Outline of LHC-TI Whitepaper

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- purpose:
  - documentation to make physics case to DoE, NSF
  - basis for a future proposal

- main sections:
  - Executive Summary
  - Introduction
  - Physics Goals
  - “Constructive Interference through Collaboration”
  - Budget and Personnel
• physics goals:
  - Precision calculations of SM cross sections
  - Signatures of new physics at the LHC

• give some examples in the following
  - simply a collection of topics I find worthwhile thinking about
  - not structured according to importance: some are more important than others; some may be beyond the current technical capabilities
  - input from others is welcome and needed: this is supposed to be a community effort!
• Precision calculations of SM cross sections: Details
  - PDF uncertainties, use full NNLO PDFs
  - QCD corrections,
    examples: $t\bar{t}Z$, $t\bar{t}W$, $t\bar{t}\gamma$, $t\bar{t} + nj \ (n = 1, 2)$, $t\bar{t}b\bar{b}$, $\gamma\gamma j$, $4j$, $\gamma + 3j$, $\gamma\gamma + 2j$, $b\bar{b}\gamma\gamma$, $gg \rightarrow Hjj$, Higgs pair production (full NLO for gluon fusion and WBF), $W + nj \ (n = 3, 4)$, $WWjj$ full exclusive NNLO for processes such as $H$, Drell-Yan, $jj$, $t\bar{t}$ full NLO for $t\bar{t}$ including decays
  - phase space integrals and dipole subtraction at NNLO
  - interface of NLO corrections with parton showers, eg. including jet production in MC@NLO
  - electroweak corrections:
    examples: Sudakov logs in Drell-Yan, $O(\alpha\alpha_s)$ corrections to $W/Z$ production, multiphoton radiation in $W/Z$ production, di-boson production
• Signatures of new physics at the LHC: Details
  - signatures of new models: examples: Little Higgs, Higgsless, Split SUSY, UED, … and interface with parton shower programs
  - Automatized tools for SUSY
  - interface of higher order (in the number of partons) SUSY processes with parton showers (e.g. squark pairs + hard jets)
  - full NLO QCD corrections including decays to SUSY processes and interface with parton showers
  - extracting SUSY parameters
• “Constructive Interference through Collaboration”: Details

☞ Why fund this now?
Need to demonstrate what physics cannot be done with low luminosity ($\sim 30 \text{ fb}^{-1}$) if we don’t get funded
examples:
1. need NLO $t\bar{t}b\bar{b}$, $t\bar{t}jj$, $t\bar{t}Z$ for $t\bar{t}H$, $H \rightarrow b\bar{b}$ to measure top Yukawa coupling
2. need electroweak Sudakov logs for $W'$, $Z'$ searches
3. need NLO corrections to $gg \rightarrow Hjj$ for $HVV$ coupling measurement in WBF
4. need detailed understanding of jet and top quark physics for detector calibration and bgd. for Higgs production: $jj$ production at NNLO, NLO corrections to $t\bar{t}$ production including decays
why can we achieve more if we get organized?

participating institutions

administrative headquarters

how to collaborate:
collaboration weeks (2 – 4/year at various locations)
collaboration meetings (per video 1/month)
• Budget and Personnel
  - Faculty: see Sekhar’s talk
  - Postdocs:
    - senior postdocs: 5 year “LHC Fellowships”
    - junior postdocs: 3 years
    - do we need a process for assigning postdocs to participating institutions?
  - Graduate Students
  - travel and equipment (computing, video conferencing, …) money
we need your help!