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Machine learning techniques for the search for top-top events with the ATLAS experiment at the LHC

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The Standard Model is currently the theory that best explains the behavior of subnuclear physics, including the definition of particles and three of the four fundamental forces acting in nature; however, it turns out to be an incomplete theory on whose integrations physicists are working in different directions: one of the most promising approaches appears to be that of effective field theories. The interaction vertex of the process that produces pairs of same-sign top quarks starting from protons is strongly suppressed in the Standard Model and must therefore be interpreted with effective field theories. The present paper focuses on this new approach for the search for same-sign top quarks and on the use of a neural network to discriminate the signal from the background. The goal is to understand whether the performance of the neural network changes when variables of different levels of reconstruction are supplied as input. Three sets of training variables have been presented to a neural network optimized for background-signal discrimination: one high-level, the second strictly low-level, the third copy of the second with in addition two main variables of b-tagging. It has been shown that the performance of the network in terms of signal-background classification remains almost unchanged: the ROC curve presents areas under itself that are almost identical. It has also been noted that for the set of low-level variables, the neural network classifies the azimuthal angles of the leptons as the most important inputs despite these having identical distributions between signal and background: this happens because the neural network is able to exploit the correlations between the variables as a discriminating characteristic. This preliminary study lays the foundations for the optimization of a multivariate approach in the search for events with two same-sign tops produced at the LHC.

Title

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