

SIGNATURES BEYOND BENCHMARK MODELS

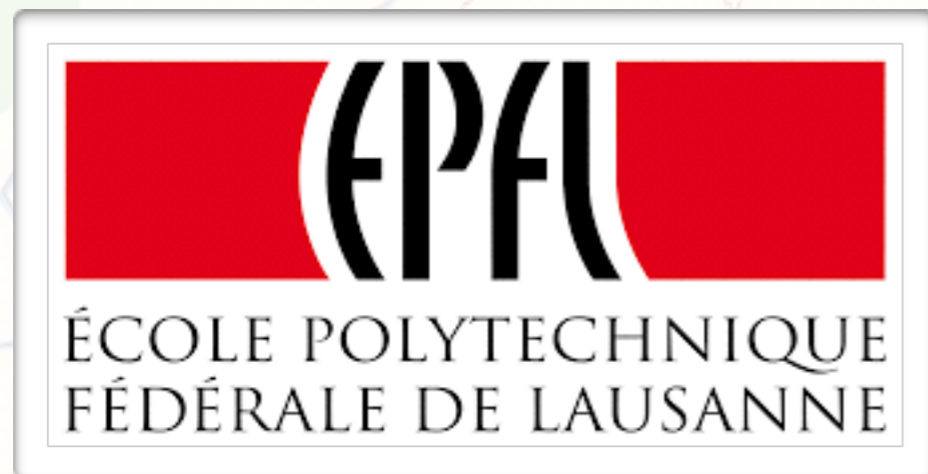
FCC-hh BSM group informal meeting

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**UNIVERSITÉ
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80-100 km long
circular tunnel

GOALS OF THE SUBGROUP

- Study motivated and generic signatures that allow to test new physics

Motivated and generic = shared by large classes of new physics scenarios

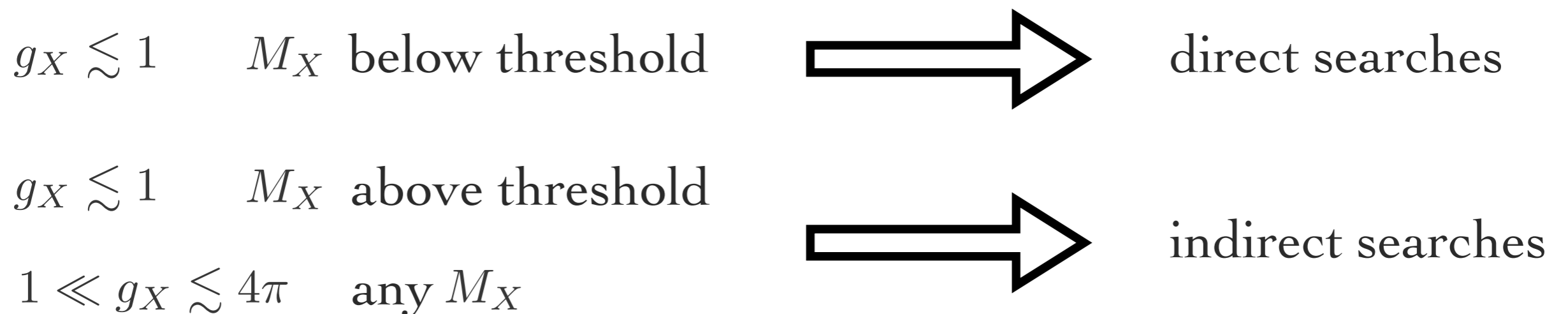
- Define collider and detector benchmarks that allow for the highest possible sensitivity to these signatures and that can help in a concrete assessment of the needed design of the future facilities

SINGATURES

- Consider signatures that are not “typical” of SUSY and DM to ensure orthogonality with SUSY and DM subgroups (that’s why the title “beyond benchmark models”)
- Of course all of the signatures considered in this subgroup can be present in SUSY and DM models, but they are not the “smoking gun” nor the key ingredients of them
- Consider signatures that allow for both direct and indirect sensitivity on new physics
- Examples of classes of signatures are
 - Pairs of SM particles with large invariant (or transverse) mass
 - One or more boosted SM massive particles
 - SM particles at large pseudo rapidity (forward region)
 - etc.

DIRECT AND INDIRECT

- The key distinction between direct and indirect new physics searches is the possibility of directly producing and observing new particles
- Two necessary conditions for direct searches
 1. The new particles are kinematically accessible
 2. They are narrow enough to be reconstructed
- These properties can be parametrized in a rather general form by the typical coupling strength of the new particle g_X and by its mass M_X



OUTLINE OF THE SECTION

- **Resonances: single production**

Di-leptons, lepton-neutrino, di-jets, di-tau, bb , tt , tb resonances, di-bosons (including Higgs), etc.

- **Resonances: associated production and VBF**

Resonances in association with forward SM particles, one forward jet, b or t (relevant for partners of the SM fermions), two forward jets (VBF), etc.

- **Resonances: pair productions**

Resonant final states with large multiplicities and low MET (overlap with RPV SUSY signatures)

- **Non-resonant signatures**

High mass di-fermion final states (useful to constrain different four fermion operators of the form $qqqq$ and $qqll$, including t and b), WW -scattering, etc.

- **Others**

Displaced signatures, dark sector signatures, etc. (suggestions are welcome)

STATUS

- There are several ongoing projects (check the Wiki page <https://twiki.cern.ch/twiki/bin/view/LHCPhysics/OtherBSM>)
- We are also looking for people interested in the FCC program and willing to contribute
- It is not necessary to make a new study for the FCC, many studies done for the LHC can be extended to FCC
- No need, in the first phase, of detailed detector simulations
- Exploratory studies and new ideas that can help in defining benchmarks for the detector studies are needed

CONTRIBUTIONS

- M. Mangano, A. Thamm, R. Torre, A. Wulzer, Resonances at 100 TeV: jets vs leptons
- C. Doglioni, A. Boveia, Di-jet benchmarks (also relation to DM group)
- C. Helsens, J. Ferrando, D. Miller, M. Mangano, B. Fuks, J.A. Aguilar-Saavedra, Boosted tops as a window to new physics
- B. Auerbach, S. Chekanov, J. Love, J. Proudfoot, A.V. Kotwal, Heavy resonances in t - t bar decays
- A. Ismail, I. Low, M. Low, L-T. Wang, WW Resonances in VBF
- A. Kotwal, Study of resonant double-Higgs production in the vector boson fusion process at a 100 TeV pp collider
- D.S.M. Alves, J. Galloway, J. Ruderman, J.R. Walsh, Running Electroweak Couplings as a Probe of New Physics
- G. Panico, J. Serra, J. Torre, A. Wulzer, EWPT at 100 TeV
- G. Bambhaniya, J. Chakraborty, T. Jeliński, M. Kordiaczyńska, R. Szafron, In quest of Right-Handed Currents [RHC]

CONCLUSION

- This group of the BSM studies is not intended to be a study of specific BSM models other than SUSY and DM nor at being an exhaustive exotica program at FCC
- In case of a discovery at LHC run-2 the full program will probably have to be re-thought focusing on the new signal
- In case of no discovery at LHC run-2 the BSM program will be (mainly) based on signatures of fine-tuned physics and therefore staying close to the LHC benchmark BSM scenarios could be completely unmotivated
- In this subgroup we aim at studying (possibly) motivated and generic signatures that are not typical of SUSY and DM
- We aim at identifying classes of signatures relevant for FCC-hh studies, both in the direct and indirect exploration
- We aim at defining detector benchmarks useful for further detector studies

THANK YOU