Snowmass 2021, EF09/10 joint meeting on dark showers

Thursday, 13 August 2020 - Thursday, 13 August 2020

Book of Abstracts

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Collider and Cosmic ray search for stable multiple charged constituents of dark atoms

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Composite Higgs boson models can provide possible solution for SM problem of Higgs mass divergence and origin of electroweak symmetry breaking. Higgs boson constituents can bind in stable multiple charged particles (like technibaryons or technileptons in Walking Tachnicolor approach). Stable -2n charged particles excess over their antiparticles results in formation of dark atoms in which such particles are bound with n He nuclei after BBN and which can play the role of a specific form of strongly interacting dark matter, which can provide solution for the puzzling contradiction in positive results of DAMA group and negative results of other experiments in direct underground search for dark matter. These multiple charged particles have no QCD interaction and thus have signatures of multiple charged stable leptons, offering new strategy for collider studies of dark matter. Accelerated in the Galaxy these particles will lead to specific type of Extensive Air Showers, challenging their search in LHAASO experiment. Combination of collider and cosmic ray studies can provide test for this hypothesis.

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V.Beylin, M.Khlopov, V.Kuksa, N.Volchanskiy, Hadronic and Hadron-Like Physics of Dark Matter. Symmetry 11(4), 587 (2019); https://doi.org/10.3390/sym11040587. e-Print: arXiv:1904.12013.

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Benchmark Models for Inclusive Dark Shower Searches

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I will talk about work in progress with Simon Knapen and Dong Xu on benchmark model building to support a proposed inclusive search strategy for dark shower searches. We discuss the relevant signature space, with particular focus on production through low-mass portals such as the Higgs boson. We plan to publish a Monte Carlo repository containing several selected benchmark models as part of the project.

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Expression of interest

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I am interested in understanding the complementarity of various analyses (dijet, emerging jets, semi-visible jets, monojet…) exploring dark QCD, possibly in the plane of prompt-displaced vs invisible fraction. It would be helpful to agree on some benchmarks models, and link to both the LHC WG on DM and LLP.
I can do generator-level studies in that respect.

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Pythia8: Dark Showers and community input

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The Hidden Valley (HV) scenario was developed in Pythia8 to allow the study of visible consequences of radiation in a hidden sector. Furthermore, the complications of hadronization within the Lund string model were addressed. This demonstrates that Pythia8 is flexible enough to handle such models. A dialogue between BSM theorists and event generator practitioners could lead to an accord that would allow the implementation of such models in a streamlined way.

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Exploring Jet Substructure in Semi-visible jets

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In this work, several jet substructure observables have been examined to compare semi-visible jets and light quark/gluon jets. These comparisons were performed using different dark hadron fraction in the semi-visible jets (signal). The extreme scenarios where signal consists either of entirely dark hadrons or visible hadrons offers a chance to understand the effect of the specific dark shower model employed in these comparisons. We attempt to decouple the behaviour of jet-substructure observables due to inherent semi-visible jet properties, from model dependence owing to the existence of only one dark shower model.

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Pythia8 plug-in for strongly coupled dark showers

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I will present a pythia 8 plugin which generates events for strongly coupled, quasi-conformal hidden valleys, also known as "soft bombs" or "Soft Unclustered Energy Patterns (SUEP)". The code can be extended easily to handle other dark showers that are currently not yet included in pythia 8.

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Overview of dark shower landscape

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Evidence for dark gluon bremsstrahlung in three dark showers event

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Exporting dark QCD via different portal models at the LHC is an exciting prospect. As we known, the dark gluon(g_v) is an indispensable ingredient in dark QCD. However, the popular two dark showers event with two dark quarks ($q_v\overline{q_v}$) in the final state cannot directly look for the evidence of dark gluon at the LHC. Inspired from the $e^+e^- \to q\bar{q}g$ process at lepton colliders for the three jet event, we propose to search the three dark showers event ($q_v\overline{q_v}g_v$) at the LHC for the evidence of dark gluon. Furthermore, the three dark showers event may also indicate the spin of dark gluon via the type of Ellis–Karliner angle and distinguish the production mode either from s-channel portal or t-channel portal.

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Introduction to the meeting and to the Snowmass SEC EF10 liaisons

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Discussion points