

MCPLOTS update and plans

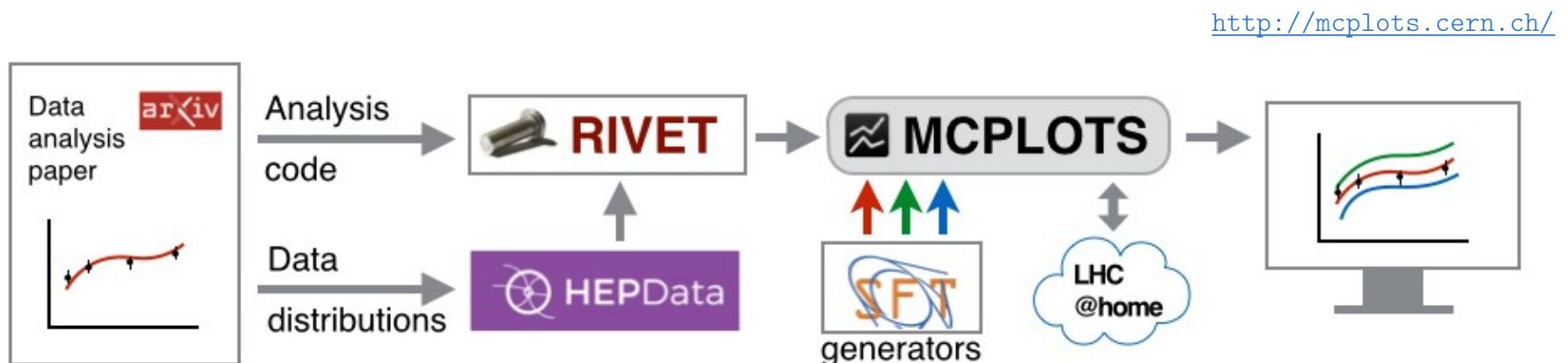
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³ National Research Tomsk Polytechnic University

