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Active Learning for analysis reinterpretation and constraining additional physics parameters

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Most Beyond Standard Model (BSM) physics theories are characterized by multiple BSM parameters. These encompass properties like new particle masses, coupling constants, decay widths, and effective field theory parameters.

When testing such theories against data, analysts might choose to consider only a subset of relevant BSM physics parameter in order to work within limits of computational resources and person power. Nonetheless, it is generally desirable to constrain all relevant physics parameters in a given BSM theory and produce exclusion contours in the n-dimensional space spanned by the BSM parameters.

To make the calculation of such n-dimensional exclusion contours more tenable, we present an advanced automated analysis workflow that allows the computationally efficient reinterpretation of preserved analyses. The workflow comprises an integrated analysis pipeline and active learning. The former automatically executes all steps of an analysis from event generation through to limit setting, reducing thus the required labor.

On the other hand, active learning is employed to guide the sampling of the multi-dimensional BSM parameter phase space to find the exclusion contours in an iterative process. The sampling process focuses on prioritizing points in the vicinity of the exclusion region, while reducing the sampling density in less relevant areas. This allows exclusions over high-dimensional theory phase spaces that are otherwise impractical.

We showcase the implementation of the workflow in the Production and Distributed Analysis (PanDA) system and intelligent Data Delivery Service (iDDS) in ATLAS. To demonstrate its utility, we present its application in an extended search for a dark Z-boson using events with four-lepton final states. Additionally, we highlight the progress made towards a second demonstration in a heavy Higgs analysis.

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