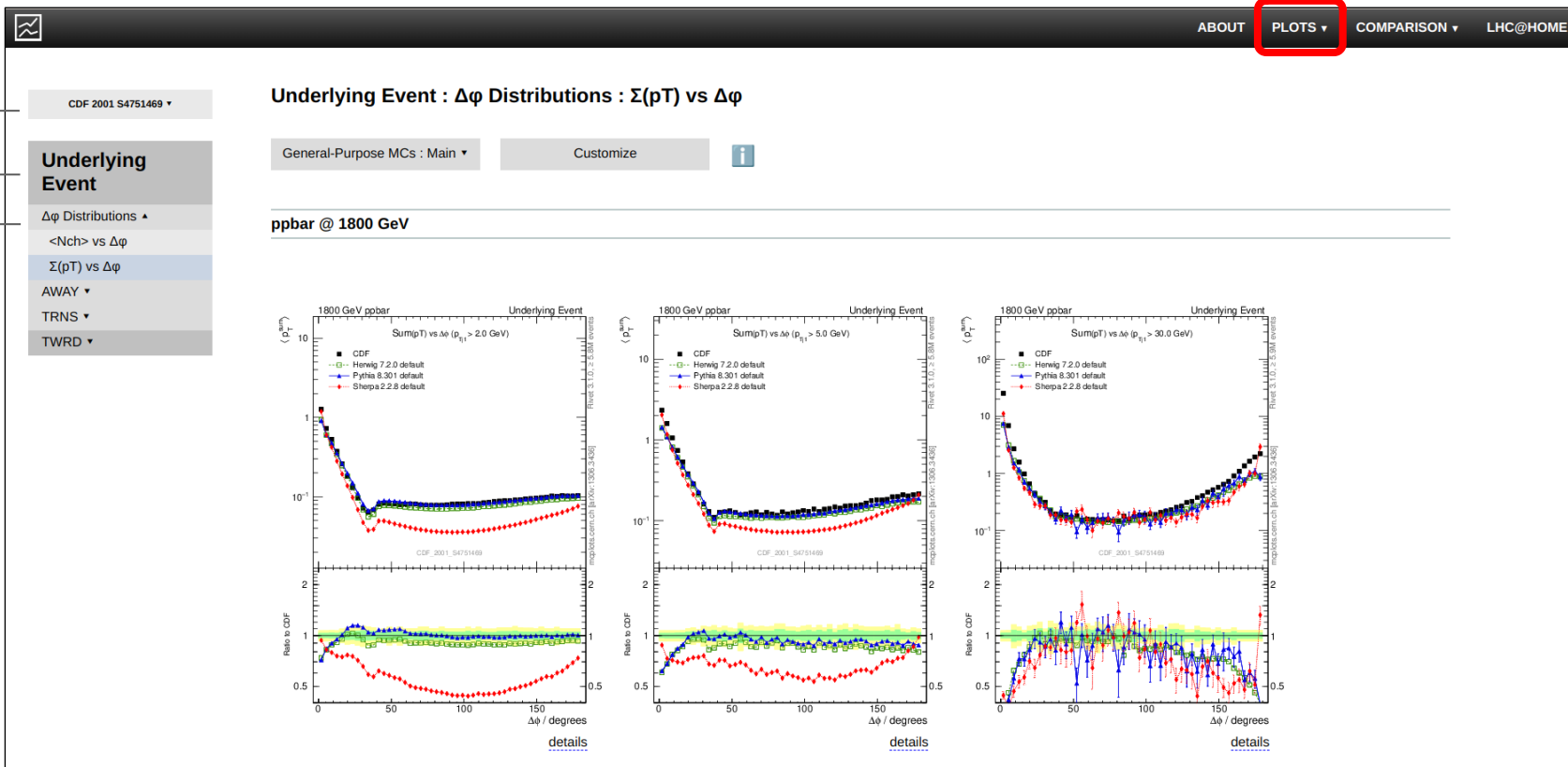[3] National Research Tomsk Polytechnic University

Pythia Week
30 April 2024

MCPLOTS : overview

Website : plots

Analysis filter (if used)

Hard process

Individual distributions

Website : comparison

Generator (tune) name

Available versions to compare

χ² for individual observables

Number of distributions used to calculate <χ²>

Paper

The first paper was published ~10 year ago :
MCPLOTS: a particle physics resource based on volunteer computing
https://doi.org/10.1140/epjc/s10052-014-2714-9

The second one : **January 2024**
Event-Generator Validation with MCPLOTS and LHC@home
in arXiv : https://arxiv.org/abs/2401.10621
submitted to EPJ+

- Full description of the updated repository and database structure

- Comprehensive user's guide (the website functionality)