MCPLOTS : overview



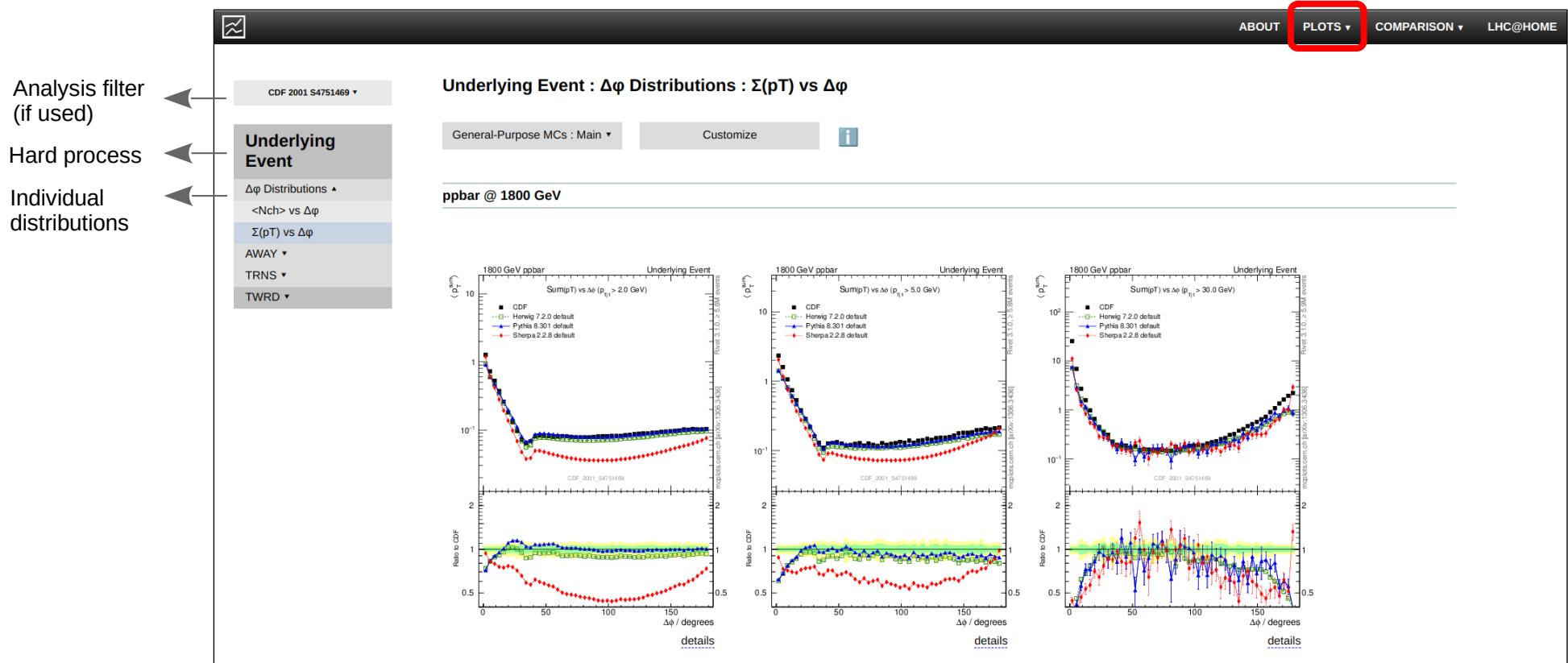
<https://rivet.hepforge.org/>

<https://ep-dep-sft.web.cern.ch/>

<https://www.hepdata.net/>

<https://lhcatome.web.cern.ch/>

Website : plots



Website : comparison

The screenshot shows the 'COMPARISON' tab selected in the top navigation bar. The main content area displays a table comparing two versions of the Alpgen + Pythia 6 generator/tune combination: v2.1.3e_6.426 and v2.1.4_6.426. The table includes columns for $\langle\chi^2\rangle$, $\langle\Delta\rangle$, and $\langle\Delta\rangle$ (min, max). A red box highlights the $\langle\Delta\rangle$ value for the first row, which is $+0.20$. A legend at the bottom left indicates color coding for χ^2 values: green for $\chi^2 < 1$, yellow for $1 \leq \chi^2 < 4$, and red for $4 \leq \chi^2$.

Generator / tune

- alpgenpythia6 ▾
- 350-CTEQ5L
- 351-CTEQ5L
- 352-CTEQ5L
- 356-CTEQ6L1**
- pro-q20-CTEQ5L
- z1-CTEQ5L
- z2-CTEQ6L1
- z2-lep-CTEQ6L1
- epos ▾
- herwig++ ▾
- herwig+++powheg ▾
- herwig7 ▾
- madgraph5amc ▾
- pythia6 ▾
- pythia8 ▾
- sherpa ▾
- vincia ▾

Alpgen + Pythia 6 (356:C) versions validation

Versions: 2.1.3e_6.426 2.1.4_6.426

Display

$\langle\chi^2\rangle$ incl. 5% "theory uncertainty" on all points	max	worst	max
2.1.3e_6.426	19	+4.8	35
pp/ppbar → Jets	1.2 0.0019 1.4	-6.5 -0.34 -0.75	1.4 0.0017 1.2
pp/ppbar → W	0.92 0.60	0.58 0.32	

Legend: [$\chi^2 < 1$] / [$1 \leq \chi^2 < 4$] / [$4 \leq \chi^2$]

(click on number in the table cell to see individual observables)

The page data is based on 402 histograms.

