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Orthogonality study for the $A/S \rightarrow Z_d Z_d \rightarrow 2l2\nu/2l2j$ with the ATLAS detector at the LHC

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The hidden abelian Higgs model is used for a search for an additional scalar decaying to two Z-dark bosons (Z_d) to two leptons, two neutrinos ($2l2\nu$). The search uses $\sqrt{s} = 13$ TeV collision data collected with the ATLAS detector at the LHC with an integrated luminosity of 139 fb^{-1} at a centre-of-mass energy $\sqrt{s} = 13$ TeV. This is a follow up to the study of the $4l$ final states [1]. In our $2l2\nu$ channel analysis, using the HAHM on Run-2 and Run-3 data with the ATLAS detector to conduct the search for an additional scalar with a distinct mass from the Higgs boson demands study of signal overlap from the $2l2j$ channel. A technique is introduced to separate signal events of our $2l2\nu$ channel from that of the $2l2j$ channel. We present the work and result of orthogonality study done to achieve this.

[1] ATLAS Collaboration. (2024). Search for a new scalar decaying into new spin-1 bosons in four-lepton final states with the ATLAS detector (CERN-EP-2024-248). arXiv:2410.16781 [hep-ex].

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