

CEDAR developments

What's new in MC applications and tools

Coordinators:

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MCnet meeting, CERN, 4-6 Sept 2019

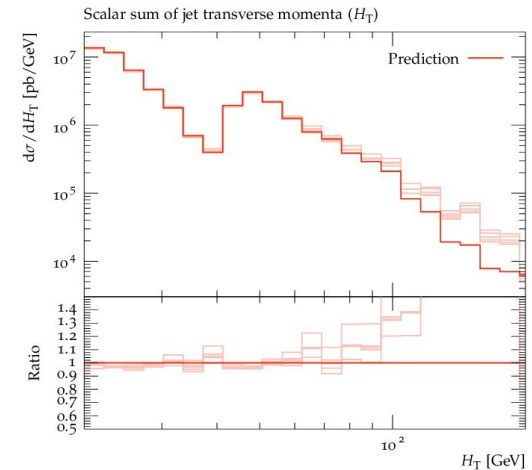
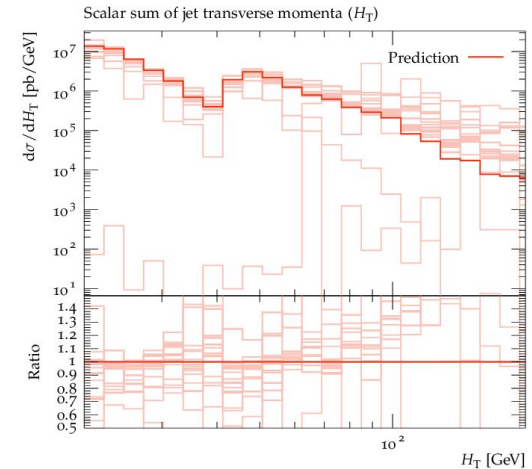
CEDAR overview

- ❖ The “MC applications” project of MCnet
- ❖ CEDAR projects:
 - Rivet SM and BSM — MC event analysis system
 - Professor — MC tuning (etc.), using Rivet
 - Contur — BSM model testing using Rivet
 - TopFitter — top quark EFT fits (via Rivet & Professor)
 - HepMC3 — next-generation event record library
 - LHAPDF — HEP-standard parton density library
- ❖ CEDAR should also be the natural contact point for experimentalists into the MCnet network
- ❖ Has it worked?!



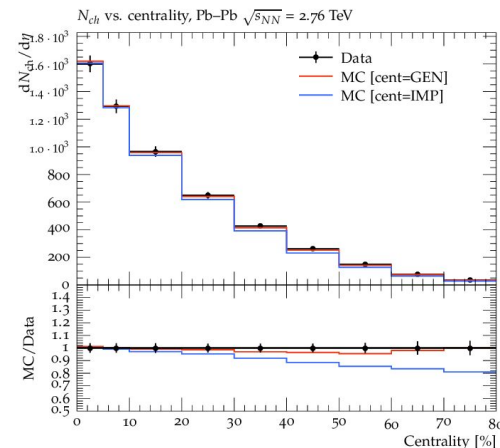
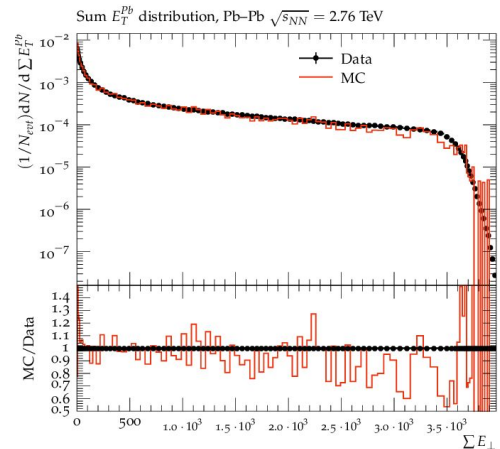
Rivet multiweights

- ❖ **Very (internally) complex automatic handling of MC systematics weight vectors**
- ❖ **Complex because ~invisible to users: requires objects that look like histograms etc. but are secretly multiplexed.** Worse: also handles counter-events and many histo types: many levels of abstraction!
- ❖ **And can re-run finalisation calculation with combined runs: RAW histogram stage.** Live but still figuring out best practice, e.g. **weight naming & filtering**, efficiency hacks



Rivet heavy ion

- ❖ “Adding heavy ion support” sounds trivial!
- ❖ Actually a stern test, with far-reaching impacts. HI observables often require centrality calibration curves: need a 2-pass run. And event/event correlations... centrality-binned!
- ❖ Also swappable definitions: few HI generators are general-purpose. [Thrashed out through e.g. Aug 2017 NBI workshop](#) (Christian Bierlich et al + ALICE reps)
- ❖ HI features in v2.7.x and v3.0.x. **Need to complete the workshop paper...**
Also spurred feedback to HI MC standards