Number of distributions used to calculate $\langle\chi^2\rangle$

► Generator (tune) name

► Available versions to compare

χ^2 for individual observables

Details for Alpgen + Pythia 6 (356:C) v.2.1.3e_6.426 vs. v.2.1.4_6.426

pp/ppbar → Jets

Observable	Cut	Energy	$\chi^2_{+5\%}$ (2.1.3e_6.426)	Δ	$\chi^2_{+5\%}$ (2.1.4_6.426)
23-jet Correlation	CMS 2013 (Forward)	7000	5.2	-3.8	1.4
	CMS 2013 (Central)	7000	5.1	-3.8	1.3
ET(J1)	CDF 1994	1800	n/a*	-	n/a*
ET(J2)	CDF 1994	1800	n/a*	-	n/a*
Transverse Minor	CMS $90 < pT < 125$	7000	0.41	+0.49	0.90
	CMS $125 < pT < 200$	7000	0.99	-	n/a*
	CMS $pT > 200$	7000	n/a*	-	n/a*
Transverse Thrust	CMS $90 < pT < 125$	7000	0.72	+0.88	1.6
	CMS $125 < pT < 200$	7000	0.72	-	n/a*
	CMS $pT > 200$	7000	1.1	-	n/a*

4

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

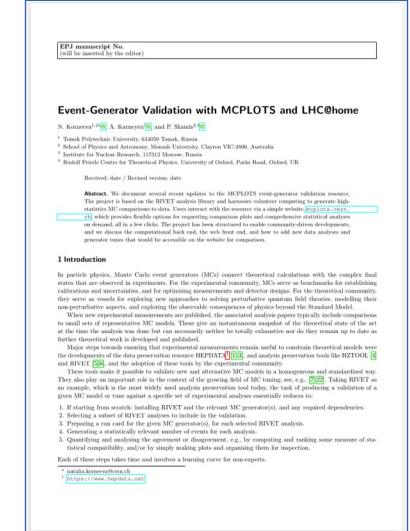
in arXiv : <https://arxiv.org/abs/2401.10621>

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



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/ :



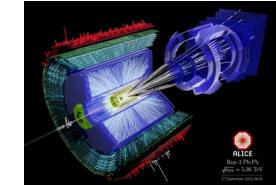
- New generators and data analyses have been implemented
- Number of **plots** to be increased by **more than 4x**

<http://mcplots-dev.cern.ch/>

Expanding the coverage :



- 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

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

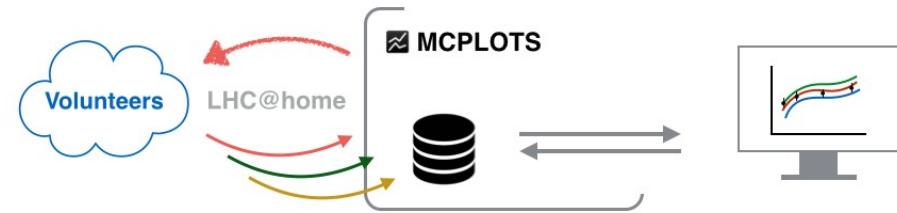
MCPLOTS workflow

Jobs are distributed to volunteers

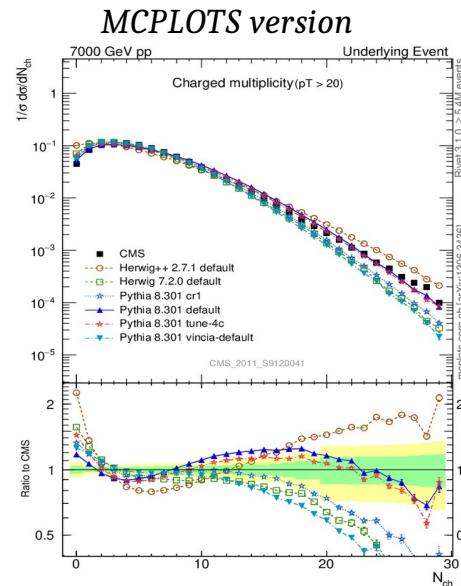
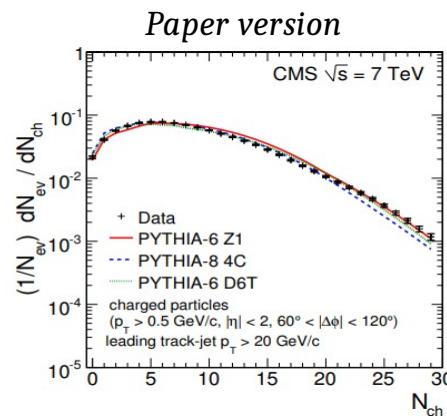
Completed ones are stored on the **server**

