Contribution ID: **104** Type: **not specified**

Exploring Parameter Spaces with Artificial Intelligence and Machine Learning Black-Box Optimisation Algorithms

Friday, 1 July 2022 17:00 (20 minutes)

Validating Beyond the Standard Model (BSM) theories usually involves scanning highly multi-dimensional parameter spaces and check observable predictions against experimental bounds and theoretical constraints. Such task is often timely and computationally expensive, namely when the BSM model is severely constrained leading to very low random sampling efficiency. In this work we tackled this challenge using Artificial Intelligence and Machine Learning search algorithms used for Black-Box optimisation problems. Using the cMSSM and the pMSSM parameter spaces, we considered both the Higgs mass and the Dark Matter Relic Density constraints to study their sampling efficiency and parameter space coverage. We find our methodology to produce orders of magnitude improvement of sampling efficiency whilst reasonably covering the parameter space.

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Session Classification: SUSY: Phenomenology and Experiment