Future Plans

LHC HXSWG Exotic Decay

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What we did for YR4: rare decays

- Recommended BRs for SM exclusive mesonic modes
  - $h \to M\gamma, h \to M\,Z, M\,W$
- Experimental status and prospects
- Theoretical survey of models yielding enhanced exclusive mesonic branching fractions

What we did for YR4: exotic decays

- General recommendations for exotic searches
  - presentation of search results
  - signal event generation
- Study of parton-level kinematics for $h \to aa\ (ss) \to\ 4f$
- Feasibility study for semi-invisible $h \to 2\gamma$ + *MET*
- Benchmarks and recommendations for displaced decays

Looking forward

- Increasing number of searches for rare and exotic decays
- Every analysis has its unique technical challenges:
  - hadronic backgrounds
  - maintaining and extending trigger pathways for signals, especially looking forward to HL-LHC
- Theoretical predictions, signal models
- Theory-experiment dialogue extremely useful

SM+S, 2HDM+S

- Well-studied and highly motivated class of models, predicts multiple final states
  - leading decay modes ($4b$, $2b2\tau$, etc) typically challenging at LHC
- Recommendations for presentation of results
  - framework for combination of channels
  - benchmark model points
- Support development of analyses searching for additional final states
  - e.g.: $2b2\tau$, different production modes for $4b$, ...

Displaced decays

- Highly motivated by theories of neutral naturalness, dark matter; reconstruction, triggering a challenge
- Recommendations for presentation of results, building on YR4
  - benchmark models
  - publication of supplementary information to enhance usability of results

Displaced decays

- Support development of analyses searching for additional final states
  - Full range of lifetimes is of interest! Many gaps in existing analysis strategies, especially for low-mass Higgs signal
    - Single displaced vertex searches: extend testable range of models, lifetimes
    - Combined prompt + displaced searches
    - Additional displaced objects, e.g. displaced photons + MET
- Expect to coordinate with efforts dedicated to displaced objects generally: e.g. LHC long-lived particle forum

Theory-experiment interface

- Provide a continuing forum for theory/experiment communication
  - trigger development:
  - object-based triggers can potentially help improve sensitivity to:
    - previously un-considered SM+S final states
    - displaced decays (single vertex? decay in tracker?)
    - new exclusive mesonic decays
- looking ahead to HL-LHC

Theory-experiment interface

- Provide a continuing forum for theory/experiment communication
    - signal modeling
        - e.g.: angular correlations in exclusive decays as implemented in Pythia
        - e.g.: parameterization of neutral naturalness signals (dark showers)
        - e.g.: choice of benchmark models for semi-invisible decays

Theory-experiment interface

- Provide a continuing forum for theory/experiment communication
    - background modeling
        - low-CM hadronic backgrounds a particular challenge
        - advise on Monte Carlo generator usage

Facilitate new analyses

- Encourage and potentially help facilitate sensitivity studies to not-yet-covered final states
  - evaluate triggering options
  - semi-invisible decay modes
  - new handles on SM+S
  - new exclusive decay modes
  - new displaced analyses
- Large luminosities ahead $\Rightarrow$ many opportunities!

Workshop in November

- Exotic Higgs Decay workshop at SLAC, November 7-8
- immediately followed by Higgs Couplings 2016
- http://indico.cern.ch/event/492240/
- All are welcome!

Summary

- Active theory-experiment dialogue will continue to be important for maximizing physics potential of LHC Run II
  - Also in preparation for HL-LHC
  - Trigger strategies (both prompt and displaced)
    - Presentation of results
      - combination of channels (benchmarks like SM+S)
      - usability (displaced, semi-invisible)
    - Address questions about signal and background modeling
- Meeting at SLAC Nov. 7-8
  http://indico.cern.ch/event/492240/