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Identifying the Higgs boson with a Quantum Computer

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A novel technique to identify events with a Higgs boson decaying to two photons and reject background events using neural networks trained on a quantum annealer is presented. We use a training sample composed of simulated Higgs signal events produced through gluon fusion and decaying to two photons and one composed of simulated background events with Standard Model two-photon final states. We design a problem such that minimizing the error of a neural network classifier is mapped to a quantum binary optimization problem (QUBO). This problem is encoded on the quantum annealer, which is designed to employ quantum adiabatic evolution to find the optimal configuration of qubits to solve the optimization problem. This is also the configuration of the network that minimizes the classification error. With the current hardware we are able to encode a problem with up to 30 correlated input variables and obtain solutions that have high efficiency to accept signal and reject background.

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