Contur

Constraints On New Theories Using Rivet

a tool for reinterpreting particle-level measurements.

12/6/2024

MCnet School, CERN

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The problem

INSPIRE HEP | literature | find (cn atlas or cn cms) and title "search"

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1,158 results | cite all | Citation Summary | Most Recent

Date of paper

2003 — 2024

Number of authors

- Single author 1
- 10 authors or less 1

Exclude RPP

- Exclude Review of Particle Physics 1,158

Document Type

- published 1,158
- article 1,157
- note 2
- conference paper 1

A search for R-parity-violating supersymmetry in final states containing many jets in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector #1

ATLAS Collaboration • Georges Aad (Marseille, CPPM) et al. (Jan 29, 2024)

Published in: *JHEP* 05 (2024) 003 • e-Print: 2401.16333 [hep-ex]

pdf | DOI | cite | claim | reference search | 2 citations

Search for new phenomena with top-quark pairs and large missing transverse momentum using 140 fb^{-1} of pp collision data at $\sqrt{s}$ = 13 TeV with the ATLAS detector #2

ATLAS Collaboration • Georges Aad (Marseille, CPPM) et al. (Jan 24, 2024)

Published in: *JHEP* 03 (2024) 139 • e-Print: 2401.13430 [hep-ex]

pdf | DOI | cite | claim | reference search | 2 citations

Search for Long-Lived Heavy Neutral Leptons with Lepton Flavour Conserving or Violating Decays to a Jet and a Charged Lepton #3

CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. (Dec 12, 2023)

Published in: *JHEP* 03 (2024) 105 • e-Print: 2312.07484 [hep-ex]

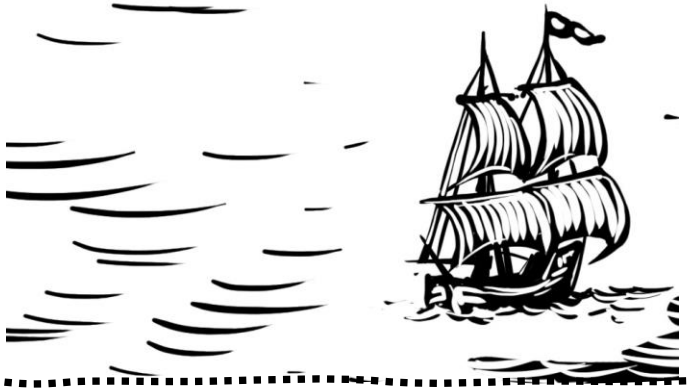
pdf | DOI | cite | datasets | claim | reference search | 6 citations

Search for flavor changing neutral current interactions of the top quark in final states with a photon and additional jets in proton-proton collisions at $\sqrt{s} = 13$ TeV #4