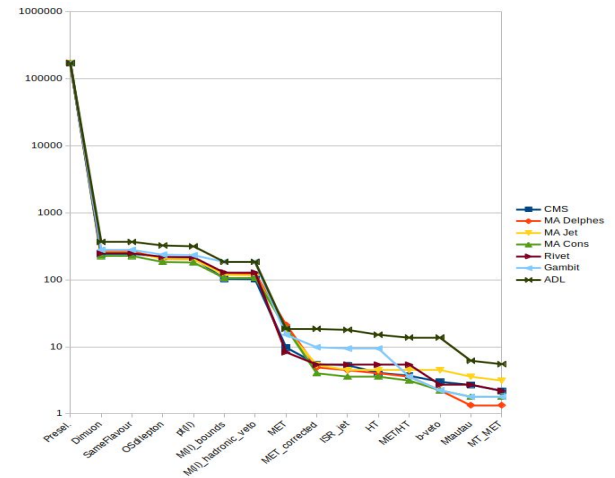
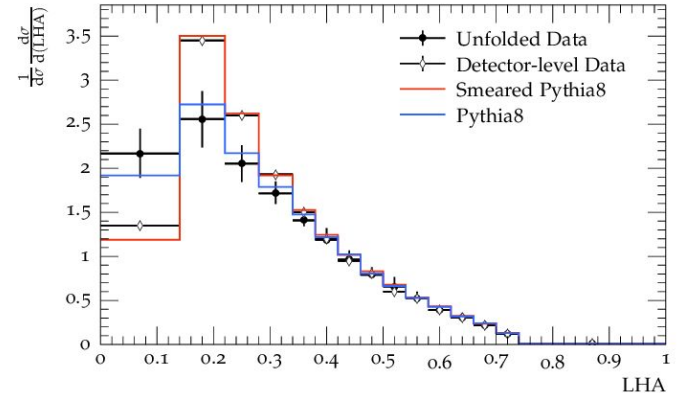
Rivet and BSM search recasting

❖ Detector smearing system:

- developed based on Gambit experience (AB)
- key features cf. Delphes, but more flexible & more analysis-specific
- **paper imminent (AB, Kar, Nordstrom), including studies of jet-substructure smearing:**

❖ Same speed as Delphes via HepMC; approach to be repeated in new universal recast code

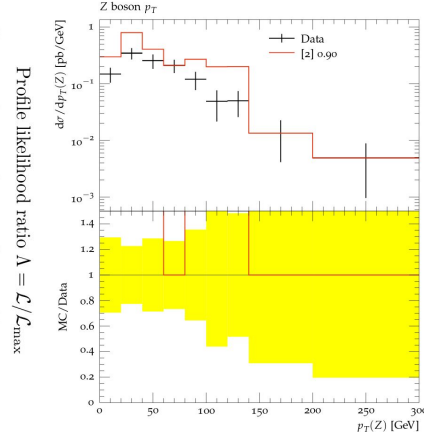
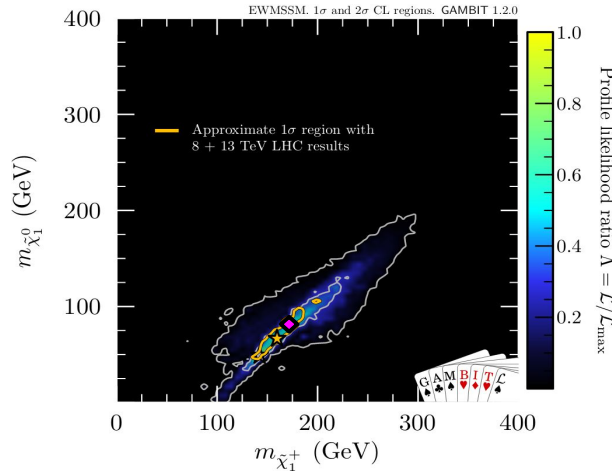
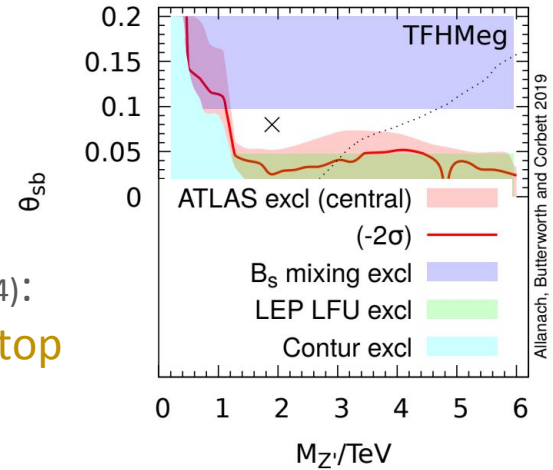
❖ Involved in Les Houches cutflow comparisons and global fit tests. Performance very good! Important cross-check on established codes



Contur — BSM limits from “SM” measurements

- ❖ **Contur: use Rivet to exclude BSM models**
Lots of publications and attention, e.g. tutorials.
(Butterworth, Grellscheid, Yallup, Corpe, ...)

