

# 15. NPLM (New Physics Learning Machine)

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## How to Obtain Support

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## General Information

<b>ML/DL Technologies</b>	NN
<b>Science Fields</b>	High Energy Physics
<b>Difficulty</b>	medium
<b>Language</b>	english
<b>Type</b>	

## Software and Tools

<b>Programming Language</b>	Python
<b>ML Toolset</b>	Keras, Tensorflow
<b>Additional libraries</b>	scipy.stats
<b>Suggested Environments</b>	bare Linux node, cern lxplus

## Needed datasets

<b>Data Creator</b>	Gaia Grosso, Marco Zanetti, Andrea Wulzer, Maurizio Pierini, Raffaele Tito d'Agnolo
<b>Data Type</b>	simulations
<b>Data Size</b>	225.2 MB compressed
<b>Data Source</b>	<a href="#">Zenodo</a>

## Short Description of the Use Case

NPLM is a strategy to detect data departures from a given reference model, with no prior bias on the nature of the new physics model responsible for the discrepancy. The method employs neural networks, leveraging their virtues as flexible function approximants, but builds its foundations directly on the canonical likelihood-ratio approach to hypothesis testing. The algorithm compares observations with an auxiliary set of reference-distributed events, possibly obtained with a Monte Carlo event generator. It returns a p-value, which measures the compatibility of the reference model with the data. It also identifies the most discrepant phase-space region of the dataset, to be selected for further investigation. Imperfections due to mis-modelling in the reference dataset can be taken into account straightforwardly as nuisance parameters.

## How to execute it

The main utilities to run the NPLM strategy have been made available in a python-based package [NPLM](#), that can be easily installed via pip.

All useful information on how to install the package can be found at: [https://github.com/GaiaGrosso/NPLM\\_package](https://github.com/GaiaGrosso/NPLM_package).

An example of the NPLM application to a simple one-dimensional use case is provided at [https://github.com/GaiaGrosso/NPLM\\_package/tree/v0.0.6/example\\_1D](https://github.com/GaiaGrosso/NPLM_package/tree/v0.0.6/example_1D).

## Annotated Description

## References

- *"Learning New Physics from a Machine"* ([Phys. Rev. D](#))
- *"Learning Multivariate New Physics"* ([Eur. Phys. J. C](#))
- *"Learning New Physics from an Imperfect Machine"* ([Eur. Phys. J. C](#))



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