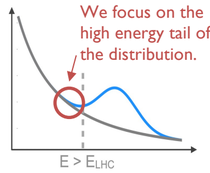
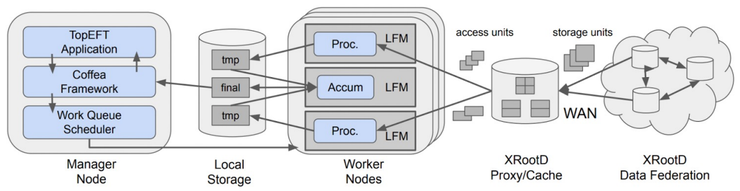
Introduction



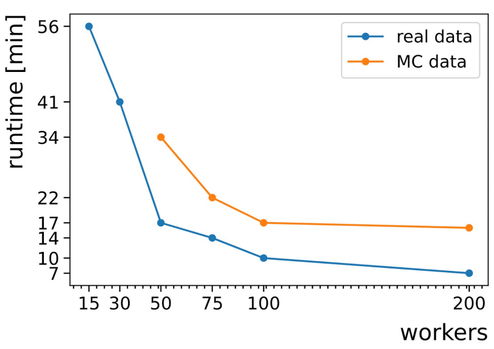
Despite its many successes, the Standard Model is still incomplete. Since there is no new particles discovered, particles beyond SM might be off shell at the LHC. While the collider is being upgraded and reaching higher energy limits, indirect methods of probing higher mass scales at the energy frontier are also important. **Effective Field Theory (EFT)** is one of the approaches that extends the discovery reach of the LHC. It is a framework that allows us to model a variety of interactions. We studied associated top production with multi-lepton final states under EFT.

Methodology



- Full Run2 data given as input to extreme event processor
- Events first pass selections then further filtered by interesting characteristics like jet multiplicity
- Multiple dataframes with top event information (event, run, luminosity block, etc.), event quantities (nleps, njets, ST, etc.), and object level information (p_T, eta of leps or jets) are accumulated to the output
- Modified the predicted number of extreme events by plugging in 26 Wilson Coefficients (EFT parameters)
- Compare the prediction with the observation from data to qualitatively examine the effect of EFT
- Visualize the extreme events with iSpy (see right)

