



Contribution ID: 1291

Type: Parallel Talk

Model independent bounds for elusive Dark Sectors at neutrino experiments

Friday, 8 July 2022 09:35 (15 minutes)

Present and upcoming neutrino experiments can be used to probe Dark Sectors (DS). We consider light DS interacting with the SM through well-motivated irrelevant portals. In our model independent approach, the DS is only characterized by two scales: the cut-off scale Λ_{UV} of the irrelevant portals, and the mass gap Λ_{IR} of the DS, identified with the mass of its lightest particle (LDSP). If the energy of the production interactions is separated from the two DS scales, the theory is approximately scale invariant, and allows to compute the production rates in a model independent fashion. The DS production happens mainly through decay of mesons produced in interactions between protons of the beam and target nuclei, partonic production through Drell-Yan process between nucleons, and bremsstrahlung from the beam protons. After production, the produced DS excitations can reach the neutrino detector, placed downstream from the target at a distance of the order of kilometers, and decay inside of it through the irrelevant portals back to SM particles.

These events are used to place bounds on the parameter space of the DS.

In general neutrino experiments are able to probe new regions of parameter space, inaccessible in high energy experiments, given the different distance of the detectors compared to the typical length scale of collider detectors. Future neutrino experiments also have the advantage to be able to start collecting data on a fairly shorter time scale, as compared to other proposed experiments.

In-person participation

Yes

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Session Classification: Dark Matter

Track Classification: Dark Matter