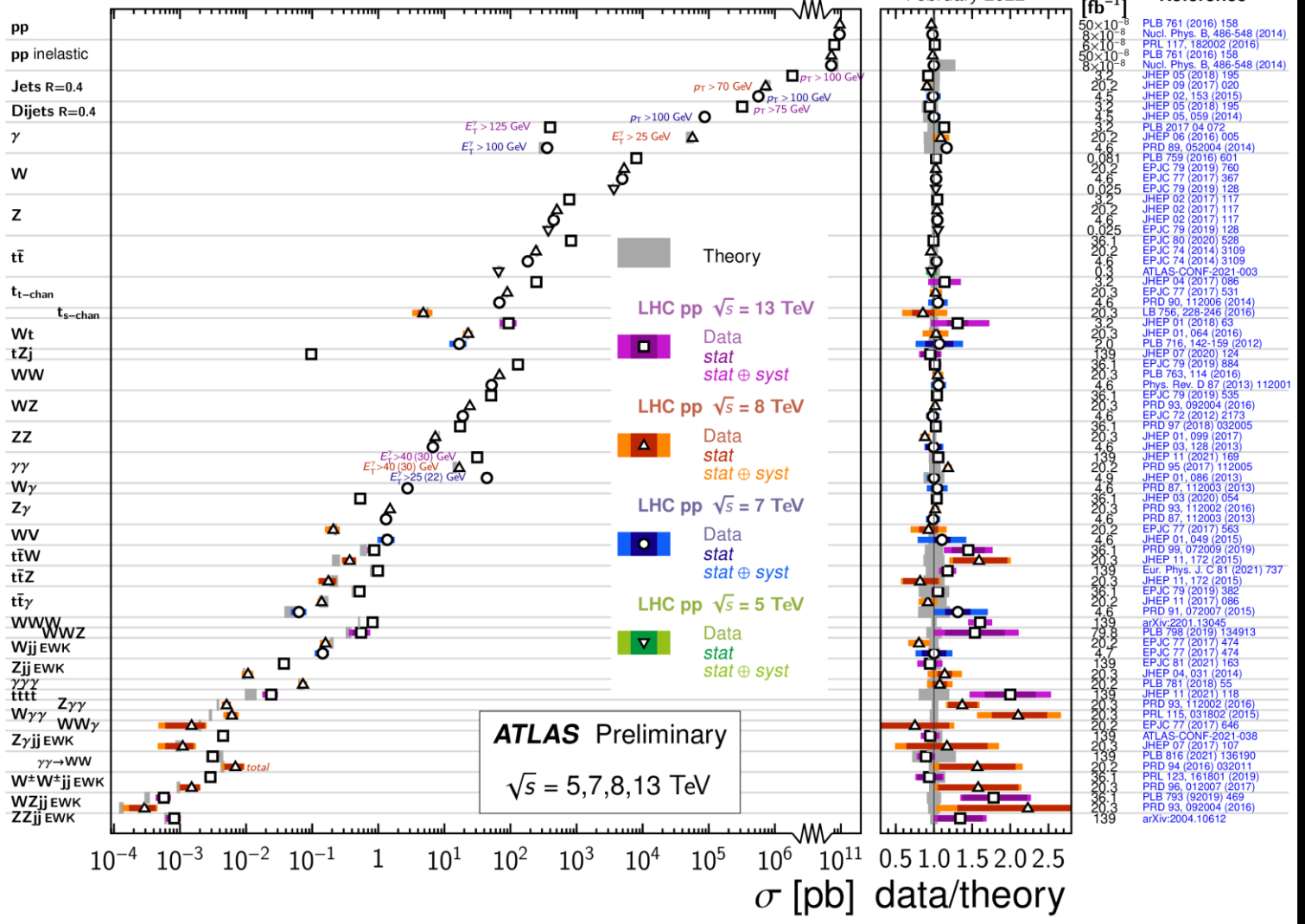
CMS Collaboration • Aram Hayrapetyan (Yerevan Phys. Inst.) et al. (Dec 11, 2023)

Published in: *Phys.Rev.D* 109 (2024) 7, 072004 • e-Print: 2312.08229 [hep-ex]

(Part of) The Solution



The LHC measurement “library”


Standard Model Production Cross Section Measurements
Status: February 2022
pp
pp inelastic
Jets R=0.4
Dijets R=0.4
γ
W
Z
tt̄
t t−chan
t s−chan
Wt
tZj
WW
WZ
ZZ
γγ
Wγ
Zγ
WV
tt̄W
tt̄Z
tt̄γ
WWW
WWZ
Wjj EWK
Zjj EWK
γγγ
tttt
Zγγ
Wγγ
WWγ
Zγjj EWK
γγ→WW
W±W±jj EWK
WZjj EWK
ZZjj EWK
total
Theory
LHC pp √s = 13 TeV
Data
stat
stat ⊕ syst
LHC pp √s = 8 TeV
Data
stat
stat ⊕ syst
LHC pp √s = 7 TeV
Data
stat
stat ⊕ syst
LHC pp √s = 5 TeV
Data
stat
stat ⊕ syst
ATLAS Preliminary
√s = 5,7,8,13 TeV
∫L dt [fb−1]
Reference
σ [pb]
data/theory

Introducing Rivet

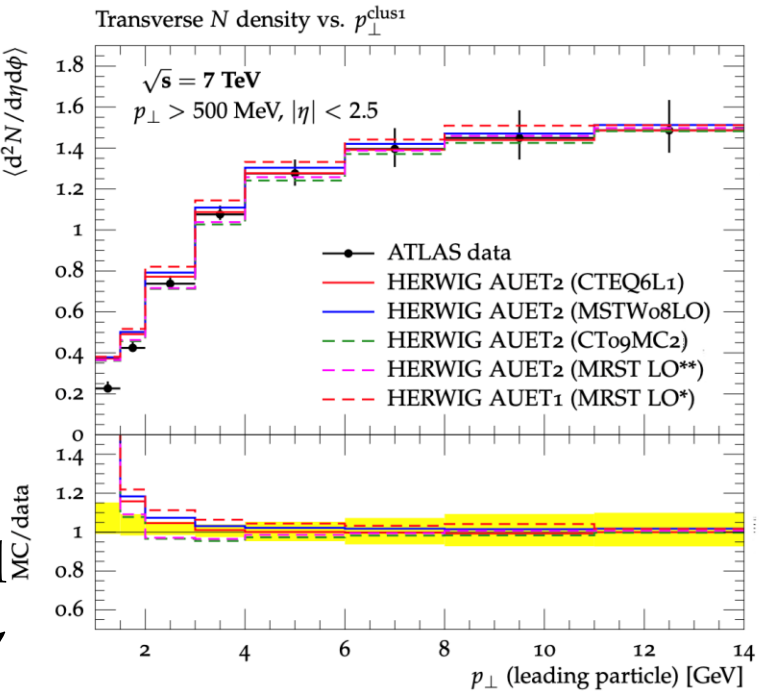
"Robust Independent Validation of Experiment and Theory"

HERA legacy (*1990s, HZTOOL*)

Developed by MCnet for tuning and validation of new MC event generators

- e.g. What does the underlying event look like in 7 TeV pp collisions?

