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## Studying the Production of a Singlet Scalar at Future $e^+ e^-$ Colliders with Deep Neural Networks

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Motivated by the multi-lepton anomalies, a search for narrow resonances with  $S \rightarrow \gamma\gamma$ ,  $Z\gamma$  in association with light jets, b-jets, or missing transverse energy was reported in arXiv:2109.02650. The global significance of the excess at 151.5 GeV is  $4\sigma$ , where the combination with the multi-lepton anomalies gives a significance much larger than  $5\sigma$ . In this paper, the final states that are considered are the  $l^+ \nu jj\gamma$ ,  $l^- \nu jj\gamma$  and  $jjjj\gamma$  and we use machine learning tools to determine the final state with the most significance. A classification model is developed in order to distinguish between the signal and background processes through the use of a Deep Neural Network (DNN) which is constructed using a dataset that consists of the energy, the pseudo-rapidity, and azimuthal angle for each of the particles in each final state. The parameters of the DNN are tuned using a hyperparameter optimisation algorithm so that the convergence of the receiver operating characteristic (ROC) curve is achieved.

### Apply to be considered for a student ; award (Yes / No)?

Yes

### Level for award;(Hons, MSc, PhD, N/A)?

MSc

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