- Developer's guide : how to implement

  ➜ a new data analysis
  ➜ a new generator (version)
  ➜ a new generator tune

- Phase-space cuts discussion

MCPLOTS source code :

https://gitlab.cern.ch/MCPLOTS/mcplots

Development

110 data analyses   **114** generators   **782116** plots
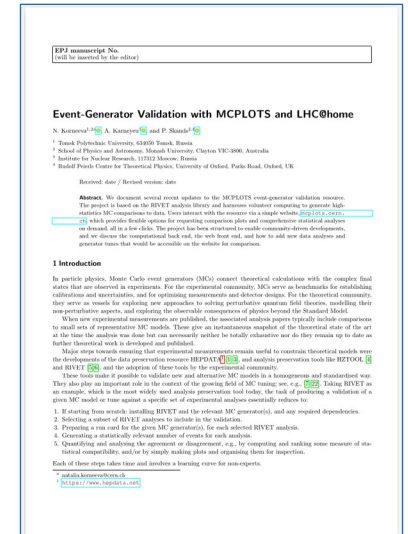
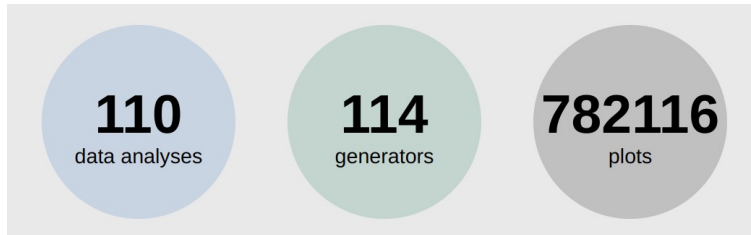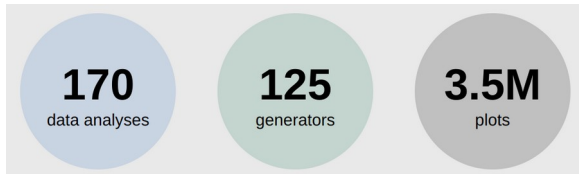**Implemented generators :** Alpgen, Epos, Herwig++ and Herwig7, MadGraph, Pythia6 and Pythia8, Sherpa, Vincia

110 data analyses with **1146 data distributions** implemented so far refer mostly to the *ee* and *pp* **HEP collider experiments**: ATLAS, CMS, D0 etc.

New production /testing/ :

170 data analyses   **125** generators   **3.5M** plots

- New generators and data analyses have been implemented
- Number of **plots** to be increased by **more than 4x**
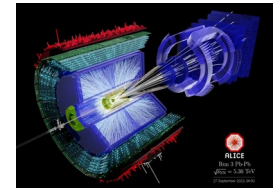
  http://mcplots-dev.cern.ch/

Expanding the coverage :

chromo

unified frontend to generators used for cosmic-ray studies

- MCPLOTS was presented to people from astroparticle community (*Wuppertal Jan'24*)
- proposal from the CHROMO team to integrate it into MCPLOTS
- in process of discussing the possibility of installing CHROMO in CERN

- re-implementation of heavy ion runs
- new analyses and generators
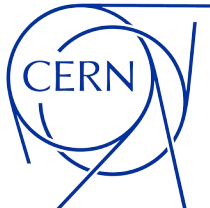
6

Development

Matching/merging :

 +
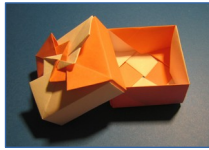
Variation of Powheg-Box/Pythia
matching parameters

- Adding of NLO generator cards (in collaboration with the Herwig team)
- Variation of matching parameters

Validation resource for the main CERN experiments :

- Close work with the experiments on their validation tasks
- Automation of adding new generator versions for quicker validation
- Improving the website validation pages

BACKUP

MCPLOTS : overview

MCPLOTS workflow

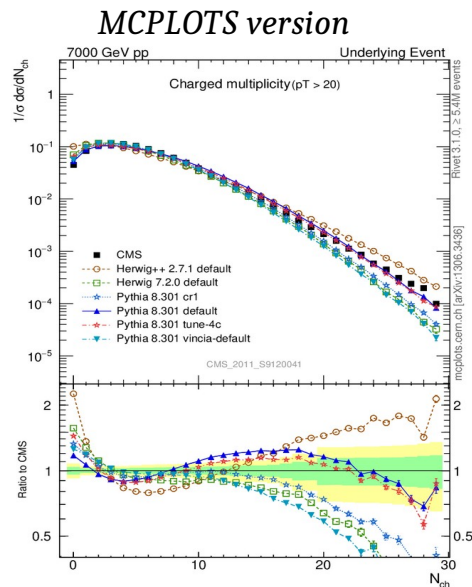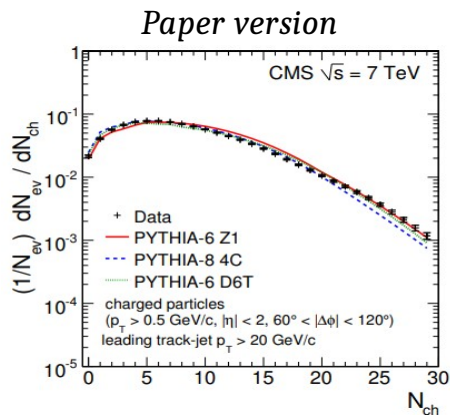**Jobs** are distributed to volunteers
Completed ones are stored on the **server**
Their descriptions – in the **database**
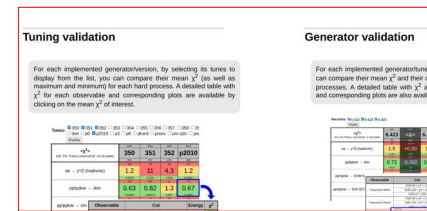The website operates with **queries** to this DB