Their descriptions – in the **database**

The website operates with **queries** to this DB

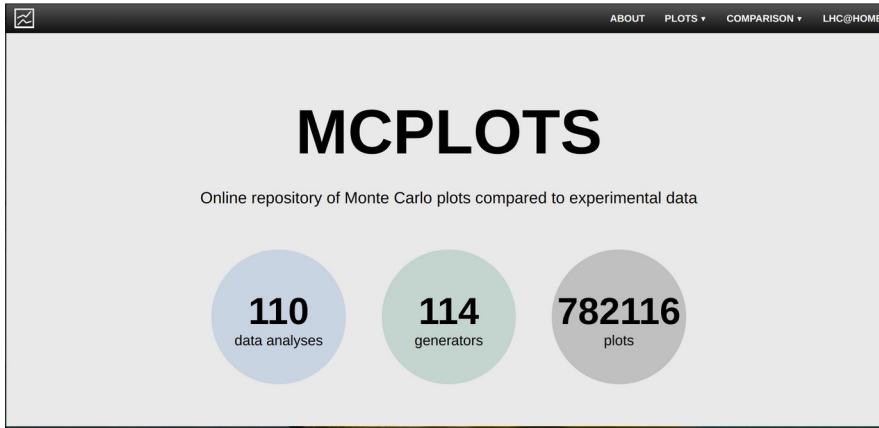


Result: dozens of G-V-T combinations for each data distribution are available; they are plotted on the fly by a user's request

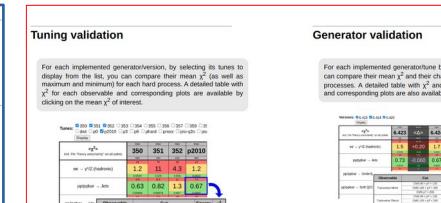
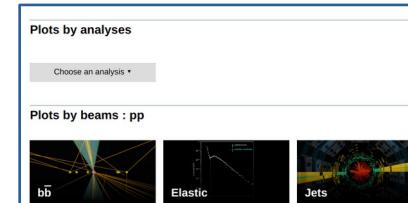
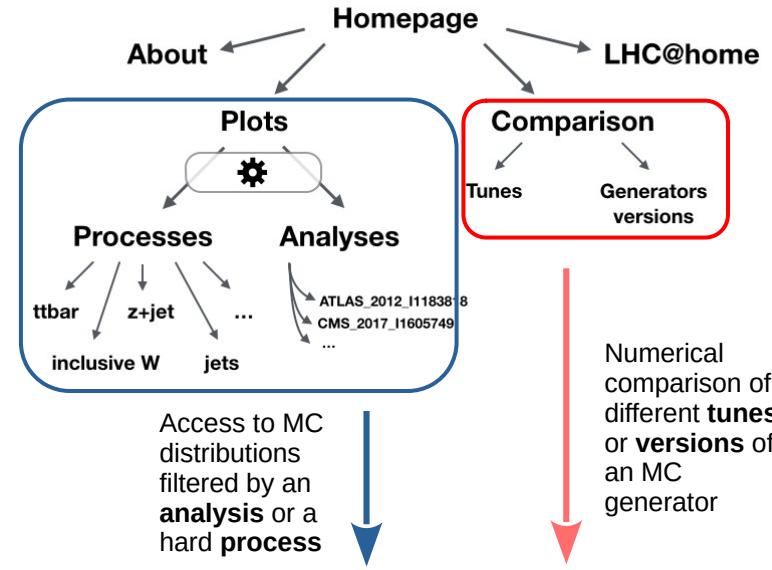


