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Search for new light gauge bosons in Higgs boson decays to four-lepton events in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector

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Some models beyond the Standard Model (BSM) suggest that the Higgs boson, discovered at the LHC during run I, can be used as a portal to look for New Physics. These models predict new sectors coupled to the SM whose presence can be inferred by observing SM final states. This opens the possibility of processes such as Higgs decays to dark vector bosons in four-lepton events, $H \rightarrow ZZ_d \rightarrow 4\ell$ and $H \rightarrow Z_d Z_d \rightarrow 4\ell$, where Z_d is a BSM light gauge boson, and whose existence is motivated by Dark Matter candidate searches. The search of exotic Higgs decays uses the data taken in pp collisions with the ATLAS detector at the LHC at $\sqrt{s} = 8$ TeV. Only electrons and muons are used. In the absence of a significant observed signal, upper bounds on the branching ratios of $H \rightarrow ZZ_d \rightarrow 4\ell$ and $H \rightarrow Z_d Z_d \rightarrow 4\ell$ relative to the branching ratio of $H \rightarrow 4\ell$ and to the SM branching ratio of $H \rightarrow ZZ^{(*)} \rightarrow 4\ell$ respectively, are set as a function of the mass of the dark vector boson at 95% C.L.

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