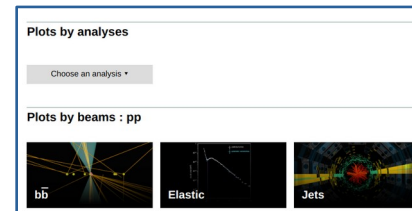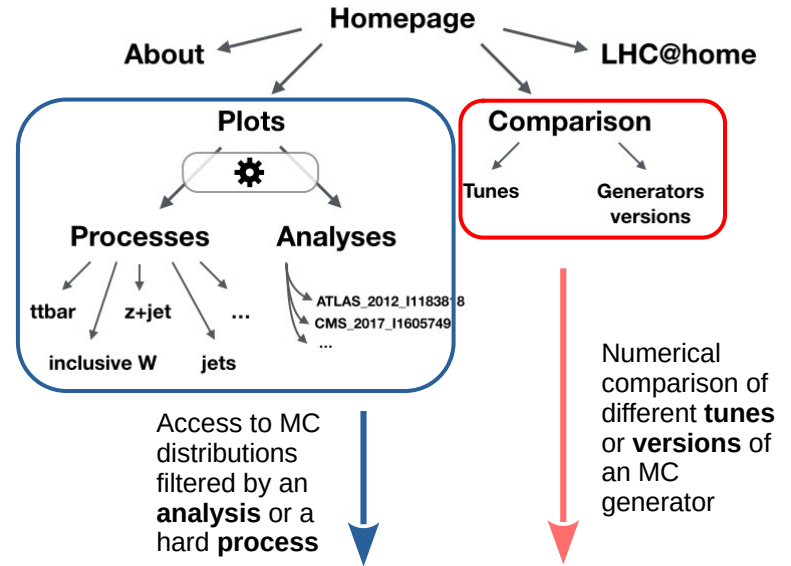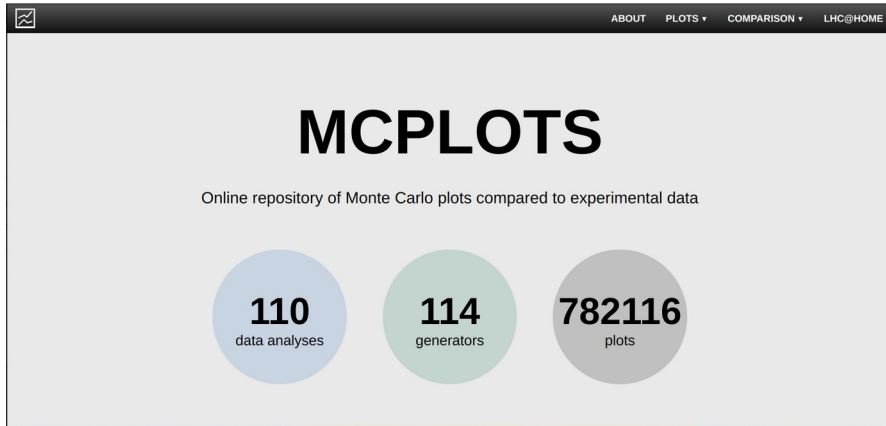**Result:** dozens of G-V-T combinations for each data distribution are available; they are plotted on the fly by a user's request
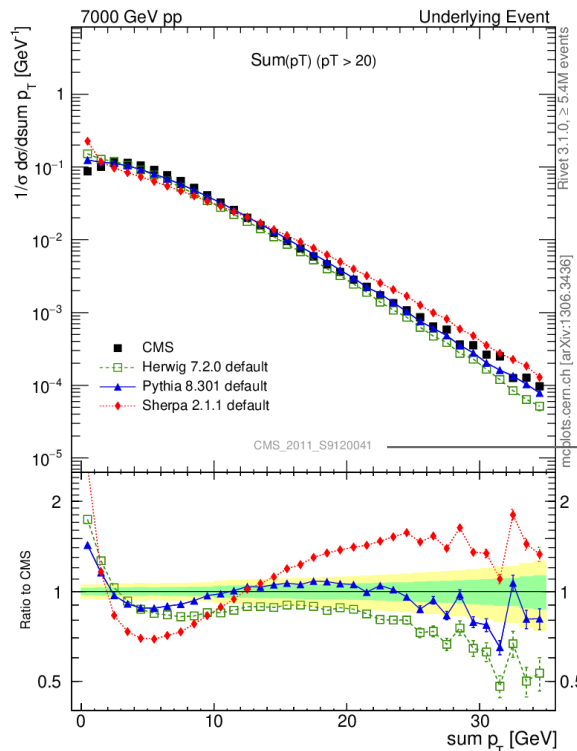

