

MCnet CEDAR

Intro and overview



Introduction

CEDAR is the name given to the not-directly-MC-development bit of MCnet — including “user” connections to MC from both experiment and theory

The name and original direction are from a UK e-science project that predated MCnet, and created Rivet and the modern HepData (and HepForge)

Two main active areas at the moment:

- Rivet: MC event analysis toolkit and code collection, for prototyping/pheno and for experimental analysis preservation to complement HepData
- Contur: a statistical BSM limit-setter based on Rivet’s analysis collection

Also, smaller/periodic efforts on Professor, YODA, TopFitter, LHAPDF, HepMC, ...



Rivet status

The big recent development in Rivet was the addition of *detector-effect* “smearing” machinery — only for non-unfolded BSM searches! Searches are a big new prospect for Rivet: lots of potential for impact and expansion

Christmas release of v2.6.0 added some bells & whistles: now able to use an ordered chain of smearing projections on particles, and jet resolution functions improved. But really needs *users*, particularly the experiments: few so far :-)

Paper possibility: validation/comparison of Rivet wrt other fast-sims and BSM recasting tools. LH began effort with MadAnalysis5; others welcome

Also in the 2.6 series: the Particle class can now have recursive structure (yes, Particle contains vector<Particle>!) ⇒ better definitions of W, Z, dressed lepton; maybe more unification of Particle and Jet. One step at a time... some consequent bugs have already been found (thanks Jon)



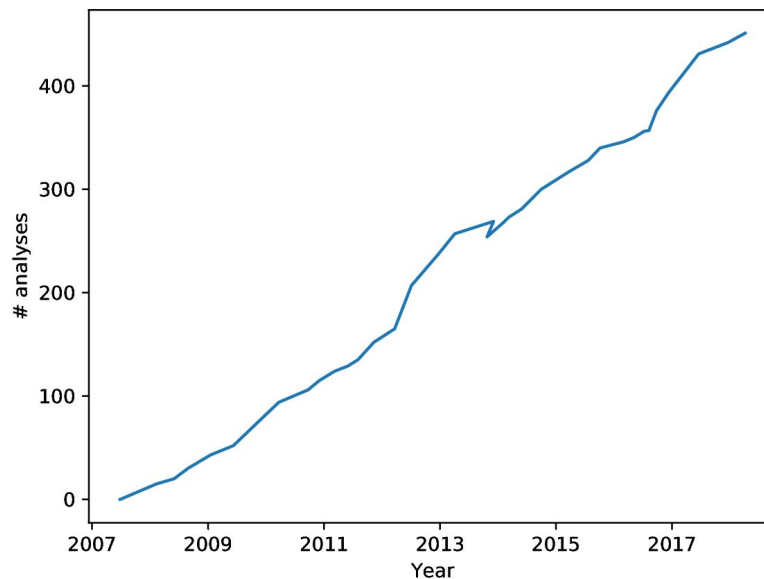
Rivet status (2)

Other v2.6 nice-to-have's: zipped data I/O, and a better build system for merging of contributed analyses, and (maybe) decoupling analysis releases from the core

Experimental submission rate has slowed a lot recently: much of last steep rise was AB BSM implementations.

Lots of ATLAS and CMS papers awaited...
nothing seen from LHCb for a long time,
ALICE = dev branch for extra functionality
(more on that later this afternoon)

Broken data sync with HepData is a worry...



Rivet next steps

Multiweights: proper use of systematics event weights. “Soon” — David G & Chris P!

Det-sim/BSM: validation & comparison paper, and please help to implement and test LHC BSM analyses — a good 1-semester/summer undergrad project

Heavy-ion functionality: 2-pass mode, data preloading, factorized finalize()

MadGraph5_aMC@NLO integration: actually quite hard to run Rivet on MG5aMC events, otherwise, and could be a game-changer for BSM uptake

Dependencies: MCUtils? FastJet contrib? Minimiser for e.g. “topness” variable...

Thread safety: Holger porting FNAL fixes for v2.6, will enable use in BSM global fits

HepData: regular HD sync was broken, and need BSM standards \Rightarrow *super*-important

Next developer + community meeting: Argyll, Scotland, May 21-24. Fully booked!

