

Snowmass EF subgroup: Flavor mixing and CP violation at high energy

<http://www.snowmass2013.org/tiki-index.php?page=Flavor+Mixing+and+CP+Violation+at+High+Energy>

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Overview

- Our subgroup studies the sensitivity of flavor- and/or CP-violating observables to New Physics in high-energy systems
- The studies we are interested in are coordinated within the EF and the IF
 - Multiple EF subgroups are involved
- In our subgroup, we have a number of uncovered studies for which we are looking for manpower

What we are interested in (I)

- Flavor and CP violation in low-energy systems (b, c, tau)
 - Sensitivity studies are coordinated by in the Intensity Frontier
- top FCNC
 - Sensitivity studies are coordinated by in the HE Frontier top subgroup
- Higgs
 - HE Frontier Higgs subgroup coordinates CP studies, we coordinate FV studies (e.g. $H \rightarrow \tau\mu$)

What we are interested in (II)

- Sensitivity to new particles through flavor-violating decays
 - SUSY, RS resonances, heavy top and bottom partners, VLQs (need manpower!)
- In almost all models, the dominant decay mode is not flavor-violating
 - Thus, either the new particle has been discovered already or the flavor violating mode needs to be experimentally more sensitive (due to better background suppression)
- Likely observation in “flavor-asymmetric events”
 - assume new particles are pair-produced and one decays in a flavor-conserving mode, the other one in a flavor-violating mode
- Dominant (flavor-conserving) decays are coordinated by HE New Particles subgroup

Open Analyses (1)

- Top/bottom partners in composite Higgs models
 - heavy fermions with possible charges of $5/3$, $2/3$, $-1/3$, $-4/3$
 - Dominant decays are to 3rd generation quarks in association with W , Z , h according to charges
 - Flavor violation would imply similar decays but with a 1st/2nd generation quark instead of a top/bottom
 - Study sensitivity to masses from current LHC limits (around 5-600GeV) to multi-TeV.

Open Analyses (2)

- Vector-like quarks
 - Studies on decays of VLQs to third generation quarks ($B \rightarrow Wt$, Zb , or Ht) are going on in EF New Particles subgroup.
 - Need to do the same studies for decays to 1st or 2nd generation quarks

Open Analyses (3)

- SUSY (simplified models)
 - Hadronic modes:
 - direct stop pair production, with one stop decaying to top + neutralino and the other decaying to charm + neutralino
 - Leptonic modes:
 - slepton (stau_R) direct pair production, with decays into e, mu, tau + chi final states
 - squark \rightarrow jet chi, chi \rightarrow lepton slepton, slepton \rightarrow lepton gravitino
 - Lepton flavor violation is present in both slepton production and decay, providing final states with leptons of different flavors
- Decoupled SUSY ("mini-split", where squarks and sleptons are in the tens of TeV)
 - in this scenario squarks are in the 10-20 TeV range and maybe only relevant for the LHC energy upgrade, while gluino and neutralinos may still be relatively light
 - main signature would be 3-body gluino decay in two quarks and missing energy
 - flavor conserving decays: gluino \rightarrow t t chi, bb chi, jj chi, are probed by ATLAS and CMS (covered by EF NP subgroup)
 - flavor violating decays we like to study: gluino \rightarrow t c chi, gluino \rightarrow b j chi

Open Analyses (4)

- Higgs
 - Lepton-flavor-violating decays (e.g. $H \rightarrow \tau\mu$)

Summary

- We are trying to estimate the sensitivity of future experiments to flavor- and/or CP-violating New Physics in high-energy systems
 - These studies span multiple EF subgroups and two frontiers
 - Several benchmark studies in our subgroup still need people
 - If you are already working on a flavor-conserving decay, it could be easy for you to modify your analysis to look also into the flavor-violating mode
- For more info see
 - <http://www.snowmass2013.org/tiki-index.php?page=Flavor+Mixing+and+CP+Violation+at+High+Energy> or send us an e-mail