Website

<http://mcplots.cern.ch/>

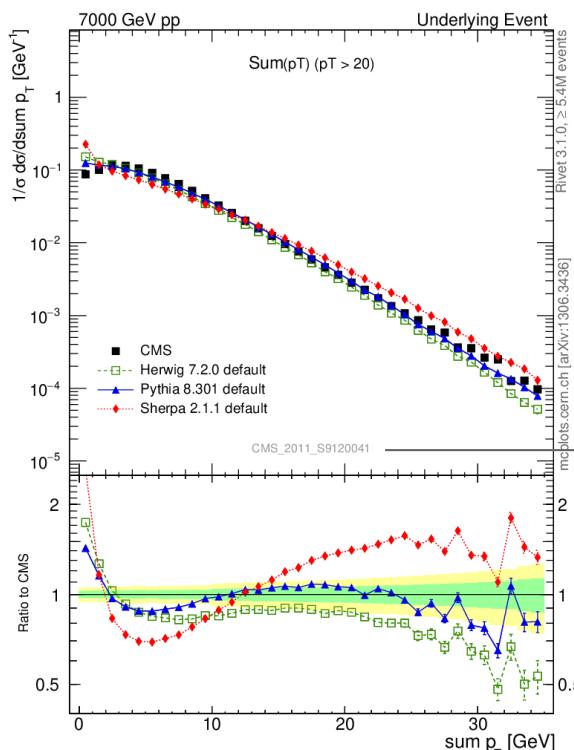


The screenshot shows the MCPlots homepage. At the top, there's a navigation bar with links for ABOUT, PLOTS, COMPARISON, and LHC@HOME. The main title "MCPLLOTS" is prominently displayed in large black letters. Below it, a subtitle reads "Online repository of Monte Carlo plots compared to experimental data". Three circular statistics are shown: "110 data analyses", "114 generators", and "782116 plots".



Website : plots

Beam parameters



Hard process

RIVET version and
of MC events

Generator-version-tune
for each MC curve



RIVET reference

Steering files and results
for each MC curve



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](#)

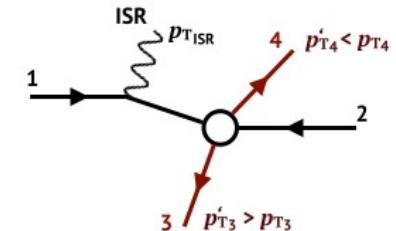
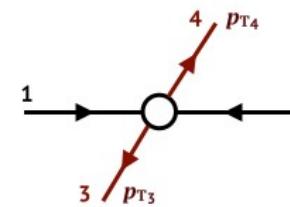
details

Plot in higher resolution
Data distribution and article paper

Phase-space cuts

Data analysis cut : physical **particle-level** final state

Generation cut : hard **partonic** process ;
it should be broader than the analysis cut

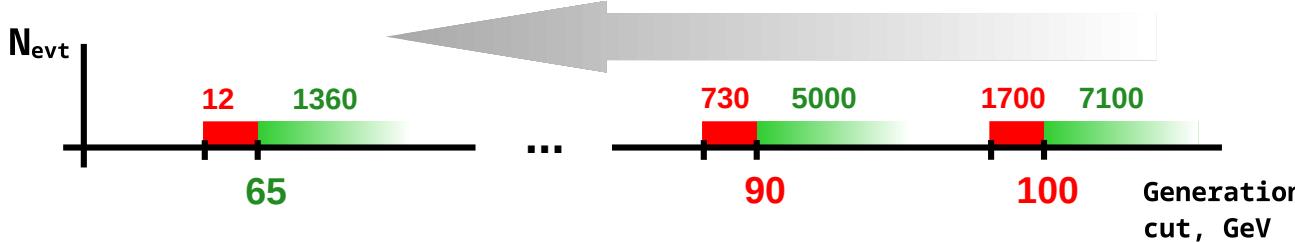


2 methods to determine an optimal generation cut

CMS_2013_I1265659 analysis : 3-jets events with $p_{\text{T}1} > 100$ GeV

1. Estimation of $\frac{N_{\text{lost}}}{N_{\text{test}}}$

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 $\sigma \cdot N_{\text{test}}$

