Simplifying Limits from Combined Searches for Narrow Resonances

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1 Introduction

Narrow resonance searches have long been a staple of experimental efforts to identify or constrain new physics beyond the standard model (BSM). Typically, the invariant mass of the system is measured and limits are placed on the production cross section times branching ratio (BR), $\sigma_{\text{prod}} \times \text{BR}_{xy}$, of new resonances within the context of specific benchmark models. In refs. [1, 2], the authors explored breaking down these constraints in a model-independent manner in terms of a "simplified limits" parameter, ζ, which depends only on the product of BRs and the ratio of the resonance width to its mass. This reparameterization of narrow resonance casts limits in terms of purely partonic quantities, making it simpler to translate constraints to specific models of interest.

Combining narrow resonance constraints from multiple channels can extend the exclusion limits of current and future searches for resonances with more than one dominant decay mode. This possibility has been explored by both ATLAS [3] and CMS [4] in diboson and dilepton channels. The constraints from different channels, however, were combined in the context of specific benchmark models where the relationships between BRs were known, introducing an additional level of model-dependence to the results. In an upcoming work [5], we will extend the concept of simplified limits to combinations of searches, demonstrating a methodology by which one may display constraints on the masses of narrow resonances within the parameter space of up to three dominant channels. We will make no assumptions as to the total number of decay channels for the resonance, maintaining the model independence present for single-channel searches while again casting constraints in terms of purely partonic quantities.

We propose applying the simplified limits methods described above to combined statistics of LHC narrow resonance searches and projected sensitivity of future colliders. These generalized constraints will then be used to identify specific desirable properties of models for discovery at future experiments and benchmark model scenarios will be explored. We invite interested parties to contact us to discuss potential collaborations.

References

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