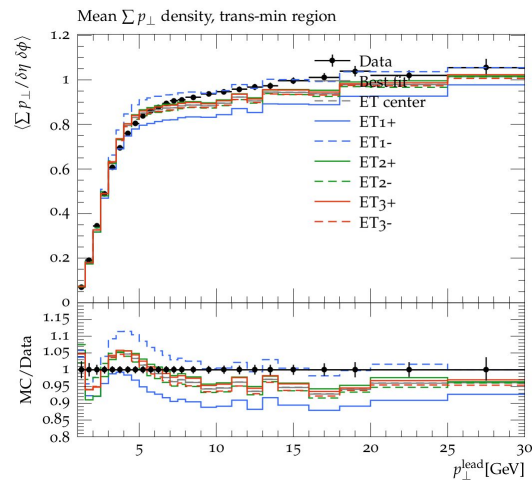
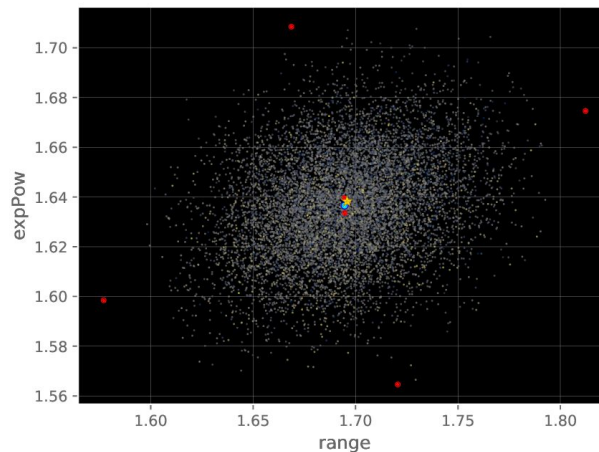
- ❖ E.g. “enhanced” 3rd Family Hypercharge Z' (arXiv:1904.10954):
Contur SM dominated by 8 TeV DY: shown “safe” from top



- ❖ \Leftarrow Les Houches study — testing Gambit EWino best-fit regions against “SM” measurements

Professor and correlations

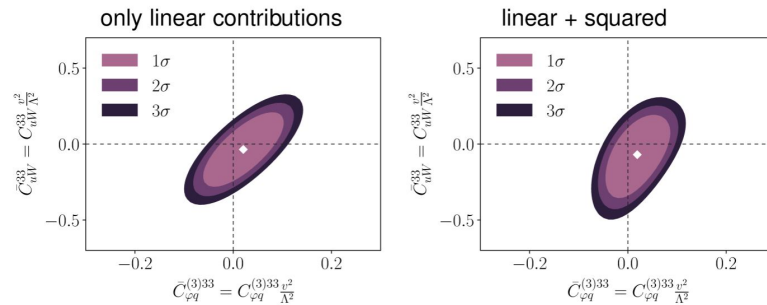
- ❖ Professor method for tuning well-established. Holger Schulz (FNAL) has been developing extensions, but core code static for some time.
- ❖ CEDAR project (AB, HS) on a better definition of MC tuning uncertainties: use old “eigentunes” idea, but define tolerances from statistical bootstrap rather than classic χ^2 threshold.
- ❖ Then perform uncertainty pruning/ranking based on a feature sensitivity measure.
- ❖ Paper soon!



Other projects

- ❖ **TopFitter:** big push to a new global fit, lots of Rivet and stat machinery coding. Studies of systematics and effects of EFT double-insertion. Contur complementarity?

- ❖ **LHAPDF:** model works... more than 18 months without a core release!
New PDF sets, now hosted at CERN not IPPP.
Recent v6.2.2 with bugfixes and MPI initialisation option. (AB)
TODO: Important improvements for N3LO and big LHC-production speed-ups



- ❖ **HepMC3:** released v3.1 with distinct namespace & library from HepMC2, I/O and constness honing.
ATLAS commissioning underway, more work to do.
(James Monk, Leif Lonnblad, AB)

CEDAR take-aways

- ❖ CEDAR still doing lots of useful work!
- ❖ Activity shifted naturally to include BSM, and is having a big influence in the “recast” community. Next stop, BSM multiweights!
- ❖ **But.** Need more people to get involved!
 - Few (UK-based) short-term studentship applications
Students, explain to me over a drink!
 - Many of the original team now less active :-)
New views keep us relevant & interesting.
 - Lots of ways to make a mark, learn code skills, ...
and save LHC computing a fortune (LHAPDF, HepMC)
- ❖ **Get involved! And advertise the shortie scheme!**