Paper version

MCPLOTS version

Website

http://mcplots.cern.ch/

Website : plots

Beam parameters

Hard process

RIVET version and
# of MC events

Generator-version-tune
for each MC curve

RIVET reference

7000 GeV pp   Underlying Event

Sum(pT) (pT > 20)

$1/\sigma \, d\sigma/d\text{sum } p_T$ [GeV^{-1}]

Rivet 3.1.0, ≥ 5.4M events

mcplots.cern.ch [arXiv:1306.3436]

- ■ CMS
- □ Herwig 7.2.0 default
- ▲ Pythia 8.301 default
- ◆ Sherpa 2.1.1 default

CMS_2011_S9120041

Ratio to CMS

sum p_T [GeV]

details

Download as: .pdf .eps .png .script.tgz #
CMS experiment: data | article paper
Herwig 7 (Def): data |generator card
Pythia 8 (Def): data |generator card
Sherpa (Def): data |generator card

Steering files and results
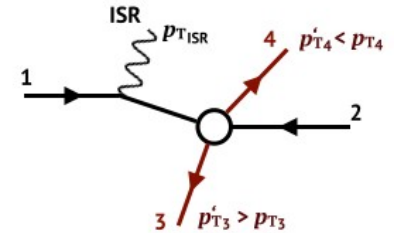for each MC curve
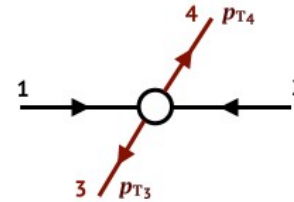
Plot in higher resolution

Data distribution and article paper

11

Phase-space cuts

Data analysis cut : physical **particle-level** final state
Generation cut : hard **partonic** process ;
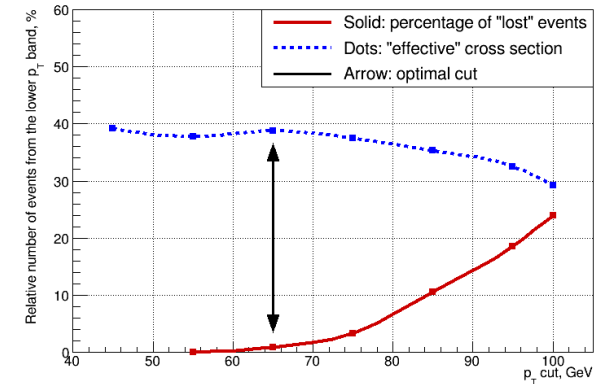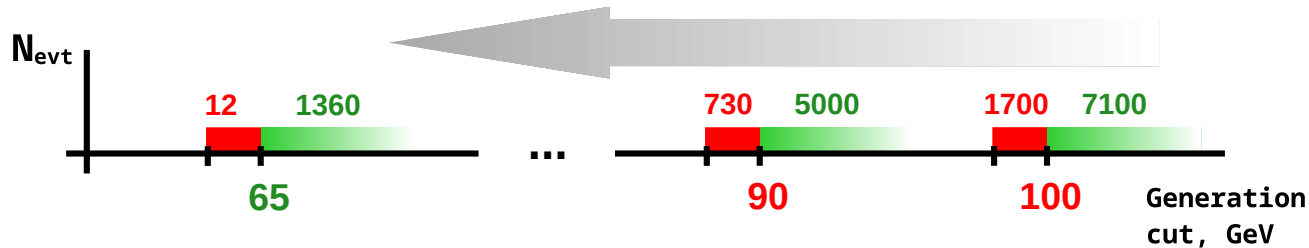   it should be broader then the analysis cut

2 methods to determine an optimal generation cut

`CMS_2013_I1265659` analysis : 3-jets events with $p_{T1} > $ **100** GeV

1. Estimation of $\dfrac{N_{lost}}{N_{test}}$

N_{lost} : *number of event that would not satisfy the given generation cut but which would pass the analysis cut*

2. Estimation of the « effective » cross section $\sigma \cdot N_{test}$