Computation Performance

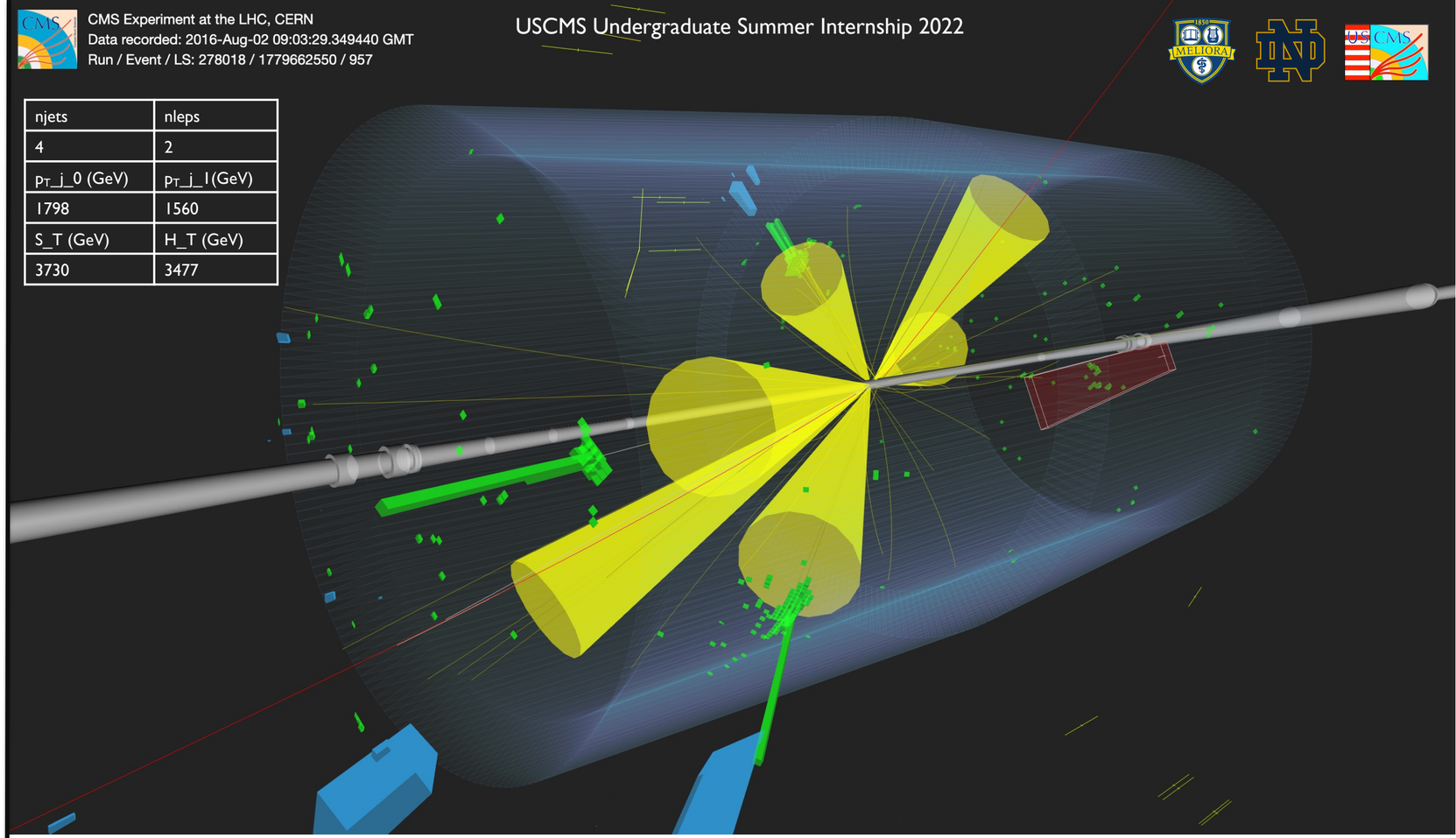


Resources usage:

Cores	4
Memory	18000
Disk	36000

Bottleneck:
Root IO of XRootD

Run the processor at scale starting from one dataset to the full dataset for real data and Monte Carlo data. Different numbers of worker are used each time to test the runtime.



njets	nleps
4	2
p_T_j_0 (GeV)	p_T_j_1(GeV)
1798	1560
S_T (GeV)	H_T (GeV)
3730	3477

Searching for Extreme Events in Multi-lepton Data from the LHC

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Results

3927 events in the full Run 2 data pass the selection.
Number of events with interesting characteristics are shown below.

Jet Multiplicity
1 12 Jets
4 ≥11 Jets
8 ≥10 Jets

Lepton Multiplicity
50 4 Leptons
0 >4 Leptons

Invariant Mass
1 5.1TeV
4 ≥4TeV
7 ≥3TeV
84 ≥2TeV

S_T
2 ≥3TeV
9 ≥2TeV

H_T
1 ≥3TeV
1 ≥2TeV

Leading Jet p_T
1 1.8TeV, 1.6TeV
6 ≥1TeV

Leading Lepton p_T
1 ≥800GeV
1 ≥600GeV
12 ≥500GeV

Distributions sensitive to EFT:
Jet multiplicity
Invariant mass
Leading leptons, jets p_T

- EFT parameters (WCs) have fairly large effects on the prediction.
- The impacts are larger at higher energies but less on distributions like number of leptons.
- Several events with high energies could be studied further.
- Statistical analysis in future work will quantitatively narrow down the intervals of WCs.

Reference

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