Vast library of measurements of final state particles produced in collisions, and variables derived from them



From ATL-PHYS-PUB-2011-008

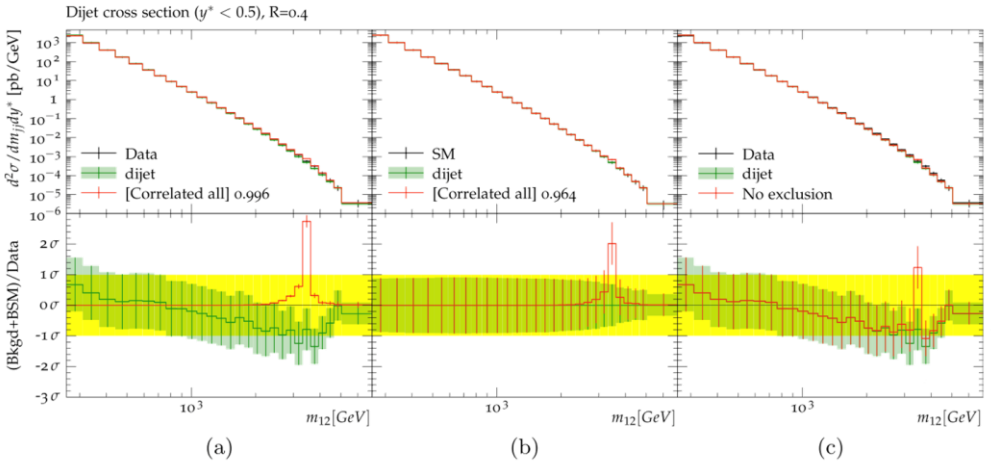
Buckley et al, Bierlich et al arXiv:1003.0694 (CPC), arXiv:1912.05451 (SciPost), arXiv:2404.15984

Introducing Contur

"Constraints On New Theories Using Rivet"

Extend the power of Rivet beyond the Standard Model

Signal-injection of final-state particles from BSM physics events on to measured cross sections in Rivet



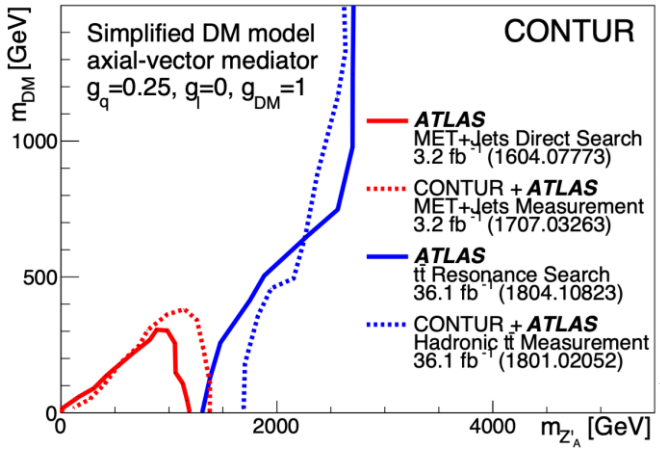
From Altakach, JMB, Ježo, Klasen, Schienbein arXiv:2111.15406 (SciPost Core)

Increasingly precise measurements and SM calculations *together* extend the reach

JMB, Grellscheid, Krämer, Sarrazin, Yallup; Buckley et al arXiv:1606.05296 (JHEP), arXiv:2102.04377 (SciPost)

A Contur-friendly measurement

- Is unfolded to particle-level
- Is defined in terms of the final state, not production process
- Has a fiducial phase space which is as inclusive as possible and reflects the actual selection
  - No hidden vetos
  - Minimal extrapolations
- For example:



Contur Software

- Written in Python: https://gitlab.com/hepcedar/contur
- Heavy use of python interface to Rivet, Yoda, and of matplotlib, scipy, numpy and more (including pyslha)
- Rivet, Yoda mainly C++ (all on gitlab)
- Can steer event generators (currently Herwig, Madgraph, Pythia) but can also be run on any existing Rivet (Yoda) output (and Rivet can run on any HepMC events)
- Can also be invoked from inside the Madgraph command-line environment (along with Rivet) or via Gambit
- Nascent GUI and ML add-ons