Contribution ID: **110**

Type: **Oral**

# Efficient search for new physics using Active Learning in the ATLAS Experiment

*Wednesday, 26 October 2022 11:30 (20 minutes)*

Searches for new physics set exclusion limits in parameter spaces of typically up to 2 dimensions. However, the relevant theory parameter space is usually of a higher dimension but only a subspace is covered due to the computing time requirements of signal process simulations. An Active Learning approach is presented to address this limitation. Compared to the usual grid sampling, it reduces the number of parameter space points for which exclusion limits need to be determined. Hence it allows to extend interpretations of searches to higher dimensional parameter spaces and therefore to raise their value, e.g. via the identification of barely excluded subspaces which motivate dedicated new searches.

In an iterative procedure, a Gaussian Process is fit to excluded signal cross-sections. Within the region close to the exclusion contour predicted by the Gaussian Process, Poisson disc sampling is used to determine further parameter space points for
which the cross-section limits are determined. The procedure is aided by a warm-start phase based on computationally inexpensive, approximate limit estimates such as total signal cross-sections. A python package, excursion [1], provides the Gaussian Process routine. The procedure is applied to a Dark Matter search performed by the ATLAS experiment, extending its interpretation from a 2 to a 4-dimensional parameter space while keeping the computational effort at a low level.

[1] https://github.com/diana-hep/excursion

## Significance

Follow-up on ACAT 2019 contribution 479, now applying Active Learning to a full-scale ATLAS physics analysis

## References

https://indico.cern.ch/event/708041/contributions/3269754/

## Experiment context, if any

ATLAS Experiment

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**Session Classification:** Track 2: Data Analysis - Algorithms and Tools

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