# Addressing Theoretical Uncertainties:
# Tuning Update

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★ Finish up the bi-level optimization paper
  ✴ Automatic adjustment of weights of observables in tuning to identify poor predictions
  ✴ Concrete comparison with ATLAS tune

★ Go through comments in breakout session

# What are the uncertainties on the predictions for the Top Mass coming from event generators?

Current method changes some settings for ISR/FSR and uses various CR models.

- ★ Is it conservative? liberal?
- ★ Are variations correlated? uncorrelated?

I/we don't know.

- ★ Requires some "expert" knowledge: some parameter combinations are more equal/sensible than others
- ★ Large number of parameters to explore: many combinations

# SciDAC Project
## Utilize High Performance Computing resources for HEP problems

★ Developed parallel workflow for parameter scans at HPC facilities

★ Exploit fastMath/MathScience resources at LBL, ANL

★ Rational polynomial approximations for building a surrogate function for predictions from fixed number of points in multiple dimensions

★ "Smarter" parameter sampling (LHS, etc.)

★ "Better" minimization techniques (reduce variance, etc.)

Example: 20-D scan of Pythia parameters for LEP

# Instead of Tuning:
## Large scale parameter exploration in Top predictions

★ Define suitable observables and pseudo-observables
  ⋆ Rivet analyses are easiest; also can handle parametrized smearing

★ Select 20-ish potentially sensitive Pythia parameters

★ Identify insensitive parameters (Saltelli, Global Sensitivity Analysis)
  ⋆ Freeze these: $p^*$. Opens up more parameter space

★ Now identify senstive parameters
  ⋆ In which observables?
  ⋆ Test on other Rivet analyses

★ Identify which analyses to perform on current data to further reduce allowed ranges of parameters

★ Observables or POs
  ✶ Assumes backgrounds look like signal and are small
  ✶ Current workflow works for Rivet analyses

★ Central prediction for comparisons
  ✶ Powheg – more accurate(?) but additional parameters
  ✶ Pythia (or Pythia tuned to Powheg?) – easier to handle
  ✶ not clear: looking for sensitivity, not accuracy

★ Selection of parameters, runs

★ Calculation of variance based on Rational Approximation

# Why has this not been done before?

Timing

★ Enough data/understanding so that you have to ask tougher questions

★ Tools/machinery to perform the task

★ Should integrate any tools from bi-level optimization that facilitates this task

No technical reason we can't do this now

# Low-hanging Fruit

★ Synergy with Matrix-Element SciDAC
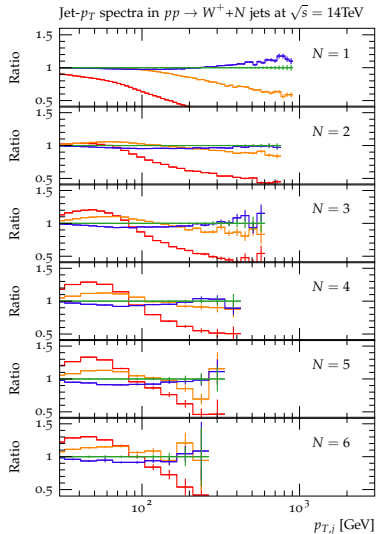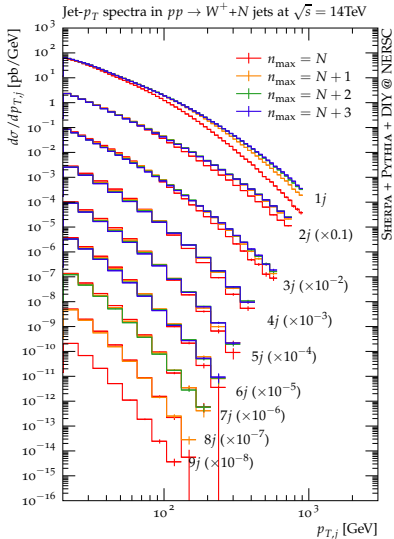★ Optimal Pythia parameters for complicated W+parton calculations

Figure: Jet transverse momentum distributions in $W^+$+jets events. We show a comparison of multi-jet merged simulations where the maximum jet multiplicity, $n_{max}$, is set to the number of measured jets, $N$ (red), to $N+1$ (maize), $N+2$ (green) and $N+3$ (blue).

# Earlier Project Ideas

Please review and comment:
```
https://docs.google.com/document/d/
1elrL4vOd2zT8gEmeMxyN0ds_
22Xe37W5zOueNrPERBA/edit?usp=sharing
```

# Hold-Up

I need a tutorial on the setup of runs on
NERSC/ALCF – which allocation, job submission
parameters, storage (today?)
and someone looking at the initial steps to make sure
it is done correctly