Contur status

Primary goal of Rivet is to provide like-for-like comparisons between particle-level measurements (archived in HepData) and full (ie final-state particle, ie precision event-generator) predictions.

- Differential cross sections
- Complex final state variables
- Intricate fiducial phase space

Contur is a post-processing stage, using the power of these comparisons to constrain (and maybe eventually find) new physics.

Key application for LHC and upgrades: ***this is the zone we are in now.***

Contur status (2)

Currently:

- All data are consistent with SM
- So assume data *are* SM, look for “wiggle room” left by experimental uncertainties
- Not able to use correlations or theory uncertainties properly

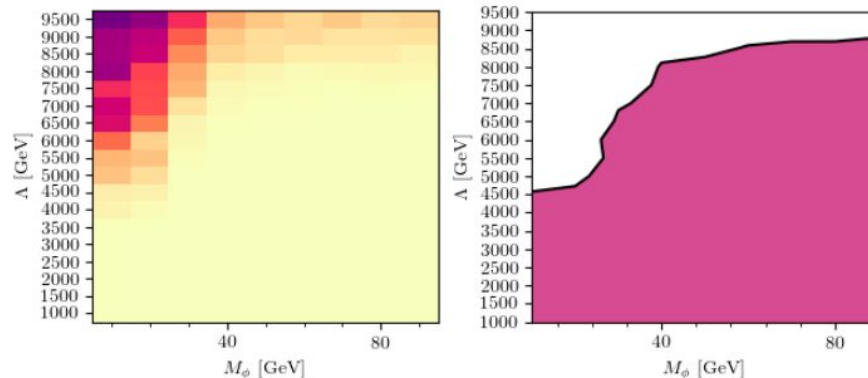
Near future:

- Include SM predictions and uncertainties
- Choice of different statistical treatments, use correlations where available

Recent results in Les Houches 2017 BSM proceedings [arXiv:1803.10379](https://arxiv.org/abs/1803.10379)

Heatmaps for CP-odd Light Scalar Model

Heatmap and contour for all available data (measurements from 7, 8 and 13 TeV runs in Rivet as of 21/9/2017)



Other projects

Professor — MC tuning/interpolation. Holger Schulz now project lead at FNAL

- BSM focus from devs; tuning continues! Stats paper promised when AB has time!

TopFitter — BSM EFT package, using Rivet and Professor on Top data. New fits in pipeline.

YODA — statistics package for Rivet and more: so many plans, so little time!

LHAPDF — standard LHC access to PDF fits. Dima Konstantinov now helping: big thanks!

- Several productive improvement routes: better/faster interpolation would save major LHC experiment CPU expense, support PDFs for virtual photons...
- No manpower for development at present: shortie projects welcome

HepMC — the standard LHC event record

- Version 3 has many MCnet contributions. Migration from v2 and some API issues need work, but *very* little manpower to move things forwards...

Resources

Many CEDAR projects have big manpower problems

Rivet's historic core team have largely had good career success: fellowships, academic posts, external jobs...

... all of which reduce (Rivet) research time! Gaps have not been filled by new RAs: also due to ITN rule changes

Result is schedule slips (cf. every-3-months Rivet plan, slow implementation and uptake of BSM features, and the multiweight-handling plan is around 5 years old!)

Unspoken truth is the academic system undervalues work on “community tools”. We need a concrete plan to incentivise new developers and experimentalist engagement. Discuss!!!



Summary

CEDAR is an important part of MCnet's engagement with the LHC experimental and pheno communities

Several projects from small to medium size, and far more ideas than we have people to implement. A great way to get students started in MCnet work, or as a component of MC theory PhDs.

Activity in BSM analysis preservation, BSM recasting, statistics and MC functional parametrisation, MC tuning, PDFs, and more. Developments will boost impact of core MCnet evgen projects.

But we have big resources problems: need to find ways (more (co-)publications, career benefits, other rewards?) to incentivise shortie & PhD students to join MCnet projects, and experimentalists to use & submit Rivet analysis codes & data.

